New Zealand Food Safety
Haumaru Kai Aotearoa

2022 Antibiotic Agricultural Compound Sales Analysis

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Te Kāwanatanga o Aotearoa
New Zealand Government

Ministry for Primary Industries
Manatū Ahu Matua

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Contents

1 Summary

Total antibiotic sales quantities decreased by 12,389 kg (23%) to 41,033 kg in 2022. This was the fifth year of consecutive decreases and was 42% below that reported in 2017. The main contributors to the 2022 decrease were the polypeptides which decreased by 11,021 kg (88%) to 1,486 kg and the macrolides which decreased by 837 kg (18%) to 3,770 kg.

Lower sales quantities were reported for eight of the sixteen classes evaluated with a combined reduction of 12,875 kg compared to 2021. The total combined increase for the eight classes with higher sales was 486 kg consisting mainly of the aminoglycosides (425 kg higher), the pleuromutilins (18 kg higher), and the sulphonamides and trimethoprim class (18 kg higher). Excluding the polypeptides from the 2022 sales total the quantity reported for the other 15 classes decreased by 3% from 40,914 to 39,547 kg compared to the previous year.

Total quantities of critically important antibiotics decreased by 562 kg (8%) to 6,285 kg mainly due to lower macrolides sales. There were also 8% decreases for the third- and fourth generation cephalosporins from 131 to 120 kg and the fluoroquinolones which decreased by 14% from 35 to 30 kg in 2021.

2 Introduction

Antibiotics are essential to the health of humans, animals, and plants. The incidence of antibiotic resistance is increasing around the world, and there are few new antibiotics being developed. The World Health Organization has identified antimicrobial resistance as one of the top ten global health threats facing humanity. Excessive use of antibiotics can lead to the emergence of resistant bacteria which may not respond to antibiotic treatment. Thus, preservation of our current therapeutic options remains vital.

Antibiotic stewardship needs to be practiced across health, primary industry, and environment sectors. Prudent use of antibiotics will help preserve therapeutic efficacy now and into the future. One way of monitoring antibiotic use is through sales. Although antibiotic sales data is not a direct measure of antibiotic use, it does provide information on the volume of antibiotics used and allows for trends to be seen over time. This allows the Ministry for Primary Industries (MPI) to evaluate whether sales trends indicate appropriate use of antibiotics and whether existing regulatory controls remain fit for purpose.

This report summarises the sales for antibiotic agricultural compounds during the 2022 calendar year and compares the sales figures to those reported for the previous five-year period (2017-2021). Increases and decreases in antibiotic sales are then analysed with veterinary and industry input to compare the changes to animal populations, animal and crop disease pressures, and other trends that have a direct impact on antibiotic use. The evaluation of use through sales focuses on key sales subgroups such as those antibiotics considered critically important to human and animal health, as well as certain primary industry sectors that contribute significantly to overall sales, though all antibiotic sales trends are reported. The result of this analysis is a comprehensive review of antibiotic sales within the reporting period, and an overview of any emerging trends that may require further consideration or changes to the regulatory framework.

The last public report on antibiotic sales in New Zealand evaluated data for the 2021 calendar year. This report can be found on the MPI website at: 2021 Antibiotic Agricultural Compound Sales Analysis (mpi.govt.nz)

3 Background

Antibiotic agricultural compounds are substances containing one or more antibiotic active ingredient and are used in the direct management of animals or plants to treat bacterial diseases. Antibiotic veterinary medicines of significance to human health are registered under the Agricultural Compounds and Veterinary Medicines (ACVM) Act 1997 as restricted veterinary medicines, requiring authorisation by a veterinarian before they can be sold or used in animals. The few antibiotic horticultural treatments available for use on crops are similarly restricted, with strict controls on who can purchase these trade name products and how they are used. All registrants of antibiotic veterinary medicine and horticultural treatments are legally required to submit a yearly sales return to the Ministry for Primary Industries (MPI).

3.1 Methodology

The Antibiotic Agricultural Compound Sales Analysis is conducted in two phases. The first phase is the collation of sales data from registrants for the period of 1 January to 31 December for the reporting year with total sales of individual trade name products converted to sales of active ingredients by weight. Registrants are also asked to provide estimates of target species for the multi-species and multiple production species products sold during the year. The total sales in kilograms of active ingredient are then compared across animal sectors, within antibiotic classes, and within target species or crops to determine overall trends in sales relative to previous reporting years. This preliminary report is then provided to veterinarians, registrants, and primary industry animal and horticultural sectors to provide comment on the sales trends and the factors influencing antibiotic use within the reporting year.

The second phase of the process is to compile the sales data and the comments received from stakeholders to review sales trends in context with the reported disease pressures and other use factors. This provides insight into why sales may have changed through the reporting year, an indication of the current perspectives on antibiotic agricultural compound use, and an evaluation of how this year's sales trends compare with those of previous years. The outcome of this process is the annual Sales Analysis report.

It is noted that some antibiotic products are manufactured in New Zealand for export and use overseas. The sales totals included in this analysis are for products sold and used within New Zealand and excludes sales of exported product.

3.2 Data limitations

The evaluation of annual antibiotic sales data as a proxy for assessing prudent use presents several limitations.

The amount of antibiotics reported as sales by registrants may not necessarily correlate with the amounts used during the sales period for various reasons including either advance buying in anticipation for use later, or bulk purchases such as in-feed products which may be used over a longer timeframe. This can impact sales volumes from year to year and as a result the volumes reported may be higher in one period and lower in the next. There may also be losses due to expiry dates being exceeded or treatments not being completed. When evaluating sales data returned by registrants none of these scenarios will be visible in the numbers of products reported.

Furthermore, there may also be complications regarding product approvals and veterinary authorisations. Where products are approved for use with multiple species it can be difficult to link the sales volumes to a particular species. Veterinarians have the authority to use their professional discretion to use antibiotics to treat their patients "off-label," or for a different species or treatment regime than that approved as part of that product's registration. Veterinarians can also authorise the use of human preparations, or import overseas remedies, if a suitable registered veterinary medicine is not available to treat their patient. While these applications of veterinary discretion are limited overall, they will have an impact on the ability of sales data to approximate use.

In addition, the reporting of antibiotic sales in kilograms of active ingredient does not consider the relative potencies and dose rates applicable to each individual active ingredient and agricultural compound. For example, administration of one antibiotic may be several times the amount needed for another equally efficacious antibiotic to achieve the same therapeutic effect. While some effort has been made to draw attention to this where relevant, such as for the penicillins, the impact on the sales analysis may not always be readily apparent or mitigatable.

Finally, the sales data used in this analysis relies on the submission of data and information from registrants and industry. MPI has no control over the accuracy or completeness of the data and information provided. The resulting analysis should therefore be regarded as indicative of overall sales trends and should not be over-interpreted.

3.3 Compounds not analysed or reported

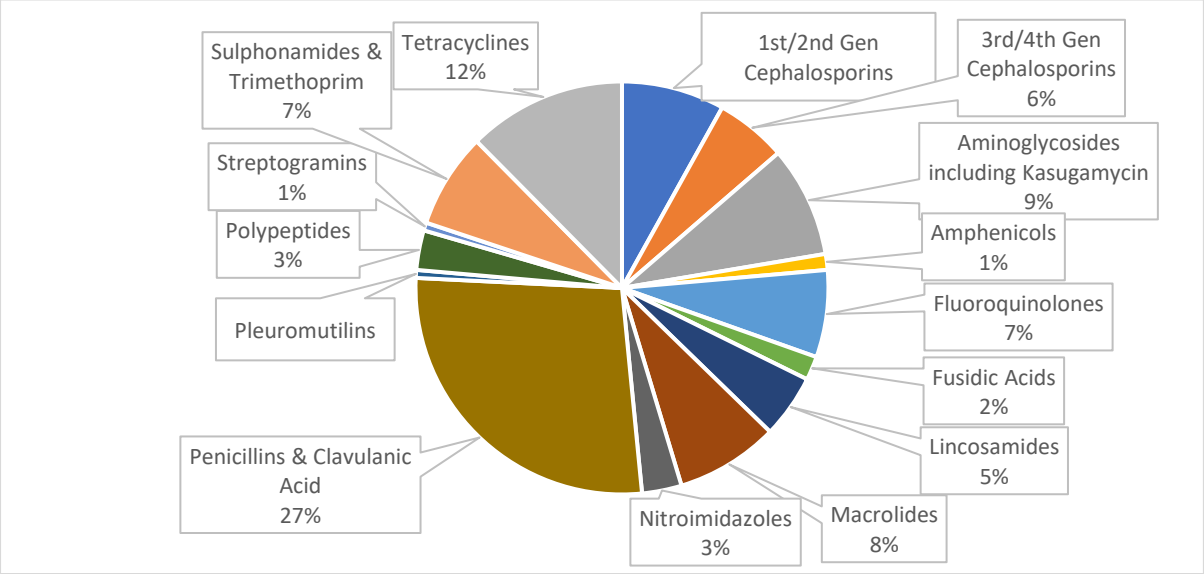
There are certain compounds used as veterinary medicines in New Zealand that are considered out of scope for antibiotic sales data collection and analysis. These include the phosphoglycolipids (e.g., bambermycins), the quinoxalines (e.g., carbadox), the aminocoumarins (e.g., novobiocin), and the orthosomycins (e.g., avilamycin), which are not used in human medicine. The ionophore compounds lasalocid, monensin, and salinomycin, are also out of scope for the antibiotic sales analysis. Ionophores are not classed as antibiotics in New Zealand.

4 General trends in antibiotic sales

4.1 Registered trade name products containing active antibiotic ingredients

A total of 241 unique antibiotic trade name products were registered for use in animals or plants under the ACVM Act in 2022 with 152 reporting sales compared to the previous year where 242 products were registered and 151 were marketed and sold. Most products sold contained a single antibiotic (106, 70%) or two antibiotic ingredients (42, 28%). There were three products sold with three antibiotics (2%) and one with four ingredients (1%).

Figure 1: Percent of trade name products sold containing each antibiotic class in 2022



The penicillins were present in 44 of the products sold (29% of products with sales) and accounted for 48% of total sales quantities compared to 38% of sales in 2021. The next largest class in terms of both products sold and quantity were the tetracyclines which were contained in 20 products (13% of products with sales) and 17% of the total sales quantity up from 14% in 2021. Sulphonamides and trimethoprim were contained in 12 products with sales (8% of products sold) and accounted for 10% of the total quantity sold (up from 7% in 2021). Macrolides were present in 13 products sold in 2022

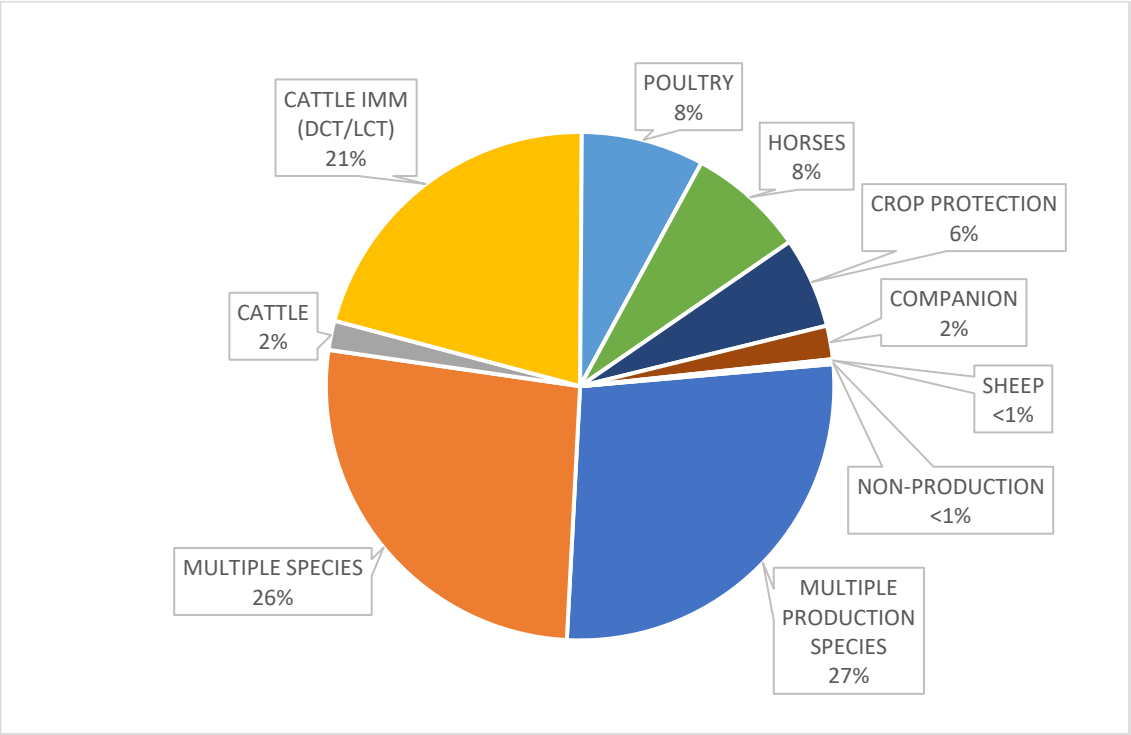
(8.5% of products with sales) and 9% of the total sales (also 9% in 2021); aminoglycosides were present in 14 products (9% of products with sales) and contributed 8% to the sales total compared to 5% in 2021. The polypeptides class were present in 5 products with sales (3%) and accounted for 5% of the sales total compared to 23% in 2021. See Figure 1 for breakdown by percentage.

Critically important antibiotics were contained in 51 products (31% of all products sold) and included one dual active and one triple active product and accounted for 15% of the total sales quantity.

Products are categorised by target species or group including intramammary treatments and other cattle-only products, sheep-only, horse only, pig/poultry, companion, and non-production animals. In addition to species-specific there are also two broader categories referred to as multi-species and multi-production species products. The difference between the two is that multiple species products are registered for use in both production and companion animals whereas multi-production species products are registered for use only in multiple food producing species.

Multi-production species products accounted for 27% of total sales with a further 23% from cattle-only products (21% were intramammary treatments and 2% other cattle-only treatments). Specific products for horses and for pigs/poultry each contributed 8% to the sales total with crop protection antibiotics the next largest at 6%. Companion and non-production species products accounted for 2% of the total. Further detail on the sales quantities for each target species product group is given later in the report.

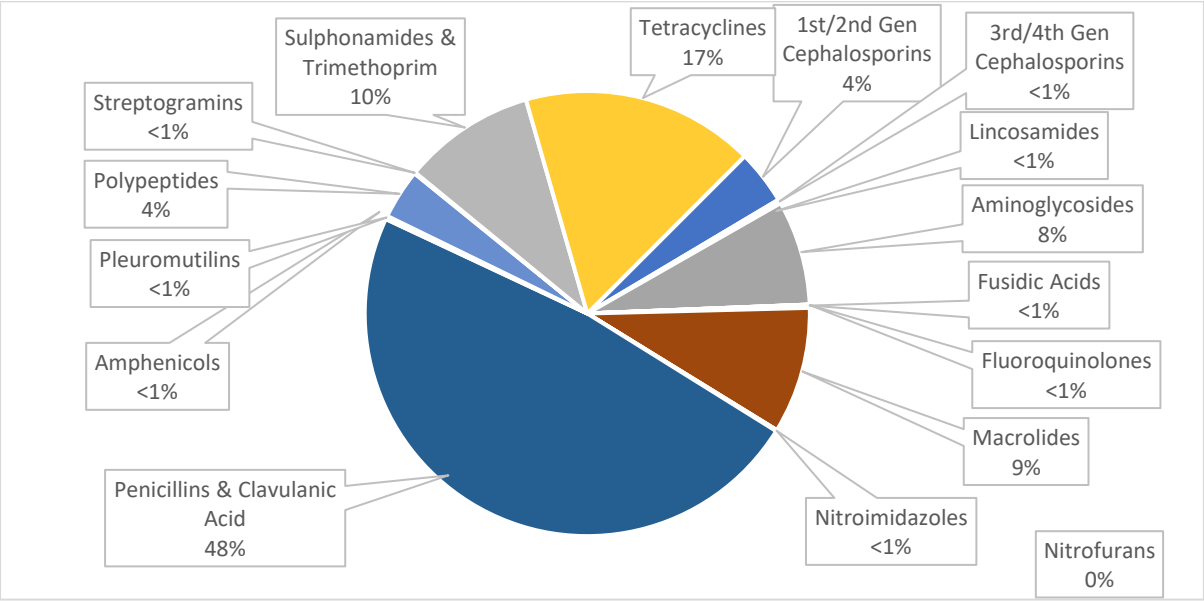
Figure 2: Percent of trade name products sold containing each product class



4.2 Total sales for 2022

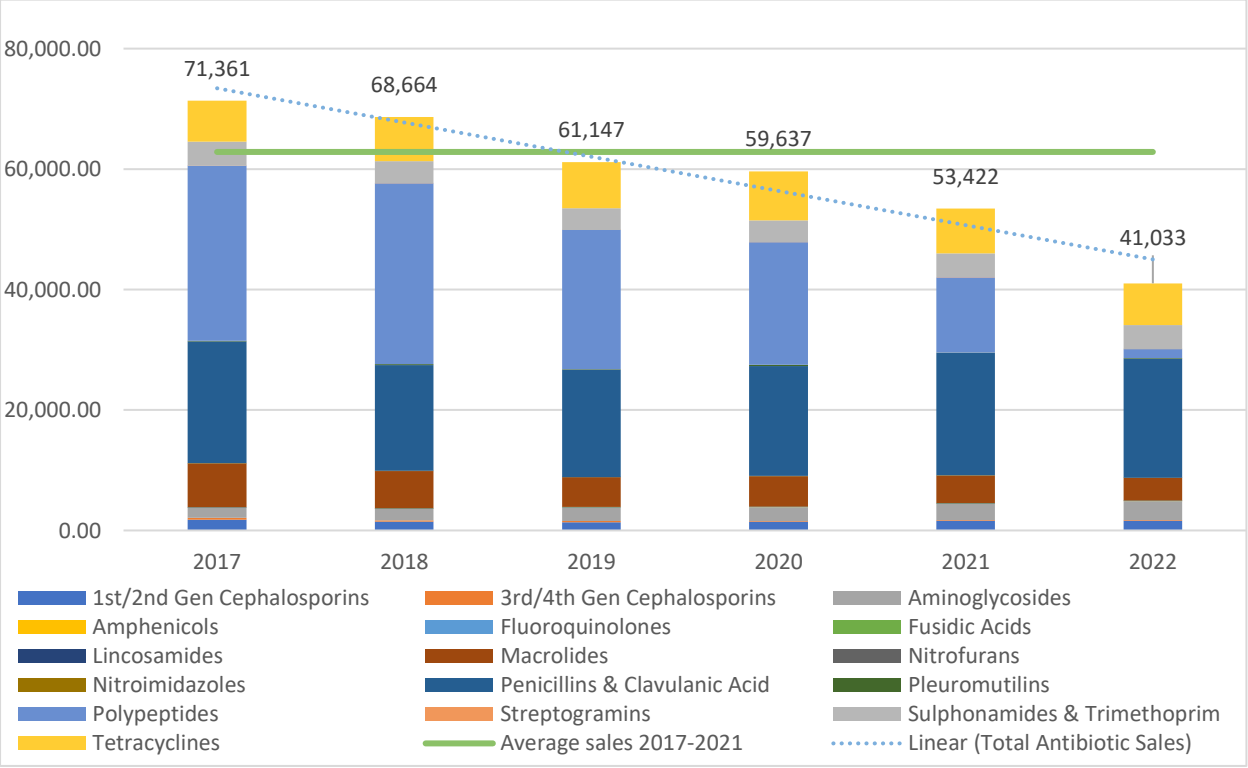
A total of 41,033 kg of antibiotic active ingredients were sold in 2022, a decrease of 23% from 53,422 kg in the previous year and continuing the decline in total sales quantities observed since 2017. Eight of the sixteen classes evaluated had lower sales reported, notably the 88% reduction in sales of polypeptides and 18% reduction in macrolides. Smaller decreases also occurred in the fluoroquinolones (14%), third and fourth generation cephalosporins (8%), tetracyclines (6.4%) and penicillins and clavulanic acids (3%).

Figure 3: Percentage of total sales for each antibiotic class in 2022



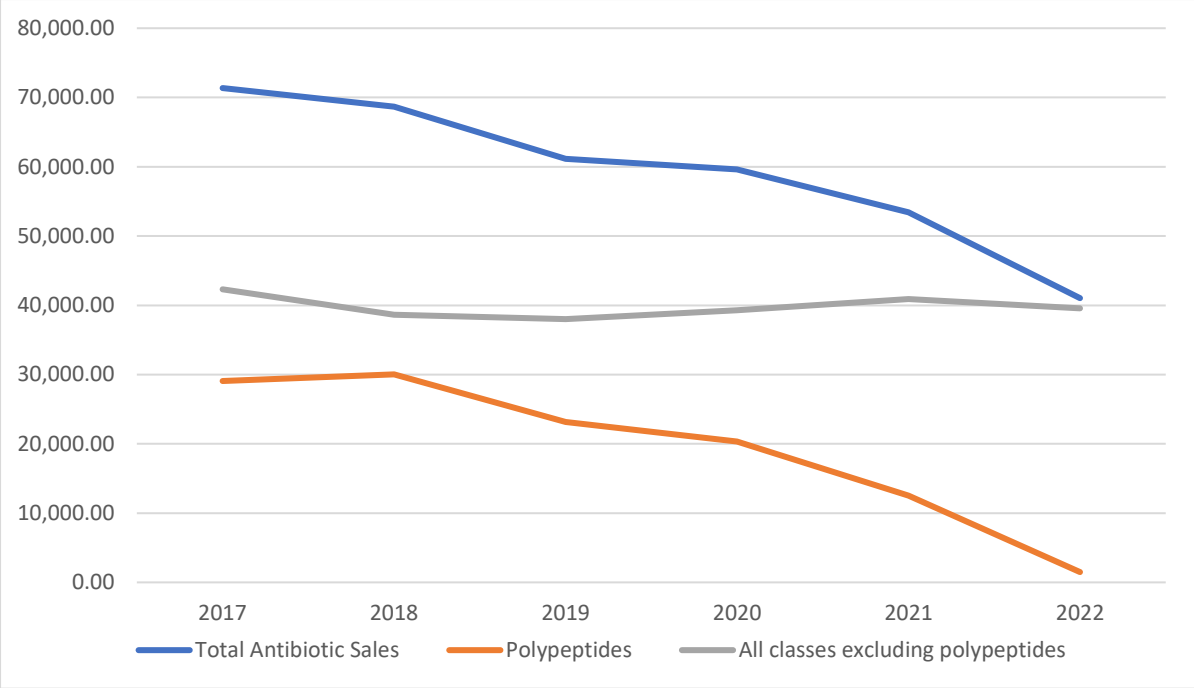
The total combined increase for the eight classes with higher sales was 486 kg. The aminoglycosides class had the largest increase with total sales 425 kg (16%) higher than 2021. The pleuromutilins increased by 18.5kg (22%) to 101 kilograms, the nitroimidazoles increased by 5kg (18%) to 34 kg and the lincosamides increased by 9kg (15%) to 66 kg. Other classes with higher sales included the first- and second-generation cephalosporins which increased by 10kg (0.6%) to 1,623 kg and the fusidic acids which were 2.7% higher at 1.13 kg. Amphenicols sales increased by 36% to 0.4 kilograms. No sales of nitrofurans were reported in 2022. Sales quantities in 2022 were 35% below the average for the previous five years.

Figure 4:Total antibiotic sales quantities by class 2017-2022 (in kilograms)



The impact of polypeptide sales on the total sales trend is shown in Figure 5 below. Quantities for the other fifteen classes (excluding polypeptides) have an average of 39,831 kg for the last five years.

Figure 5: Impact of polypeptide quantities on overall sales (in kilograms)



The penicillins and clavulanic acids share of total sales increased to 48% from 38%, despite a 3% reduction in quantity sold from 20,276 kilograms to 19,756 kg.

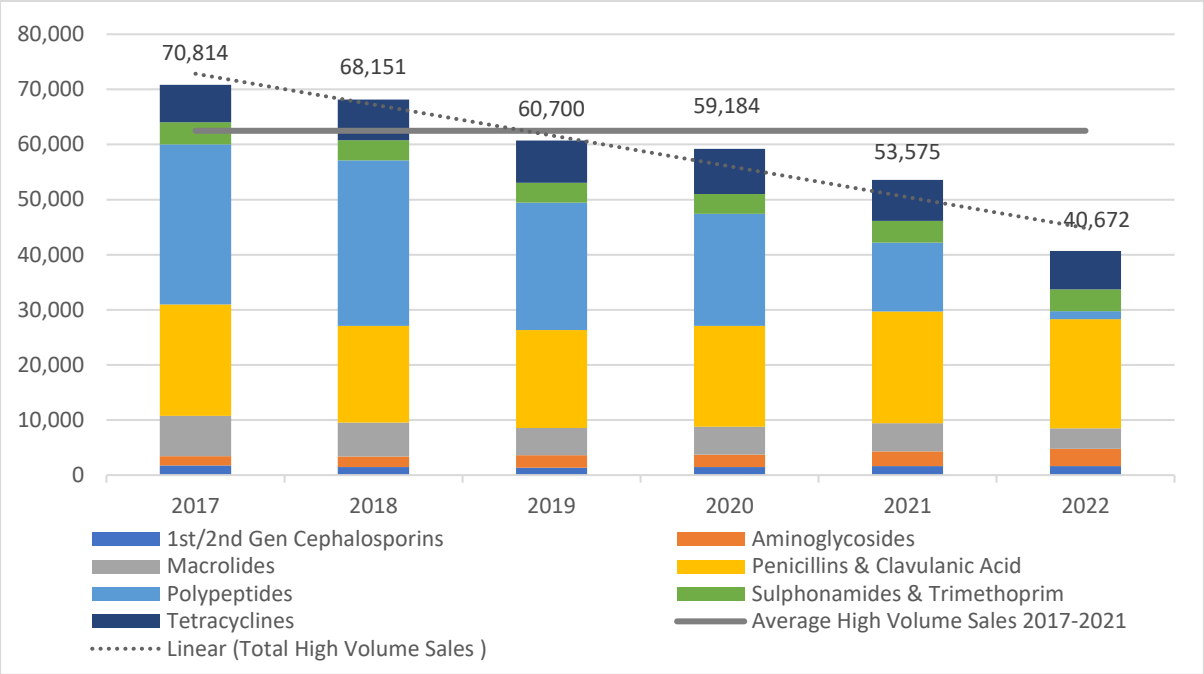
Similarly, tetracyclines sales were 6% lower at 6,958 kg and a share of the total sales quantity increasing from 14% to 17%. The total for the sulphonamides and trimethoprim class was relatively unchanged with 3,952 kg and 10% share of sales (up from 7% in 2021). The macrolides share of sales remained at 9% despite the 18% decrease in quantity to 3,770 kg; the aminoglycosides share increased to 8% up from 5% in 2021 with a 16% increase in sales to 3,124 kg. The polypeptides accounted for just 4% of total sales compared to 23% in 2021 due to the reduction in zinc bacitracin from 12,507 kg to 1,485 kg. Sales of this compound were over 30,000 kg in 2018 with substantial year-on-year decreases occurring since then. The only other polypeptide sold for veterinary use in New Zealand is polymyxin with total sales typically below one kilogram. Quantities of first and second generation cephalosporins were relatively unchanged with 1,622 kg accounting for 4% of total sales (up from 3% in 2021). All other classes had less than 1% share of the total sales in both 2022 and 2021.

These changes are discussed in further detail later in the report.

4.3 High volume and low volume sales groups

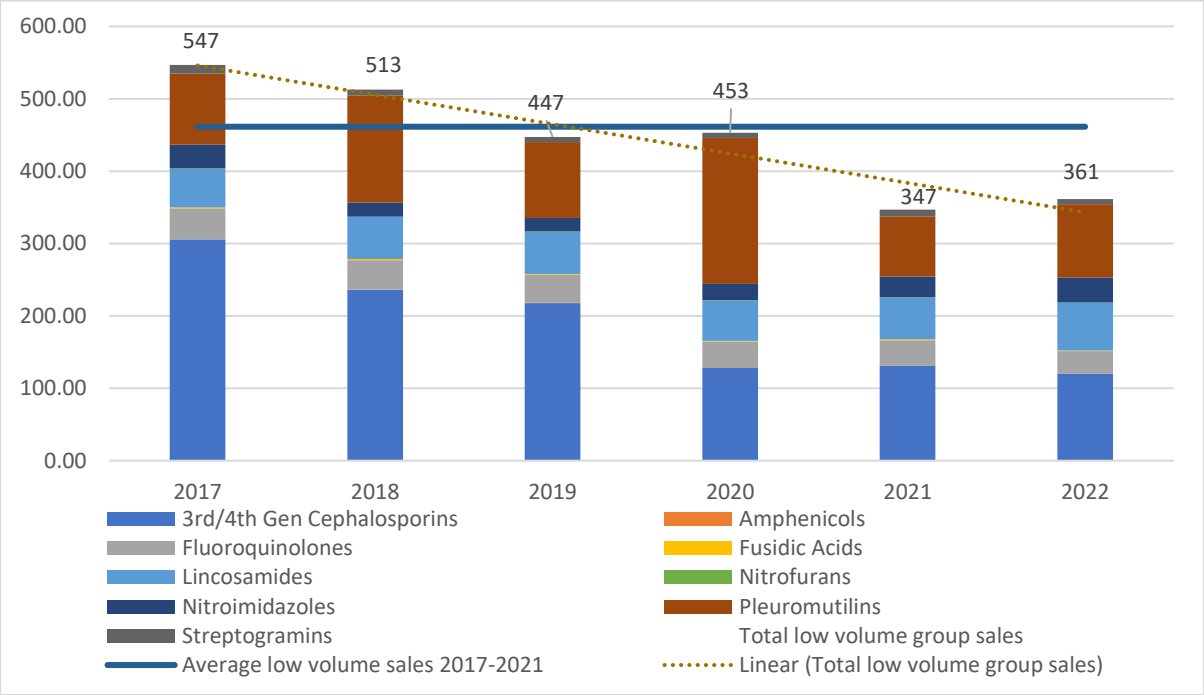
Antibiotic class sales can be divided into high-volume and low-volume groups depending on whether sales volumes were under or over 1,000 kg. The high-volume sales group consists of seven antibiotic classes: polypeptides, penicillins and clavulanic acids, tetracyclines, macrolides, sulphonamides and trimethoprim, aminoglycosides, and first- and second-generation cephalosporins. This group comprised more than 99% of total antibiotic sales, with penicillins and clavulanic acids accounting for 49% followed by the tetracyclines (17%), aminoglycosides (8%) and macrolides (9%). High-volume group sales declined by 23% to a total of 40,672 kg continuing the downward trend observed since 2017.

Figure 6: High-volume antibiotic sales quantities 2017-2022 (in kilograms)



The low-volume sales group is comprised of the nine classes and subgroups with sales below 1,000 kg. Nitrofurans are typically included in this group however no sales were reported in 2022. Six of the classes in the low-volume sales group have five or fewer registered trade name products, and three of those have just one product each. The total combined quantity for this group (0.9% of total sales) was 361 kg (4% higher than 2021). Two of the five critically important classes or subgroups accounted for 41% of the low volume group sales total; the third and fourth generation cephalosporins (33% of the low volume sales total) and the fluoroquinolones (8%). The remaining low volumes sales classes are the amphenicols, pleuromutilins, lincosamides, nitroimidazoles, streptogramins, fusidic acid, and nitrofurans. Low volume group sales have typically remained between 0.6% and 0.9% of the total annual volume.

Figure 7: Low-volume antibiotic sales quantities 2017-2022 (in kilograms)



4.4 Critically important antibiotics

4.4.1 Antibiotic classification and review

One of the objectives of the New Zealand Antimicrobial Resistance Action Plan, initiated in 2017, was to review and optimise antibiotic regulation. In 2019, the ACVM team began an extensive review and reassessment programme for all registered antibiotic trade name products. When complete, the reassessment programme will have assigned an importance classification to all antibiotic agricultural compounds in use in New Zealand and reassessed all antibiotic trade name products regarding label claims, dose rates, and prudent use statements. This will ensure approved uses reflect prudent use and good antimicrobial stewardship.

