New Zealand Food Safety
Haumaru Kai Aotearoa

2021 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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1 Summary

Overall, antibiotic sales decreased by 6,215 kilograms (10%) to 53,422 kilograms in 2021. This is the fourth successive year in which volumes have reduced. The combined volume reduction for six of the sixteen classes with lower sales was 9,175 kilograms. Of the ten classes where sales were higher the increase was 2,960 kilograms.

Sales for the polypeptides class decreased by 7,833 kilograms which was 39% lower than the previous year. The other classes with significant decreases in volume were the tetracyclines with a 9% reduction (745 kilograms), the macrolides with a 9% reduction (477 kilograms), and the pleuromutilins which were 59% (119 kilograms) below the amount sold in 2020. Excluding the polypeptides, the combined sales for the other fifteen classes increased by 4% to 40,914 kilograms compared to 39,296 kilograms in 2020.

Four of the ten classes with higher sales accounted for 99% of the combined increase of 2,960 kilograms:

- penicillins and clavulanic acid (2,013 kilogram - 11% increase)
- aminoglycosides (437 kilograms - 19.3% increase)
- sulphonamides and trimethoprim (342 kilograms - 9.5% increase) and
- first-and second-generation cephalosporins (153 kilograms - 10.5% increase).

Total sales of critically important antibiotics decreased by 1.3% in 2021 to 6,848 kilograms following three years of successive decreases. The minimal decrease was due to lower macrolide sales of 477 kilograms (9.4%), offset by higher aminoglycoside sales (excluding kasugamycin – agricultural chemical) which were 382 kilograms (22.6%) higher than 2020. Critically important antibiotic classes accounted for 12.8% of total sales which was 1.2% lower than reported in 2020.

2 Introduction

Antibiotics are essential to the health of humans, animals, and plants. The development of antimicrobial resistance is therefore one of the most significant risks to human, animal, and plant health. The development of antimicrobial resistance is one of the top ten global health threats. As bacteria become more resistant to current therapies, there are fewer options available for treatment. The incidence of antibiotic resistance is increasing across the world, and there are few new antibiotics being developed. Thus, preservation of our current therapeutic options remains vital.
Antibiotic stewardship needs to be practiced across all the human health, primary industry, and environment sectors. Prudent use of antibiotics will help preserve current therapeutic efficacy. One way of monitoring antibiotic use is through sales. Although 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 as well whether existing regulatory controls remain appropriate.

This report summarises the sales for antibiotic agricultural compounds during the 2021 calendar year and compares the sales figures to those reported for the previous five-year period (2016-2020). 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 2020 calendar year, from 1 January to 31 December. This report can be found on the MPI website at:
2020 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 as restricted veterinary medicines, requiring authorisation by a veterinarian before they can be sold or used in animals. The few antibiotic agricultural chemicals available for use on crops are also restricted, with strict controls on who can purchase these trade name products and how they are used. All registrants of antibiotic veterinary medicine and agricultural chemicals are legally required to submit a yearly sales return to 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 on the various target species for the various types of multi-target products that have been 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 throughout 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 notified by registrants none of these scenarios will be visible in the numbers of products reported.

Furthermore, there may also be complications regarding product label claims and veterinary authorisations. Where products have label claims for use with multiple species it can be difficult to link the sales volumes to a particular species. Veterinarians also 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. 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.

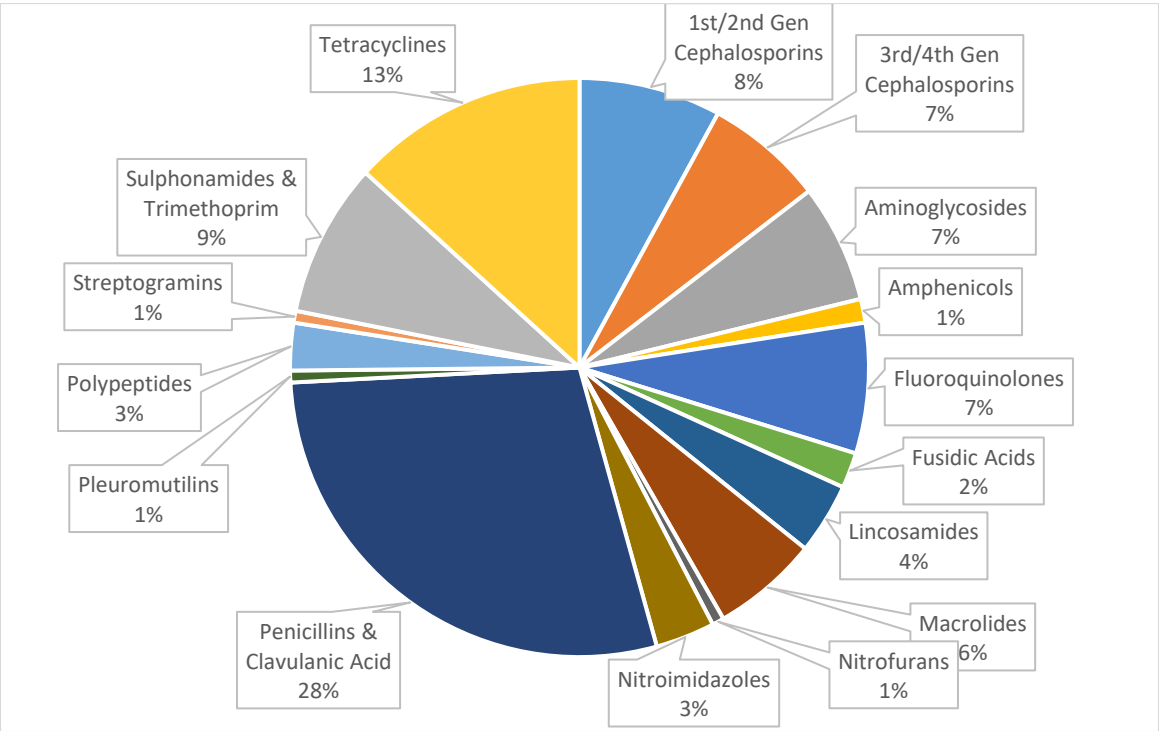
4 General trends in antibiotic sales

4.1 Registered trade name products containing active antibiotic ingredients

A total of 242 unique antibiotic trade name products were registered for use in plants or animals under the ACVM Act in 2021. A total of 151 of these products had sales reported, a decrease from 2020 where 251 products were registered and 157 were marketed and sold. Most of those sold contained a single antibiotic (107, 70% of products with sales) or two antibiotic ingredients (40, 26% of products with sales). There were three products sold with three antibiotic ingredients (2% of products with sales) and one with four antibiotic ingredients (1% of products with sales).

The class with the highest sales volume was the penicillins with 20,276 kilograms (38% of total sales) which were present in 43 of the products sold (28% of products with sales) with one or two active ingredients in each. The next largest class in terms of volume was the polypeptides with 12,507 kilograms (23% of total sales) which were present in only 3% of the products with sales in 2021.

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

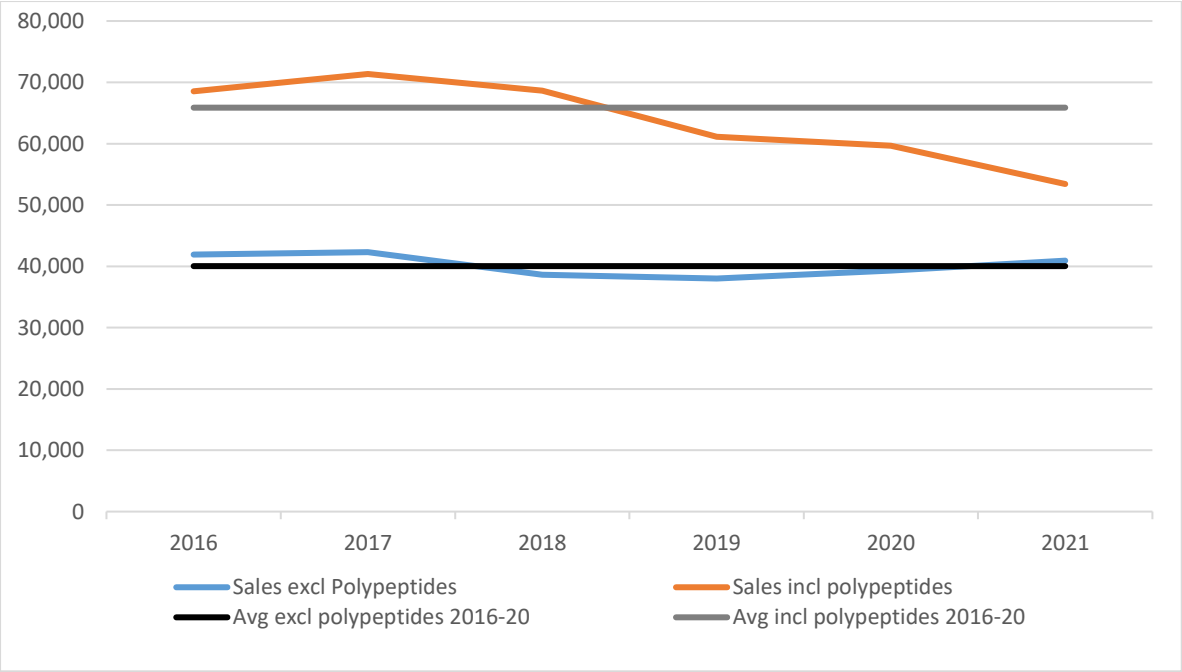


The tetracyclines class were included in 35 products of which 20 reported sales (each containing one to three active ingredients), the first and second generation cephalosporins were included in 21 products of which 13 reported sales (each containing one ingredient), and sulphonamides and trimethoprim were included in 20 products of which 13 had sales reported (containing one to four active ingredients each). The aminoglycosides were also included in 20 products of which 14 had sales reported, each containing one to two active ingredients). A total of 48 products (31% of all products sold) contained critically important antibiotics, including one dual active and one triple active product.

4.2 Total sales for 2021

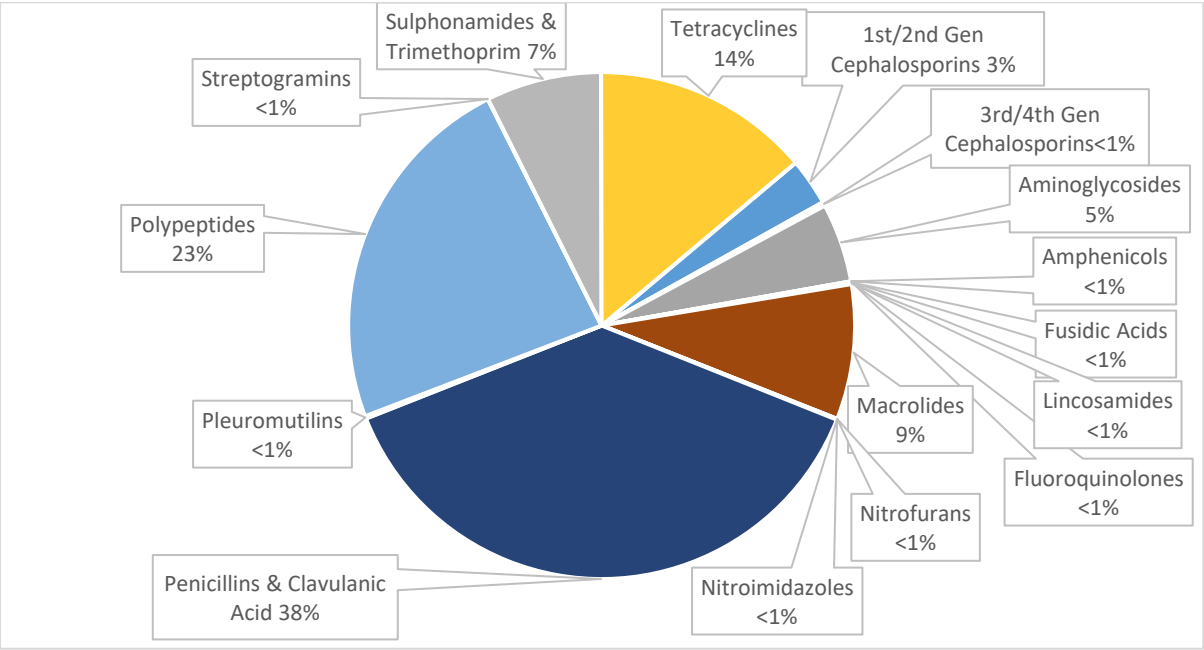
A total of 53,422 kilograms of antibiotic active ingredient were sold in 2021, a decrease of 6,215 kilograms (10.4%) compared to the 2020 total of 59,637 kilograms. This decrease continued the trend of lower annual total sales since 2017. Six of the sixteen classes had decreases in sales, notably the reductions of 38% for polypeptides, 9% for tetracyclines and 9% for the macrolides. Smaller volume decreases also occurred for the pleuromutilins (59% lower), nitrofurans (88% lower) and fluoroquinolones (1.3% lower). The 2021 sales total is 19% lower than the average for the previous five years. Excluding the polypeptides from the sales total the volume for the other fifteen classes increased by 1,618 kilograms compared to 2020 (an increase of 4%) from 39,296 kilograms to 40,914 kilograms. Sales quantities excluding the polypeptides were 2% above the average for the last five years.

Figure 2: Total sales 2016-2021 including and excluding polypeptides (in kilograms)



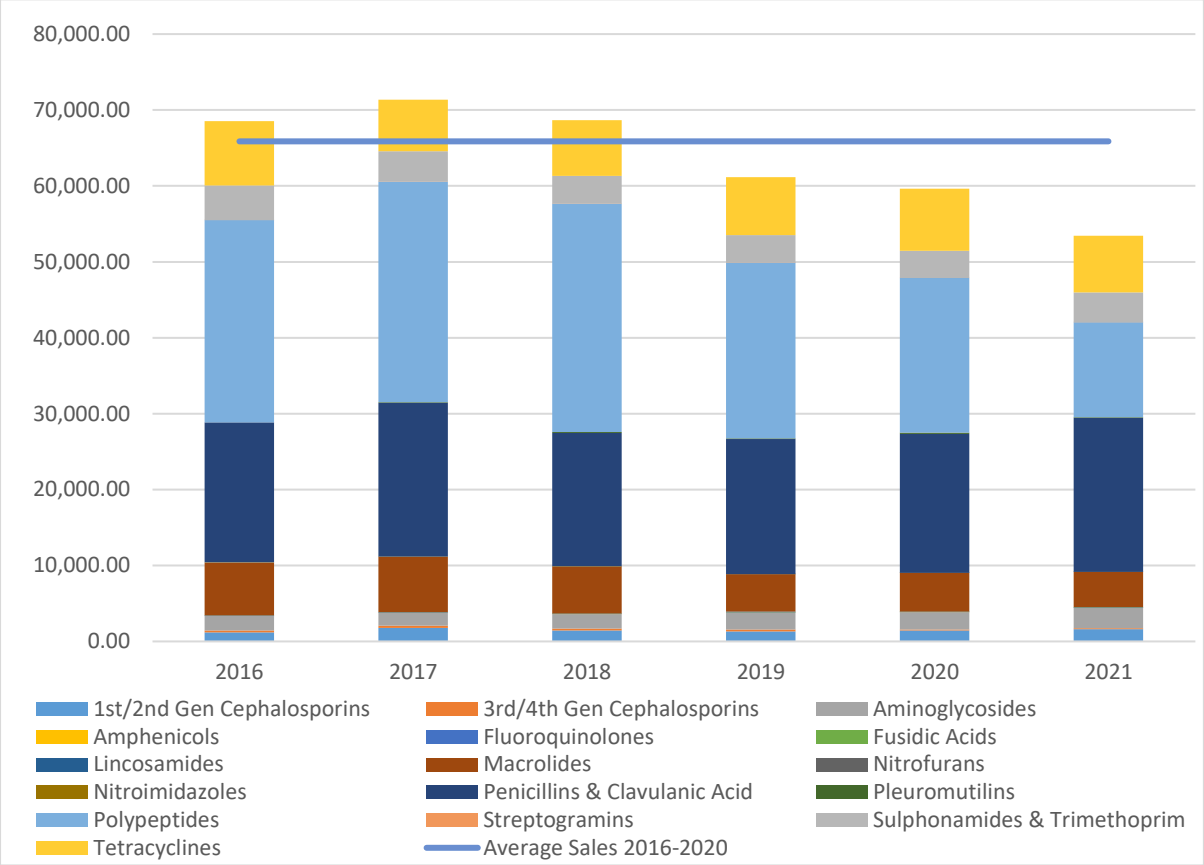
The class with the largest percentage of total sales in 2021 was the penicillins (including clavulanic acid), with 38% (20,276 kilograms), followed by the polypeptides with 23% (12,508 kilograms) and the tetracyclines with 14% (7,347 kilograms). The combined contribution from all other classes was 25% of total sales volume.

Figure 3: Percent of total sales volume containing each antibiotic class in 2021



Of the ten classes with higher sales in 2021 the largest volume increases occurred in penicillins and clavulanic acids (2,013 kilograms) and aminoglycosides (437 kilograms).
Sales increases were also reported for all generations of cephalosporins (11% for first and second generation and 2% for third and fourth generation), sulphonamides and trimethoprim (10%), nitroimidazoles (30%) and lincosamides (5%). The remaining three classes (nitrofurans, fusidic acid and amphenicols) had minor volume increases however their contribution to overall sales was negligible (0.003% of total sales in 2021).