The New Zealand criteria for the antibiotic agricultural compound importance classifications have been developed after an evaluation of the classification criteria applied by the World Health Organization (WHO) to antibiotics used in humans, and the criteria applied by the World Organisation for Animal Health (WOAH) to antibiotics used in animals. This allows the New Zealand classifications to be applied to each individual antibiotic compound after taking both the importance of the compound to human and animal health, and the relative risk of developing antimicrobial resistance, into consideration.

Three classifications have been established for antibiotic agricultural compounds: critically important antibiotic, highly important antibiotic, and important antibiotic.

Antibiotic agricultural compounds are classed as **critically important** when they:

- have few or no suitable therapeutic alternatives in human and/or animal medicine or horticultural use in New Zealand; and
- are considered critical to the clinical treatment and resolution of disease caused by bacteria in humans, animals, and/or plants; and
- have a scientifically known and significant susceptibility to the development of AMR from either direct use or cross-resistance from another antibiotic or class of antibiotics.

Antibiotic agricultural compounds are classed as **highly important** when they:

- are considered significantly important to the clinical treatment and resolution of disease caused by bacteria in humans, animals, and/or plants; and
- have a recognised and/or demonstrated potential for the development of AMR from either direct use or cross-resistance from another antibiotic or class of antibiotics.

And finally, antibiotic agricultural compounds are classed as **important** when they:

- are considered important to the clinical treatment of disease in humans, animals and/or plants; and
- have characteristics that may lead to the development of AMR from either direct use or cross-resistance from another antibiotic or class of antibiotics

The review and reassessment programme has been divided into four tranches to facilitate completion of this work. Classifications in Tranche 1, which focused on macrolides, third and fourth generation cephalosporins, and penicillins, have been completed. The outcomes of these classifications are as follows:

- Registered veterinary macrolides, which include erythromycin, oleandomycin, spiramycin, tilmicosin, tulathromycin, and tylosin, have been classed as **critically important antibiotic agricultural compounds** in New Zealand.
- Registered third or fourth generation cephalosporins, which include cefovecin, cefpodoxime, ceftiofur, and cefquinome, have been classed as **critically important antibiotic agricultural compounds** in New Zealand.
- Registered penicillins, which include amoxicillin, ampicillin, cloxacillin, penethamate hydriodide, penicillin G benzathine, and penicillin G procaine, have been classed as **highly important antibiotic agricultural compounds** in New Zealand.

Formal reassessments of all registered products containing these antibiotic agricultural compounds are currently underway under section 29 of the ACVM Act 1997. The remaining tranches of work will be organised as follows:

- Tranche 2: Veterinary and horticultural aminoglycosides, fluoroquinolones, lincosamides, and 1st/2nd generation cephalosporins
- Tranche 3: Fusidic acid, tetracyclines, sulphonamides and trimethoprim, and polypeptides (zinc bacitracin and polymyxin),
- Tranche 4: Amphenicols, nitrofurans, nitroimidazoles, pleuromutilins, and virginiamycin.

Horticultural aminoglycosides (streptomycin and kasugamycin) will no longer be reassessed in a separate tranche, instead they will be reassessed as part of tranche 2 alongside veterinary aminoglycosides.

The antibiotics in tranches 2-4 will be assigned importance classifications before undergoing a formal reassessment of all registered products containing these antibiotic agricultural compounds.

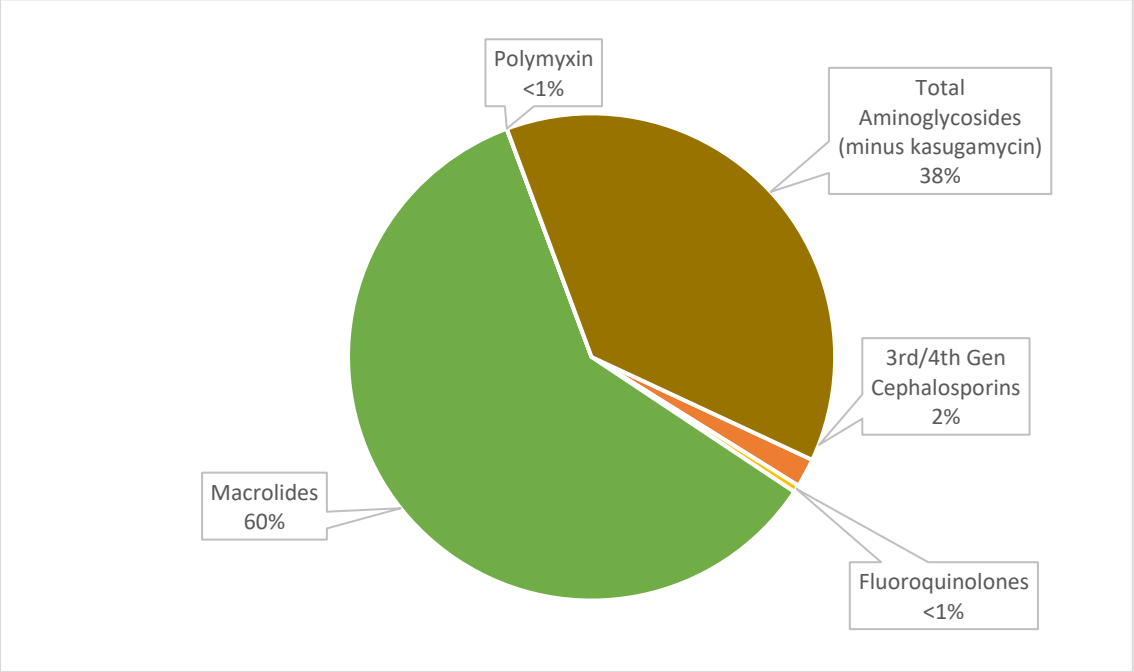
For the purposes of this report, all registered compounds in the macrolide and third- and fourth-generation cephalosporin classes, as well as compounds in the fluoroquinolone and aminoglycoside classes, will be considered critically important antibiotics. In addition, the polypeptide antibiotic polymyxin will also be considered critically important. The provisional classification of the fluoroquinolones, aminoglycosides, and polymyxin is based on the current WHO and OIE classifications for these antibiotics, with final classification for these compounds to follow. The only exception to this provisional classification is kasugamycin, an aminoglycoside used as a horticultural antibiotic that is not considered critically important due to its limited use solely in horticulture and unique antimicrobial resistance risk profile.

4.4.2 Overall summary of 2022 sales for critically important antibiotics

Critically important antibiotic compounds accounted for 15% of total antibiotic sales in 2022 with 6,285 kg reported compared to 6,848 kg in the previous year (a decrease of 8%). The macrolides class accounted for 60% of critically important antibiotic sales (down from 67% in 2021) followed by the aminoglycosides (excluding kasugamycin) with 38% (up from 30% in 2021). The remaining 2% of the

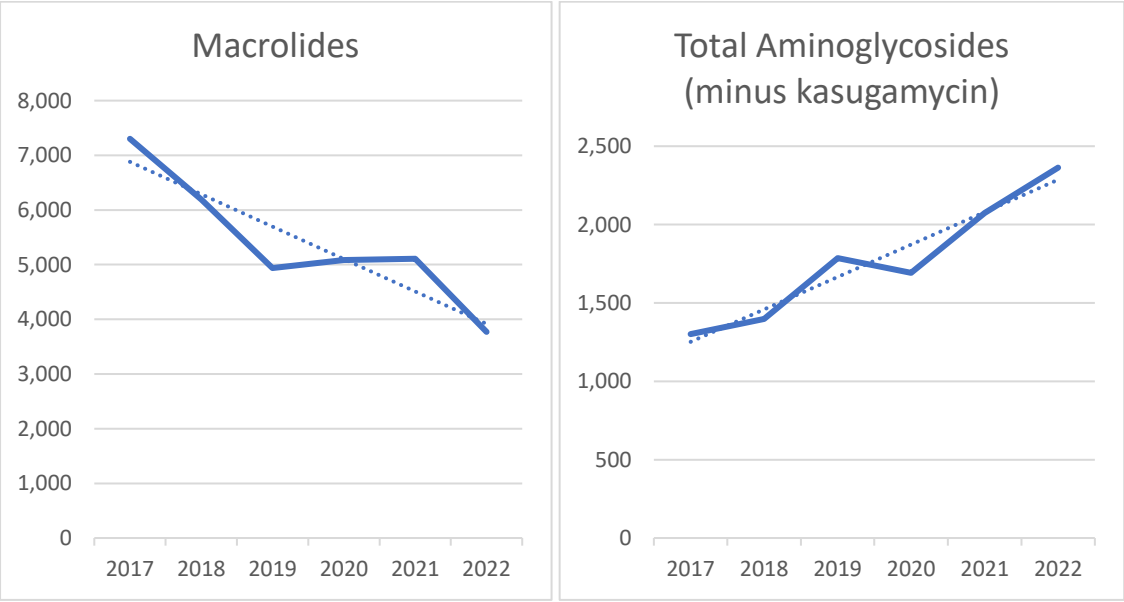
critically important antibiotic sales quantity consisted of the third and fourth generation cephalosporins, fluoroquinolones, and polymyxin with a total of 152 kg.

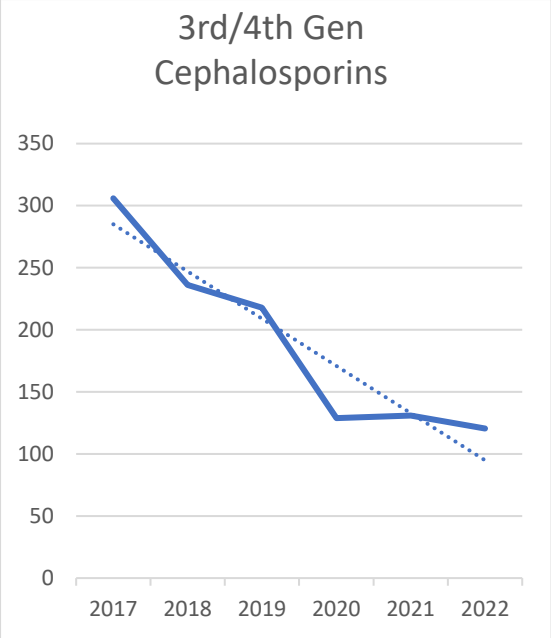
Figure 8: Distribution of 2022 sales quantities within the critically important antibiotic sub-group



The macrolides were the main contributor to the lower total for the critically important classes with a 18% decrease to 3,770 kg from 4,607 kg in 2021. Decreases were also reported for the third and fourth generation cephalosporins (8% lower at 120 kg) and the fluoroquinolones (14% lower at 30 kg). Sales of critical aminoglycosides increased by 290 kg (14%) to 2,363 kg compared to 2,073 kg in 2021. Polymyxin sales decreased by 4% to 0.89 kg.

Figure 9: Critically Important Antibiotic class sales quantities over time (in kilograms)




3rd/4th Gen Cephalosporins
350
300
250
200
150
100
50
0
2017
2018
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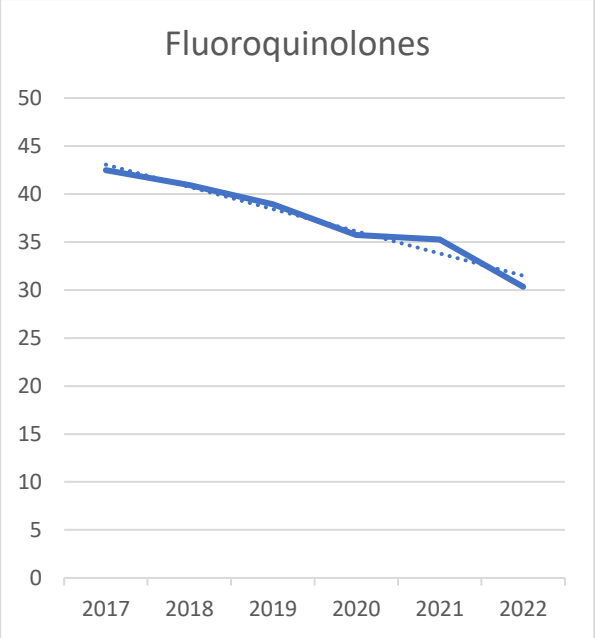
2021
2022


Fluoroquinolones
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45
40
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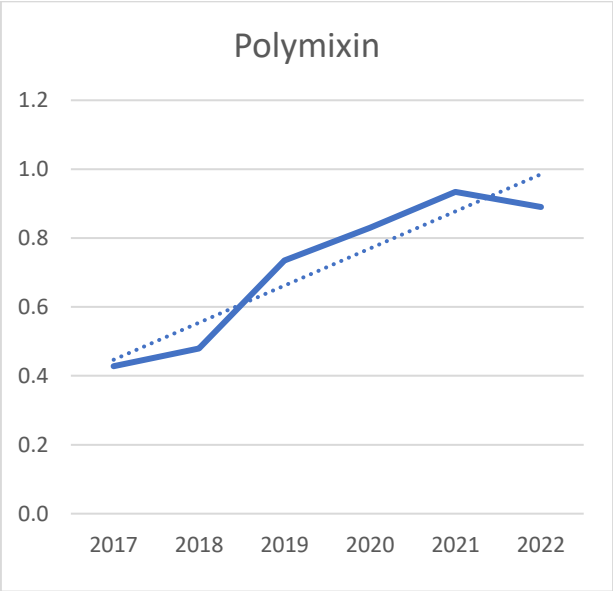
Polymixin
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1.0
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0.2
0.0
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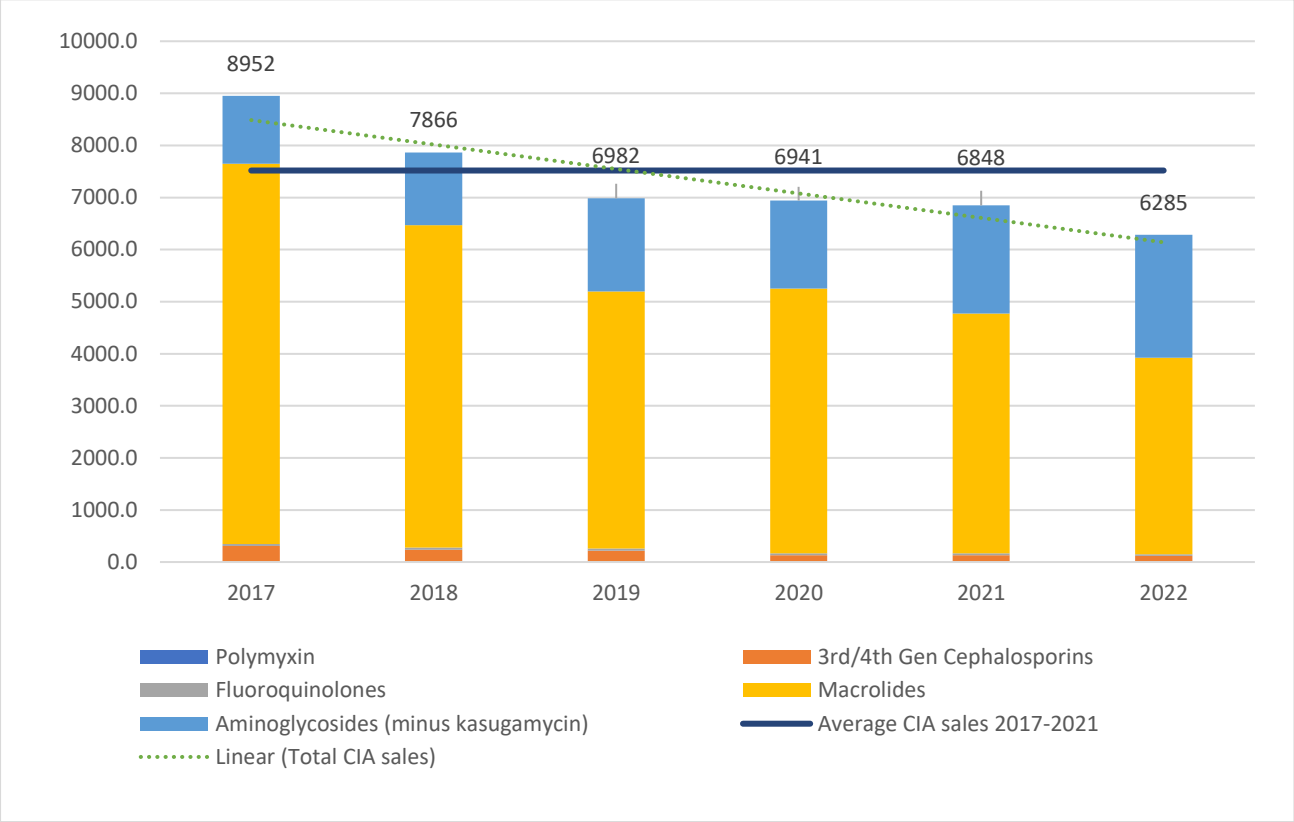
2022

Figure 10: Critically Important Antibiotic sales quantities 2017-2022 (in kilograms)



Critically important antibiotic sales were 16% lower than the average for the same classes 2017-2021.

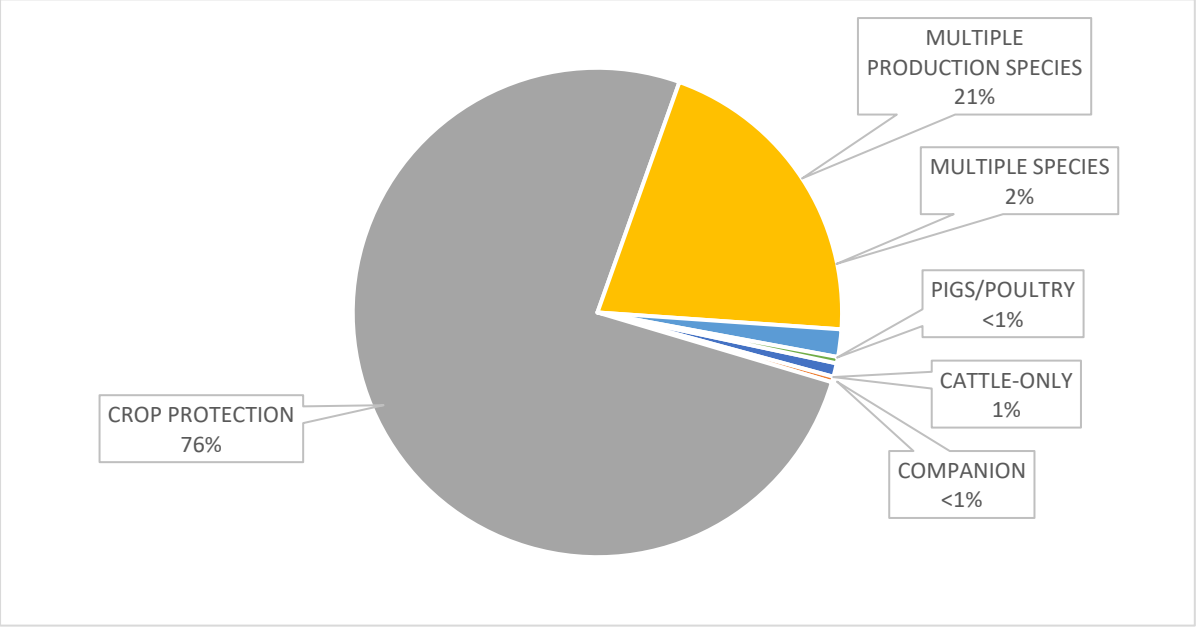
5 Antibiotic Sales Trends by Class

5.1 Aminoglycosides

Sales of aminoglycosides increased for the third successive year to 3,125 kg from 2,699 kg in 2021. This class contributed 7.6% to the total sales quantity compared to 5% in the previous year. Aminoglycosides are used in a wide range of companion and production animal species, with streptomycin and kasugamycin approved for use in certain fruit crops. The distribution of sales by product type is shown in Figure 11 below. A total of 14 products containing aminoglycosides had sales reported (9% of products with sales).

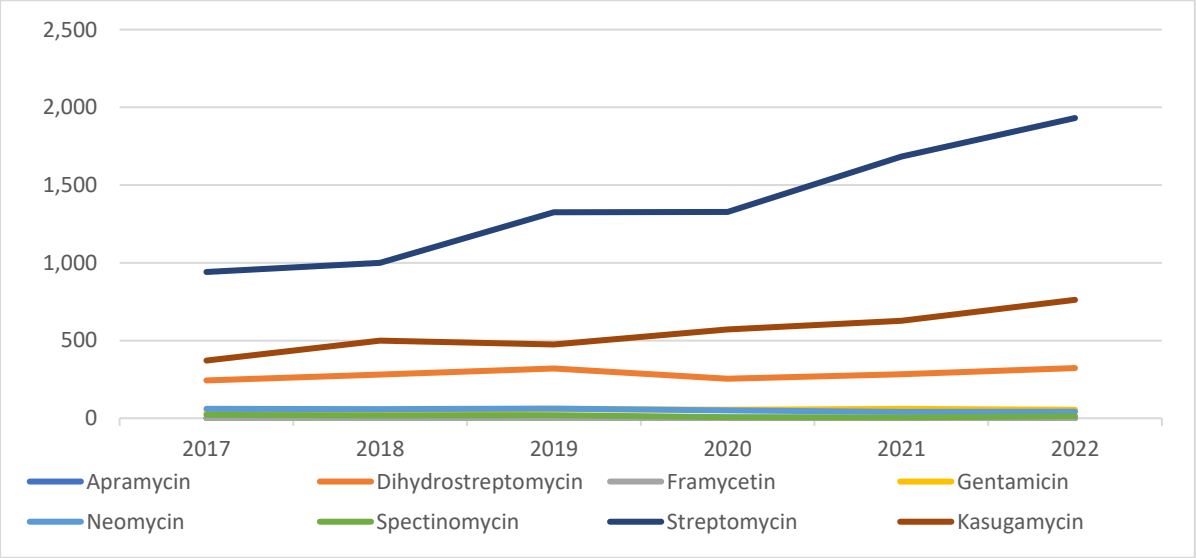
Just under 76% of aminoglycosides quantities were sold for use in crop protection with the remainder sold for use in animals with most (21%) in multiple production species products.

Figure 11: Distribution of aminoglycosides sales quantities by product type



Overall total aminoglycosides sales were 16% higher compared to 2021 and 38% higher than 2020. Quantities sold for all antibiotics in this class increased in 2022 apart gentamycin (10% decrease). No sales of apramycin were reported.

Figure 12: 2022 aminoglycosides sales quantities compared to the previous five-year sales trends (in kilograms)

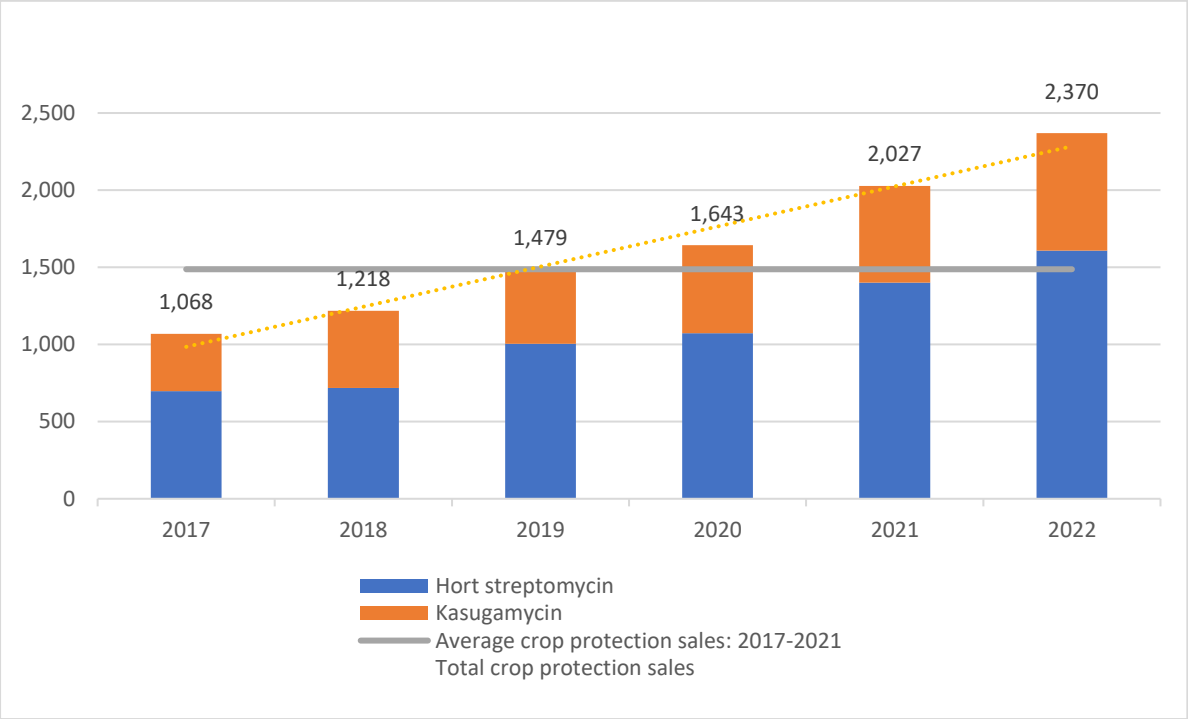


Streptomycin accounted for 62% of total aminoglycoside sales, followed by kasugamycin with 23% with the remaining six compounds collectively accounting for the remaining 15%. Streptomycin quantities increased by 15% to 1,931 kg and a 2% increase from 3% to 5% in the share of total sales. Antibiotics in the aminoglycosides class provisionally classed as critically important (apramycin, dihydrostreptomycin, framycetin, gentamicin, neomycin, streptomycin, and spectinomycin) accounted for 75% of class sales and just over 3.8% of total antibiotic sales in 2022 with 2,363 kg compared to 2,073 kg in 2021 (77% of total sales for the class).

5.1.1 Crop protection aminoglycoside sales

Total sales of aminoglycosides sold in trade name products for crop protection were 2,370 kg which was 17% higher than 2021 following a 23% increase the previous year. The percentage contribution to total sales increased from 4% to 6% in 2022.

Figure 13: Total crop protection aminoglycosides sales quantities 2017-2022 (in kilograms)

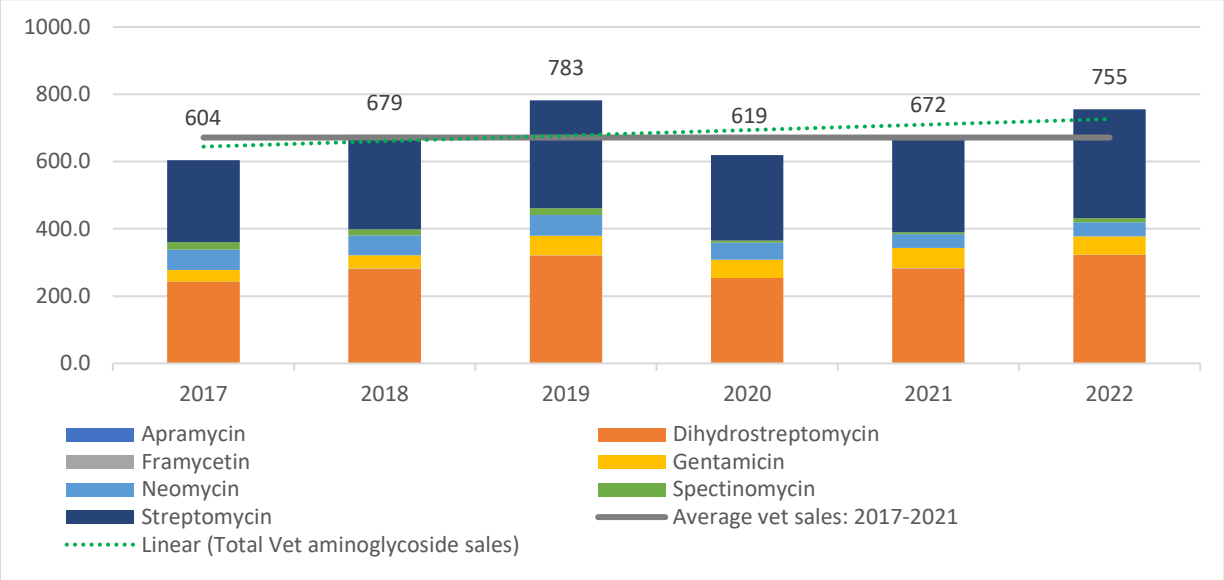


Sales of these compounds have been increasing since 2017 and the quantity sold in 2022 exceeded the average for the preceding five years by 59%. Further analysis can be found in the crop protection antibiotic section (6.9 in this report).

5.1.2 Veterinary aminoglycoside sales

Quantities of veterinary aminoglycosides increased by 11% in 2022 to 755 kg with higher amounts reported for five of the six antibiotics with sales. Total veterinary aminoglycosides sales accounted for 24% of the class total and 2% of overall total sales. Streptomycin and dihydrostreptomycin are used to treat a variety of gram-negative bacterial infections and sales for these compounds increased by 12% to 645 kg and accounted for 86% of veterinary aminoglycoside sales. The largest percentage increase was spectinomycin, used to treat respiratory infections and enteritis in poultry and pigs, with a 7kg (55%) increase to 13 kg in 2022. Sales of framycetin increased by 13% to 0.3kg and neomycin increased by 2% to 42 kg. Framycetin is used exclusively in companion animals for the treatment of ear and skin infections. Neomycin is used in dairy cattle as a treatment for mastitis and is also commonly used for treating skin and eye infections in companion animals. Gentamicin sales decreased by 11% to 54 kg and contributed 7% to class sales; this compound is used in companion animals and horses to treat a variety of gram-negative infections. Most veterinary aminoglycosides are distributed by injection (92%) with 4% in intramammary treatments and the remaining 2% administered in water, applied topically or by intra-aural or intra-ocular methods.

Figure 14: Total veterinary aminoglycoside sales quantities 2017-2022 (in kilograms)



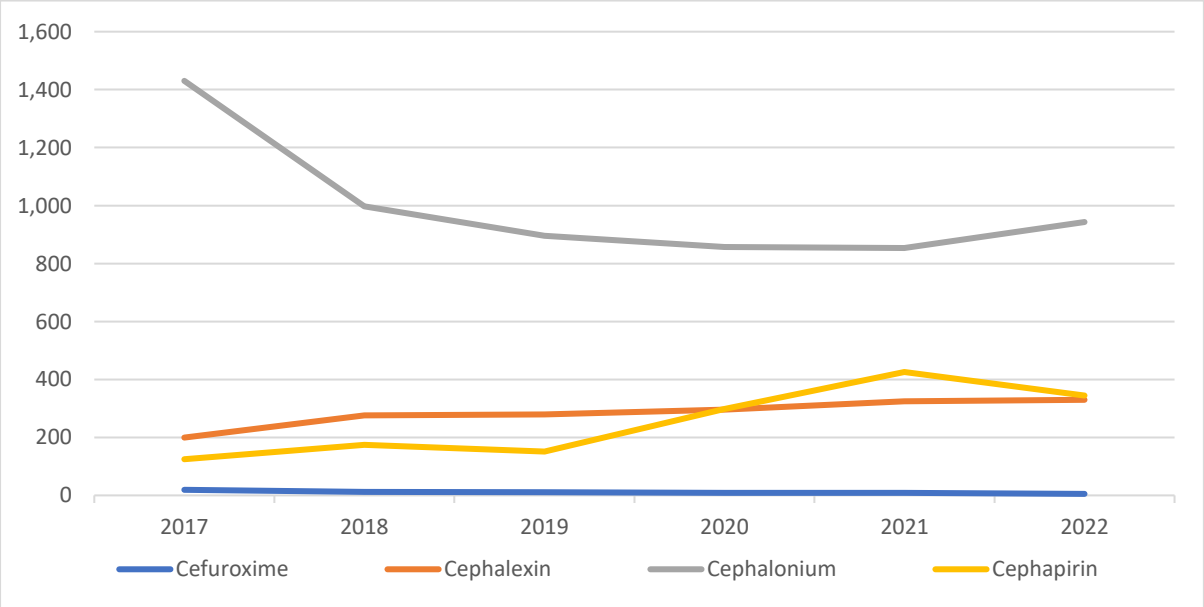
5.2 Cephalosporins

5.2.1 First and Second Generation Cephalosporins

Sales of first and second generation cephalosporins increased by 1% to 1,623 kg and accounted for 4% of the total quantity sold (up from 3% the previous year). Lower sales of cephapirin (19% lower with 344 kg) and cefuroxime (41% lower at 5 kg) were reported, offset by increases in cephalonium (up 11% to 943 kg) and cephalexin (up 1% to 330 kg).

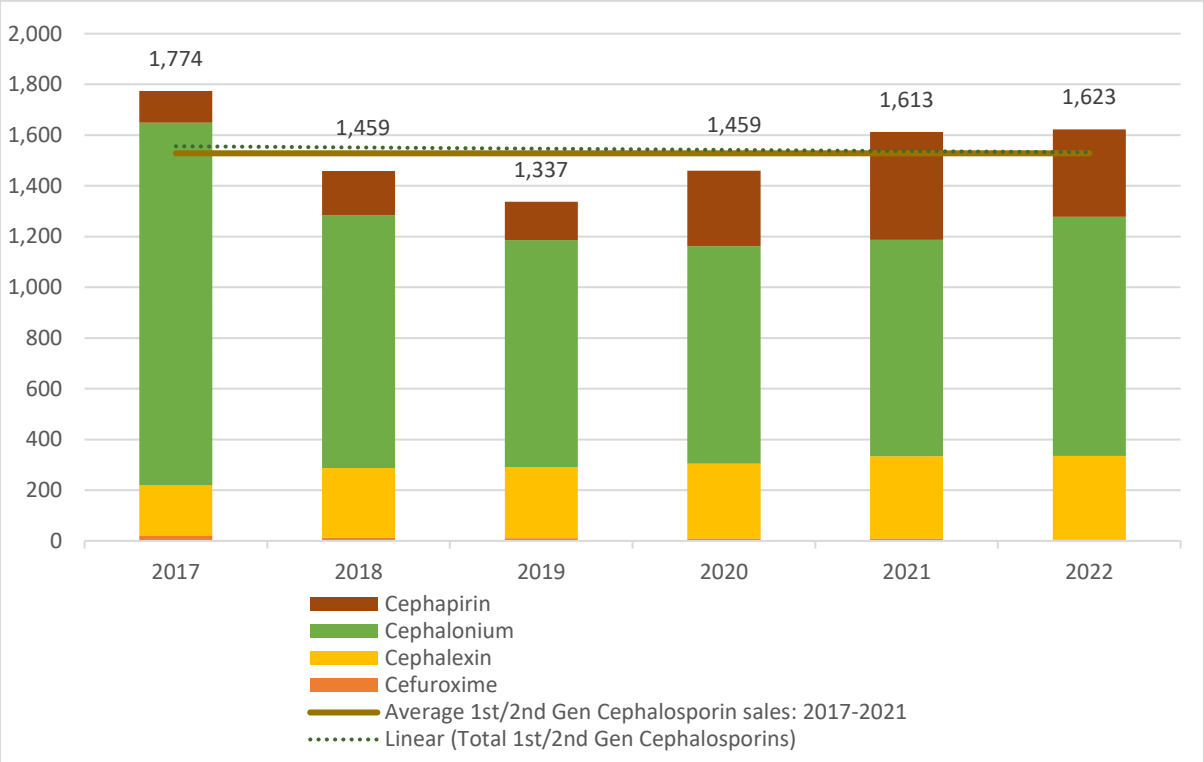
Cephalonium accounted for 58% of the quantity sold for this class (up from 53% in 2021) with cephapirin contributing 21%, cephalexin 20% and cefuroxime less than 1%. Sales of cephapirin decreased by 19% to 344 kg following substantial increases in 2020 and 2021. Sales of cephalexin have increased each year since 2017 whereas quantities of cephalonium increased in 2022 after four years of successive decreases.

Figure 15: 2022 first- and second-generation cephalosporin sales quantities compared to the previous five-year sales trends (in kilograms)



Just under 80% of class sales were contained in cattle-only products with cephalonium registered for use in dry cattle therapy products and cefuroxime used in lactating cattle therapy products. Cephapirin is registered for use in cattle- only products with around one-third of sales for intrauterine and two-thirds in intramammary treatments. Cephalexin has been used exclusively in companion animal species since 2017, despite being registered for injectable use in multiple species and intramammary products for cattle. Distribution of first and second generation cephalosporins was mainly by intramammary methods (72%) with 20% delivered orally and 8% by intrauterine delivery.

Figure 16: Total first- and second-generation cephalosporin sales quantities 2017-2022 (in kilograms)



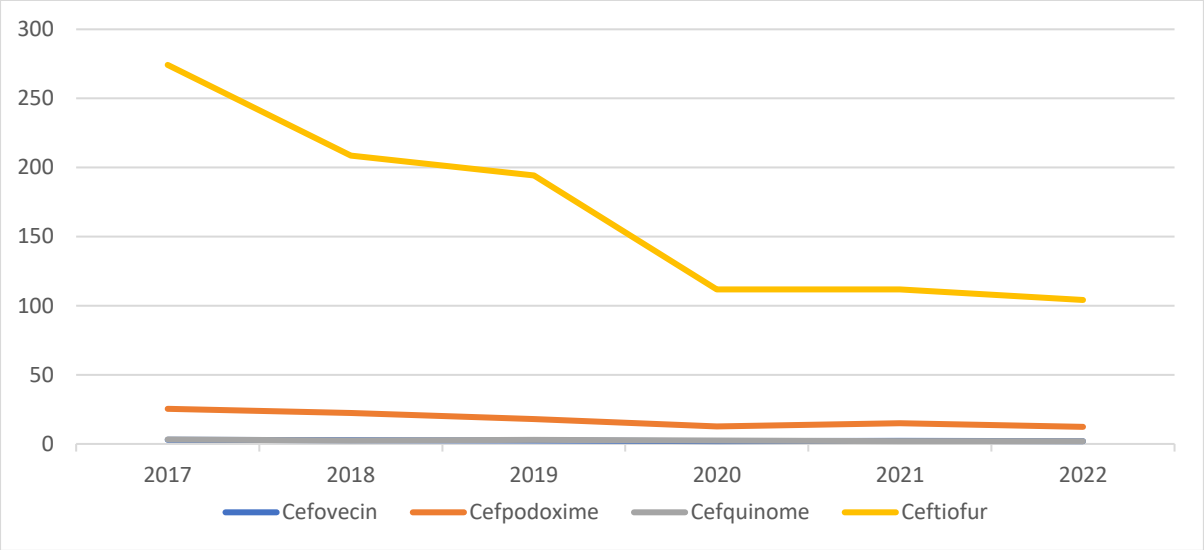
Sales of first and second generation cephalosporins were 6% above the previous five-year sales average.

5.2.2 Third and fourth generation cephalosporins

Quantities of third and fourth generation cephalosporins sold in 2022 decreased by 8% to 120 kg with decreases reported for all four antibiotics in this class, all of which are regarded as critically important antibiotics in New Zealand accounting for 0.29% of total sales and 2% of critical antibiotic sales.

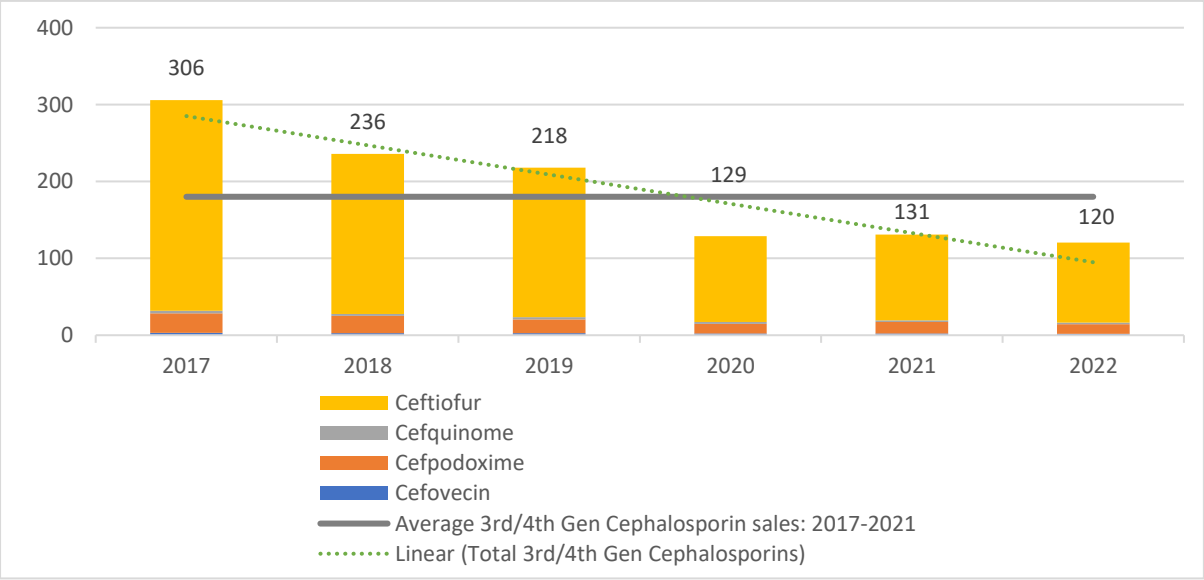
Ceftiofur accounted for 86% of class sales with 104 kg (down from 111 kg in 2021) followed by cefpodoxime with 12 kg (10% of class sales down from 15 kg in 2021) and cefovecin (2 kg in both 2022 and 2021). Cefquinome is the only fourth-generation cephalosporin approved for use in New Zealand accounting for the remaining 4% (just under 2 kg). Percentage shares of class sales were consistent with the previous year's results with the largest change being a 2% decrease for cefpodoxime and a 1% increase for ceftiofur.

Figure 17: 2022 third- and fourth-generation cephalosporin sales quantities compared to the previous five-year sales trends (in kilograms)



Quantities of both ceftiofur and cefquinome were at their lowest for over eight years with all sales reported in multiple production species products. Cefpodoxime and cefovecin were sold in companion animal treatment products (just under 12% of class sales) with amounts consistent with 2021 levels. Less than 1% of class sales (cefquinome) was sold in cattle-only products. Just under 90% of the class was sold for delivery by injection with 10% by oral means and less than 1% by intramammary methods.

Figure 18: Total third and fourth generation cephalosporin sales quantities 2017-2022 (in kilograms)



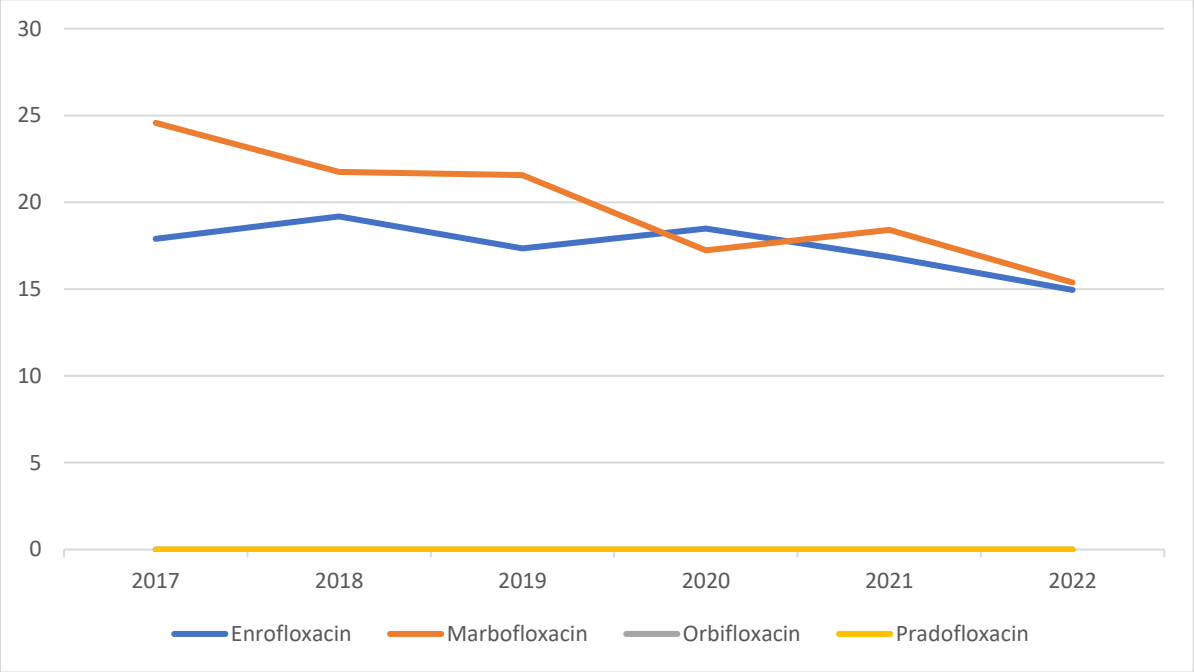
Third and fourth generation cephalosporins sales were 33% below the average for the previous five years.

5.3 Fluoroquinolones

Overall sales quantities for this critically important class continued to decline with lower amounts reported for both antibiotic active ingredients with sales. The total sold was 30 kg consisting of 15 kg each of marbofloxacin and enrofloxacin compared to 18 kg and 17 kg respectively in 2021. The quantity of marbofloxacin sold decreased by 16% and enrofloxacin sales were 11% lower than 2021.

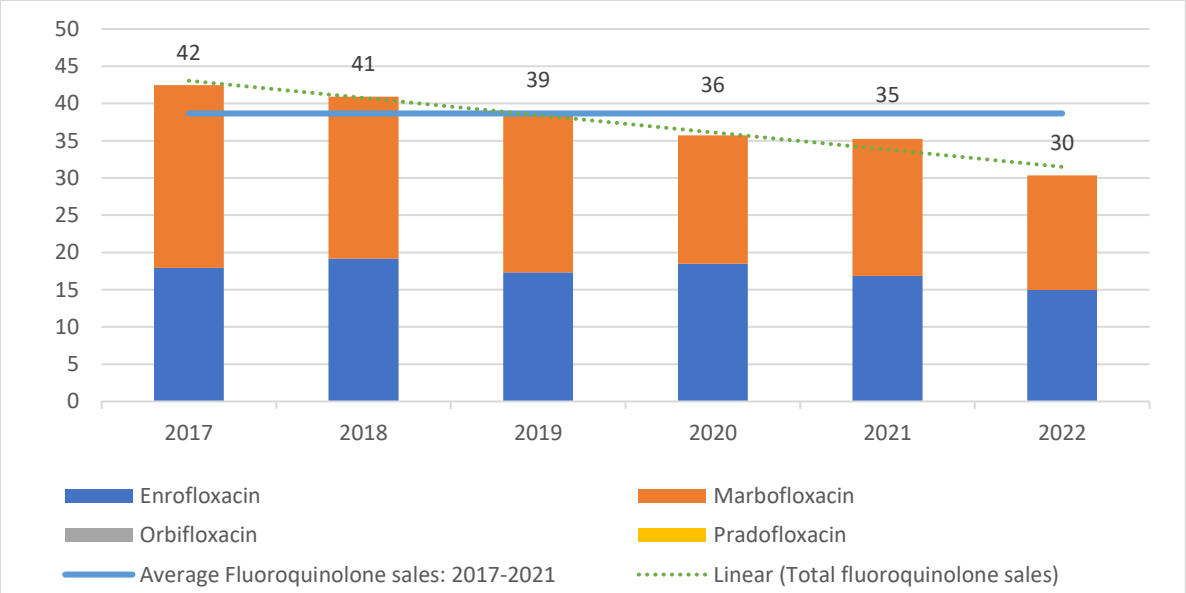
The fluoroquinolones continue to comprise a very small part (0.07%) of total antibiotic sales and 0.5% of critical antibiotic sales. No sales were reported for either orbifloxacin or pradofloxacin in 2022.

Figure 19: 2022 fluoroquinolones sales quantities compared to the previous five-year sales trends (in kilograms)



Just under 50% of the quantity sold in this class were contained in companion animal products, with 39% sold in for use in multi-production species products and 11% in cattle-only products. Over 50% of the antibiotics were administered by injection with 49% delivered orally and the remainder by intra-aural means.

Figure 20: Total fluoroquinolone sales quantities 2017-2022 (in kilograms)



Enrofloxacin is registered for use as a treatment for respiratory tract, urinary and gastrointestinal infections in cattle, pigs, and companion animals. Marbofloxacin is used to treat mastitis in dairy cattle and respiratory diseases and mastitis metritis agalactia syndrome (MMA) in pigs. Marbofloxacin is

also used to treat ear infections in companion animals. Sales of fluoroquinolones in 2022 were 22% below the average for the previous five years.

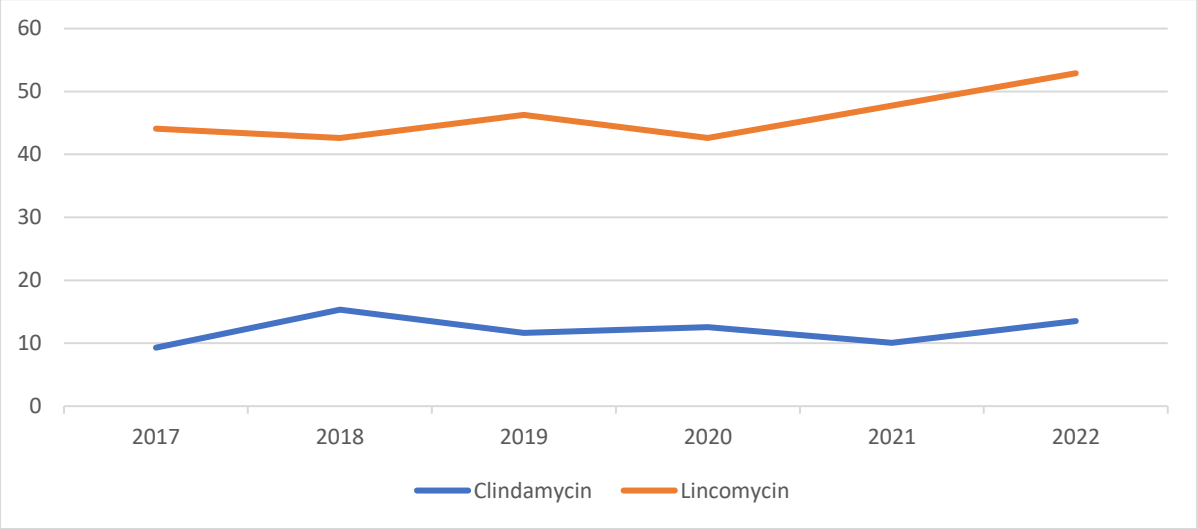
5.4 Fusidic acid

Sales of fusidic acid remained at a similar level to those reported for the previous three years at 1.13 kg with only a 2.7% increase compared to 2021. Fusidic acid is contained in products sold for use in companion animals as a topical treatment for eye, ear, and skin infections.

5.5 Lincosamides

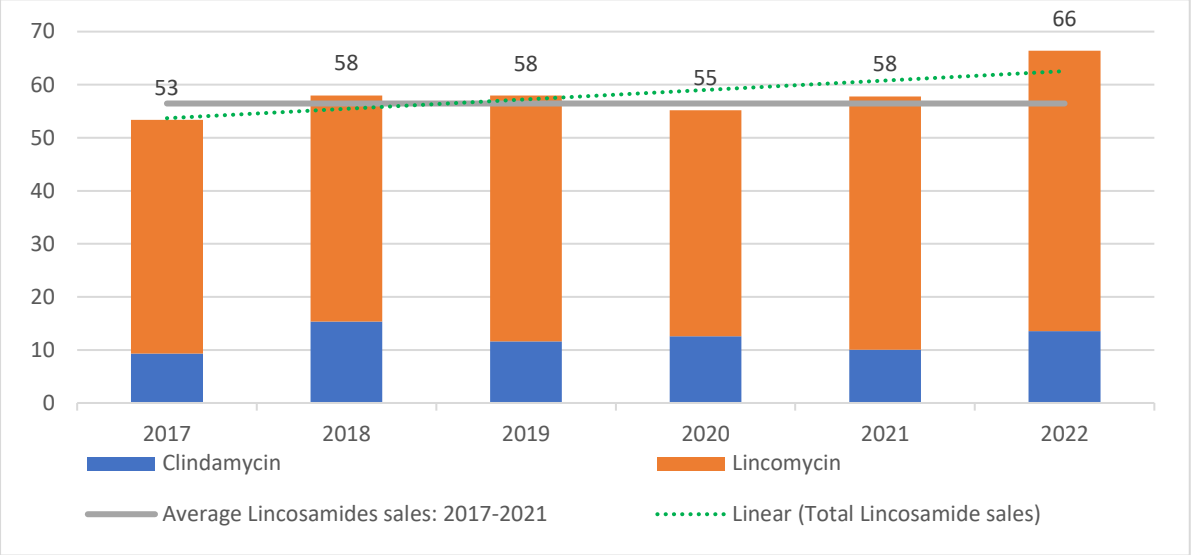
Increased quantities of both lincosamide active ingredients registered for use in New Zealand were reported with a combined total of 66 kg compared to 58 kg in 2021 which accounted for 0.1% of total sales. Increased amounts of both lincomycin (11% higher) clindamycin (35% higher) were reported in 2022. Despite having the lesser of the two increases**,** lincomycin continued to dominate sales for this class with 80% (53 kg) compared to clindamycin with 20% (14 kg) compared to 83% and 17% in 2021. Lincomycin sales were reported in intramammary products (70% of class sales) and pig and poultry-specific products (10% of class sales) whereas clindamycin sales were reported only in companion animal products (20% of class sales). Lincosamides in non-intramammary products were administered either orally or in water.

Figure 21: 2022 lincosamides sales quantities compared to the previous five-year sales trends (in kilograms)



In addition to being used as an intramammary treatment lincomycin is also registered for the treatment of respiratory diseases in poultry and dysentery and enteritis in pigs. Clindamycin is registered to treat skin, bone, respiratory, and dental infections in dogs and cats. Lincosamide sales were 17% above the average for the previous five years and 25% above the quantity sold for this class in 2017.

Figure 22: Total lincosamides sales quantities 2017-2022 (in kilograms)

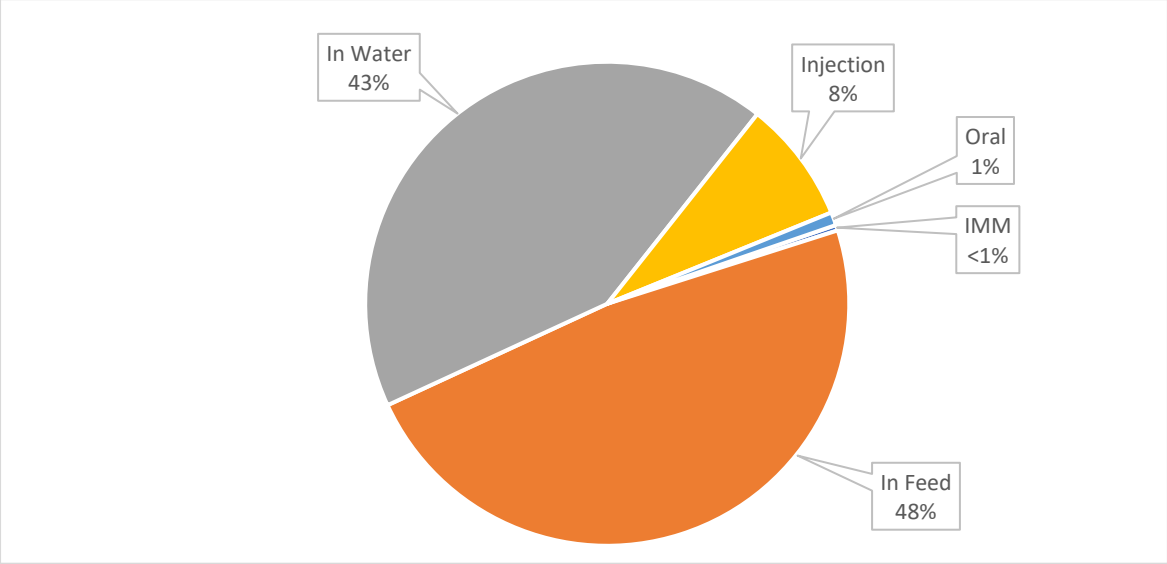


5.6 Macrolides

Sales quantities for this critically important class decreased by 18% from 4,607 kg to 3,770 kg with the contribution to total sales remaining relatively unchanged at 9%. The macrolides share of critical antibiotic sales decreased by 7% to 60% in 2022. Lower sales were reported for three of the five compounds in this class with the most significant change being a 18% (839 kg) decrease in the quantity of tylosin sold from 4546 kg to 3,707 kg. A decrease in sales of 2 kg for both oleandomycin and spiramycin was reported, with 14 kg sold for the former and 33 kg for the latter. In contrast increased sales were reported for tilmicosin (73% higher with 16 kg which was the same as the amount sold in 2020) and tulathromycin (20% higher at 0.36 kilograms). As in previous years no sales were reported for erythromycin.

Just under half of macrolides sales (48%) were in-feed products with 23% sold as in in-water products and 8% administered by injection with the remainder delivered by intramammary or oral treatments.

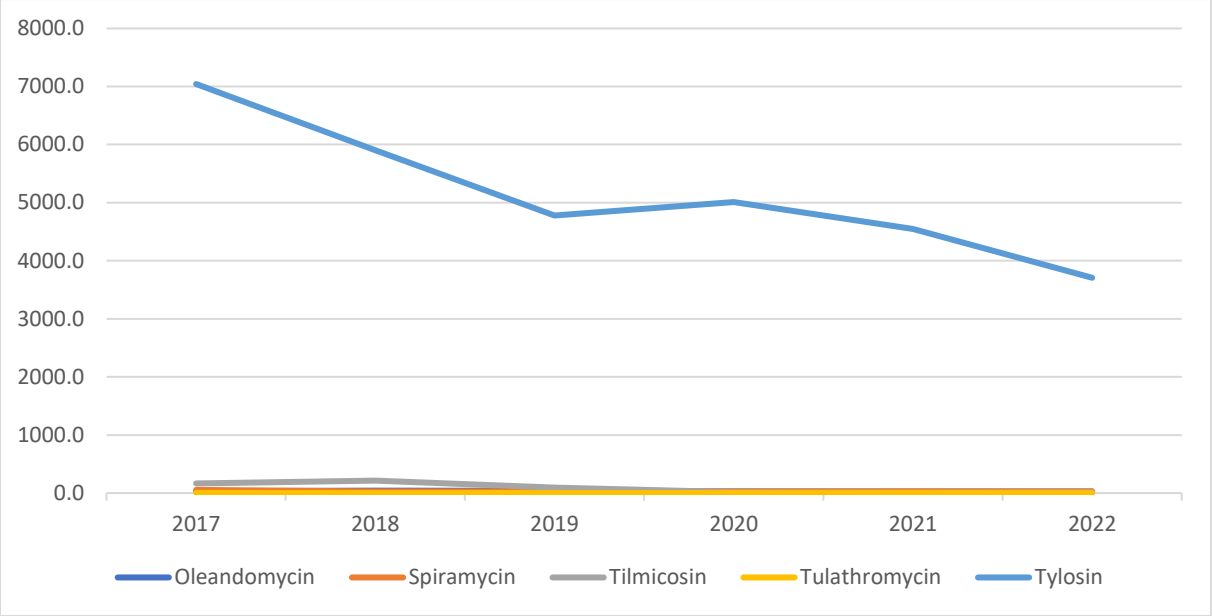
Figure 23; Macrolides sales distribution methods 2022



Tylosin is registered as a treatment for respiratory disease in chickens, ileitis and arthritis in pigs, mastitis and respiratory disease in cattle, liver abscess in beef cattle, and mastitis and respiratory

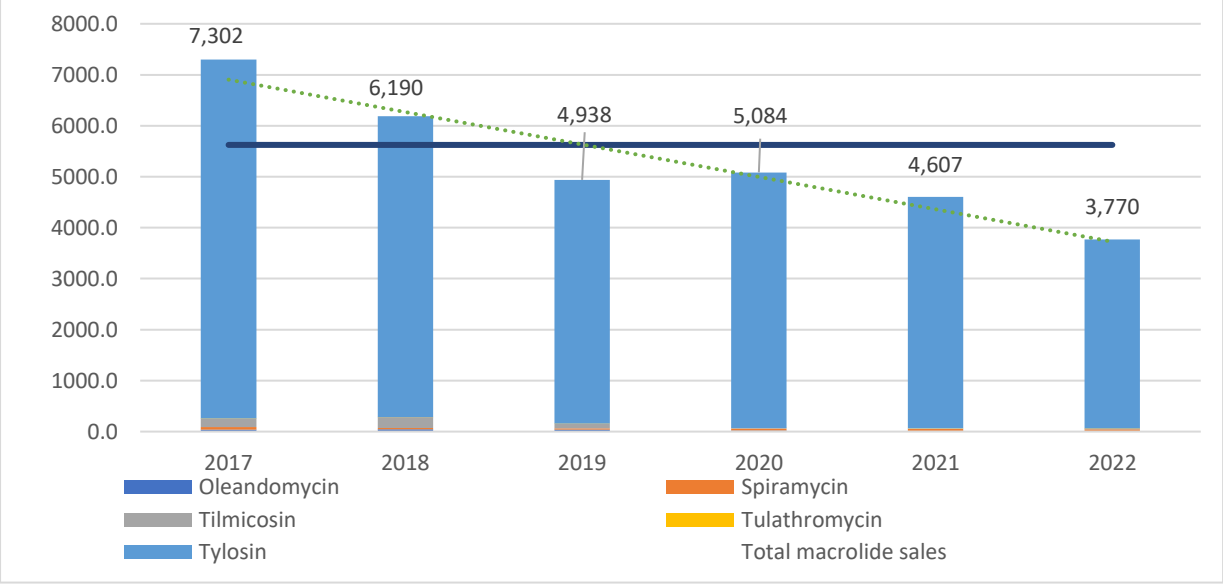
disease in goats. Tilmicosin is registered as a treatment for respiratory disease in cattle and footrot in sheep, oleandomycin for use in lactating cattle therapies whereas spiramycin is used in companion animal treatments.

Figure 24: 2022 macrolide sales quantities compared to the previous five-year sales trends (in kilograms)



Over 55% of macrolides sales were in multi-production species products (tylosin, tilmicosin and tulathromycin) with 43% sold in pig- and poultry specific products (tylosin) and the remainder sold for use in cattle-only (tylosin and oleandomycin) and companion animal (spiramycin) products. Overall sales for this class have decreased since 2017 and the 2022 sales total was 33% below the average for the previous five years.

Figure 25: Total macrolides sales quantities 2017-2022 (in kilograms)



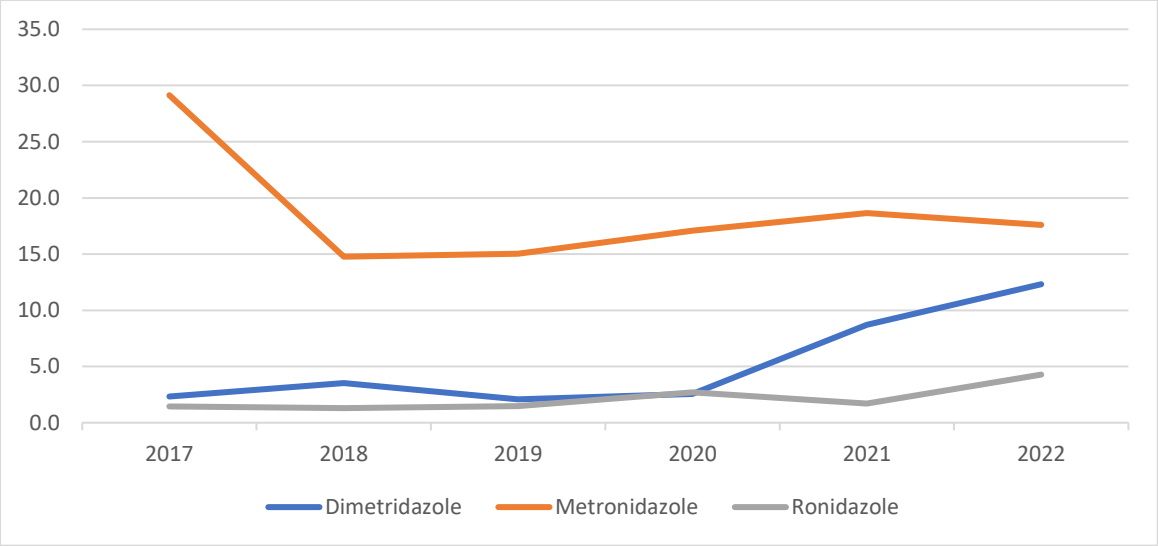
5.7 Nitrofurans

Nitrofurazone is registered for the treatment of skin infections in aquarium fish only. No sales were reported for this class in 2022.