Figure 4: Total Antibiotic Sales 2016-2021 (in kilograms)



Just over half of penicillins sales consisted of penicillin G procaine. Most of this compound was sold in multi-species injectable formulations used in dogs, cats, horses, ruminants, and pigs, primarily for the treatment of respiratory, gastrointestinal, and local infections. Volumes of amoxicillin also increased by 10% to 1,381 kilograms whereas sales of clavulanic acid, which is always co-formulated with amoxicillin, only increased by 2% and accounted for just 176 kilograms (1%) of total class sales.

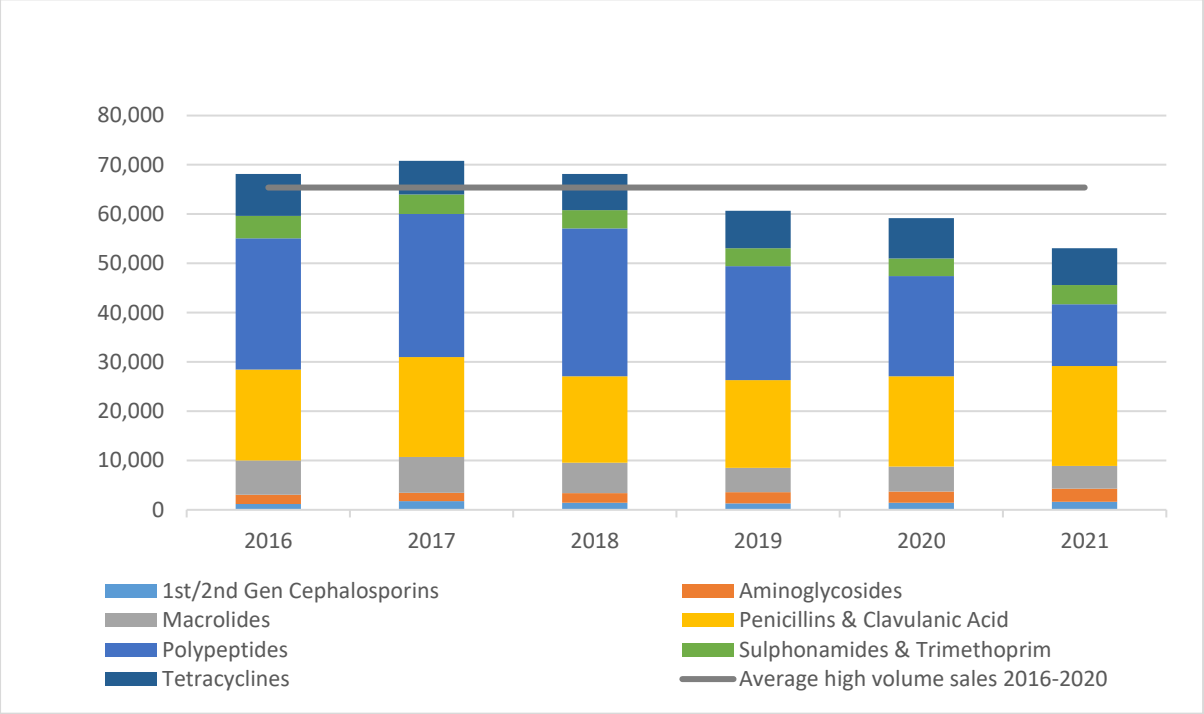
The polypeptides class had the highest volume of antibiotic sales prior to 2021. Following decreased sales volumes (and increased sales of penicillins), the polypeptides became the second highest seller in 2021, with 23% of total sales (down from 34% in 2020). The polypeptide zinc bacitracin is registered for the treatment of enteritis in pigs and poultry and the treatment of eye and ear infections in cats, dogs, and horses. The only other polypeptide sold for veterinary use in New Zealand is polymyxin with total sales of less than one kilogram reported for 2021 which is consistent with volumes reported for this compound for the last three years.

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

4.3 High volume and low volume sales groups

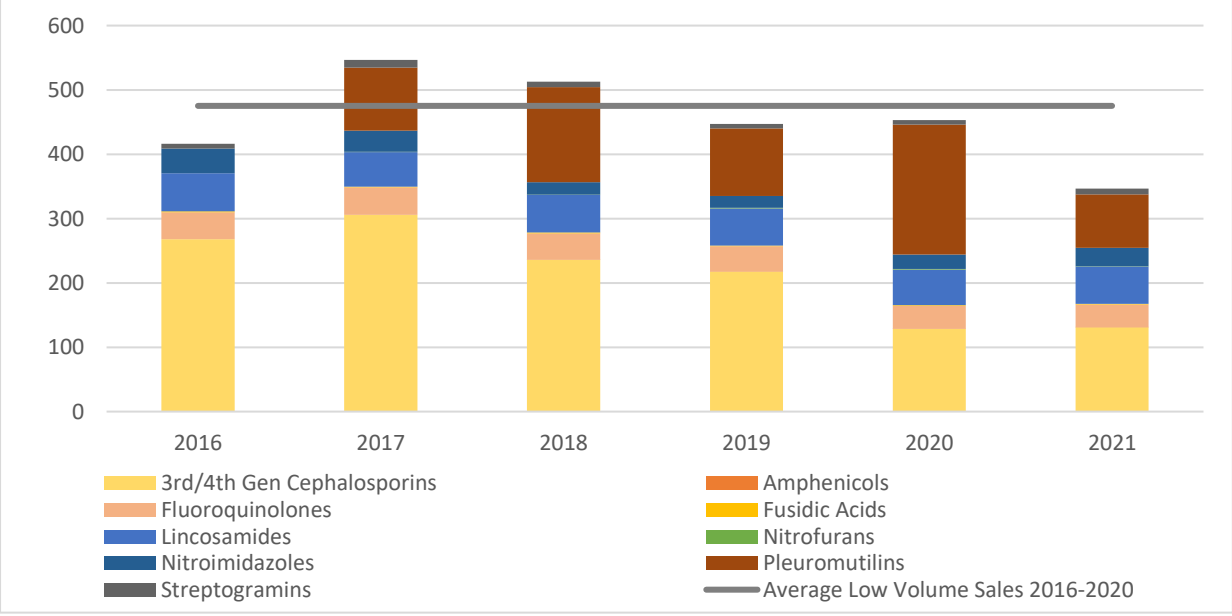
Antibiotic sales can be divided into high-volume and low-volume sales groups. The high-volume sales group includes all classes and subgroups with sales of over 1,000 kilograms and consists of seven antibiotic classes: polypeptides, penicillins and clavulanic acids, tetracyclines, macrolides, sulphonamides and trimethoprim, aminoglycosides, and first and second generation cephalosporins. The high-volume sales group comprised more than 99% of total antibiotic sales, with 61% of those sales made up of the polypeptide and penicillin classes in 2021.Total high-volume group sales declined by 10% to a total of 53,075 kilograms in 2021 continuing the downward trend for this group since 2017.

Figure 5: High-volume antibiotic sales 2016-2021 (in kilograms)



The low-volume sales group is comprised of the nine classes with sales less than 1,000 kilograms, six of which are made up of sales from five or fewer registered trade name products, and three of those are classes with just one product each. The combined sales total for this group was 23% lower in 2021 with 347 kilograms, or 0.6% of total sales. Two of the five critically important classes (or subgroups) account for just under half of the total in the low volume sales group; the third and fourth generation cephalosporins (38% of the low volume sales total) and the fluoroquinolones (10%). The remaining low volume sales classes consist of amphenicols, pleuromutilins, lincosamides, nitroimidazoles, streptogramins, fusidic acid, and nitrofurans. Sales in this group have consistently remained between 0.6% and 0.9% of the annual sales total.