5.8 Nitroimidazoles

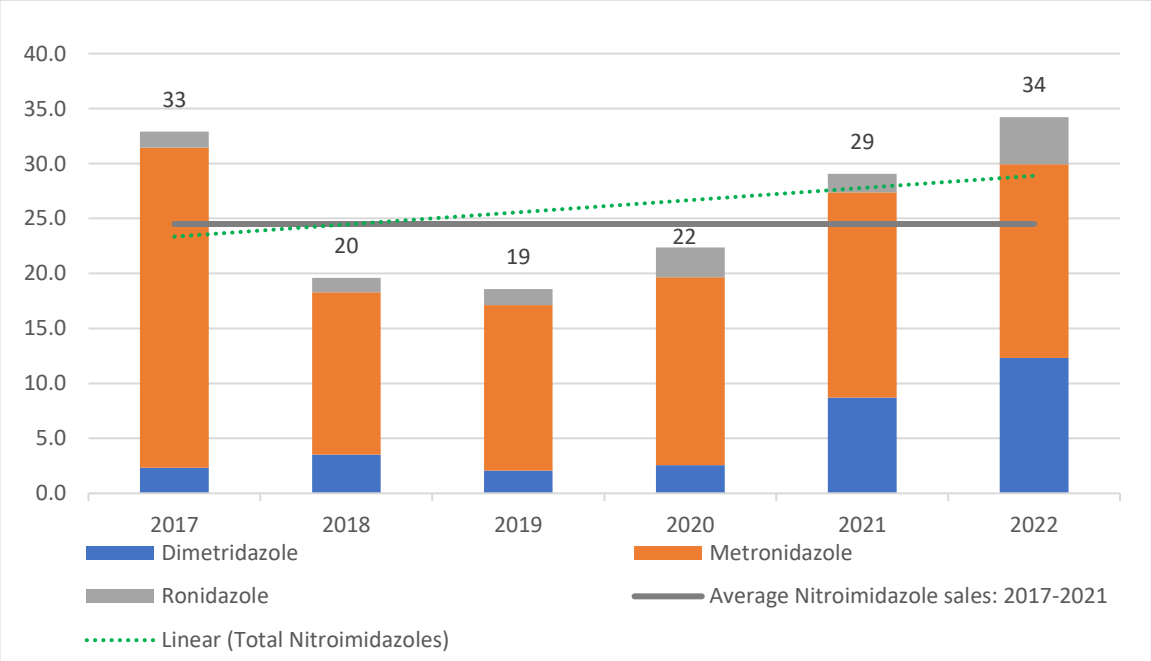
Sales for this class increased by 18% for the second successive year to 34 kg which accounted for 0.08% of total sales. Dimetridazole sales increased by 4 kg to 12 kg (36% of class sales) and ronidazole increased by over 2 kg to 4 kg (13% of class sales). Metronidazole accounted for around 50% of the class total with 18 kg compared to 64% in the previous year following a 6% decrease in the quantity sold. Around 51% of this class were sold in oral treatments with 49% sold for in-water delivery.

Figure 26: 2022 nitroimidazoles sales quantities compared to the previous five-year sales trends (in kilograms)



Dimetridazole sales were reported in multi-species products to treat dysentery in pigs, blackhead in poultry and game birds, and canker in pigeons. Ronidazole is also registered for use to treat canker in pigeons whereas products containing metronidazole were found in companion animal products.

Figure 27: Total nitroimidazoles sales quantities 2017-2022 (in kilograms)

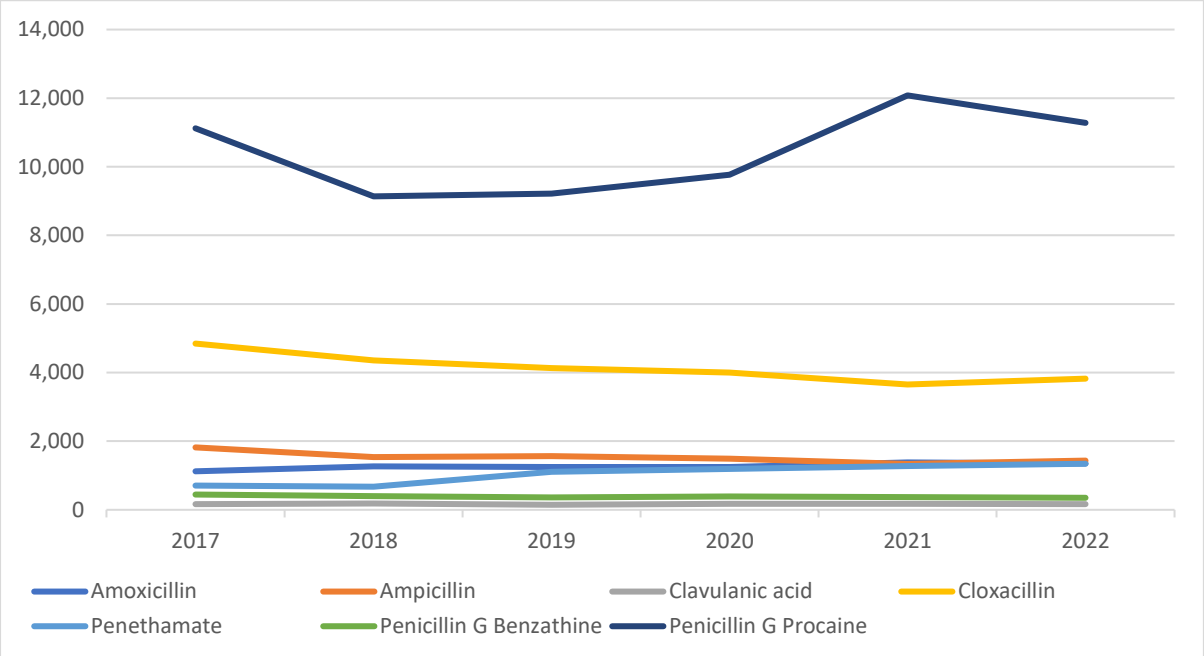


Nitroimidazoles sales were 40% above the average for the last five years.

5.9 Penicillins and clavulanic acid

The penicillins were the largest single class of antibiotic compounds in terms of both volumes sold and the number of products with sales. The quantity sold in 2022 was 3% lower at 19,756 kg compared to 2021 but despite this decrease the percentage share of the total sales for this class increased to 48% from 38% in 2021.

Figure 28: 2022 penicillins and clavulanic acid sales quantities compared to the previous five-year sales trends (in kilograms)

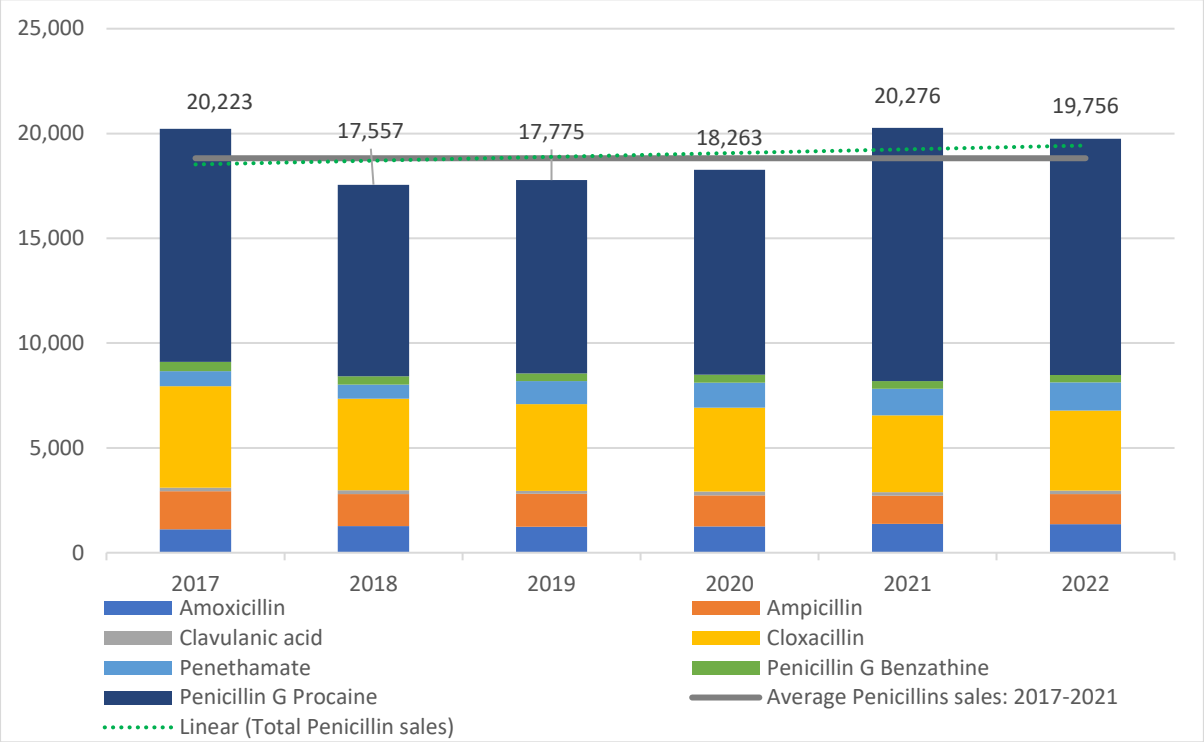


Penicillin G procaine sales continued to account for most of the quantity in this class despite a decrease of 802 kg (7%) in the amount sold to 11,278 kilograms (57% of class sales compared to 60% in the previous year). Cloxacillin accounted for 19% of class sales with 3,823 kg which was 5% higher than the previous year. Quantities of ampicillin sold increased by 8% to 1,439 kg and penethamate sales were 5% higher at 1,342 kg whereas amounts of amoxicillin sold decreased by 2% to 1,354 kg. Ampicillin, amoxicillin and penethamate each contributed between 6 and 7% of class sales. Penicillin G benzathine sales quantities decreased by 5% to 350 kg and accounted for 2% of class sales. Clavulanic acid is co-formulated with amoxicillin and consistent with the decrease in quantities for the latter, sales of this compound were 4% lower at 169 kg and 1% of class sales in 2022.

Products containing penicillins were mostly sold in multiple species products (48%) and intramammary treatments (36%). The next largest sales (8%) were in multiple production species products with the remaining 7% sold in cattle-only, companion animal and sheep-only products. Most penicillins were sold for administration by injection (60%) with 36% by intramammary methods and 4% in oral treatments. The remainder (less than 1%) was sold in intra-ocular products.

Total penicillins class sales were 5% above the five-year average in 2022.

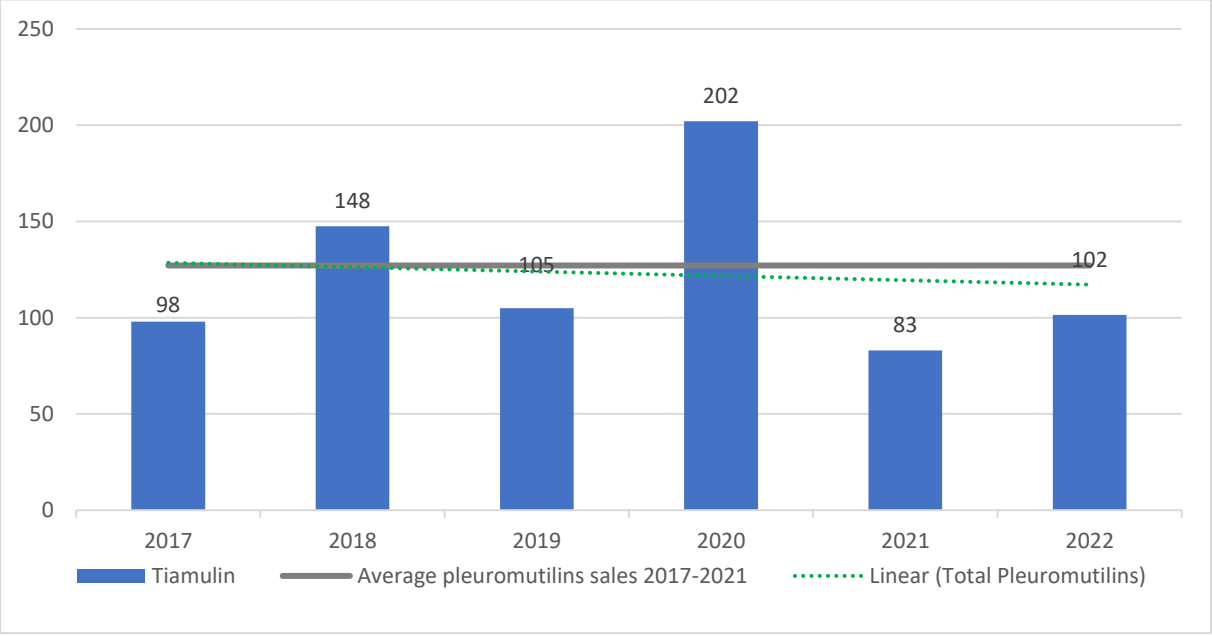
Figure 29: Total penicillin sales quantities 2017-2022 (in kilograms)



5.10 Pleuromutilins

Tiamulin is the sole pleuromutilin registered in New Zealand and is sold in multi-production species products for use in poultry and pigs. Sales increased by 22% in 2022 to 102 kg following a 59% decrease from the previous year. All tiamulin sold was in pig and poultry-specific products for in-feed administration. Tiamulin is registered to treat respiratory disease in poultry and pneumonia and dysentery in pigs. The overall sales for this group remain very low, at less than 0.5% of total sales and were 20% below the average for the previous five years.

Figure 30: Total pleuromutilins sales quantities 2017-2022 (in kilograms)



5.11 Polypeptides

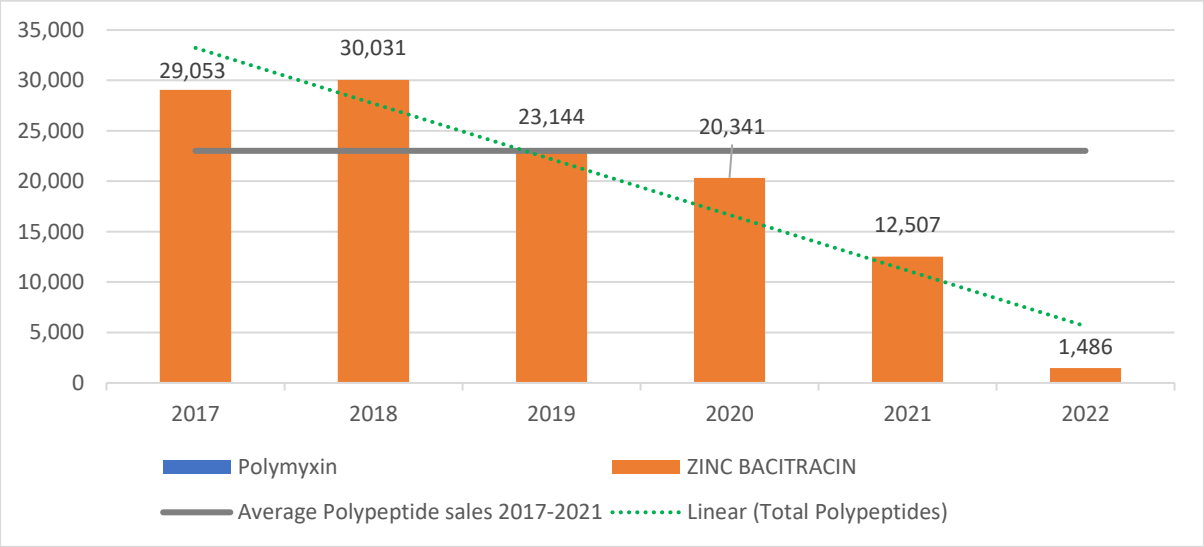
5.11.1 Polymyxin

Sales of the critically important polypeptide polymyxin decreased by 4% in 2022 to 0.89 kg and accounted for 0.06% of the sales total for this class and 0.01% of critical antibiotic sales. Polymyxin is found in multi-species products used in topical treatments in companion animals and horses, with quantities reported remaining below one kilogram for all reporting periods

5.11.2 Zinc bacitracin

Zinc bacitracin, which is not a critically important antibiotic, accounted for over 99% of the class sales volume. This compound was sold for use in pig and poultry-specific and multi-production species in-feed products. Sales decreased by 88% in 2022 from 12,507 kg to 1,485 kg which is the lowest quantity reported for this compound since sales reporting began. This is the fourth consecutive substantial decrease and follows a 39% reduction in 2021.

Figure 31: Total polypeptides sales quantities 2017-2022 (in kilograms)

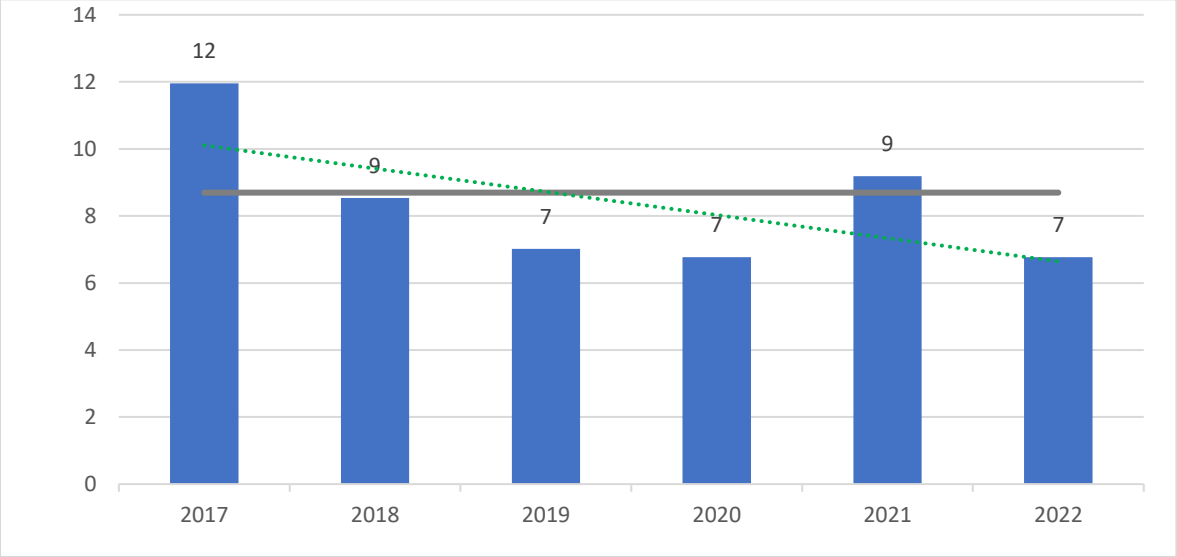


Zinc bacitracin is registered for use as a pig and poultry treatment with all 2022 sales attributed for use in meat poultry to treat intestinal disease. This compound was last sold for use in pigs in 2019. Sales of polypeptides accounted for 4% of the overall sales total (down from 23% the previous year) and 94% less than the average for the previous five years.

5.12 Streptogramins

Virginiamycin is the sole representative of the streptogramins class. Sales of this compound decreased from 9 kg to 7 kg with all reported quantities in horse-specific in-feed products. Annual sales of virginiamycin are reasonably consistent at around 7–10-kg.

Figure 32: Total streptogramins sales quantities 2017-2022 (in kilograms)



Virginiamycin is registered for use in poultry and horse specific products however sales in 2022 were only reported in the latter as a treatment for laminitis and accounted for 0.1% of the total sales volume. The quantity sold was 22% less than the average for the last five years.

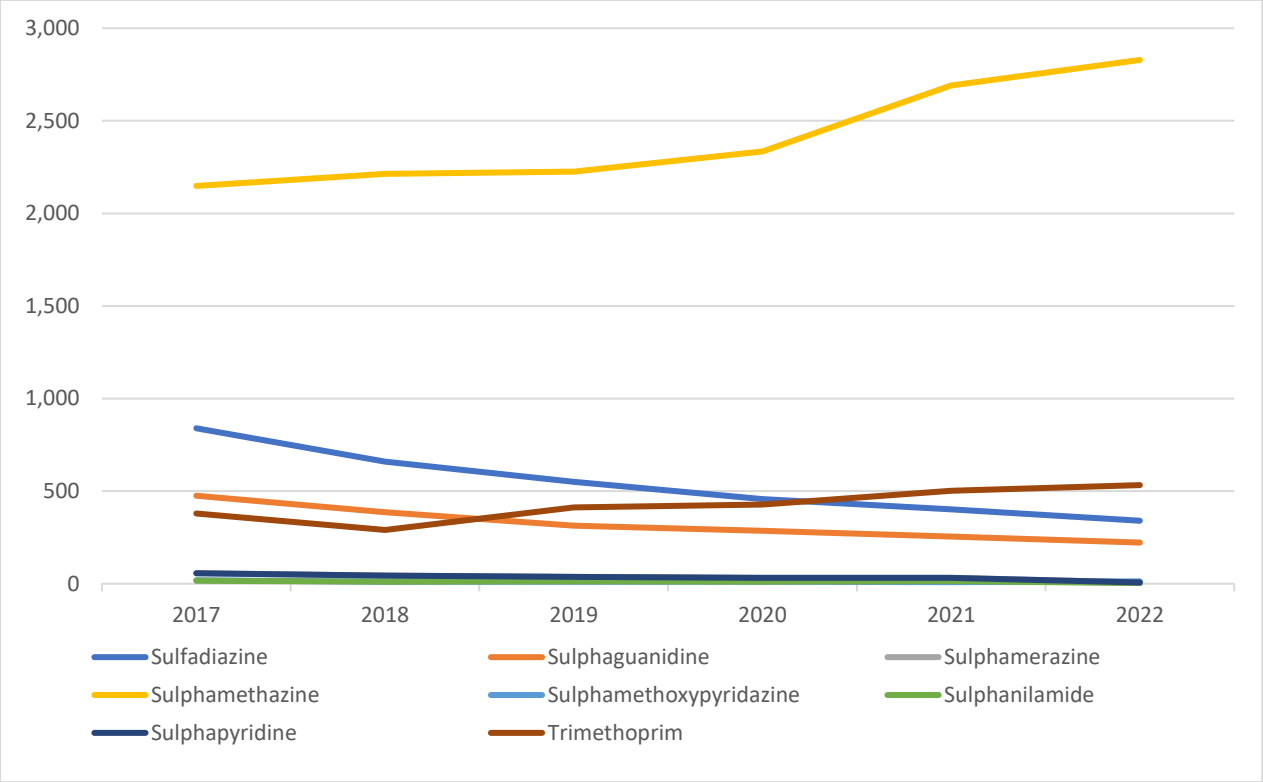
5.13 Sulphonamides and trimethoprim

Overall sulphonamides and trimethoprim sales increased by 18 kg (0.5%) in 2022 to 3,952 kg which accounted for just under 10% of total sales compared to 7% in 2021. Products containing sulphonamides and trimethoprim are generally formulated as multi-active combinations of antibiotics, most commonly including trimethoprim with one, two, or three sulphonamides.

Five of the eight compounds in this class had lower sales with a combined total reduction of 154 kg compared to a total increase of 173 kg for the three with higher sales. Two compounds account for 86% of sales in this class with sulphamethazine volumes increasing by 138 kg (5%) to 2,828 kg (72% of class sales) and trimethoprim increasing by 6% to 533 kg (13% of class sales) which are the highest amounts sold for each compound for over eight years. The third compound with higher sales was sulphamethoxypyridazine which increased by 47% to 12 kg which was consistent with amounts reported in previous reporting periods.

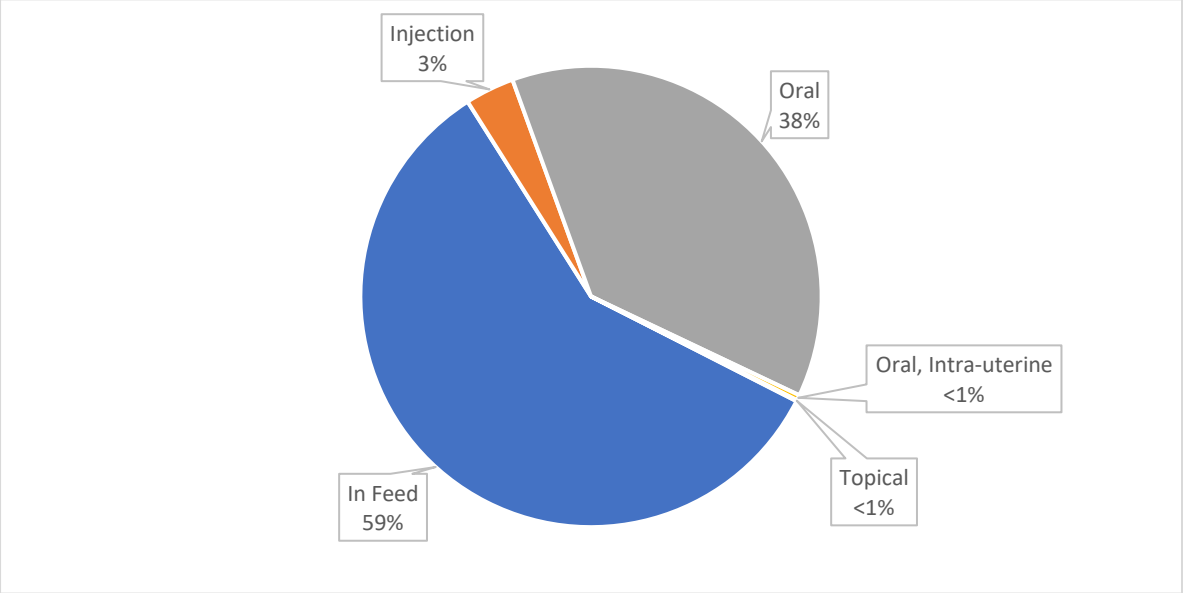
Decreased sales were reported for both sulphamerazine (25 kg lower at 7 kg) and sulphaguanidine (32 kg lower at 222 kg). The largest reported volume decrease was for sulfadiazine (6% of class sales) which was 62 kg (15%) lower at 340 kg from 402 kg in 2021. This was the sixth successive year in which sales have decreased for this compound. The largest reported percentage decrease was for sulphanilamide with an 80% reduction in quantities sold from 15 kg to 3 kg.

Figure 33: 2022 sulphonamides and trimethoprim sales quantities compared to the previous five-year sales trends (in kilograms)



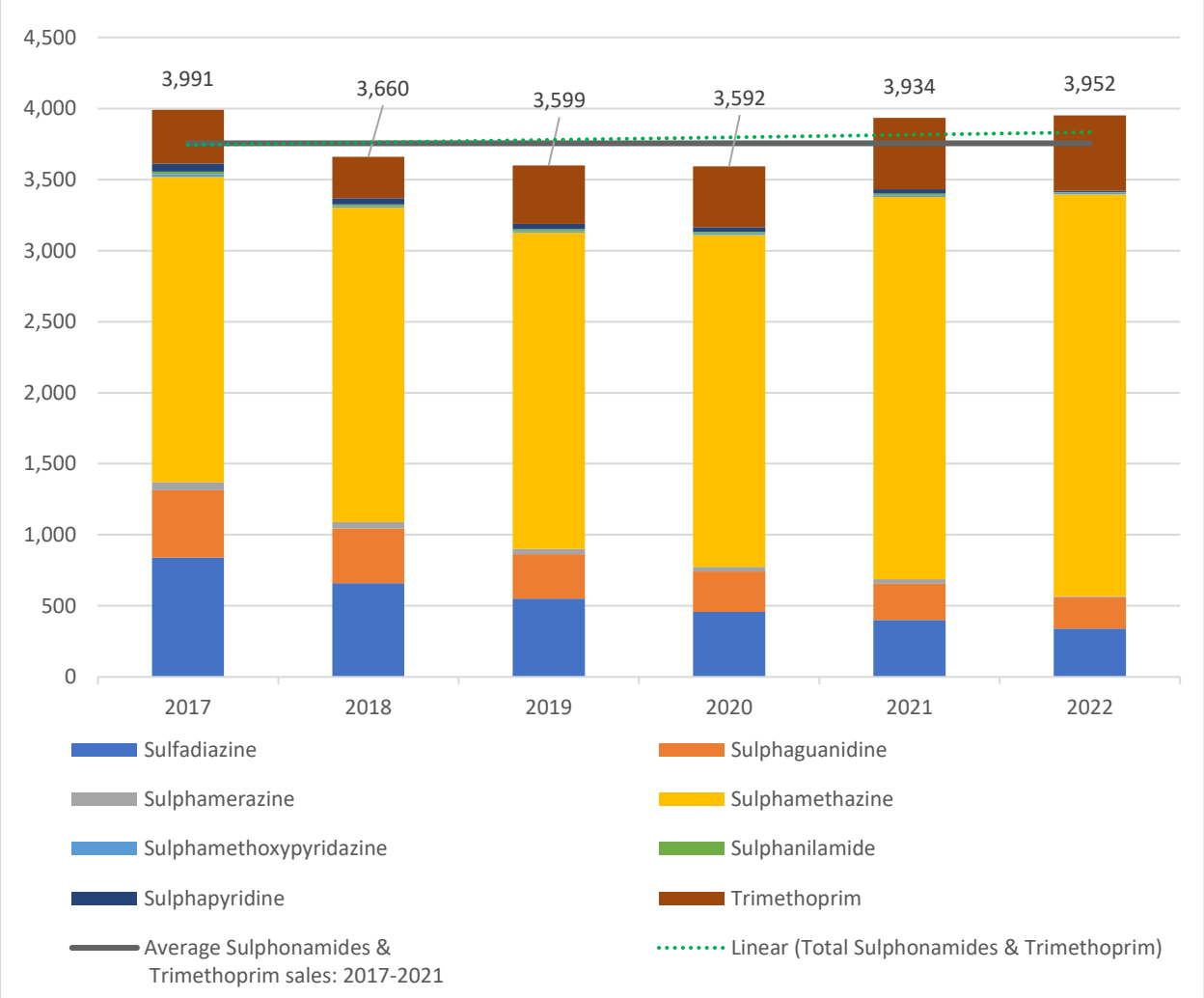
Products containing sulphonamides are generally co-formulated and most commonly contain trimethoprim (10 products including one quadruple-active product). However, there was also one single-active and one triple-active sulphonamide product. Over 76% of the quantity sold were in horse-specific products with 22% in multiple species products and the remaining 2% in multiple-production species and cattle-only products. The sulphonamides, with or without potentiation with trimethoprim, are registered for use to treat respiratory, intestinal, urinary tract and other infections. Most products containing sulphonamides and trimethoprim compounds were sold as in-feed (59%) or oral treatments (38%) with the remaining 5% for administration by injection, topical or oral/intra-uterine means.

Figure 34: Sulphonamides and trimethoprim sales delivery methods in 2022



Sales for this class were 5% higher than the average for the last five years.

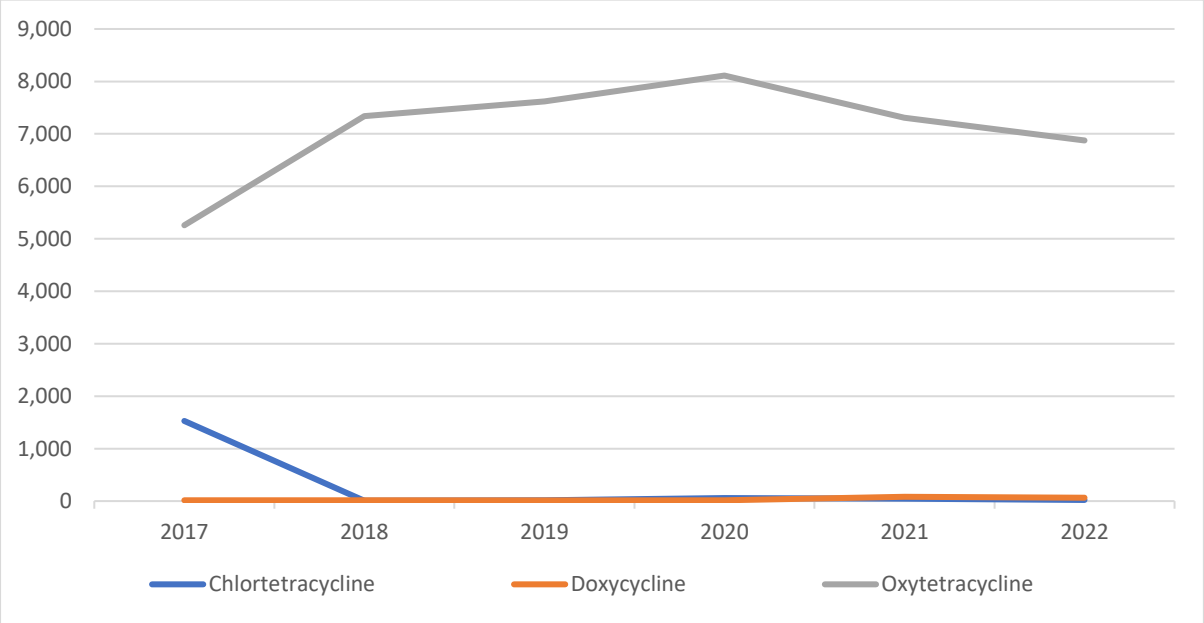
Figure 35: Total sulphonamides and trimethoprim sales quantities 2017-2022 (in kilograms)



5.14 Tetracyclines

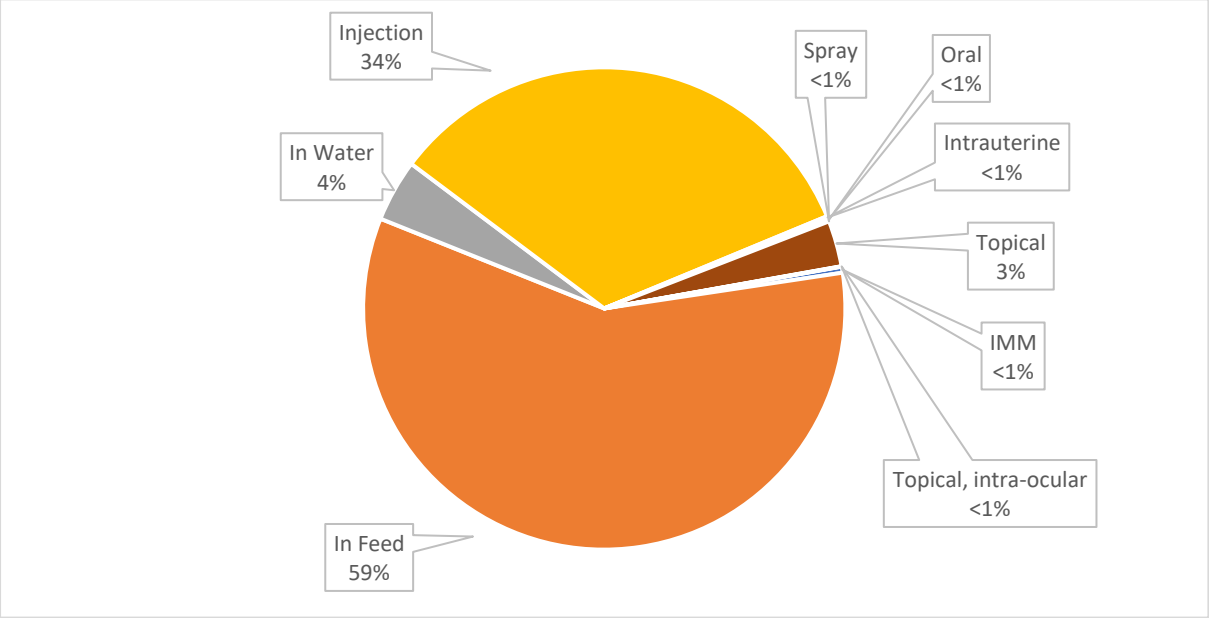
Lower sales quantities were reported for all three antibiotics in this class resulting in a 6% decrease from 7,437 kg to 6,959 kg. Oxytetracycline accounted for 99% of class sales with 6,873 kg and 91% of the decrease in class volumes with quantities sold 433 kg below the 2021 level. The quantity sold in 2022 was the lowest total for this compound since 2018. Sales for doxycycline decreased by 20 kg to 62 kg (24%) however the amount sold was twice as high as the five-year sales average for this antibiotic following a 69-kg increase in 2021. Chlortetracycline sales decreased by 52% to 23 kg which is slightly higher than the amount sold in 2019 for this compound.

Figure 36: 2022 tetracyclines sales quantities compared to the previous five-year sales trends (in kilograms)



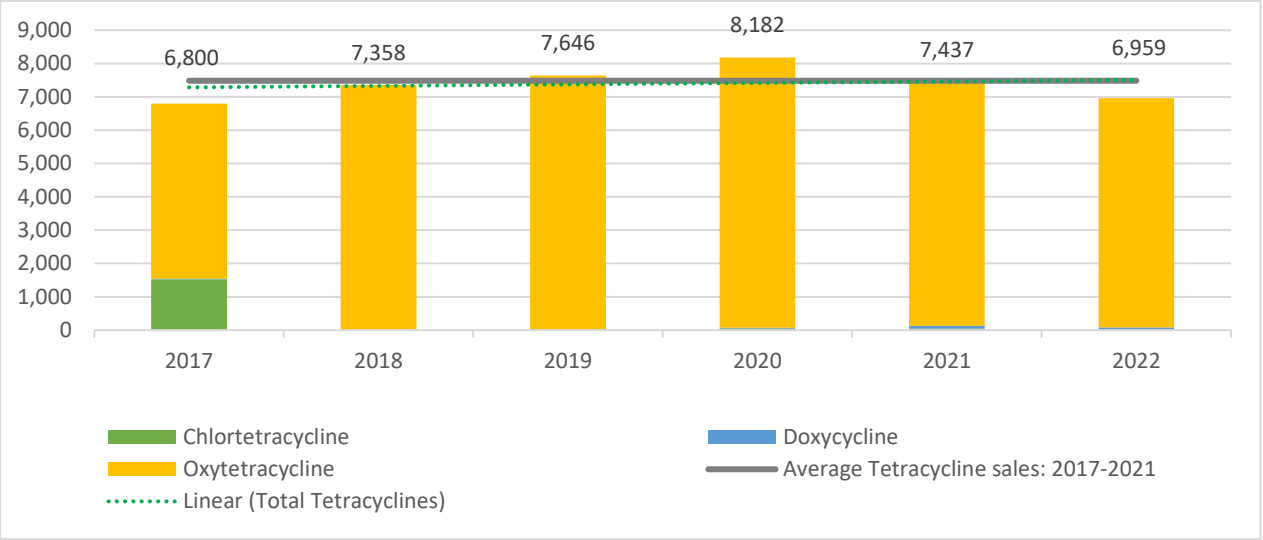
The majority of tetracyclines were sold in multi-production species products (96%) with 3% being sold in multi-species products and the remainder in companion animal/non-production and cattle-only products. Most of the class sales were for administration as in-feed products (59%) with a further 34% by injection, 4% in water, 3% applied topically and the remainder (less than 1%) by oral, intrauterine, intramammary or intra-ocular/intra-oral methods. Oxytetracycline is a broad spectrum antibiotic effective against a range of gram-positive and gram-negative bacteria, and was sold for use in cattle, poultry, pigs, and sheep. Chlortetracycline was primarily sold for use as a topical application for cattle, sheep, and pigs, whereas doxycycline is sold in products registered for use in companion animals including caged birds.

Figure 37: Tetracyclines sales quantities delivery methods in 2022



The amount of tetracyclines sold in 2022 was 7% below the average for the previous five years.

Figure 38: Total tetracyclines sales quantities 2017-2022 (in kilograms)



6 Veterinary antibiotic sales by species group

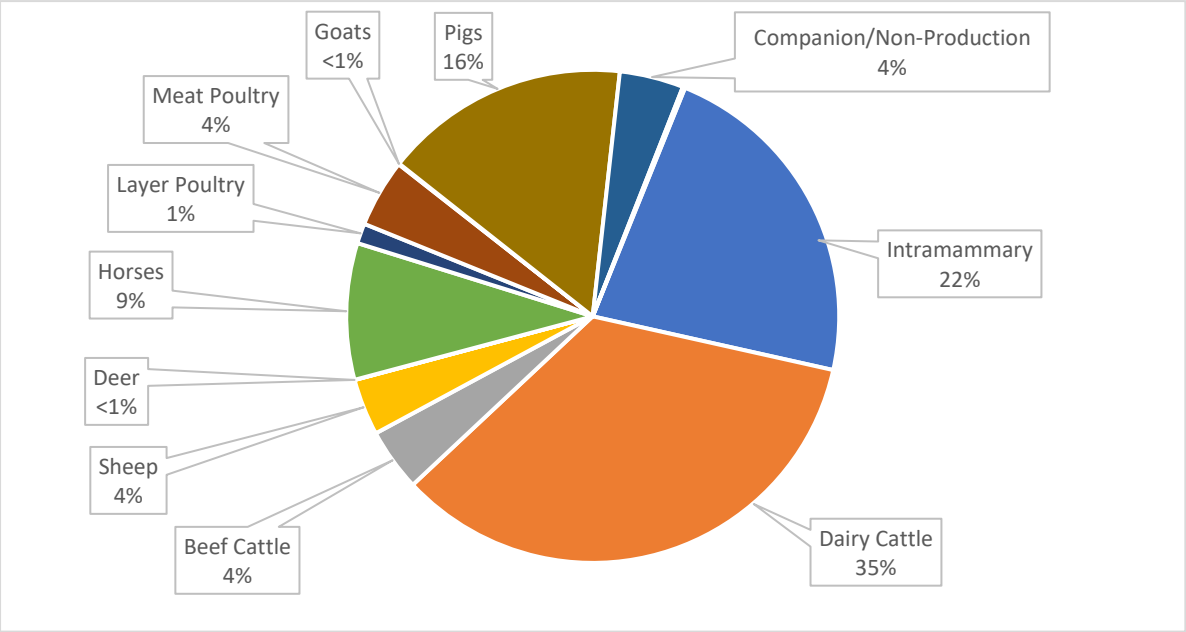
6.1 General trends by species group or class

When evaluated based on the species, crop, or sector approved for each registered product, some clear patterns emerge regarding active ingredient sales. Products containing amphenicols, fluoroquinolones, fusidic acid, nitrofurans, and nitroimidazoles are almost exclusively used in companion and non-production animals, while nearly all remaining classes are primarily or exclusively used in production animal species.

The proportions of sales for each species in accordance with the approved uses and registrant estimates for each product are shown in Figure 39 below: for example, products approved for use only in horses are classed as horse-specific products because their sales are intended for use solely

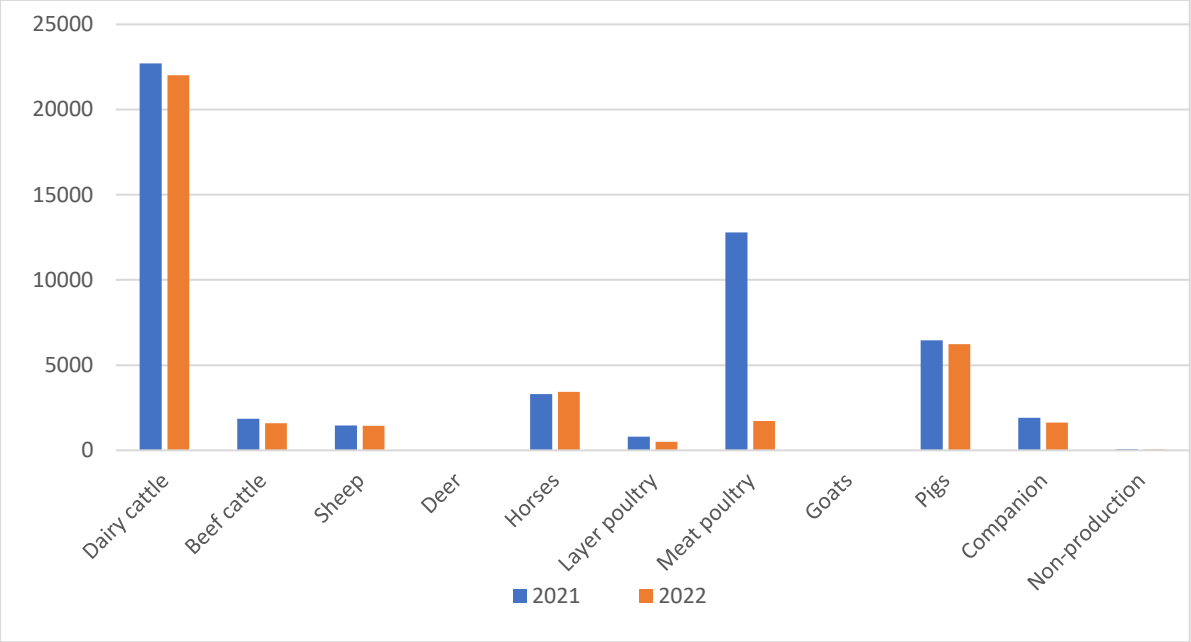
in horses. When evaluated in this manner, it is clear there are some compounds that are primarily or exclusively sold for use in certain species or groups, such as the pleuromutilins for pigs and poultry. There are however products approved for use in multiple species or multiple production species for which it is more difficult to discern intended use. For these products, veterinary medicine registrant companies have provided estimates of the proportions for each multi-species and multiple production species product to provide insight on how these products are likely to be used in practice.

Figure 39: 2022 antibiotic sales quantities by species/sector including registrant estimates of use



Taking registrant estimates into consideration for multi-species and multi-production species products in addition to quantities sold in species-specific products, 57% of total sales were sold for use in dairy cattle (up from 41% in 2021), 16% sold for use in pigs (up from 13% in 2021), 9% sold for use in horses (up from 6%), 4% for use in meat poultry (down from 24%). Product-specific and registrant estimated volumes were lower for all target species except for horses which increased by 3% compared to 2021 as shown in Figure 40 below.

Figure 40: Comparison of antibiotic sales quantities for 2021 and 2022 including registrant estimates of use (in kilograms)



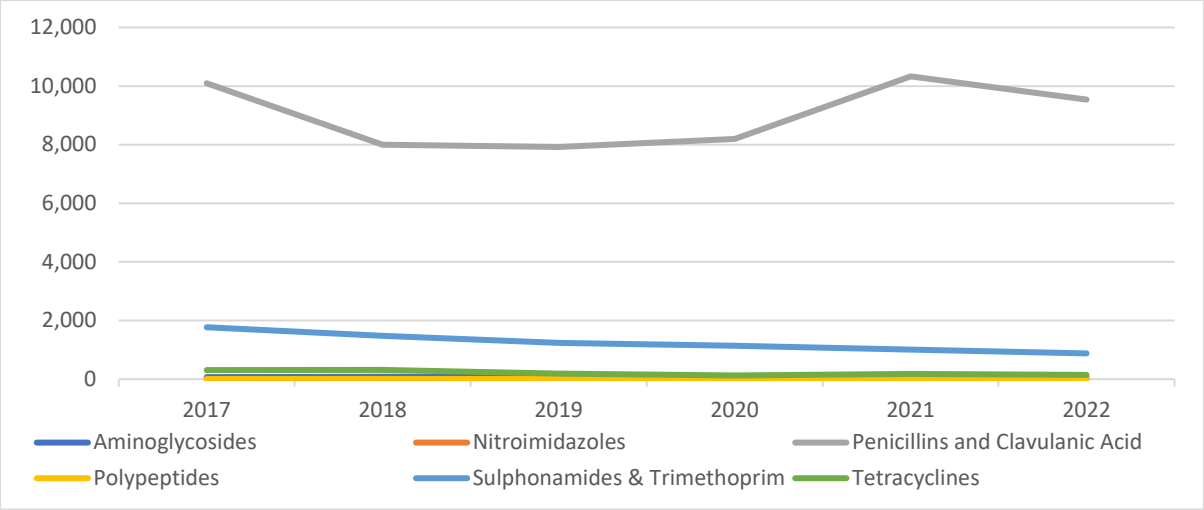
The largest reductions in quantities for a particular species were observed for poultry with decreased amounts attributed for use in both meat poultry (87% lower) and layer poultry (37% lower). The total quantity attributed for use in pigs also decreased by 3% and companion animals were 15% lower at 1,625 kg. Amounts attributed for use in cattle also decreased with dairy cattle quantities decreasing by 3% and beef cattle by 15%.

6.2 Multi-species products

Multi-species products are approved for use in companion and production animals apart from use in poultry. A total of 90% of multi-species product quantities contained penicillins with the next largest contributor being the sulphonamides and trimethoprim class with 8%. The remaining 2% consisting of tetracyclines, aminoglycosides and nitroimidazoles. Quantities of antibiotics in multi-species products decreased by 8% from 11,583 kg to 10,639 kg, accounting for 26% of total sales (up from 19% in 2021) and 9% of all trade name products sold in 2022.

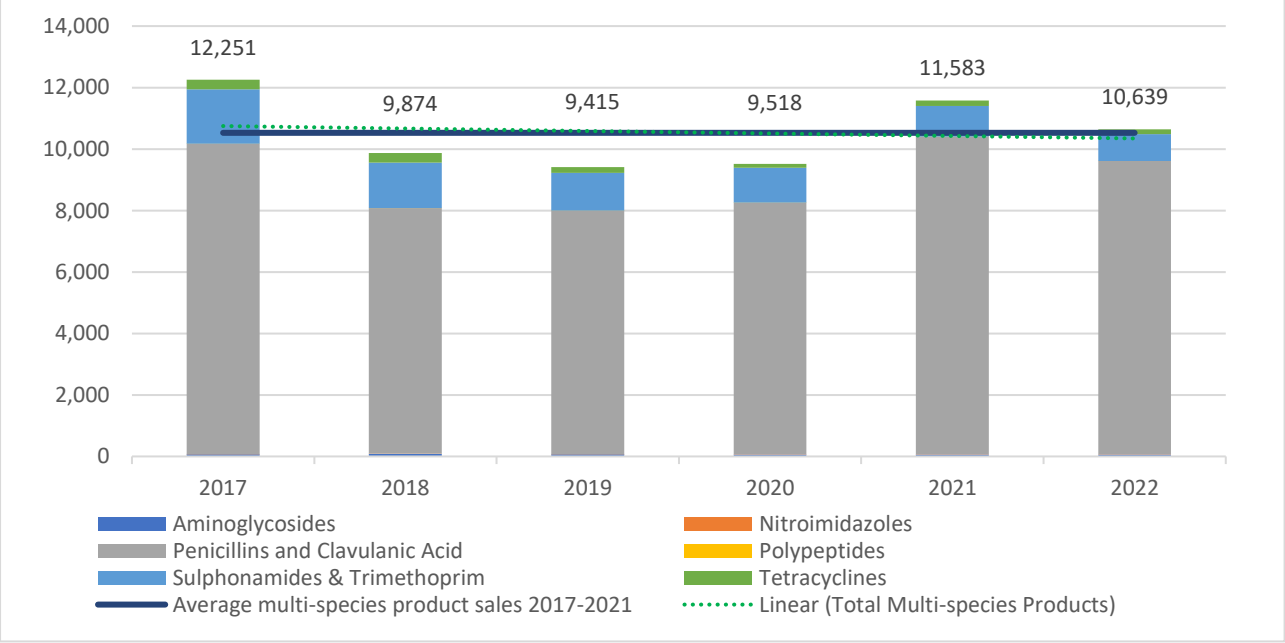
Decreased quantities were reported in this group of products for several classes including the penicillins and clavulanic acid which were 6% lower at to 9,541 kg from 10,329 kg in 2021, sulphonamides and trimethoprim quantities decreased by 126 kg (14%) to 877 kg, tetracyclines quantities were 28 kg (16%) lower at 150 kg, aminoglycosides amounts were 6 kg (10%) lower at 57 kg and the polypeptides were 20% lower at 0.53 kg. In contrast the quantity of nitroimidazoles increased by 41% to 12 kg in multi-species products.

Figure 41: 2022 multi-species product antibiotic sales quantities compared to the previous five-year sales trends (in kilograms)



Multi-species antibiotic quantities sold in 2022 were 1% below the average for the last five years. The percentage contribution made by the penicillins in these products has risen steadily from 82% in 2017 to 90% in 2022 whereas the contributions from both the sulphonamides and trimethoprim class and the tetracyclines have declined from 15% to 8% and 3% to 1% respectively over that time.

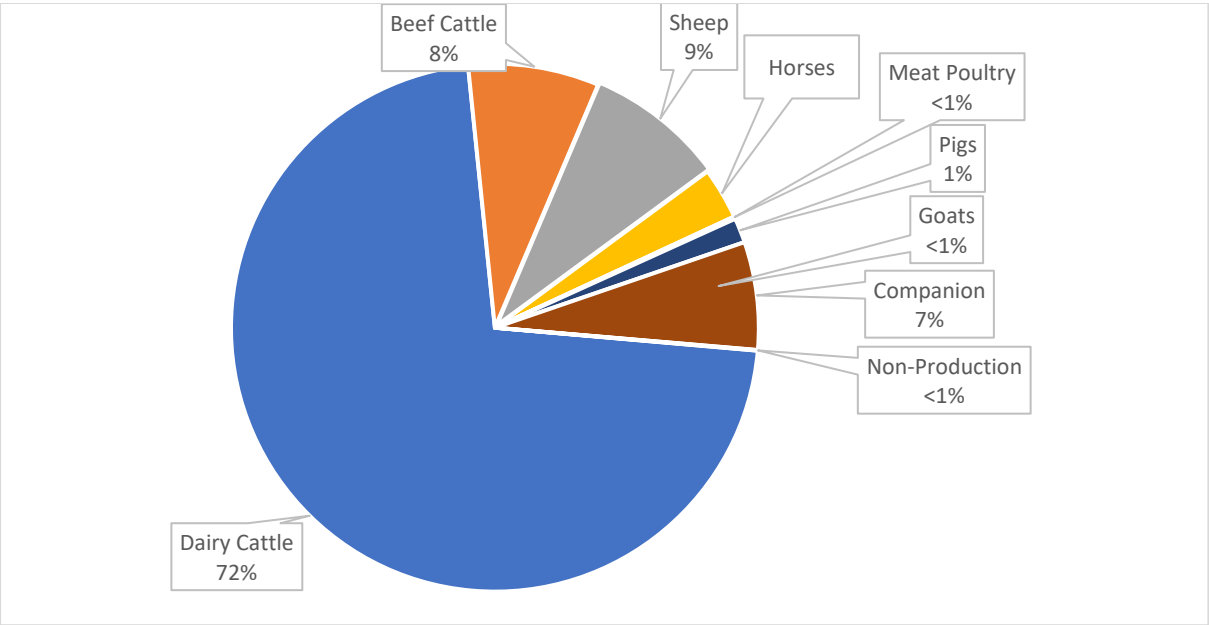
Figure 42: Total multi-species product antibiotic sales quantities 2017-2022 (in kilograms)



Two classes of critically important antibiotics are present in multi-species products with a total quantity of 57 kg (0.5% of multi-species quantities) consisting of aminoglycosides (mostly gentamycin and neomycin) with minor amounts of polypeptides (polymyxin). Based on registrant estimates, 94% of the critically important antibiotics in these products were sold for use in horses and 6% were for use in companion animals.

The majority (72%) of multi-species product antibiotics were attributed by registrants as being sold for use in dairy cattle with 9% for use in sheep, 8% for use in beef cattle and 6% for use in companion animals. The remaining 5% was included in treatments for horses (2%), pigs (2%), meat poultry and goats (less than 1% each).

Figure 43: Distribution of multi-species product sales quantities by animal species/class and using registrant estimates



Most multi-species products were sold as injectable formulations (88%) with 10% to be administered by oral methods and the remaining 2% in water, applied topically or by intra-ocular means.

The main driver for the reduction in penicillins class sales contained in multi-species products was a 784 kg decrease in penicillin G procaine quantities attributed to lower amounts sold for use in dairy cattle (54% of the reduction), companion animals (31%), horses (10%) and pigs (7%). Based on registrant estimates penicillin G procaine was the compound most sold for use in beef cattle, sheep, horses, pigs, and companion animal products. No sales of penicillin were attributed to either goats or non-production animals

Most sulphonamides and trimethoprim in multi-species products were also attributed as sold for use in dairy cattle (85%), followed by sheep (6%), beef cattle (4%), companion animals (2%), goats and pigs (1% each) and accounted for 8% of multi-species product volumes.

Oxytetracycline is the only tetracycline present in multi-species products and accounted for 2% of total sales for this class with most of the volume sold also being attributed for use in dairy cattle. For the nitroimidazoles, 68% of the sales in this group were attributed to meat poultry and 32% attributed to non-production animals. All nitroimidazoles sales were in multi-species products in 2022.

6.3 Multiple production species products

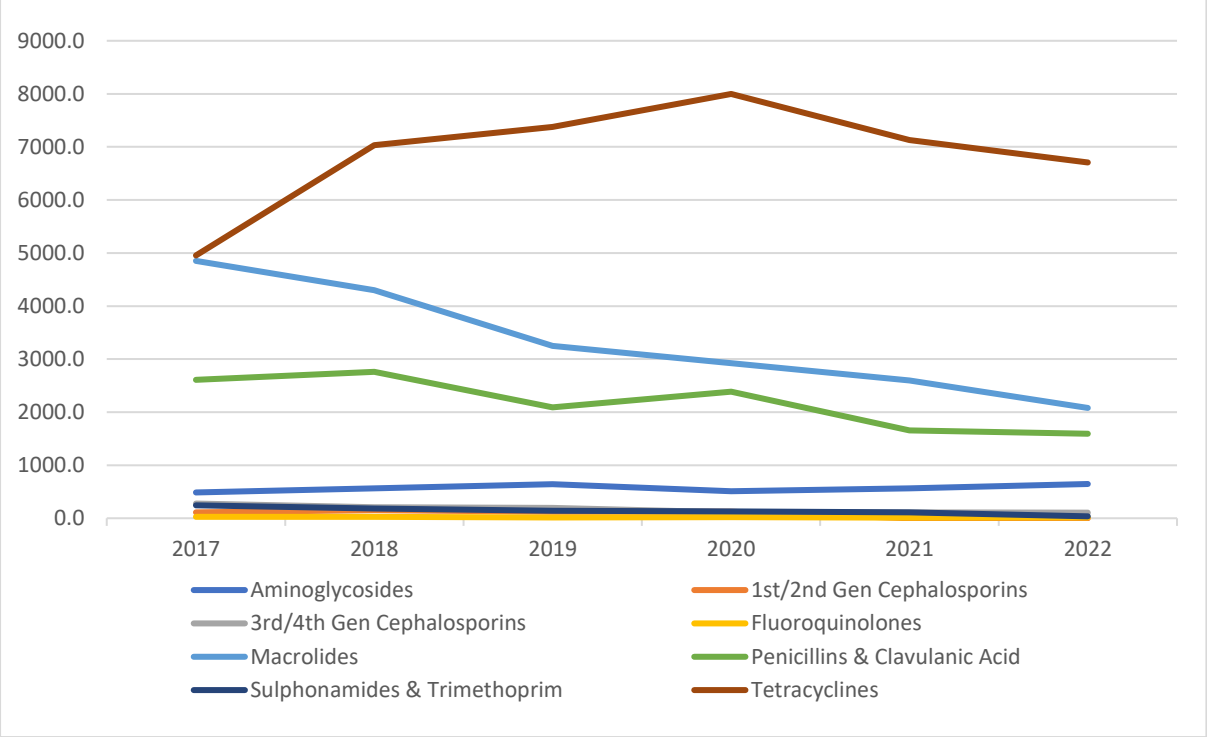
Multiple production species products include those intended for use in cattle, sheep, pigs, poultry, and/or horses. Products specifically registered for use in cattle-only (including intramammary treatments), pig and poultry-specific, horse-specific products and sheep-only products will be addressed later in this report. The key difference between multi-production species products and multi-species products is that the former is exclusively used in production animals, whereas the latter can be used in either production or companion animals.

A total of 33 products registered for use in multiple production species had sales reported with a total of 11,178 kg which was 8% lower than the amount sold in 2021. Despite this decrease the percentage contribution to total sales from these products increased from 23% to 27%. Lower Sales were reported for five of the seven classes in these products including two which are critically important. The largest decrease occurred in the macrolides which were 20% lower at 2,079 kg due to a 515 kg reduction in tylosin, offset slightly by higher amounts of tilmicosin and tulathromycin. For the other critically important class the quantity of third and fourth generation cephalosporins was 7% lower at 106 kg mainly due to an 8 kg decrease in ceftiofur sales. In contrast quantities of aminoglycosides in

multi-production species products were 14% higher at 646 kg with higher amounts of streptomycin and dihydrostreptomycin. Fluoroquinolones increased by 6% to 12 kg mainly due to higher marbofloxacin sales.

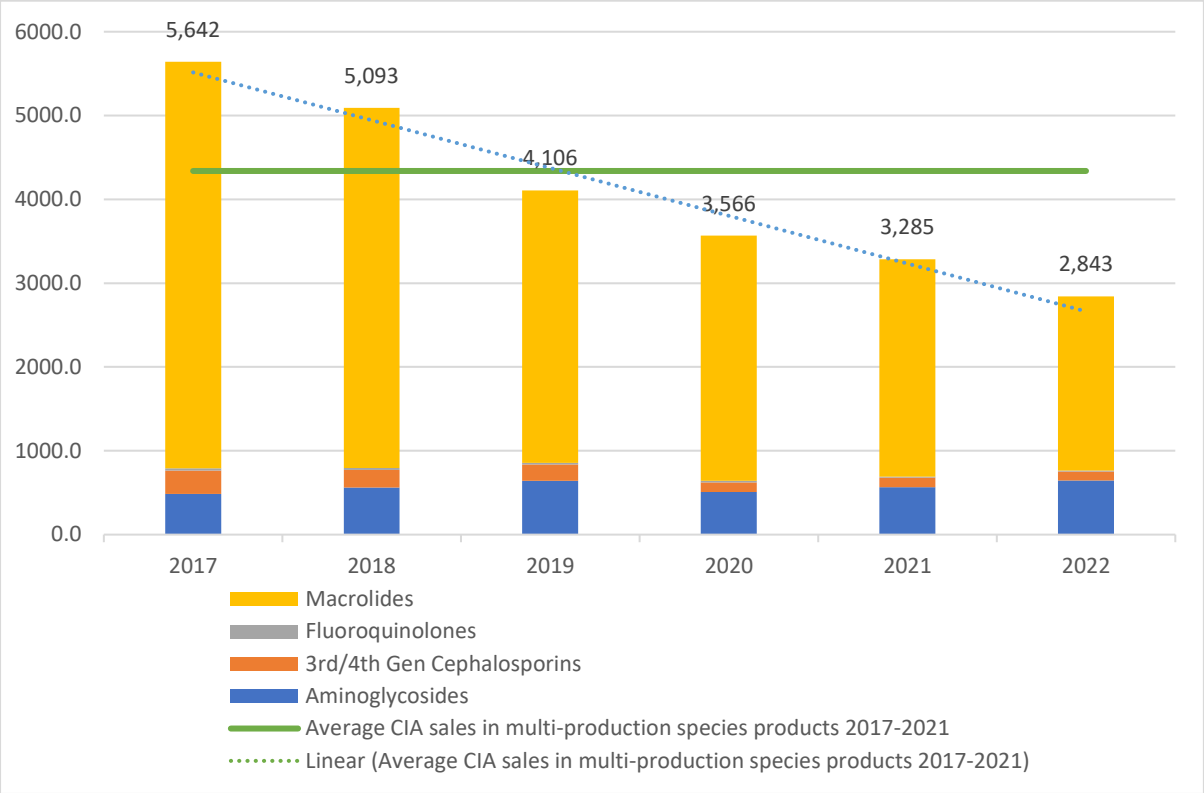
Decreased sales were reported for the tetracyclines (6% lower at 6,705 kg), sulphonamides and trimethoprim quantities were 67% lower at 36 kg compared to 111 kg in 2021 and amounts of penicillins and clavulanic acid also declined by 4% to 1,593 kg.