Figure 6: Low-volume antibiotic sales 2016-2021 (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, for which work began 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 in which they are used. 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 five 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:

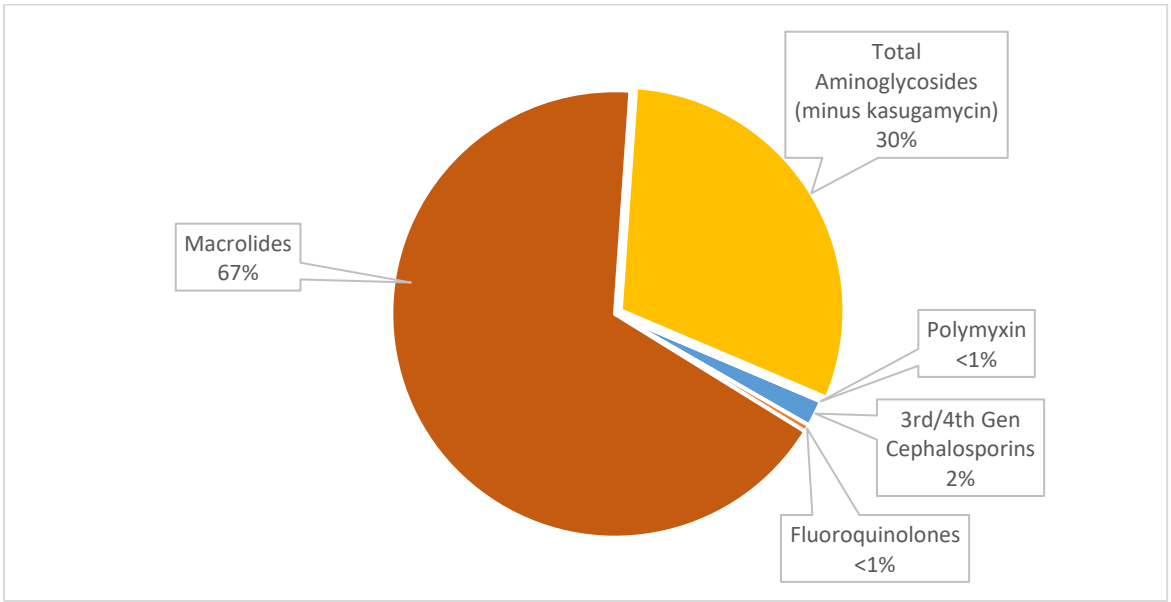
- Tranche 2: Veterinary aminoglycosides, fluoroquinolones, lincosamides, and 1st/2nd generation cephalosporins
- Tranche 3: Fusidic acid, tetracyclines, sulphonamides and trimethoprim, and polypeptides (zinc bacitracin and polymyxin),
- Tranche 4: Amphenicols, nitrofurans, nitroimidazoles, pleuromutilins, and virginiamycin,
- Tranche 5: Horticultural aminoglycosides (streptomycin and kasugamycin).

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 WOAH 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. Kasugamycin will be formally classified in Tranche 5 of the reassessment programme.

4.4.2 Overall summary of 2021 sales for critically important antibiotics

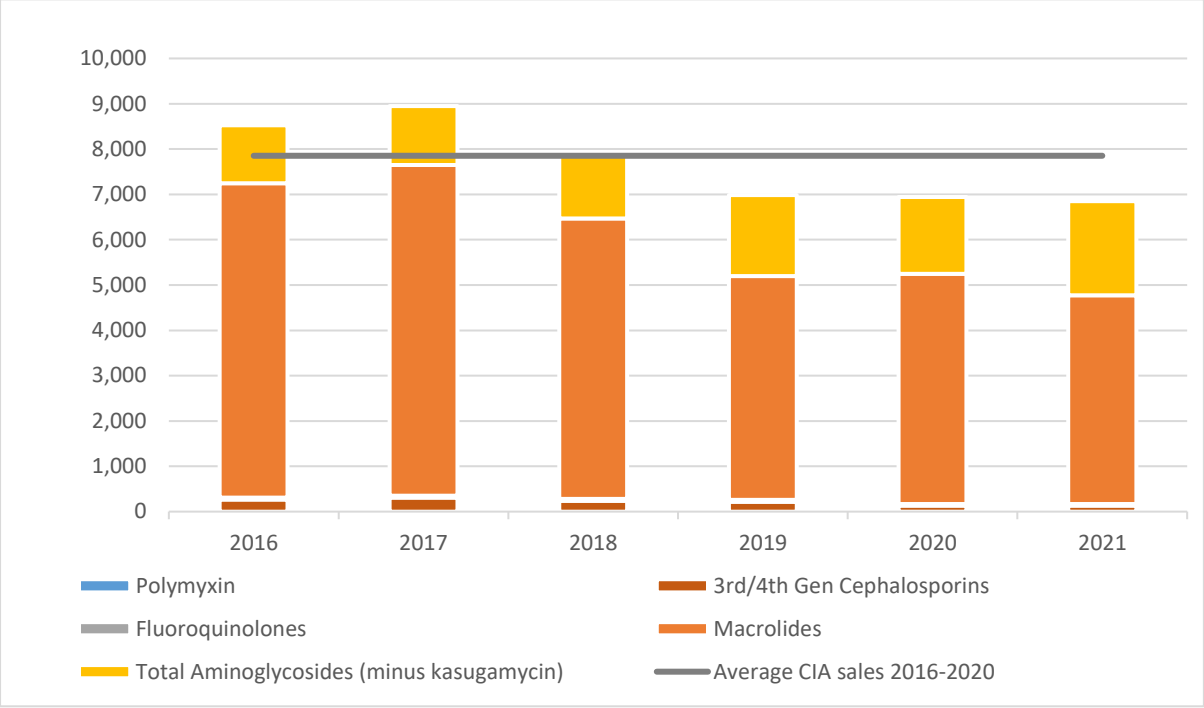
Sales of products containing critically important antibiotic compounds accounted for 13% of total antibiotic sales with 6,848 kilograms. The macrolides were the largest contributor to total sales at 8.6% (67% of critically important antibiotic sales), followed by aminoglycosides (excluding kasugamycin) at 3.9 % of the total (30% of critically important antibiotic sales). The remaining critically important antibiotics (third and fourth generation cephalosporins, fluoroquinolones, and polymyxin) accounted for just 0.3% of the 2021 total sales collectively and just over 2% of total critically important antibiotic sales.

Figure 7: Distribution of 2021 sales within the critically important sub-group



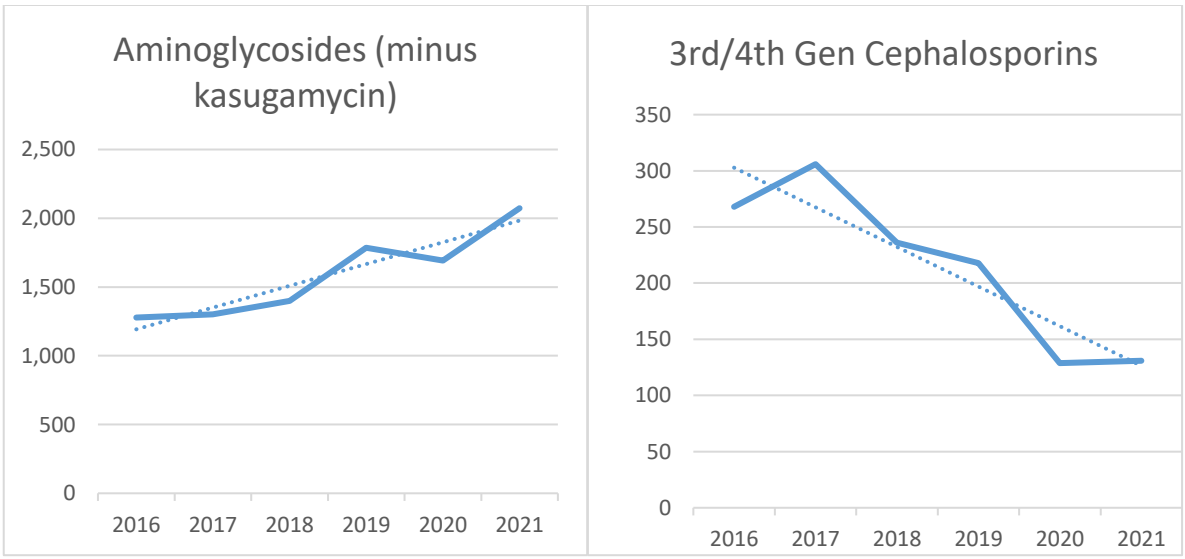
The 1.3% decrease in critically important antibiotic sales compared to 2020 was mainly due to a 9.4% decrease in macrolides offset by a 22.6% increase in aminoglycosides (excluding kasugamycin). Volumes increased slightly for polymyxin (11.3%) and the third- and fourth generation cephalosporins (1.7%). Sale volumes of fluoroquinolones decreased by 1.3%. The total sales of critically important antibiotics sold in 2021 was 12.8% lower than the average for the previous five years.