Figure 44: 2022 sales quantities in multi-production species products compared to the previous five-year sales trends (in kilograms)



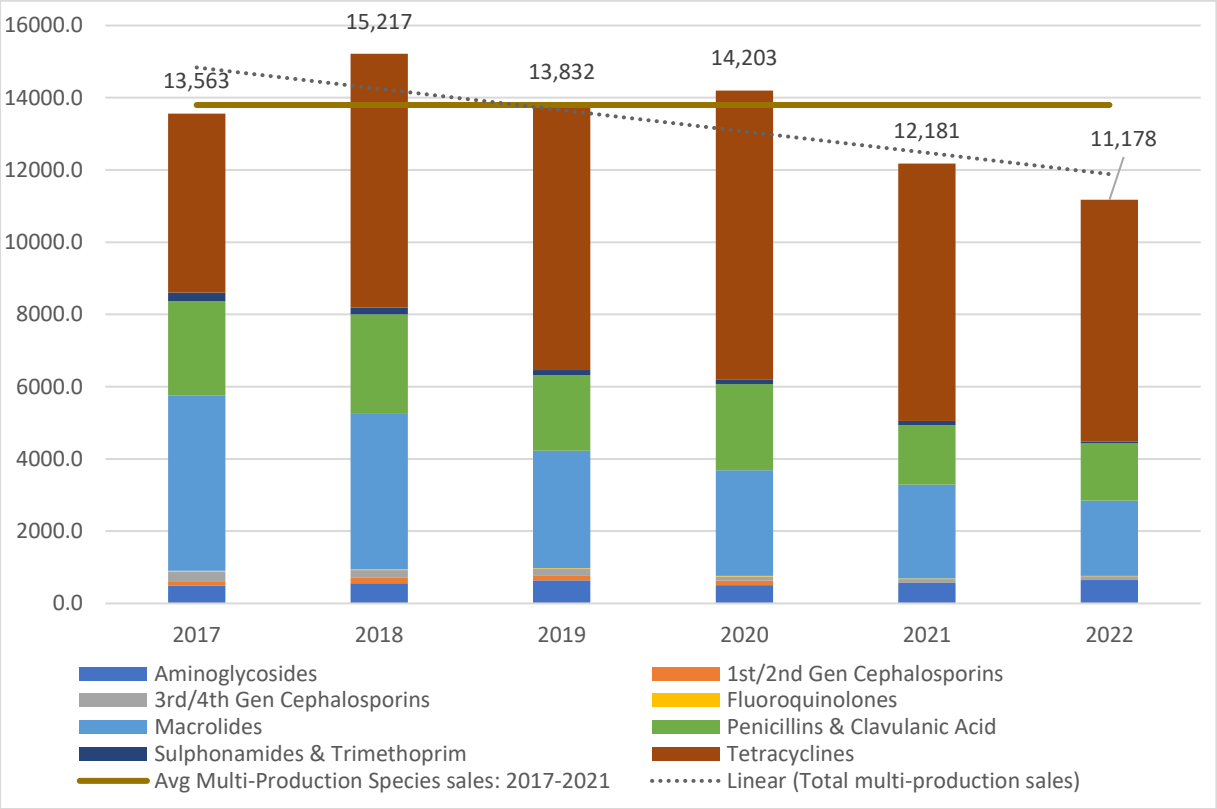
Critically important antibiotics account for just over 25% of the quantity for this group (2,843 kg) compared to 27% in 2021 (3,285 kg). The four critically important classes in these products contain nine antibiotics: cefquinome, ceftiofur, dihydrostreptomycin, streptomycin, enrofloxacin, marbofloxacin, tilmicosin, tulathromycin and tylosin. The overall critically important antibiotic class quantities in these products have declined for four of the last five years and was just over half of the volume sold in 2017.

Figure 45: Sales quantities of critically important antibiotics in multi-production species products (in kilograms)



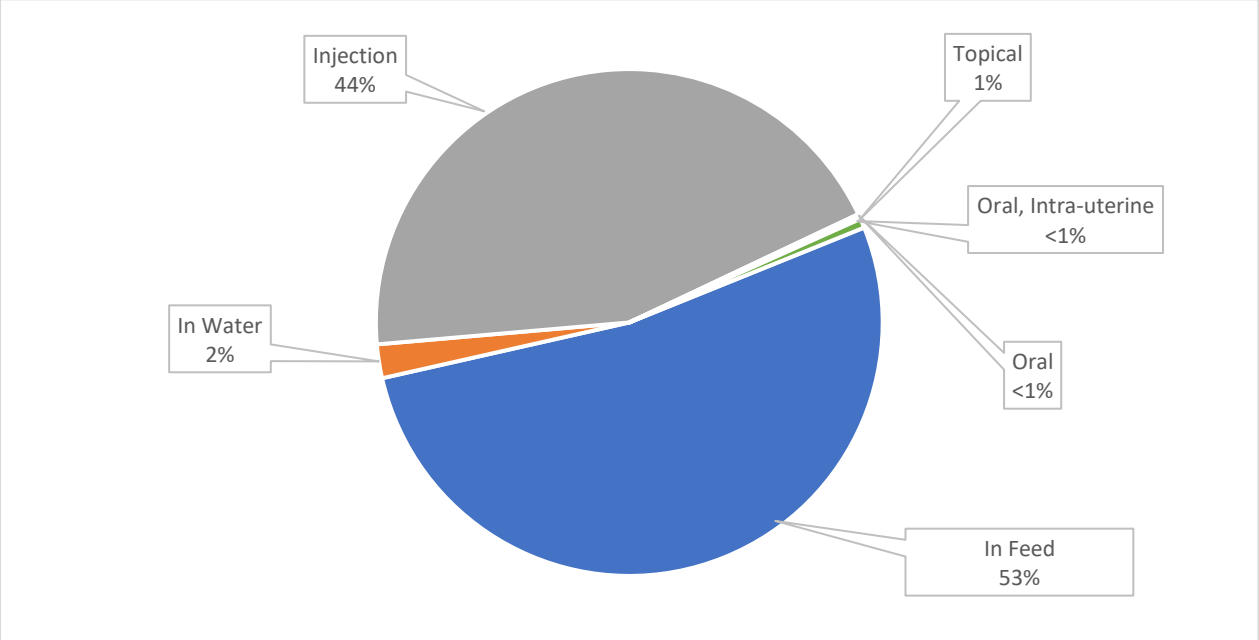
Total antibiotic sales quantities in multi-production species products were 20% below the average for the previous five years with tetracyclines accounting for 60% of group sales (up from 56% in 2021) and macrolides contributing 19% (down from 24% in 2021). Penicillins and clavulanic acids accounted for 14% (up from 13% in 2021) and the aminoglycosides 6% (up from 4%).

Figure 46: Total multi-production species product antibiotic sales 2017-2022 (in kilograms)



Fifty three percent of the antibiotics in multi-production species products were delivered by in-feed methods, 44% were administered by injection and the remaining 3% were delivered in water or applied topically or by oral/intrauterine methods.

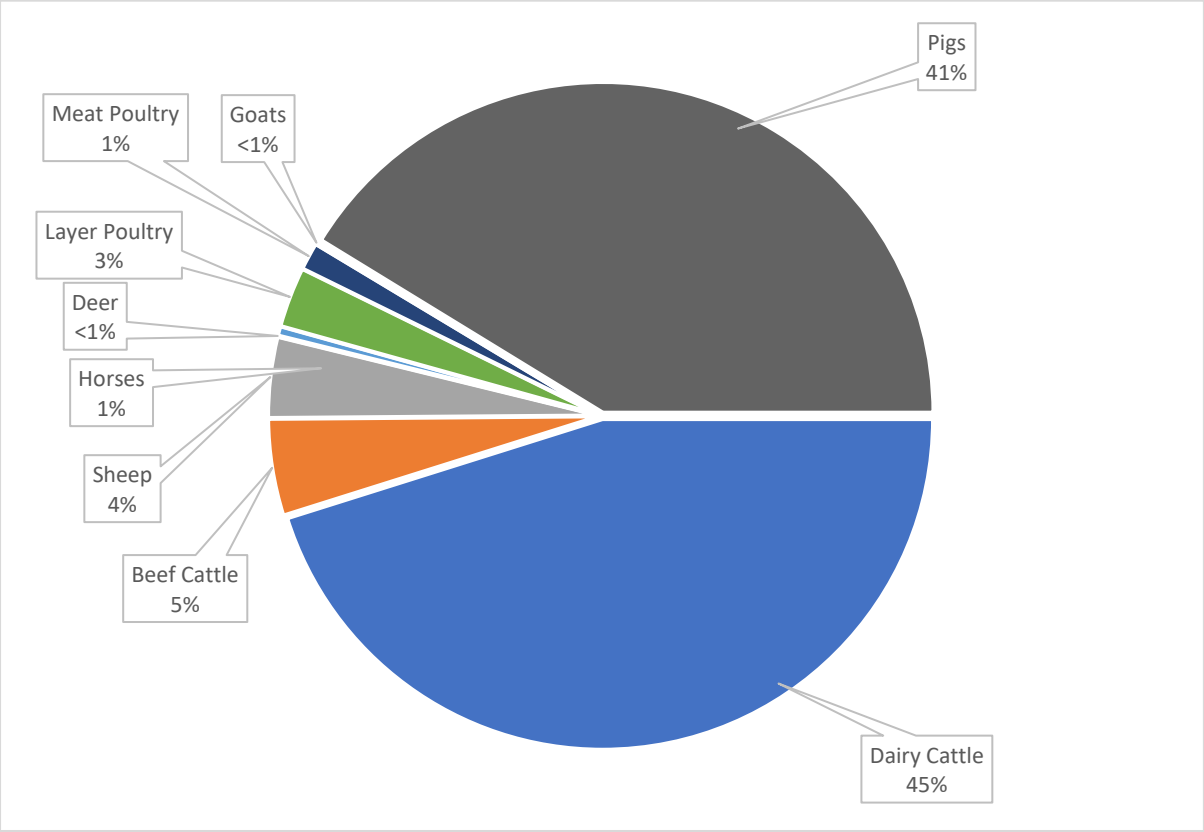
Figure 47: Multi-production species product delivery methods in 2022



Taking registrant estimates into consideration the distribution of antibiotics by species is relatively unchanged from the previous year. Dairy cattle continued to be the dominant target with 45% of the

total quantity (up from 43% in 2021), followed by pigs (41% up from 40%), beef cattle (6% down from 7%), sheep (4% up from 3.6%) and layer poultry (3% down from 6%). Horses, goats, and deer accounted for just over 1% of multi-production species product sales.

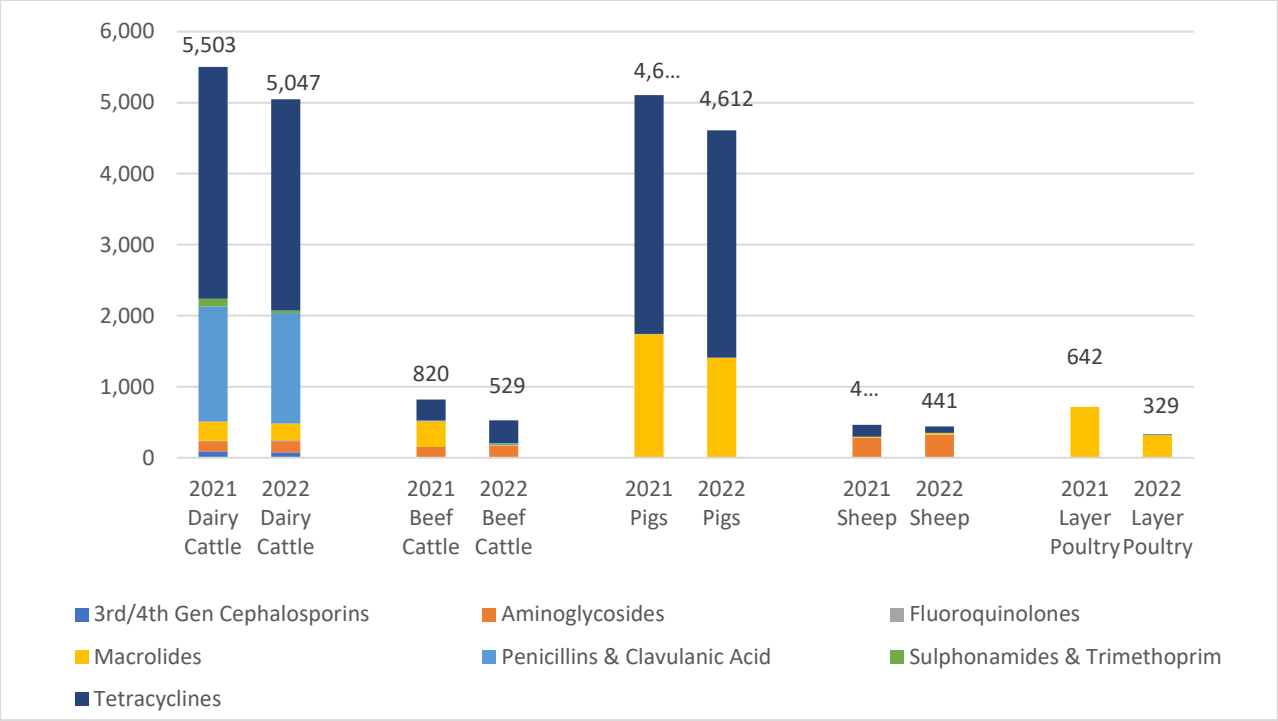
Figure 48: Distribution of sales quantities for multiple production species products by target species or group in 2022 including registrant estimates of use



Tetracyclines (mainly oxytetracycline) accounted for 59% of the quantity attributed to dairy cattle with 31% from penicillins and clavulanic acid (mostly penethamate hydriodide) and 5% from macrolides (mostly tylosin). Total sales for all classes of multi-production species antibiotics attributed to dairy cattle decreased by 456 kg (8%) to 5,047 kg in 2022 with the tetracyclines accounting for 63% of this decrease, 16% from the sulphonamides and trimethoprim class, 15% from the penicillins and macrolides 6%. For beef cattle the decrease of 292 kg mainly consisted of lower quantities of macrolides offset slightly by increases in tetracyclines and aminoglycosides. For pigs, the overall reduction in multi-production species product quantities was 69 kg consisting of lower quantities of tetracyclines offset by an increase in macrolides.

The amount of antibiotics in these products attributed for use in sheep decreased by 5% to 440 kg with a 74 kg reduction in tetracyclines offset by increases in macrolides (12 kg) and aminoglycosides (40 kg). The quantity attributed to layer poultry decreased by 49% to 329 kg with a 325-kg reduction in macrolides offset slightly by a 12-kg increase in tetracyclines.

Figure 49: Multi-production species antibiotic sales quantities attributed to dairy cattle, beef cattle, pigs, sheep and layer poultry in 2022 (in kilograms)



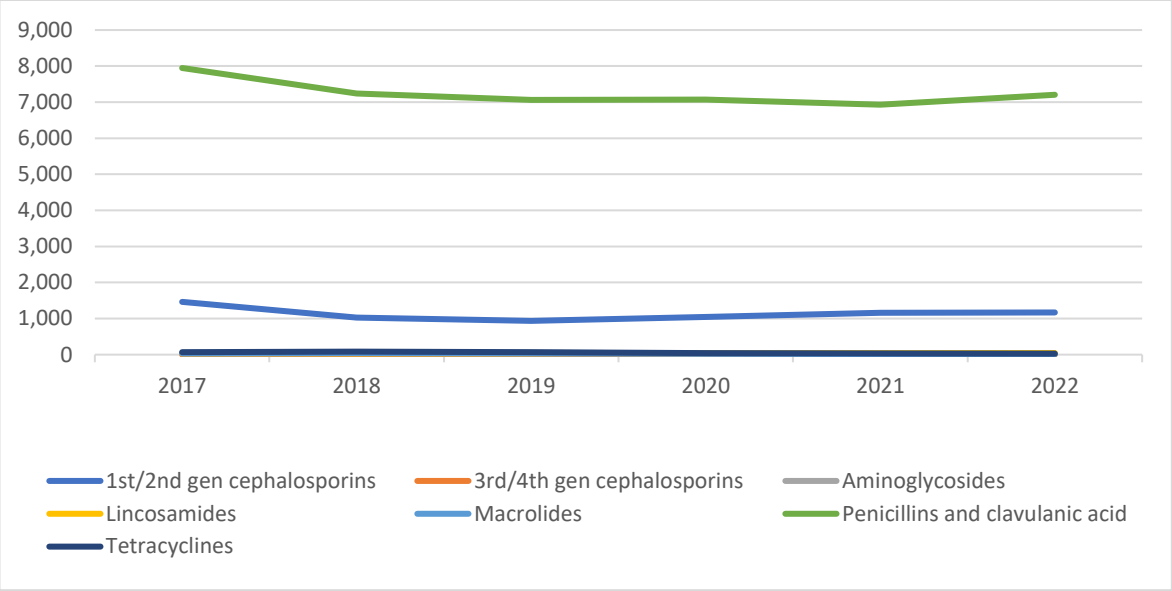
The total quantity of antibiotics attributed by registrants as sold for use in horses in multiple production species products was relatively unchanged from the previous year at 51 kg although there was a 10 kg increase in the amount of third and fourth generation cephalosporins offset by 12 kg decrease in tetracyclines. The amount attributed for use in deer was unchanged from 2021 at 5 kg however for goats the quantity doubled with an increase in tetracyclines of around 10 kg and a 3 kg reduction in macrolides.

6.4 Intramammary products – dry cow and lactating cow therapies

6.4.1 Overall intramammary sales

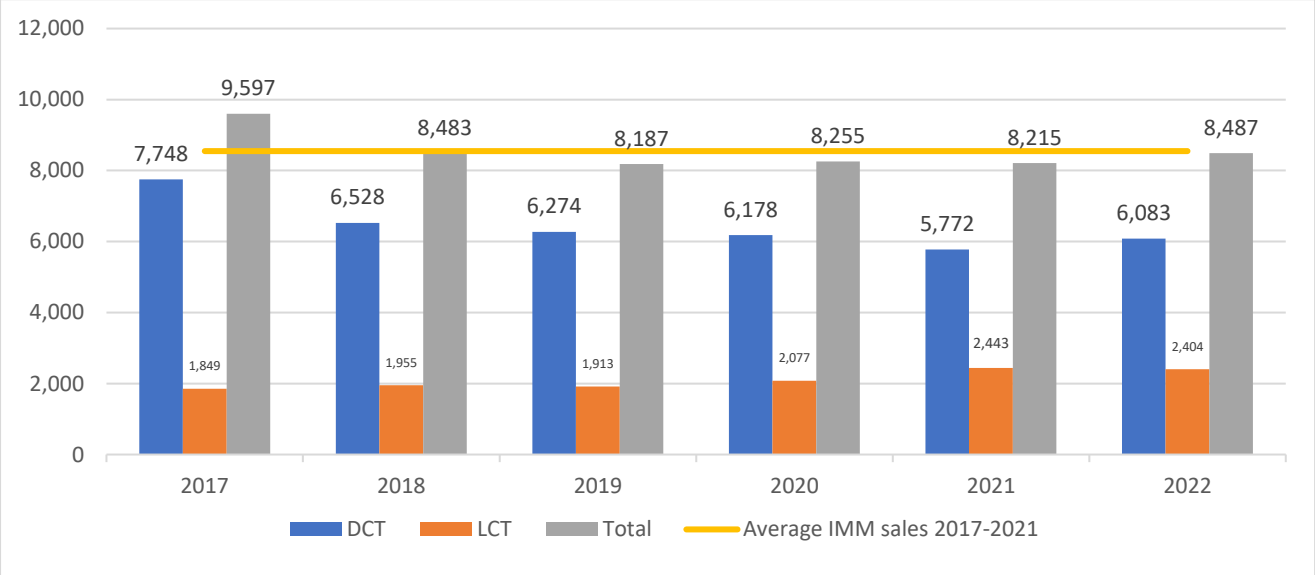
The total quantity of antibiotics contained in intramammary products increased by 3% to 8,487 kg compared to 8,215 kg in the previous year. The main contributors to higher sales in 2022 were the penicillins and clavulanic acids which increased by 4% from 6,930 to 7,201 kg and a 1% increase in first-and second-generation cephalosporins from 1,160 to 1,169 kg. Both classes are found in DCT (dry cow therapy) and in LCT (lactating cow therapy) intramammary products.

Figure 50: 2022 intramammary sales quantities 2022 compared to the previous five-year sales trends (in kilograms)



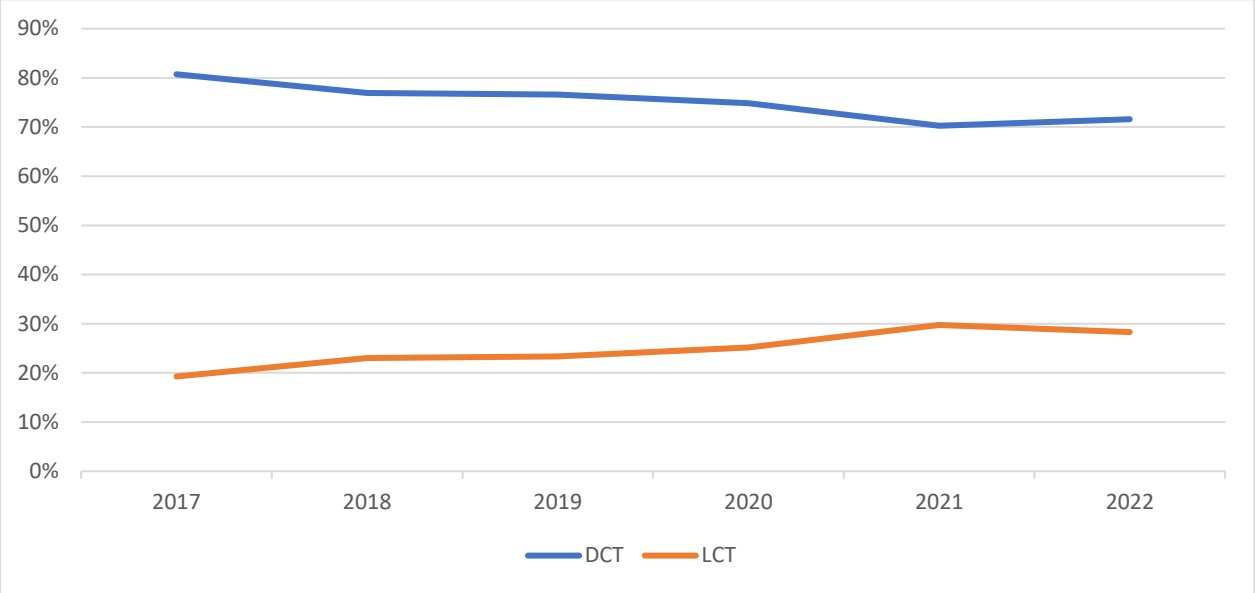
Dry cow therapy (DCT) treatments are used through the non-lactation period, whereas lactating cow therapy (LCT) treatments are administered during lactation. Total antibiotic sales in intramammary products are 11% less than the peak recorded in 2017 and 1% less than the sales average for the previous five years. The total quantity of critically important antibiotics in intramammary products decreased by 4% to 42 kg mainly due to lower sales of aminoglycosides and macrolides.

Figure 51: Total IMM sales quantities over time (in kilograms)



Of the 26 intramammary products with sales, 14 were DCT treatments responsible for over 71% of total sales with 12 LCT treatments accounting for the remainder with just over 28% which was reasonably consistent with the results from the 2021 sales analysis. Over time the percentage share of antibiotic quantities between the two product types has shifted from a DCT/LCT ratio of 80% / 20% to 70% / 30%. In 2022 there was a slight increase in the DCT share to 72% with LCT reducing to 28% due to a 5% increase in DCT and a 2% decrease in LCT antibiotic quantities.

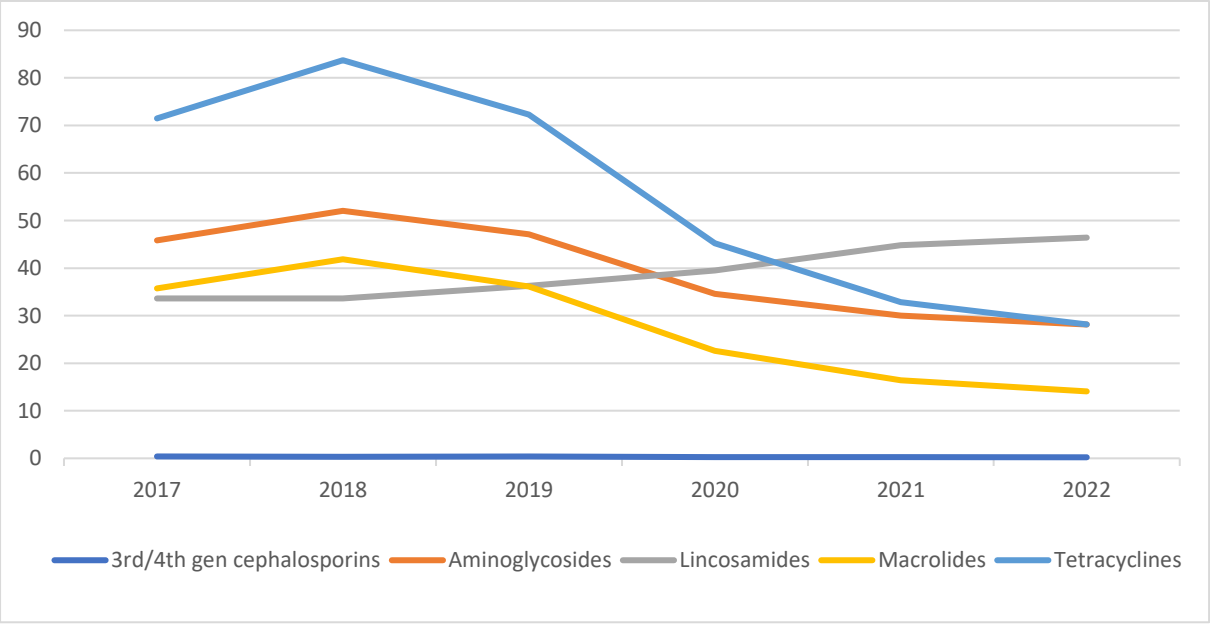
Figure 52: DCT and LCT treatments percentage trend 2017-2022



There were no intramammary products registered containing amphenicols, fluoroquinolones, fusidic acid, nitrofurans, nitroimidazoles, pleuromutilins, polypeptides, streptogramins, or sulphonamides and trimethoprim.

Five classes can be described as “low volume” intramammary antibiotics and are present in LCT rather than DCT products. Sales quantities for four of these five classes decreased with a total reduction of 9 kilograms offset by a 1.5 kg increase in amounts of lincosamides volumes.

Figure 53: Low volume intramammary sales quantities over time (LCT products) in kilograms

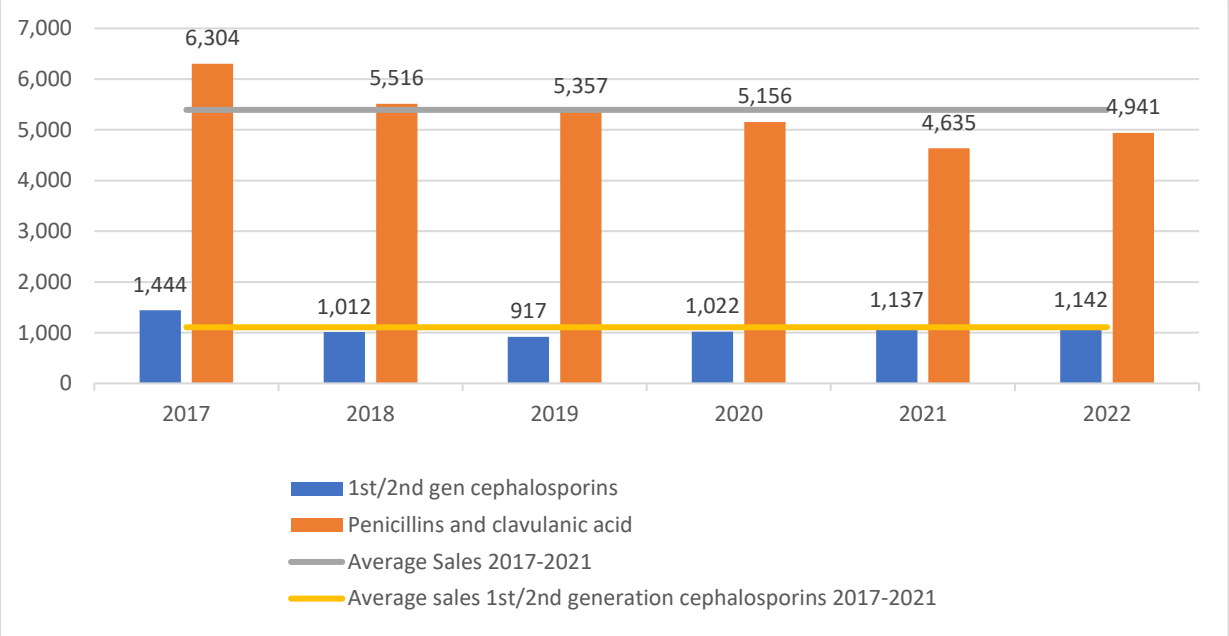


6.4.2 Dry cow therapies (DCT)

Quantities of antibiotic contained in DCT products were 5% higher in 2022 at 6,083 kg with the main contributor being the penicillins and clavulanic acids which increased by 306 kg (7%) to 4,941 kg following a 10% decrease in the previous year. The penicillins and clavulanic acids account for 81% of sales in this group with an 8% increase in ampicillin to 1,438 kg and a 6% increase in cloxacillin to

3,502 kg. Sales of the first and second generation cephalosporins in DCT products increased for the fourth successive year with quantities 5 kg (0.4%) higher at 1,142 kg. Cephalonium sales increased by 10% to 944 kg offset by a 30% decrease in the amount of cephapirin to 198 kg.

Figure 54: DCT antibiotic sales quantities over time (in kilograms)



Sales of the penicillins and clavulanic acids were 8% less than the average for the previous five years whereas for the first and second generation cephalosporins volumes were 3% above the average.

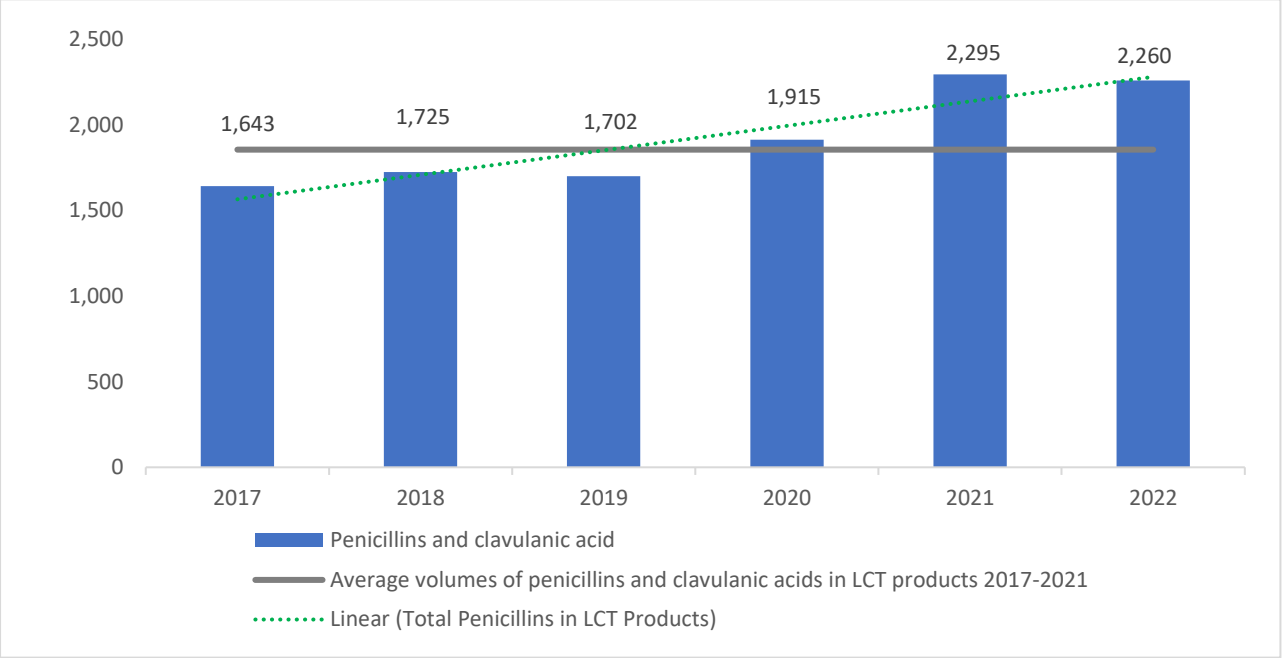
The total number of syringes sold in DCT treatments increased by 512,992 to 11,143,708 compared to 2021. Higher syringe numbers were reported for both antibiotic classes with the number of syringes containing penicillins increasing by 435,280 (7%) whereas for the first and second generation cephalosporins the number of syringes increased by 77,712 (2%).