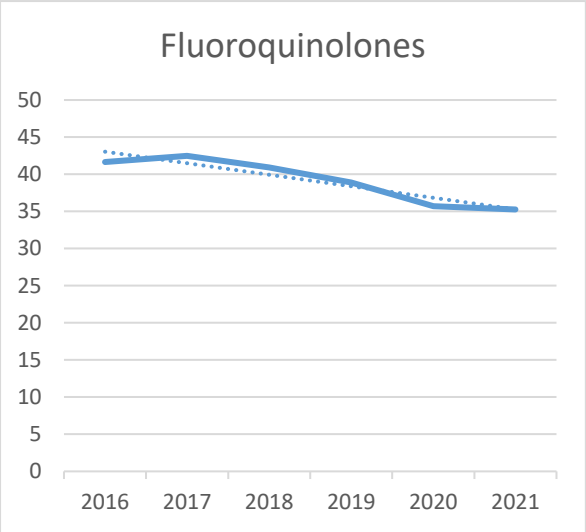
Figure 8: Critically Important Antibiotic sales, 2016-2021 (in kilograms)

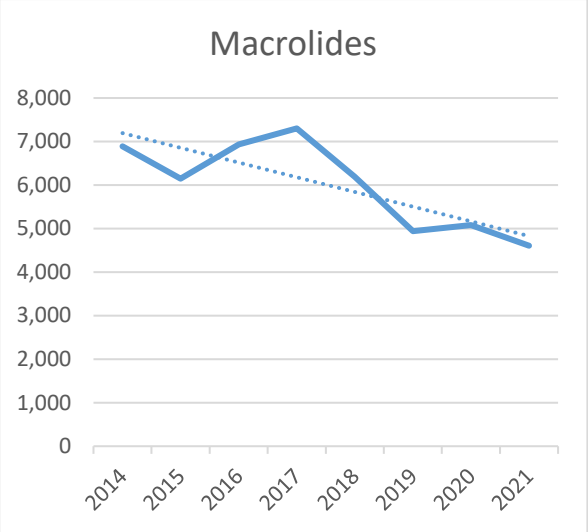


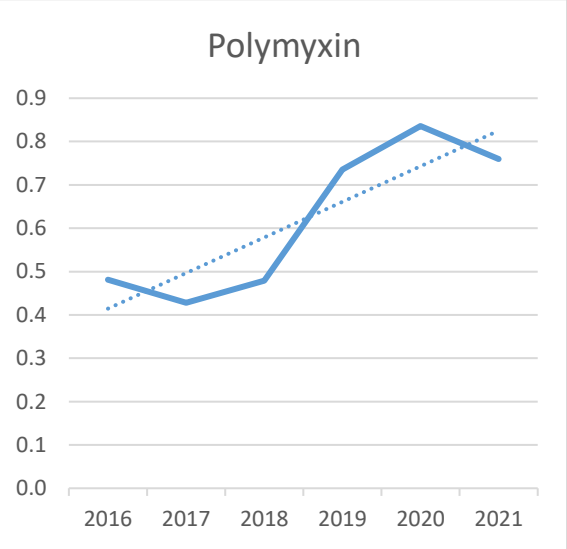
Year-on-year sales decreases for the third and fourth generation cephalosporins and fluoroquinolones appear to have stalled since 2020 as shown in figure 9 below. Sales of the third and fourth generation cephalosporins had declined by an average of 24% from 2018 to 2020 whereas fluoroquinolones declined by an average of 6% for the same period.

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







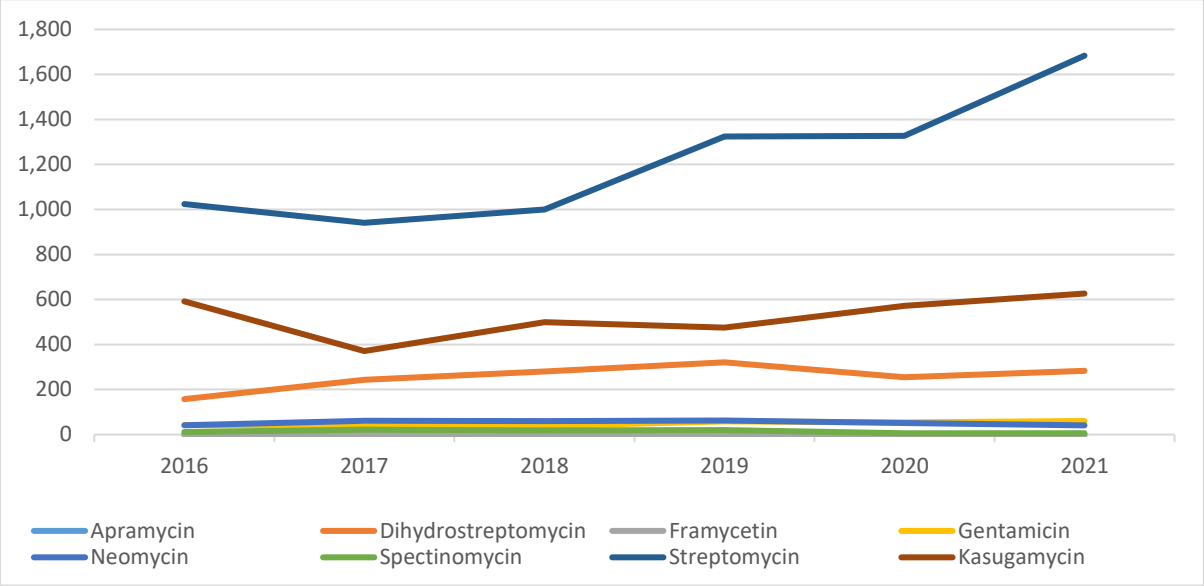


5 Antibiotic Sales Trends by Class

5.1 Aminoglycosides

Aminoglycosides are used in a wide range of companion and production animal species, with streptomycin and kasugamycin approved for use in certain fruit crops. Total aminoglycoside sales (veterinary and crop protection) were 19% higher than the previous year at 2,700 kilograms (5% of total sales), mainly due to increased quantities of streptomycin and kasugamycin. Increased sales were also reported for framycetin to 0.26 kilograms (146% increase) and gentamycin to 60 kilograms (12.5% increase) whereas lower quantities were reported for both neomycin (20.5% decrease to 41 kilograms) and spectinomycin (7.5% decrease to 6 kilograms).

Figure 10: 2021 aminoglycosides sales compared to the previous five-year sales trends (in kilograms)

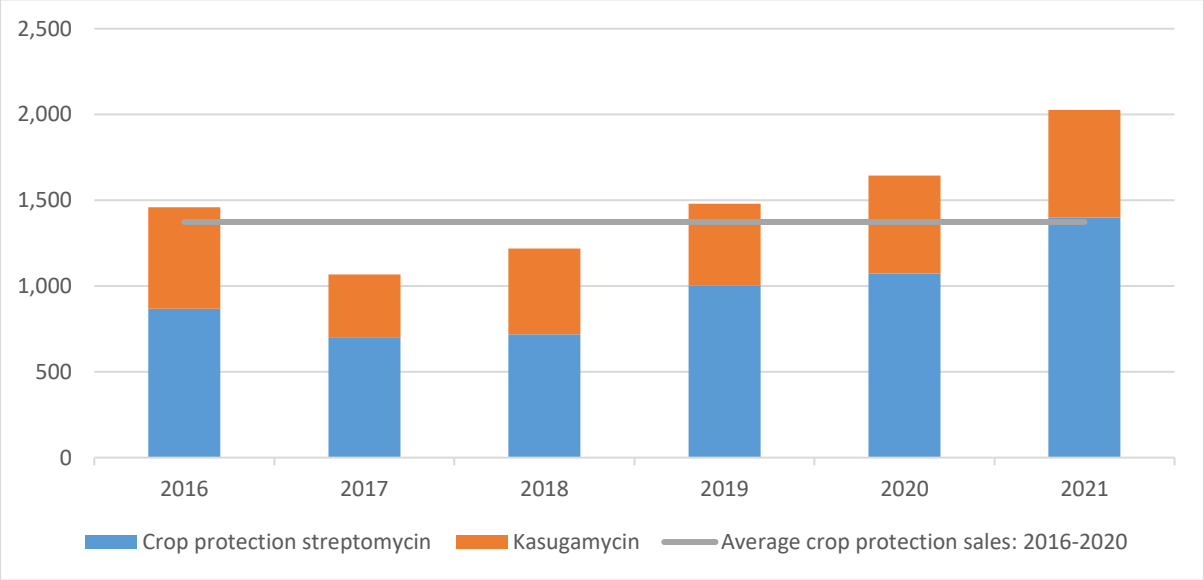


Streptomycin accounted for 62% of total aminoglycoside sales, followed by kasugamycin (23%) with the remaining 15% consisting of six other compounds, with no sales reported for apramycin in the 2014-2021 period. It is noted that apramycin, dihydrostreptomycin, framycetin, gentamicin, neomycin, streptomycin, and spectinomycin have been provisionally classed as critically important antibiotics. Critically important aminoglycosides accounted for over 4% of total antibiotic sales in 2021 with 2,073 kilograms.

5.1.1 Crop protection aminoglycosides sales

Total sales of trade name products for crop protection containing aminoglycosides increased by 23% in 2021, accounting for 3.8% of total antibiotic sales.

Figure 11: Total crop protection aminoglycosides sales 2016-2021 (in kilograms)

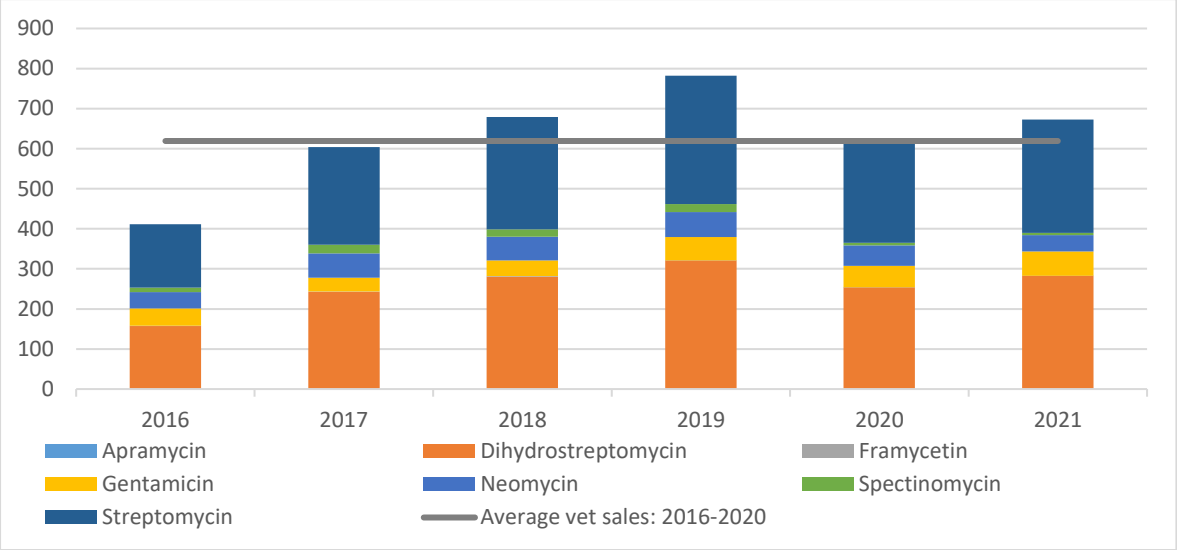


Sales of antibiotics in crop protection products have been increasing since 2017 and the volume reported in 2021 exceeded the average for the preceding five years by 48%. Total aminoglycosides sales for crop protection were 2,027 kilograms and comprised 75% of the class total. Further analysis can be found in the crop protection antibiotic section (6.9 in this report).

5.1.2 Veterinary aminoglycosides sales

Total sales of veterinary aminoglycosides increased to 673 kilograms, with sales 9% above 2020 levels and higher quantities reported for five of the seven compounds in this group.

Figure 12: Total veterinary aminoglycosides sales 2016-2021 (in kilograms)



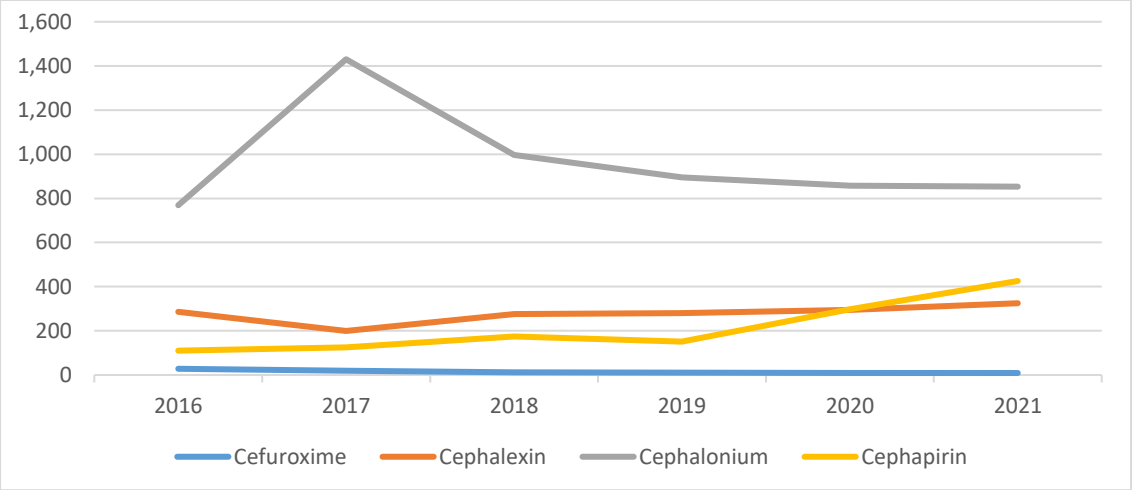
Sales of streptomycin and dihydrostreptomycin increased by 11% and accounted for 84% of veterinary aminoglycoside sales. Gentamicin sales increased by 13% compared to 2020 and comprised 9% of sales in this group. A decrease in sales of 20% was reported for neomycin. Overall sales volumes for framycetin and spectinomycin remained relatively low and accounted for 1% of veterinary aminoglycoside sales. No sales were reported for apramycin. Total veterinary aminoglycosides sales were 9% above the average for the previous five years.

5.2 CEPHALOSPORINS

5.2.1 First and second generation cephalosporins

The total sales quantity for the first and second generation cephalosporins increased by 11% to 1,612 kilograms in 2021 and accounted for 3% of total antibiotic sales. Most of this increase was the result of higher sales of cephapirin-based products which increased by 43% to 425 kilograms and a share of total class sales rising to 26% from 20% the previous year. Quantities of cephapirin sold were almost three times the 2019 total of 151 kilograms. Sales of cephalexin also increased by 10% to 325 kilograms with the proportion of total class sales for this compound remaining at 20%. The volume of cephalonium-based product sales was relatively unchanged from 2020 at 853 kilograms, however their contribution to class sales fell from 59% to 53%. Cefuroxime sales continued to decline and were less than a third of their 2018 peak (5% decrease to 8.7 kilograms) and comprised 1% of class sales.

Figure 13: 2021 first and second generation cephalosporins sales compared to the previous five-year sales trends (in kilograms)

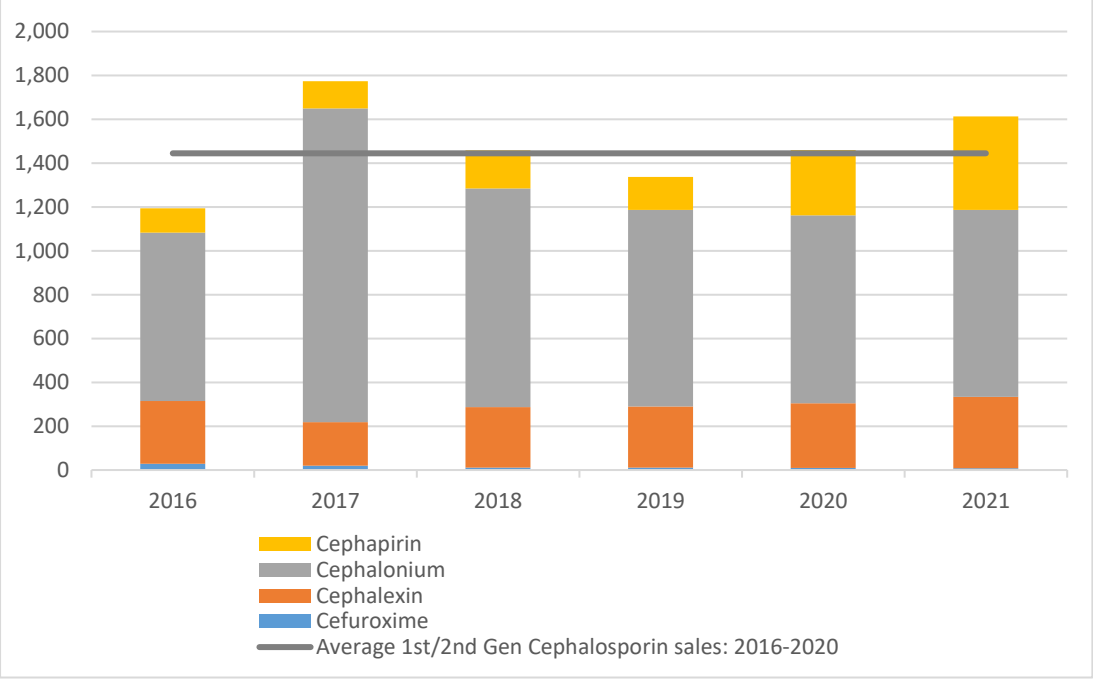


Cephalonium, cephapirin, and cefuroxime are used in intramammary and intrauterine therapies in dairy cattle including treatment and prevention of mastitis. Cephapirin is registered for use in cattle-only products with around one-third of sales for intrauterine and two-thirds in intramammary treatments. Cephalonium is registered for use in dry cow therapy products whereas cefuroxime is registered for use in lactating dairy cattle.

Cephalexin products are registered for use in lactating cattle and in multiple species products however this antibiotic has been exclusively sold for use in companion animals since 2017.

Total sales for this class were 11% above the average for the previous five years.