Translating syringe sales into four-quarter treatments at drying off, this increase equates to 108,820 more cows treated with penicillins and 19,428 more cows treated with first and second-generation cephalosporins at the end of lactation.

6.4.3 Lactating cow therapies (LCT)

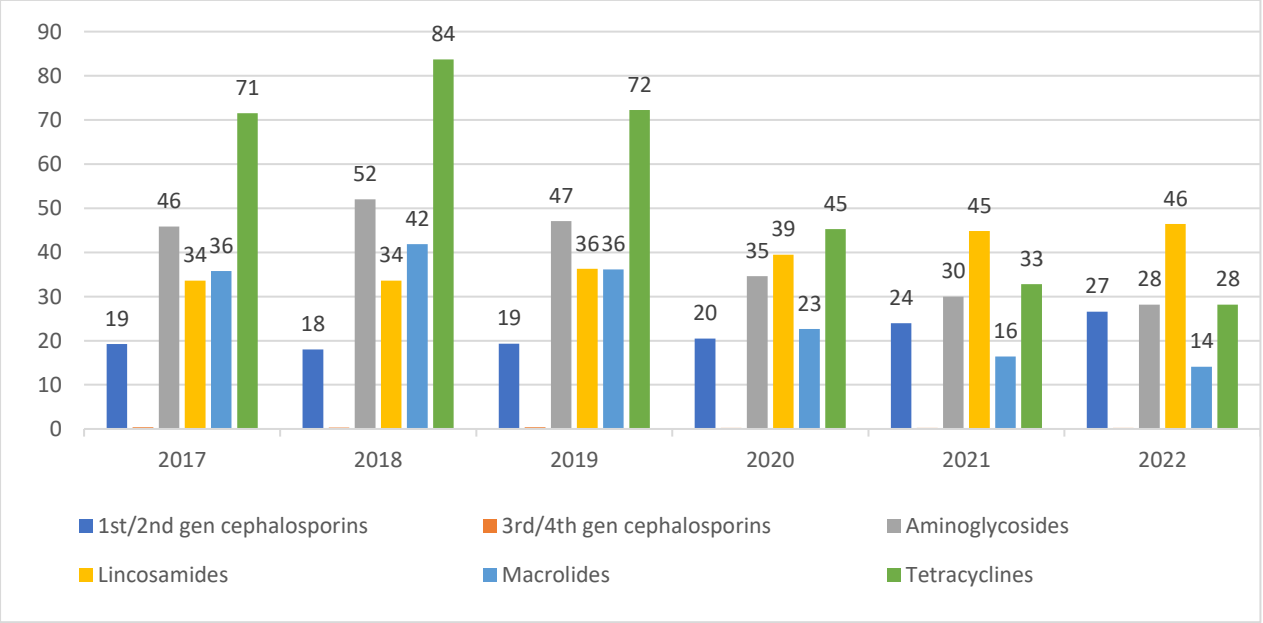
Overall LCT antibiotic quantities were 2% lower in 2022 at 2,404 kg largely due to a 35 kg (2%) decrease in amounts of the penicillins and clavulanic acids to 2,260 kg. In contrast sales of lincosamides increased by 4% to 46 kg and first and second generation cephalosporins were 11% higher at 27 kg. Sales for the other four classes in LCT products decreased by a total of 9 kg. The critically important antibiotic content in LCT products was 9% lower at 42 kg with macrolides and aminoglycosides sales each decreasing by approximately 2 kg.

Figure 55: LCT sales quantities 2017-2022 - Penicillins (in Kgs)



Volumes of penicillins sold in LCT products were 22% above average for the last five years.

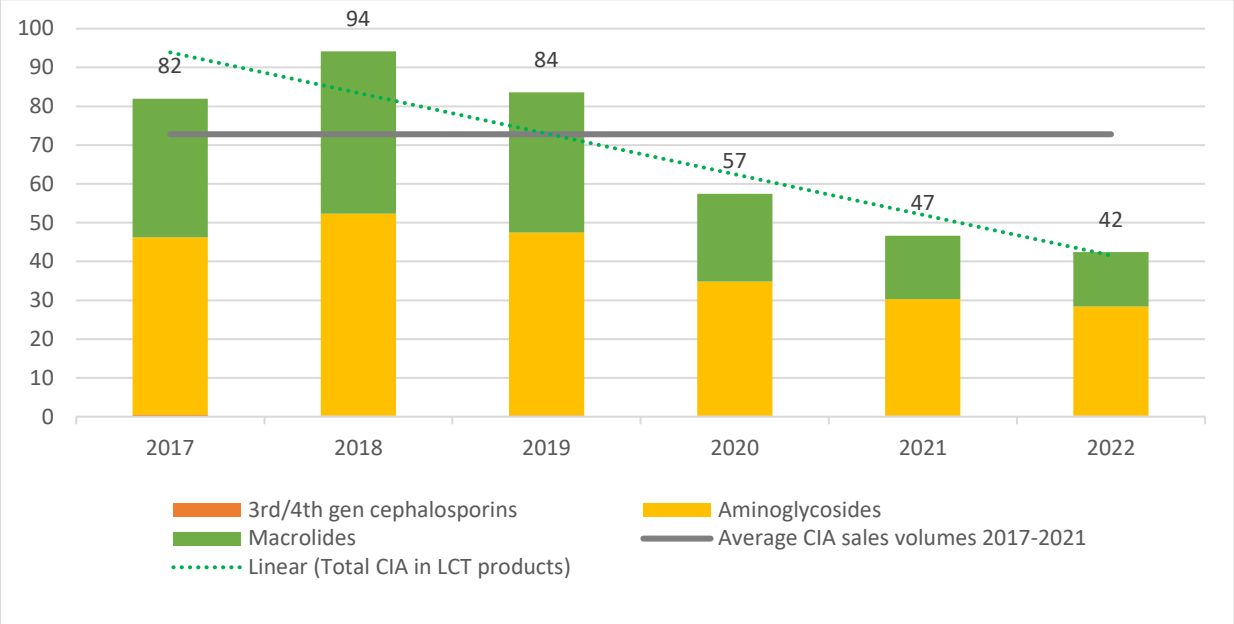
Figure 56: LCT sales 2017-22 - all other classes (in kilograms)



The lincosamides class had the second-highest sales in LCT products with quantities increasing for the fourth successive year. The first-and second generation cephalosporins have also had successive increases however sales of aminoglycosides, macrolides and tetracyclines have decreased for the last four reporting periods

Critically important antibiotics quantities in LCT products have decreased since 2018 and were 42% below the sales average for the last five years for these classes.

Figure 57: Quantities of Critically Important Antibiotics in LCT products 2017-2022 (in kilograms)



Syringe numbers for LCT products decreased by 4% from 2,980,454 to 2,856,020 in 2022. Almost 90% of this reduction was in syringes containing penicillins with 111,000 fewer in contrast to a 371,000 syringe increase for the same class in 2021. Syringe numbers for first and second generation cephalosporins increased by 7% to 92,080. The number of syringes containing critically important antibiotics decreased by 19,000 (6%).

This equates to 27,750 fewer cattle receiving penicillin and clavulanic injections as a four-quarter LCT treatment, and 4,750 fewer cattle receiving syringes with critically important antibiotics.

6.5 Pig and poultry-specific products

There were four products specifically registered for use in pigs and poultry with sales in 2022 and a total sales quantity of 3,210 kg. Sales were again dominated by the polypeptides and the critically important macrolides as in previous years. The percentage share for the polypeptides decreased from 86% to 46% and the percentage share for the macrolides increased from 13% to 50%. The remaining 4% consisted of pleuromutilins, lincosamides, and the critically important aminoglycosides. No sales were reported for tetracyclines.

Given these products are registered for use in both pigs and poultry, registrants were also requested to provide estimates for sales attributed to each species. In 2022 registrants estimated that 49% of antibiotics contained in pig and poultry specific products were sold for use in meat poultry with 45.5% sold for use in pigs and 5.5% sold for use in layer poultry. The comparative figures for 2021 were 88% attributed to meat poultry, 11% attributed to pigs and 1% attributed to layer poultry.

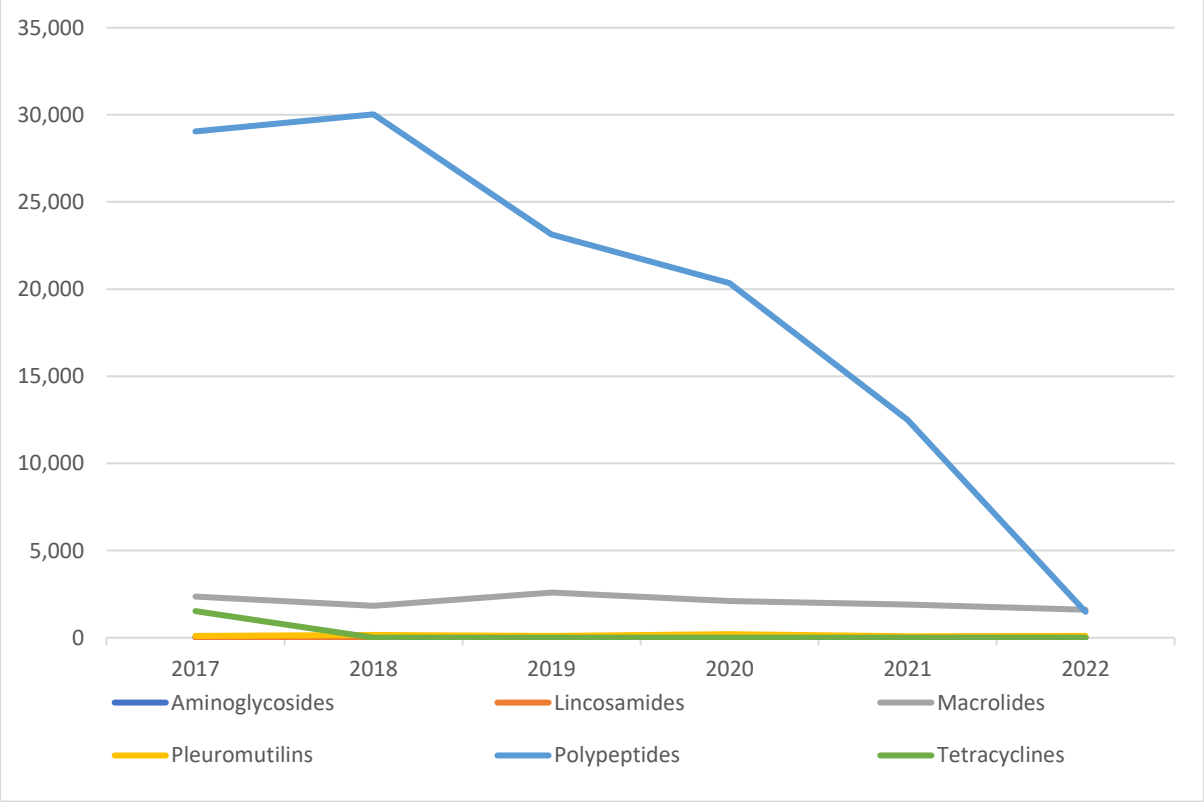
For the two dominant classes the change in percentage contributions in 2022 was due to an 88% reduction in the polypeptide zinc bacitracin and a 16% reduction in the macrolide tylosin. The quantity of zinc bacitracin sold was 1,485 kg in 2022 compared to 12,506 kg in the previous year with all sales of this compound in pig and poultry products specifically for use in meat poultry. Quantities of the critically important antibiotic tylosin decreased from 1,908 kg to 1,604 kg and registrants attributed sales of this compound for use in layer poultry, meat poultry and pigs.

The sales volume for the critically important aminoglycosides increased from 6 kg to 13 kg in 2022 giving a total of critically important antibiotic quantity of 1,617 kg which was 15% lower than the 2021 total of 1,913 kg. Given the magnitude of decreases in other classes, the percentage share of critically important antibiotics in this group increased from 13% to 50%. The contribution to total annual critically important sales from these products remained at 26% in 2022.

The total combined increase for the three classes with higher sales in pig and poultry specific products was 29 kg mostly due to higher amounts of pleuromutilins (up 22% to 102 kg) and the 7 kg increase in aminoglycosides. Quantities of lincosamides also increased from 3 kg to 6 kg.

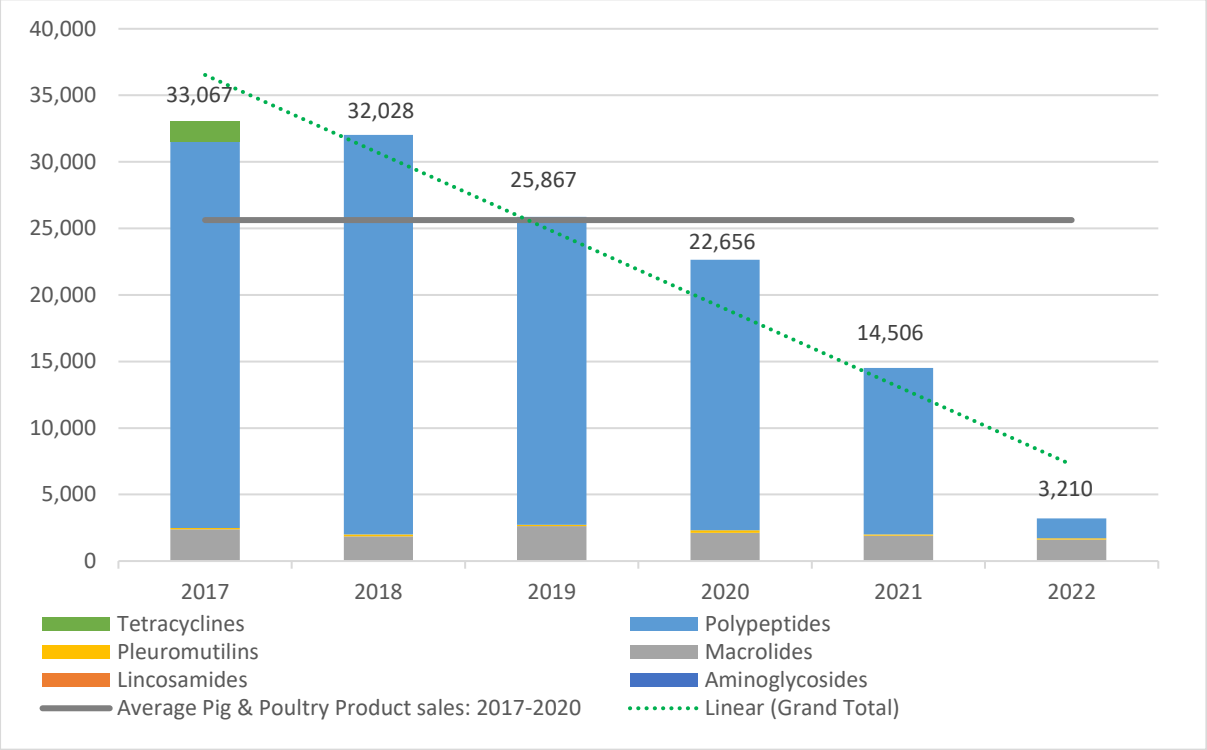
None of the products specifically registered for pig and/or poultry use contained cephalosporins, fluoroquinolones, fusidic acid, nitrofurans, penicillins and clavulanic acid, or sulphonamides and trimethoprim.

Figure 58: Total pig- and poultry-specific product antibiotic sales quantities compared to the previous five-year sales trends (in kilograms)



Total antibiotic sales in pig and poultry specific products were 87% below the average for the previous five years.

Figure 59: Total antibiotic sales quantities in pig and poultry-specific products 2017-2022 (in kilograms)



In addition to those products specifically registered for pig and poultry use, an additional 5263 kg of multi-production and multi-species products were attributed by registrants as sold for use in these species.

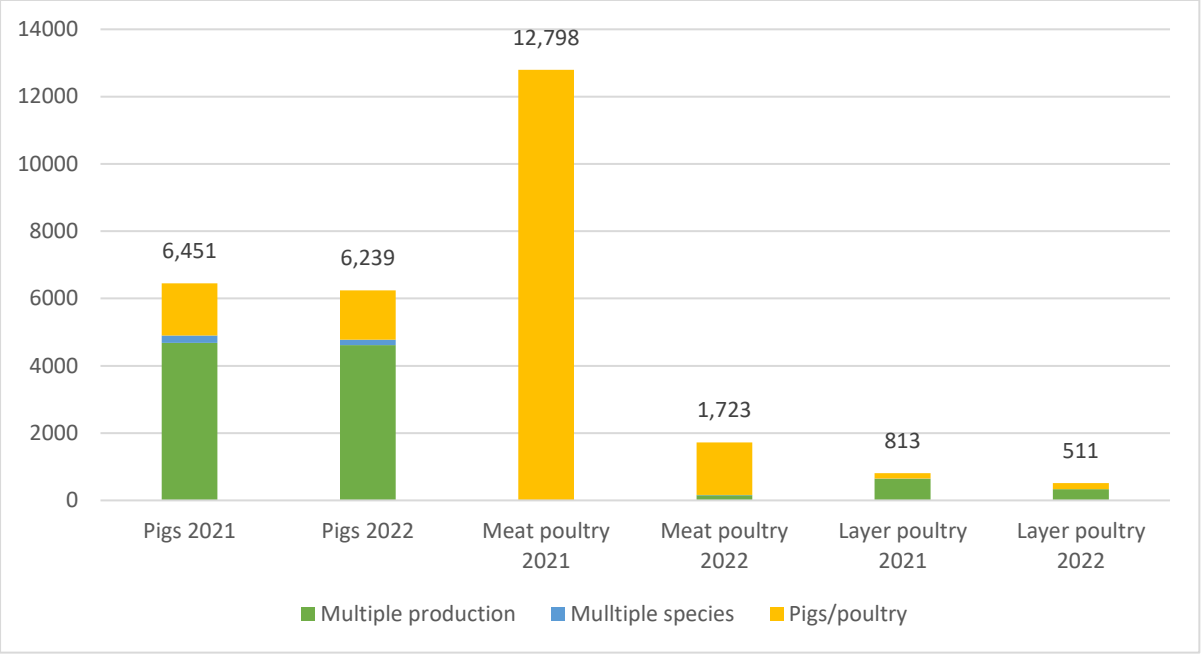
For pigs, the additional usage consisted of 4,612 kg of multi-production species products (3,201 kg of tetracyclines and 1,404 kg of macrolides) and 163 kg of multi-species products (157 kg of penicillins and 7 kg of sulphonamides and trimethoprim) giving a total of 6,239 kg of antibiotics attributed for use in pigs of which 46% was tylosin (2,847 kg) and 51% oxytetracycline (3,200 kg). This represents 77% of all tylosin and 47% of all oxytetracycline sold in 2022.

For layer poultry the additional usage consisted of 329 kg of multi-production species products (317 kg of macrolides and 12 kg of tetracyclines). The total antibiotic quantity attributed to layer poultry was 511 kg of which 397 kg was tylosin (11% of all tylosin sold), 91 kg of tiamulin (90% of all tiamulin sold) and 12 kg of oxytetracycline (0.2% of all oxytetracycline sold) and 7 kg of spectinomycin (50% of all spectinomycin sold) and 3 kg of lincomycin (7% of all lincomycin sold).

An additional 150 kg of antibiotics in multiple production species products (90 kg of macrolides and 60 kg of tetracyclines) and 8 kg in multi-species product sales (all nitroimidazoles) were attributed for use in meat poultry. The total antibiotic quantity attributed to meat poultry was therefore 1,723 kg consisting of 1,485 kg of zinc bacitracin (100% of zinc bacitracin sold in 2022), 170 kg of tylosin (5% of tylosin sold in 2022), 60 kg of oxytetracycline (1% of oxytetracycline sales) and 8 kg of dimetridazole (68% of all dimetridazole sold in 2022).

A comparison of the distribution of the quantities for each of the different product types where registrants attributed sales for use in pigs in 2021 and 2022 is shown in Figure 59 below.

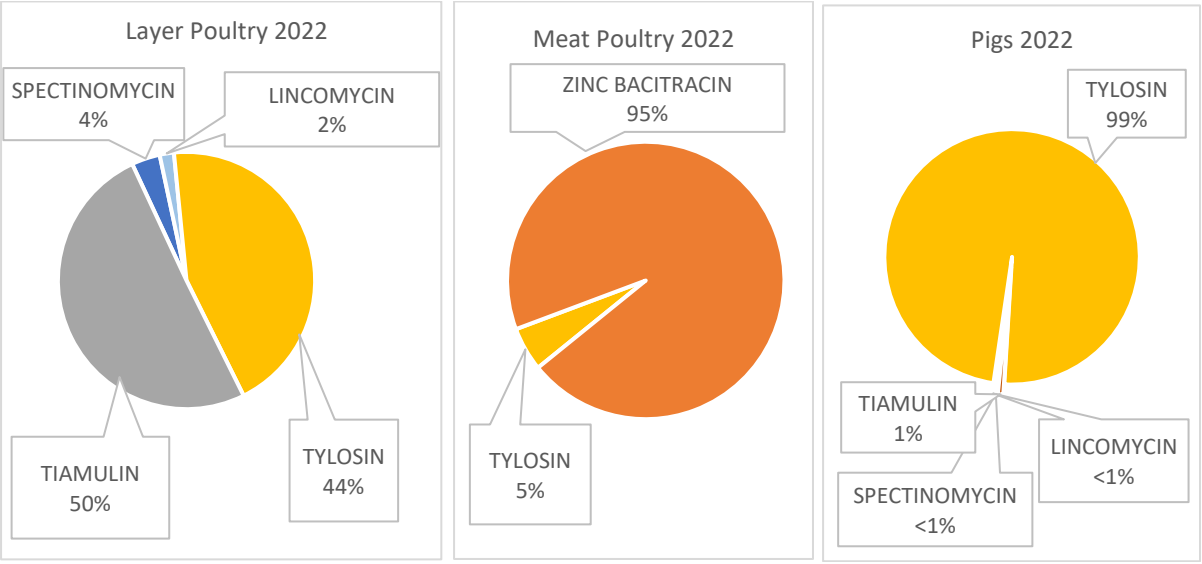
Figure 60: Comparison of 2021 and 2022 total pig and poultry antibiotic sales quantities as attributed by registrants (in kilograms)



Taking this additional amount into consideration the total attributed quantity of antibiotics used in pig and poultry treatments is 8,473 kg compared to 20,062 kg sold in 2021. As these additional totals are based on registrant estimates however, only those products sold exclusively for pig and poultry use will be considered in this analysis.

For pig and poultry specific products the quantity attributed by registrants to layer poultry increased by from 166 to 181 kg with higher sales of tiamulin, spectinomycin and lincomycin and lower amounts of tylosin. In contrast meat poultry attributed quantities decreased from 12,792 kg to 1,565 kg with lower sales of zinc bacitracin and tylosin. The decreases in sales attributed for use in pigs resulted in a reduction from 1,547 kg to a total of 1,463 kg with lower sales of tylosin and tiamulin offset slightly by increases in spectinomycin and lincomycin.

Figure 61: Estimates of use stratified by target species or class for pig and poultry specific products



Compared with the percentage share of quantities in 2021 for the same target species/class for pig and poultry specific products this represented a 10% increase for tiamulin from 40% to 50% and a

reduction in tylosin from 57% to 44% for layer poultry. For meat poultry the percentage of zinc bacitracin decreased from 98% to 95% with an increase in tylosin from 2% to 5% whereas for pigs the percentages were relatively unchanged from those in 2021.

6.6 Horse-only products

Overall sales for horse-specific products increased by 8% to 3,042 kg from 2,814 kg with higher sales of all antibiotics contained in these products and the contribution to total sales increasing from 5% to 7%. Products sold for use solely in horses contained antibiotics from only two classes: sulphonamides and trimethoprim which account for 99% of the sales quantities, and streptogramins with 1%. There were 9 products with sales reported. No critically important antibiotics were sold in horse-specific products in 2022.

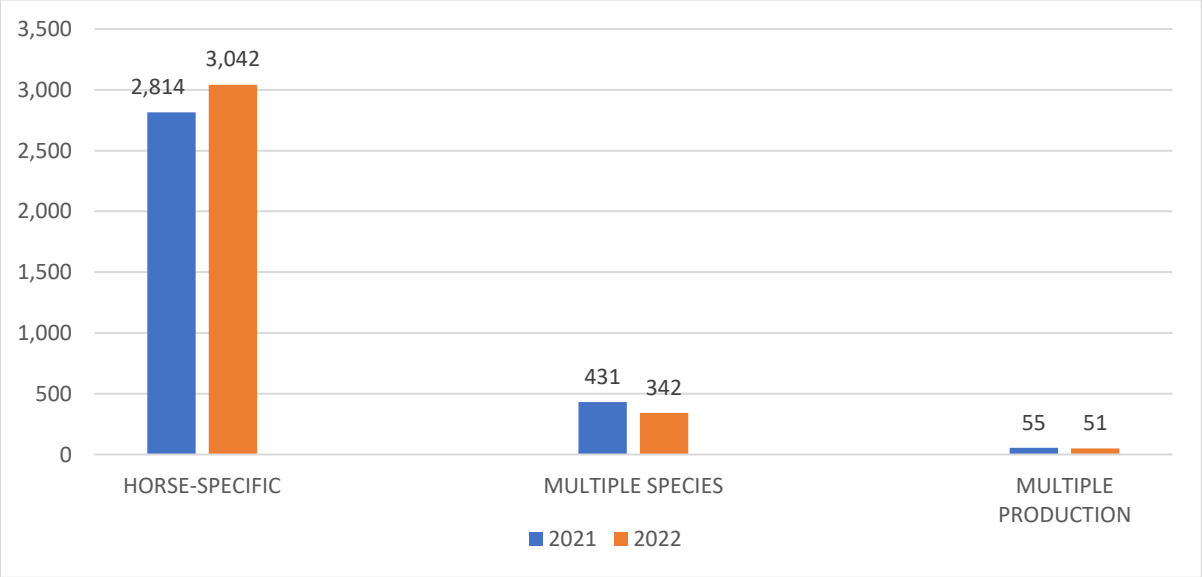
In addition to horse-specific products, registrants estimated that an additional 393 kg of antibiotics in multi-species products and multiple production species products were also sold for use in horses making a total of 3,436 kg and 8% of total antibiotic sales which is 136 kg (4%) higher than 2021.

For horses, the additional usage consisted of 342 kg of multi- species products and 51 kg of multi-production species products. The total additional amount consisted of 278 kg of penicillin G procaine (down from 360 kg in 2021), 53 kg of gentamycin (down from 59 kg in 2021), 22 kg of oxytetracycline (up from 5 kg in 2021) and 21 kg of ceftiofur (an increase from 11 kg for this critically important antibiotic from 2021). Taking these additional estimates into account the total amount of critically important antibiotics attributed for use in horses was 75 kg (1% of total critically important antibiotic sales).

A comparison between 2022 and 2021 of the distribution of sales attributed for use in horses for the different product types in addition to the sales of antibiotics in horse-specific products is shown in Figure 61 below.

Because this additional quantity is based on estimates rather than product-specific sales data, only those products sold exclusively for use in horses will be considered further.

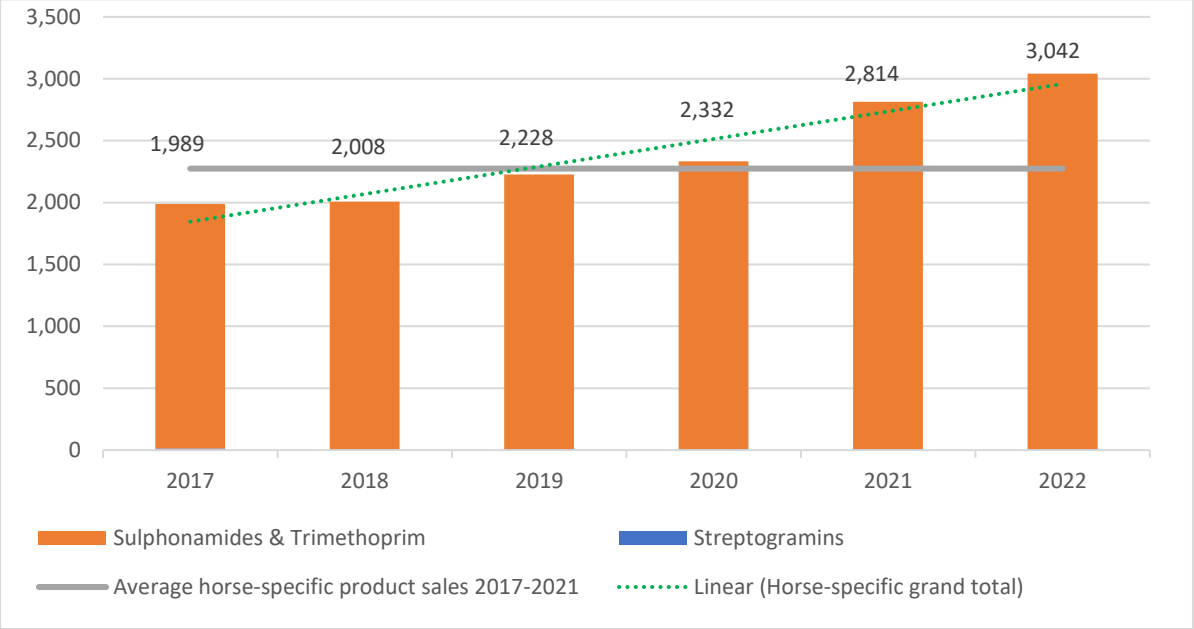
Figure 62: Antibiotics sold in 2022 for use in horses attributed by registrants/horse specific (in kilograms)



Increased sales for horse-specific products were due to higher quantities of all three antibiotics in the sulphonamides and trimethoprim class, particularly for sulphamethazine. Sales of this compound were 2,493 kg (187 kg above the 2,305 kg sold in 2021) and accounted for 87% of the class sales. Higher quantities of both trimethoprim (8% higher at 506 kg and sulfadiazine 17% higher at 37 kg) were also reported. Quantities of streptogramins sold in horse-specific products decreased from 9 kg

to 7 kg. Total sales of antibiotics contained in horse-specific products were 34% above the average for the previous five years.