Figure 14: Total first- and second-generation cephalosporins sales, 2016-2021 (in kilograms)

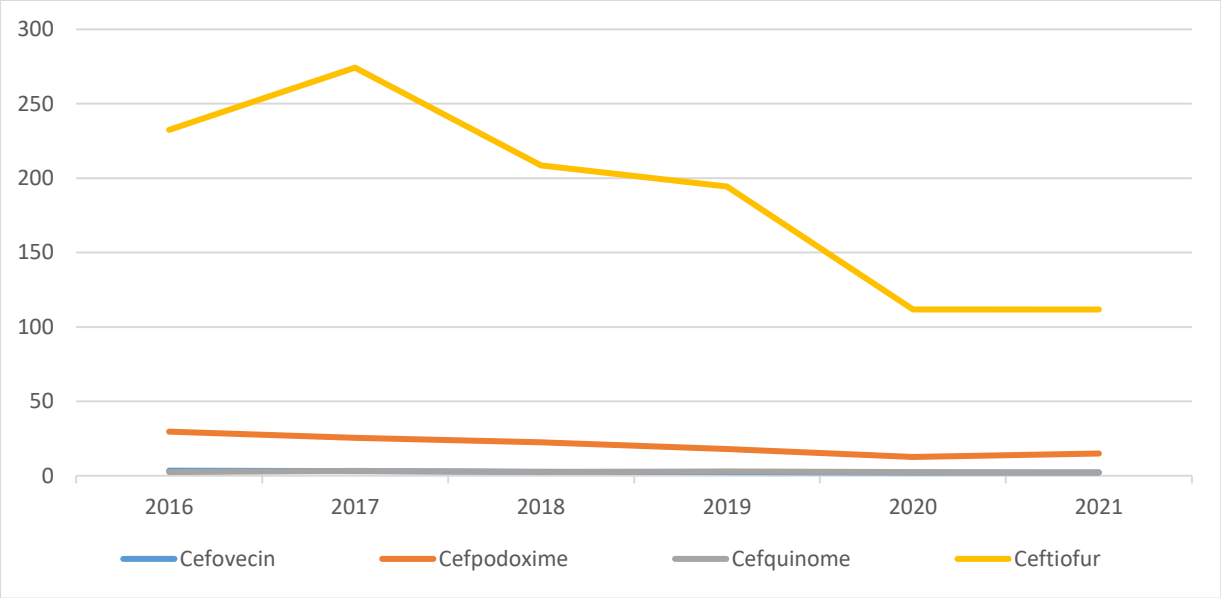


5.2.2 Third and fourth generation cephalosporins

The third and fourth generation cephalosporins are all classed as critically important antibiotics in New Zealand and make up 0.25% of total antibiotic sales, with ceftiofur comprising 85% of the 131-

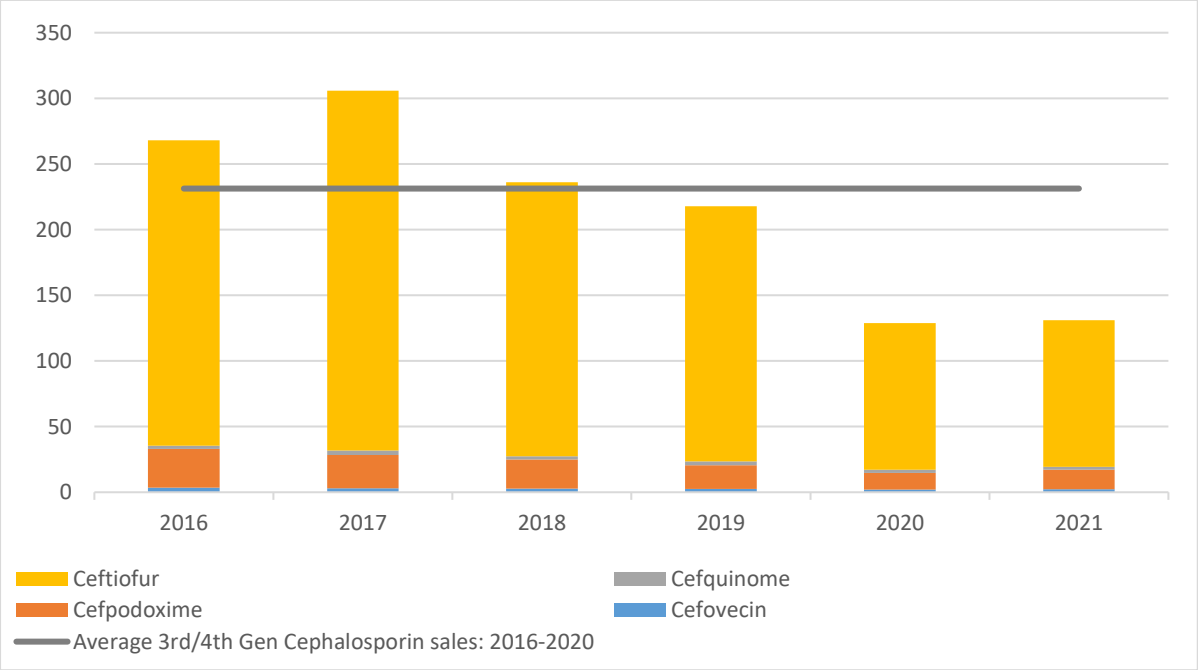
kilogram sales total. Three of the four compounds in this class approved for use in New Zealand are third generation cephalosporins, with cefquinome being the only fourth-generation compound.

Figure 15: 2021 third and fourth generation cephalosporins sales compared to the previous five-year sales trends (in kilograms)



Registrants estimated that around 80% of ceftiofur was sold for use in dairy cattle, 9% in beef cattle and 11% in horses. Ceftiofur sales volumes were relatively unchanged from the previous year at 112 kilograms. Overall class sales increased by 2% in 2021 due to a 19% increase in cefpodoxime (to 15 kilograms) and a 6.5% increase in cefovecin (to just over 2 kilograms), both of which are used in companion animal treatments. Sales for this class were 43% below the average for the previous five years.

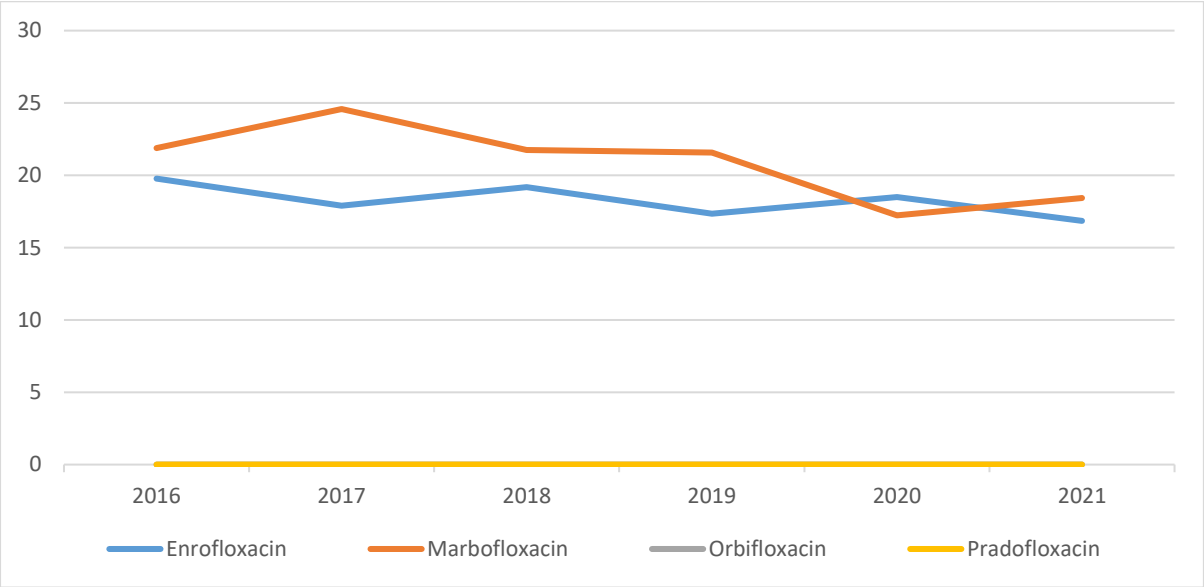
Figure 16: Total third and fourth generation cephalosporins sales, 2016-2021 (in kilograms)