Figure 63: Total antibiotic sales in horse-specific products 2017-2022 (in kilograms)



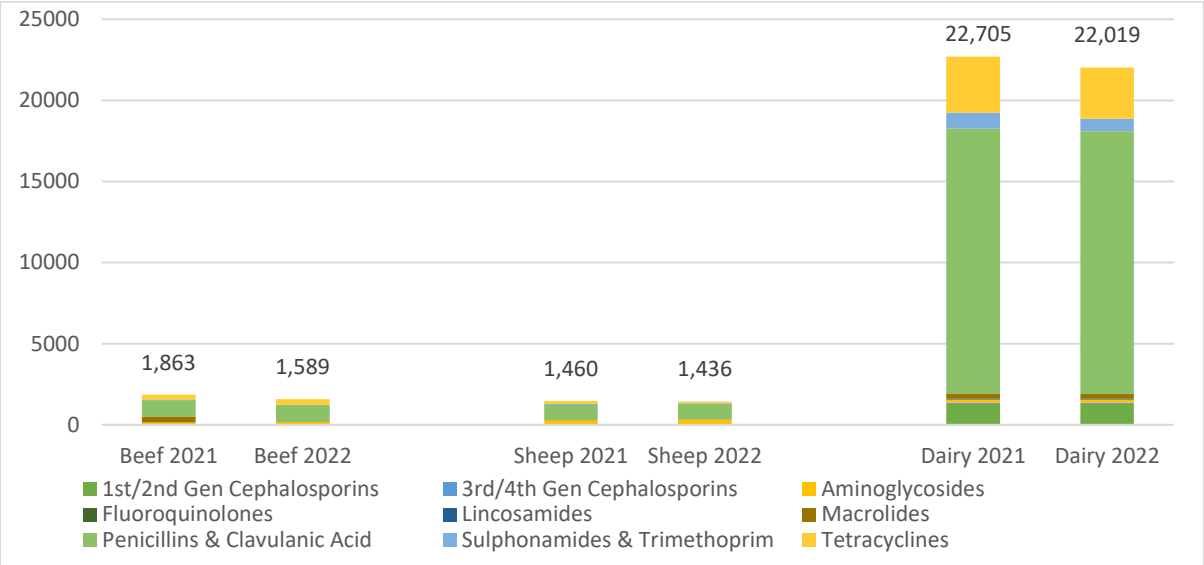
6.7 Cattle-and sheep-only products

The reported sales total for cattle-only and sheep-only products (excluding intramammary products) increased by 8% to 976 kg from a total of 12 products with sales. This represents 2% of the total sales quantity. Six different classes were included in these products, including two containing critically important antibiotics which accounted for 4% (40 kg) of total cattle-and sheep product specific antibiotic sales.

Based on registrant estimates an additional 5,046 kg of antibiotics in multiple production species products was attributed for use in dairy cattle and 529 kg in beef cattle with 440 kg attributed for use in sheep. For multiple species products the additional quantity attributed for use was 7,777 kg for dairy cattle, 867 kg for beef cattle, and 920 kg attributed for use in sheep. The total additional amount attributed for use in dairy cattle (excluding intramammary products) was 12,825 kg, for use in beef cattle 1,395 kg, and for use in sheep 1,361 kg. Compared to 2021 this represents a reduction of 1,018 kg attributed to dairy cattle and a 288 kg decrease in sales attributed to beef cattle (mostly from multi-production species products). The additional volume from these products attributed to sheep was relatively unchanged from 2021 with a 19 kg reduction.

The total amount of antibiotics attributed to cattle and sheep from multi-production and multiple species products was 15,581 kg, of which 65% consisted of penicillins and clavulanic acid, 22% tetracyclines, 6% sulphonamides and trimethoprim, and 1% first and second generation cephalosporins. The remaining 6% (1,008 kg) consisted of critically important antibiotics, all of which were contained in multiple production species products. Compared to 2021 this was a 23% (305 kg) reduction in critically important antibiotics in these products attributed for use in cattle and sheep with 48% of this volume attributed for use in dairy cattle, 34% in sheep and 18% in beef cattle. At a class level, decreases in the amounts of third and fourth generation cephalosporins (18 kg lower at 82 kg) and macrolides (367 kg lower at 269 kg) were offset slightly by an increase in the aminoglycosides of 80 kg to 646 kg. The volume of critically important antibiotics in the additional quantity attributed for use for dairy cattle decreased by 5% to 482 kg, for beef cattle the reduction was 65% to 181 kg however the amount attributed for use in sheep increased by 17% from 293 to 345 kg.

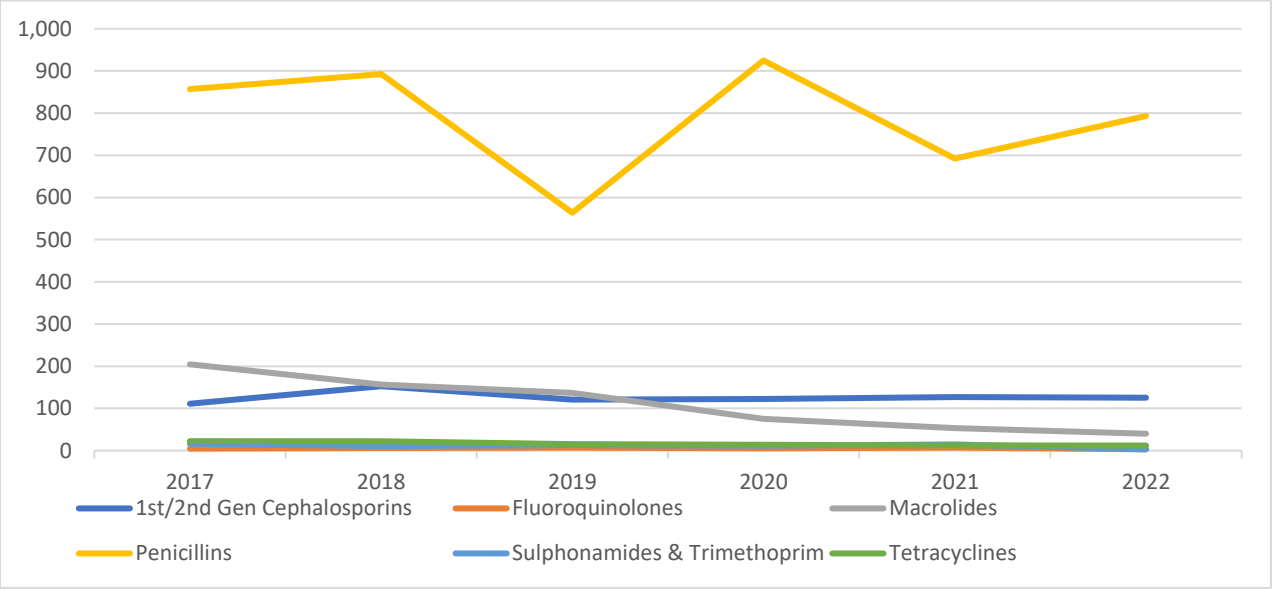
Figure 64: 2022 total sales quantities (including intramammary products) for dairy cattle, beef cattle and sheep as attributed by registrants for multiple production species, multiple species, and cattle and sheep specific product sales (in kilograms)



Because this additional volume is based on estimates rather than product-specific sales data, only those products sold exclusively for use in cattle and sheep will be considered further.

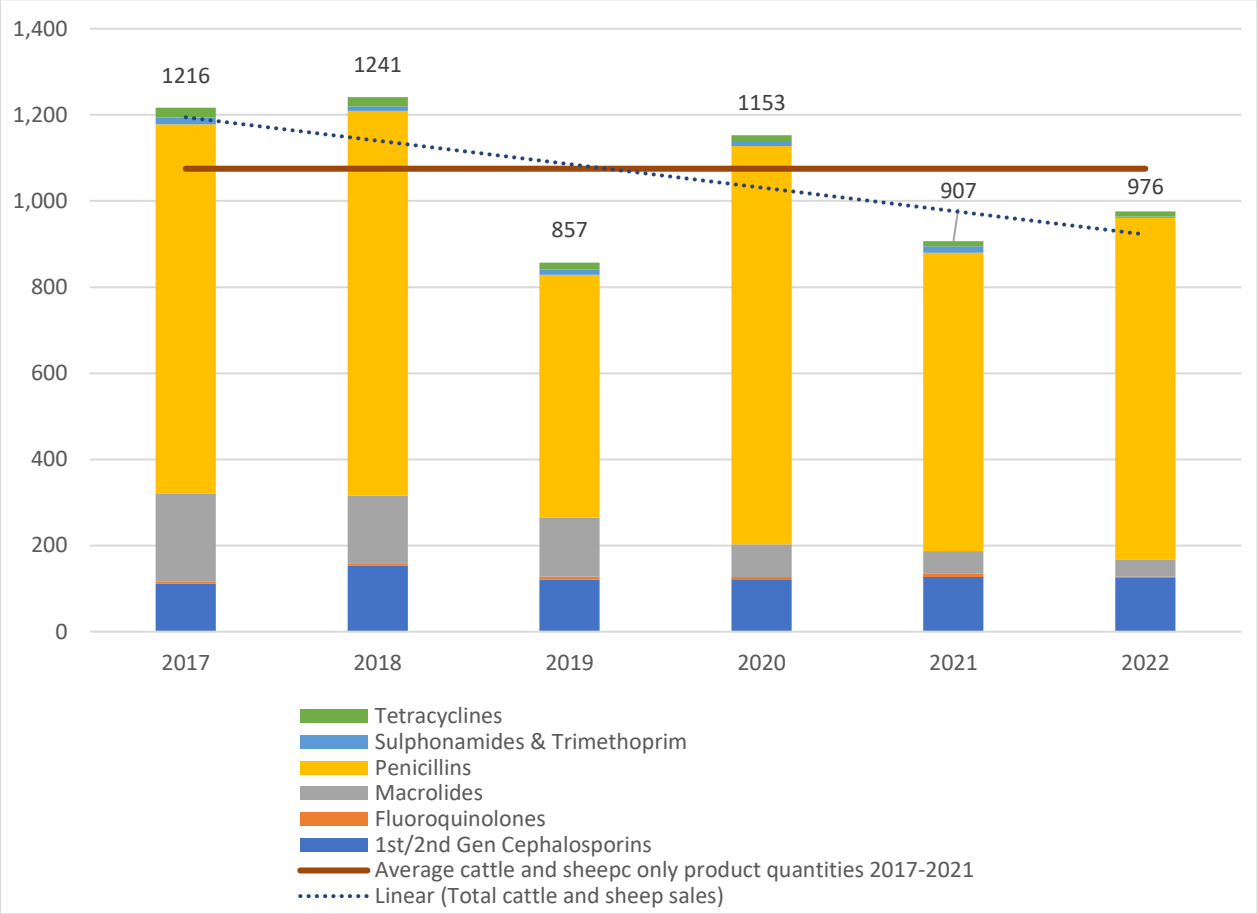
Penicillins and clavulanic acids accounted for most of the quantity sold in cattle-and sheep-only products with 793 kg, an increase of 100 kg compared to 2021. First and second generation cephalosporins accounted for 124 kg of sales, followed by the macrolides with 40 kg (25% decrease from 2021) and the tetracyclines with 12 kg. The fluoroquinolones, sulphonamides, and trimethoprim had a combined total of 6 kg in these products.

Figure 65: 2022 Cattle- and sheep-only product sales quantities compared to the previous five-year sales trends



The sales quantity of critically important antibiotics in cattle and sheep-specific products decreased by 28% from 60 kg to 43 kg. Over 85% of antibiotics included in cattle-only and-sheep only products were administered as injectable formulations,14% by intrauterine and less than 1% by topical methods.

Figure 66: Total cattle- and sheep-only product sales quantities 2017-2022 (in kilograms)



Antibiotic sales in cattle-and sheep-only products were 9 % below the average for the previous five years.

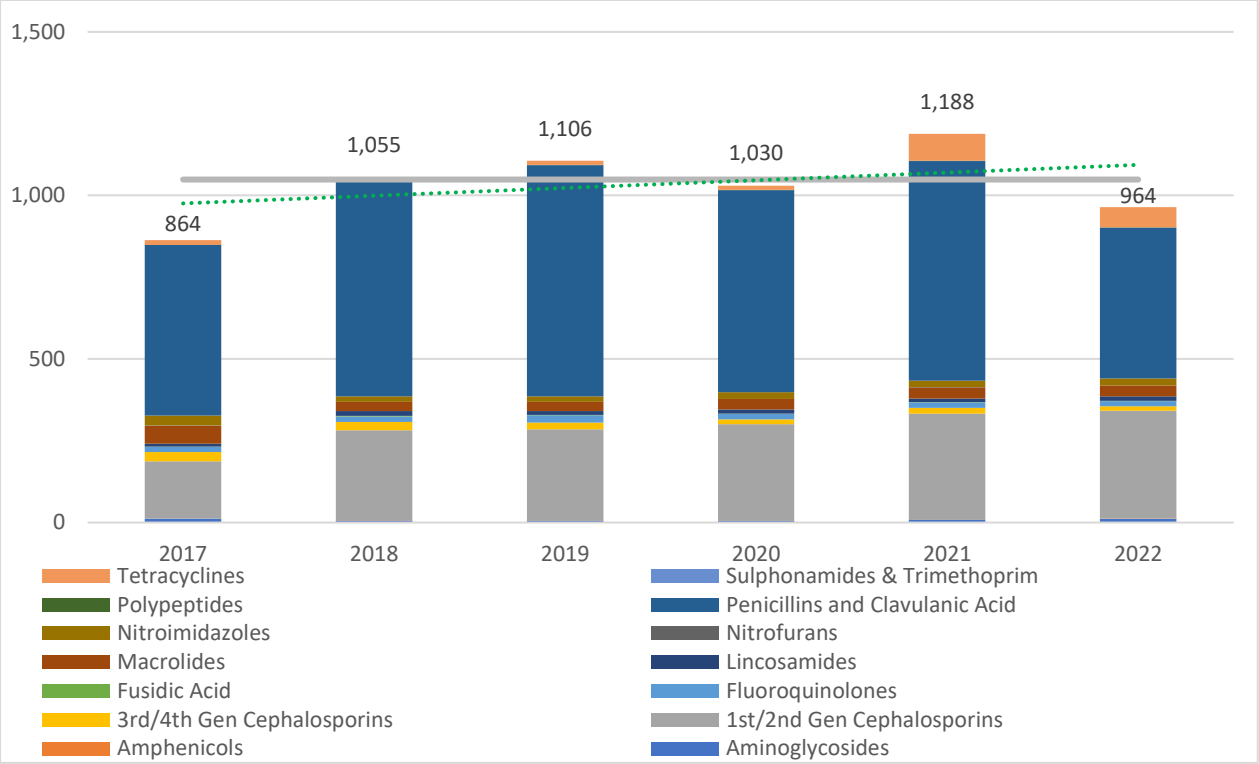
6.8 Companion animals and non-production species products

Sales quantities of antibiotics in companion and non-production animal products decreased by 223 kg (19%) to 964 kg in 2022. Companion and non-production animal products are intended to treat dogs, cats, cage birds, pigeons, and aquarium fish, and represented 30% of products with sales but only 2% of the total sales volume.

Based on registrant estimates an additional 717 kg of antibiotics in multi-species products were attributed to companion and non-production animals compared to 795 kg in 2021. The total quantity of antibiotics in specific products or attributed for use in multi-species products was 1,681 kg which represented a 15% reduction from the 1,982 kg reported in 2021. A total of 95% of the additional volume consisted of penicillins, specifically penicillin G procaine and amoxicillin, 3% from sulphonamides and trimethoprim, and less than 1% for both tetracyclines and polypeptides. Just under 0.5% (3 kg) of the additional volume contained critically important antibiotics, specifically neomycin and gentamicin, with similar quantities reported in 2021. As this additional volume is based on registrant estimates rather than specific sales data, this analysis will be limited to those products sold exclusively in companion and non-production species.

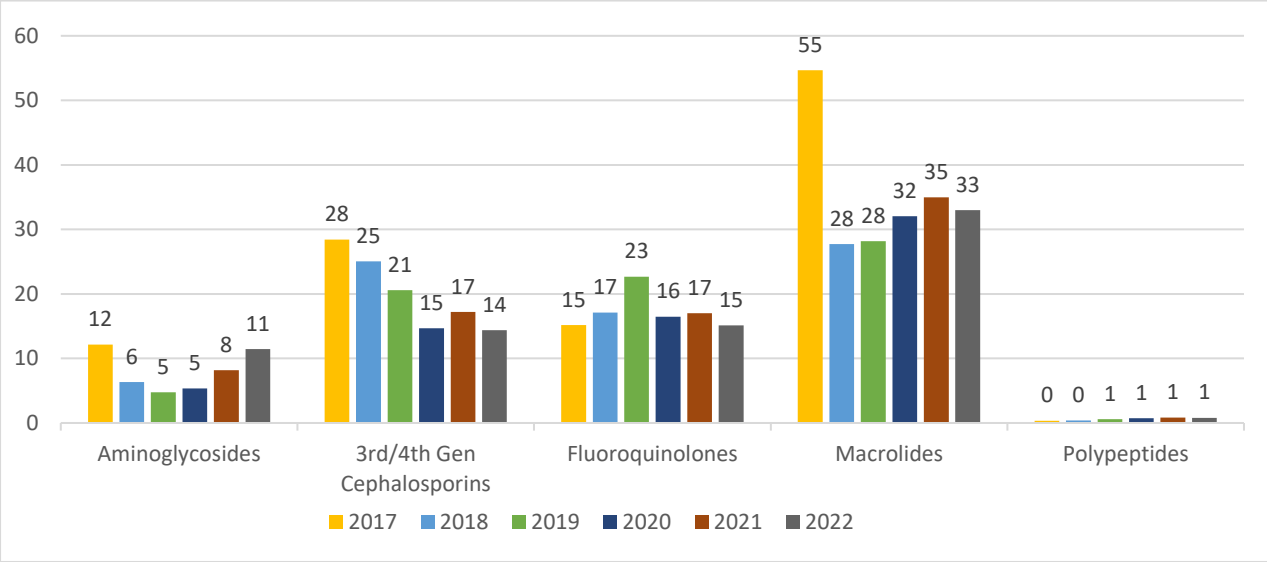
Lower sales quantities in companion animal and non-production species products were reported for 7 of the 13 classes with a total volume decrease of 224 kg. The largest decrease was for the penicillins with a 31% decrease (210 kg) to 460 kg and a share of group sales of 48% compared to 53% in 2021. The tetracyclines volume decreased by 20 kg (24%) to 62 kg following a 531% increase in 2021. For the six classes with higher sales the total increase was 13 kg.

Figure 67: Total sales quantities for companion animal and non-production species products 2017-2022 (in kilograms)



Sales of critically important antibiotics in companion animal and non-production species products decreased by 4% to 75 kg with a total decrease of 7 kg with reductions in four of the five classes offset by a 3 kg increase in the aminoglycosides.

Figure 68: Critically important antibiotic sales for companion and non-production animal products 2017-2022 (in kilograms)



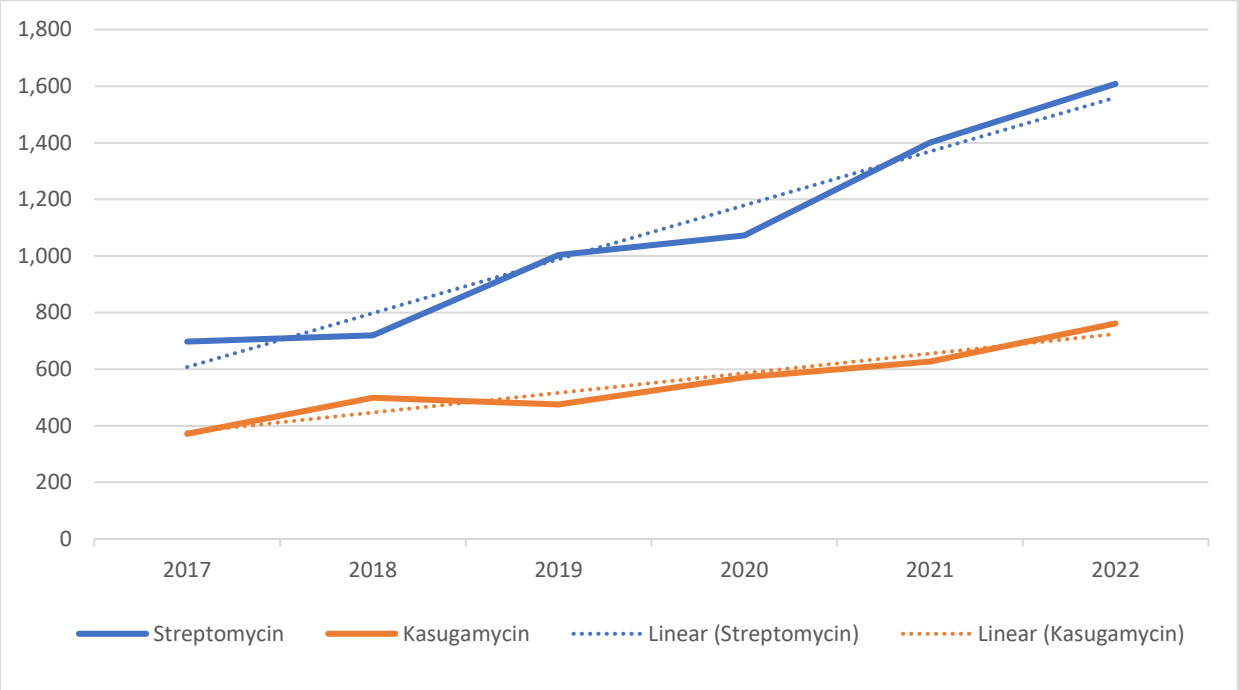
There were no registered companion animal or non-production species products containing sulphonamides and trimethoprim and no sales reported for nitrofurans in 2022.

Most of these products are sold as oral treatments (71%) with 28% delivered by injection and the remainder by topical, intra-aural or intra-ocular methods.

6.9 Crop protection antibiotics

Sales of antibiotics for crop protection increased by 17% to 2,370 kg from 2,027 kg in the previous year. Quantities of both streptomycin and kasugamycin increased by 15% and 22% respectively. Streptomycin volumes have increased each year since 2017 whereas kasugamycin volumes have increased since 2019. Streptomycin accounts for 68% of the sales total for antibiotics used in crop protection and is used in kiwifruit, pome fruit and stone fruit. Kasugamycin accounts for the other 32% and is used only in kiwifruit.

Figure 69; Sales trends for antibiotics sold for use in crop protection 2017-2022 (in kilograms)

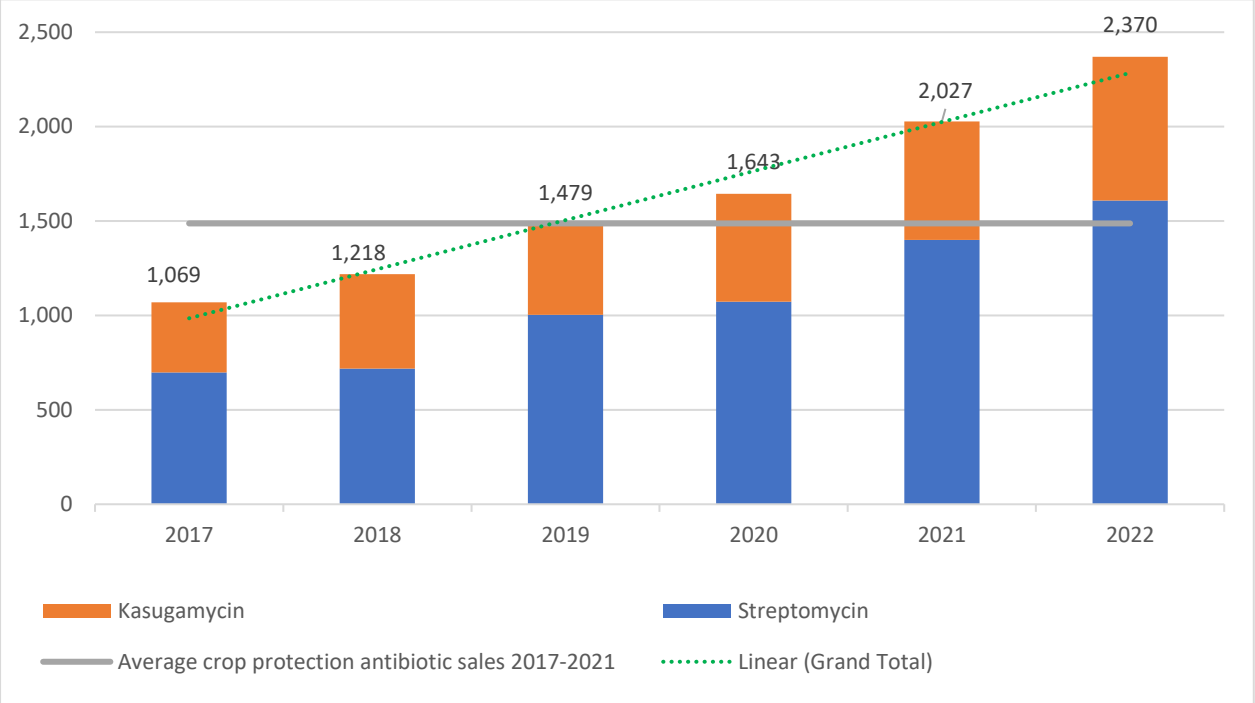


Sales of these compounds were 60% above the five-year sales averages and the total was more than double the amount sold in 2017.

Zespri and New Zealand Apples and Pears report usage of antibiotics for crop protection will vary over time, however these higher sales quantities may relate to increasing frequency of warm, wet, weather events coinciding with bloom periods.

New Zealand Apples and Pears expect reliance on streptomycin for the treatment of fire blight to continue for some time. New Zealand Apples and Pears continue to invest in research and development projects for alternative options for the control of fire blight including biological, cultural, alternative crop protection products, and plant breeding. Replacement of trees currently in the ground with fire blight resistant options is a long-term strategy, both through the breeding process and as trees remain in the ground for 10-20 years.

Figure 70: Total sales quantities for crop protection antibiotics 2017-2022 (in kilograms)



7 Conclusions

Antibiotic sales quantities decreased by 12,389 kg (23%) to 41,033 kg mainly due to the large decrease in the volume of polypeptides (specifically zinc bacitracin) sold in 2022. Sales for the other fifteen classes (excluding the polypeptides) were consistent with the average for the previous five years at around 40,000 kg. Decreased quantities of macrolides, penicillins, and tetracyclines were offset by increases in aminoglycosides and first and second generation cephalosporins. The volume of aminoglycosides sold in 2022 (3,125 kg) was 86% higher than that sold in 2017 with increases in five of the six sales periods since then.

Based on registrant estimates of use for multiple production species, multi-species products, and species-specific products 54% (22,019 kg) of antibiotics were sold for use in dairy cattle of which 8,487 kg were for intramammary treatments. The reduction in zinc bacitracin had the most impact on sales attributed for use in meat poultry with an 88% decline to 1,485 kg sold and a total meat poultry sales volume of 1,723 kg. Antibiotic sales attributed to layer poultry declined by 42% to 511 kg. The total antibiotics sold for use in pigs declined by 9% to 6,239 kg.

The percentage volume attributed by registrants for use in beef cattle declined by 15% to 1,589 kg and accounted for 4% of the total sales volume. For sheep, the volume was relatively unchanged at 1,436 kg. As per previous years, sales of antibiotics intended for use in the sheep and beef sectors remain very low, likely attributable to lower disease pressures in pastoral farming systems with 7% of the sales total.

For intramammary cattle treatments there was a slight shift away from LCT with a 2% decrease in sales to 2,404 kg compared to a 5% increase in DCT quantities to 6,083 kg. Antibiotics sold or attributed for use in horses increased for the fourth year in succession to a total of 3,436 kg. The sales quantity for companion and non-production animals decreased by 15% to a total of 1,681 kg.

The volume of critically important antibiotics decreased by 8% to 6,285 kg in 2022 mainly due to a decrease in macrolides volumes offset by an increase in aminoglycosides with most of this reduction occurring in multi-production species products.

8 Calculated antimicrobial use

Use of sales data to approximate use by species has several limitations including products being approved for use with multiple species, products being purchased in advance and the impact of sales patterns being subject to variability associated with supply chain issues. Products may also be subject to loss or expiry before they can be used or owners not completing a full course of treatment. Some of this variability may be mitigated by use of registrant estimates concerning multi-species products, however other issues such as product loss or incomplete treatment would require farm usage to be directly monitored which is not currently feasible in New Zealand.

To aid understanding of approximate antibiotic use, MPI introduced an antimicrobial use (AMU) calculation for antibiotics used in production animals in the 2020 antibiotic sales report. Production animal species are the primary target for this type of calculation because they are by far the dominant users of veterinary antibiotics, with sales in production animals comprising 90% of the 2022 antibiotic sales volume.

The methodology used aligns with that employed by the European Medicines Agency (EMA), utilising standardised liveweights for each food-producing species representing the most likely age and weight at which animals will be treated. The weight estimate is then multiplied by population data for the target year to provide a population correction unit (PCU) for each class, and the class-level PCUs are summed to produce a New Zealand PCU for all species in the reporting year. This number is then divided by the total mass of antibiotics sold in that year, minus those known to be used solely in horticulture, companion animals, and non-production animals, to estimate the AMU.

To establish the New Zealand PCU for 2022, Statistics New Zealand population data has been used to provide for raw population numbers for the reporting year for beef, dairy, sheep, deer, and goats. Statistics New Zealand data for horses typically includes racehorses and working farms and these

figures have been augmented with numbers of horses used in sport and other equestrian and recreational purposes. For pigs and poultry, the data is an estimate of numbers that were present (and potentially treated) in the annual period based on the annual kill of growers, rather than “point in time” census data. The breeding herd/flock is then stratified into different class groups and average weights previously consulted with beef, dairy, deer, sheep, goat, horse, pig, and poultry industry representatives. The complete list of values used for all species can be found in the Appendix.

Based on a total production animal New Zealand PCU of **6,695,340,714** kg and the veterinary antibiotic sales total of 36,981 kg, the 2022 New Zealand AMU is **5.5234 milligrams antibiotic per kilogram liveweight biomass.**

In 2021 the respective numbers were **6,832,703,668** (PCU) and 7.522 milligrams antibiotic per kilogram liveweight biomass (AMU) with a veterinary sales total of 51,395 kg.

Although there are no 2022 AMU estimates published at this time, New Zealand’s estimate is well below the most recently published international estimates. The most recent data available from the World Organisation for Animal Health estimated a global AMU of 95.74 milligrams antibiotic per kilogram biomass for 2018, with the lowest regional AMU value at 17.99 milligrams antibiotic per kilogram biomass for Africa. The 2018 AMU calculated for the region in which New Zealand would be considered, Asia, Far East, and Oceania, was 160.69 milligrams antibiotic per kilogram biomass.[1]

[1] (World Organisation for Animal Health: Annual Report on Antimicrobial Agents Intended for Use in Animals, 6th Edition, 2022)

9 Appendix:

Antimicrobial Use Data 2022

	Beef			Dairy			Sheep		Deer		Pigs[1]		Poultry[1]			Goats[2]	Horses[2]
	0-1yr 30%	1-2yrs 30%	>2yrs 40%	0-1yr 10%	1-2yrs 10%	>2yrs 80%	Hoggets 70%	Ewes 30%	<1yr 45%	Mature 55%	Growers	Breeders	Layers	Broilers	Turkeys		
Standardised Weights (Kg)	200	470	520	180	430	600	55	65	60	110	70	210	2.3	1	2	60	457
2022 Population - Raw	3,898,000	3,898,000	3,842,000	6,136,000	6,136,000	6,136,000	25,334,000	25,334,000	794,000	794,000	608,956	32,000	4,600,000	119,539,000	500,000	93,606	148,362
2022 Population - Stratified	1,169,400	1,169,400	1,536,800	613,600	613,600	4,908,800	17,733,800	7,600,200	357,300	436,700	608,956	32,000	4,600,000	120,439,000	250,000	93,606	148,362
PCU (subset class)	233,880,000	549,618,000	799,136,000	110,448,000	263,848,000	2,945,280,000	975,359,000	494,013,000	21,438,000	48,037,000	42,626,920	6,720,000	10,580,000	120,439,000	500,000	5,616,360	67,801,434

Total PCU (kilograms)	**6,695,340,714**
Total 2022 Sales (kilograms)	36,981
AMU (kg)	0.00000552
AMU (mg antibiotic/kg)	5.5234

Population Data Sources

Populations for food-producing animals reflect commercial industry populations only. It is recognised that there are also non-commercial populations that use a proportion of overall antibiotic volumes sold.

- Beef, Dairy, Sheep, and Deer: Statistics NZ Population data (June 2022)
- Pigs: Direct communication with NZ Pork
- Poultry: Direct communication with PIANZ
- Goats: Beef + Lamb NZ Compendium of New Zealand Farm Facts 2022 (note: quoted number was a 2019 population value)
- No stratification has been applied to pigs or poultry (class specific population data provided by NZ Pork and PIANZ)

- No stratification has been applied to goat and horse populations as all animals are likely to be treated with antibiotics

https://www.stats.govt.nz/information-releases/agricultural-production-statistics-year-to-june-2022
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