5.3 Fluoroquinolones

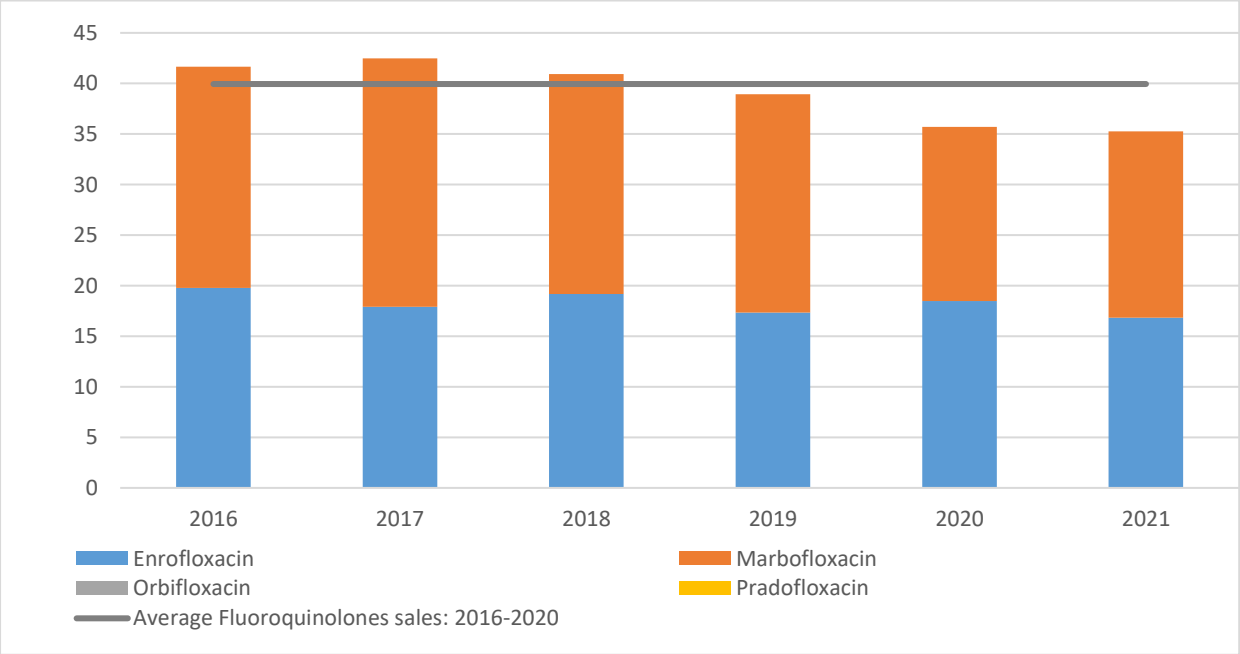
Sales of the critically important fluoroquinolones decreased by 1.3% to 35 kilograms, comprising 0.07% of total sales. Marbofloxacin comprised 52% of the sales total for the class with 35 kilograms and enrofloxacin accounted for the remaining 48% in 2021. Marbofloxacin volumes increased by 7% whereas enrofloxacin sales decreased by 9% compared to the previous year. No sales were reported for orbifloxacin or pradofloxacin in 2021.

Figure 17: 2021 fluoroquinolones sales volumes compared to the previous five-year sales trends (in kilograms)



Products containing enrofloxacin and marbofloxacin are approved for use in companion animals, cattle, and pigs. Registrants estimated that approximately 95% of enrofloxacin was used in companion animals and 5% used in cattle whereas marbofloxacin products were almost entirely sold for use in cattle in 2021. Total sales of fluoroquinolones have remained below 40 kilograms for the last three years and were 11% below the average sales for the previous five years.

Figure 18: Total fluoroquinolones sales, 2016-2021 (in kilograms)



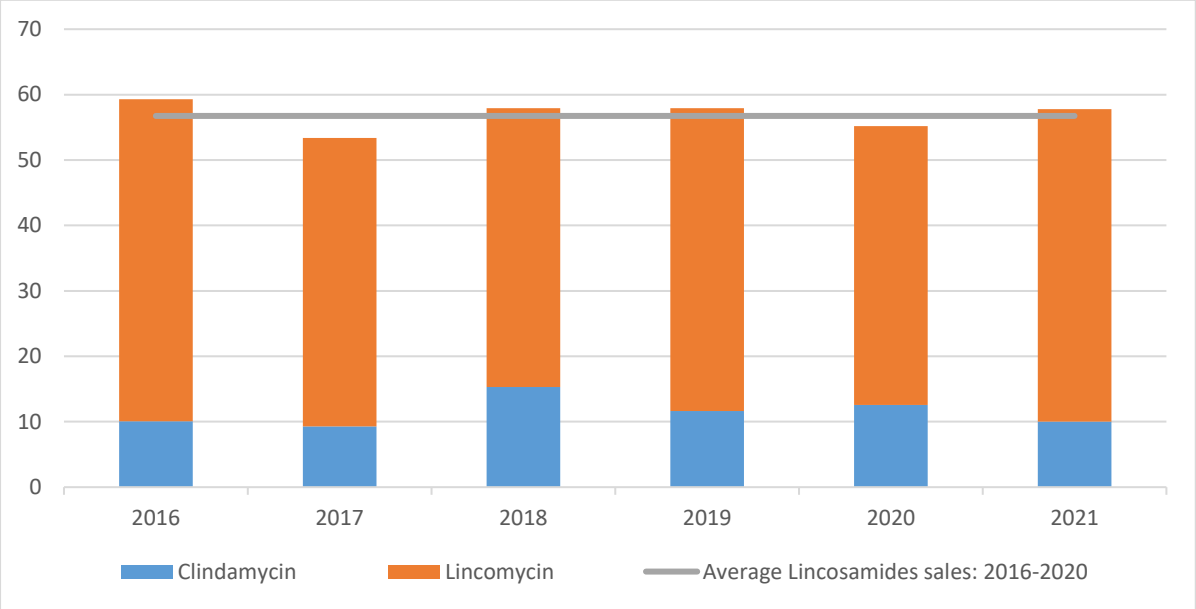
5.4 Fusidic acid

Sales of fusidic acid increased by 11% to 1.1 kilograms between 2020 and 2021 with sales remaining consistently below two kilograms since 2014. This compound is registered for use in companion animals as a topical treatment for eye, ear, and skin infections.

5.5 Lincosamides

Sales of lincosamides increased by 5% to just under 58 kilograms accounting for 0.1% of total sales in 2021. Two compounds in this class are registered for use in New Zealand, with clindamycin (17.5% of class sales) registered exclusively for use in companion animals and lincomycin sales (82.5% of class sales) registered exclusively for use in cattle, pigs, and poultry. Registrants estimated that just over 68% of lincosamide sales in 2021 were sold for use in dairy cattle. Lincomycin sales increased by 12% and clindamycin sales decreased by 20% in 2021.

Figure 19: Total lincosamides sales, 2016-2021 (in kilograms)

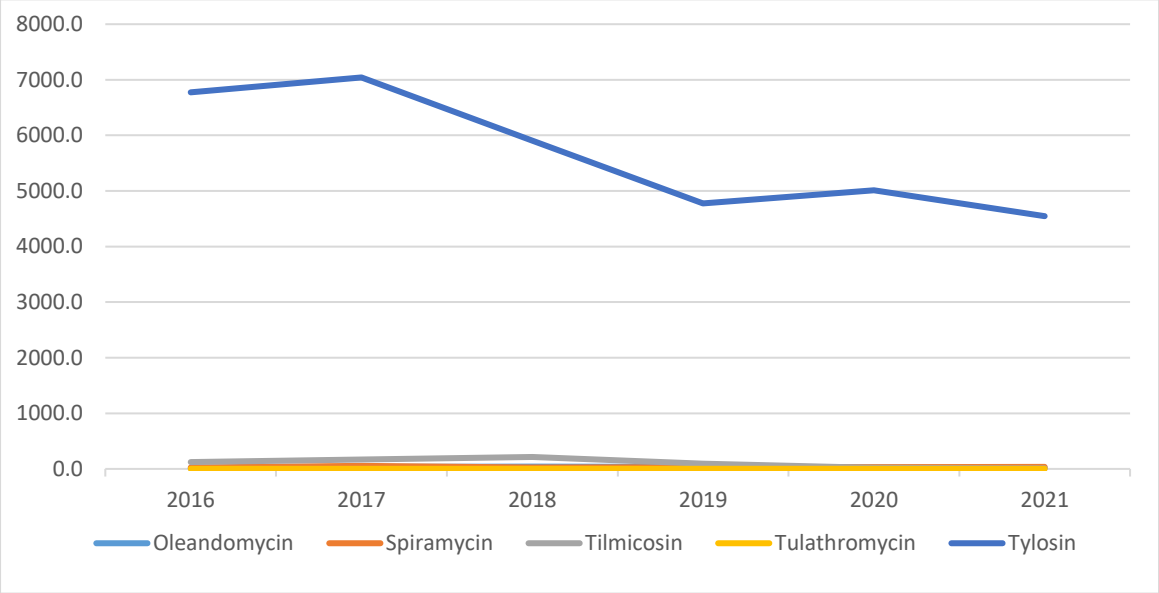


Overall sales totals for the lincosamides have remained stable between 53 and 60 kilograms since 2016. Clindamycin sales volumes have remained between 10 and 15 kilograms since 2014, with lincomycin volumes between 40 and 50 kilograms for all but one year since 2014. Lincosamides sales were 4.5% above the previous five years sales average.

5.6 Macrolides

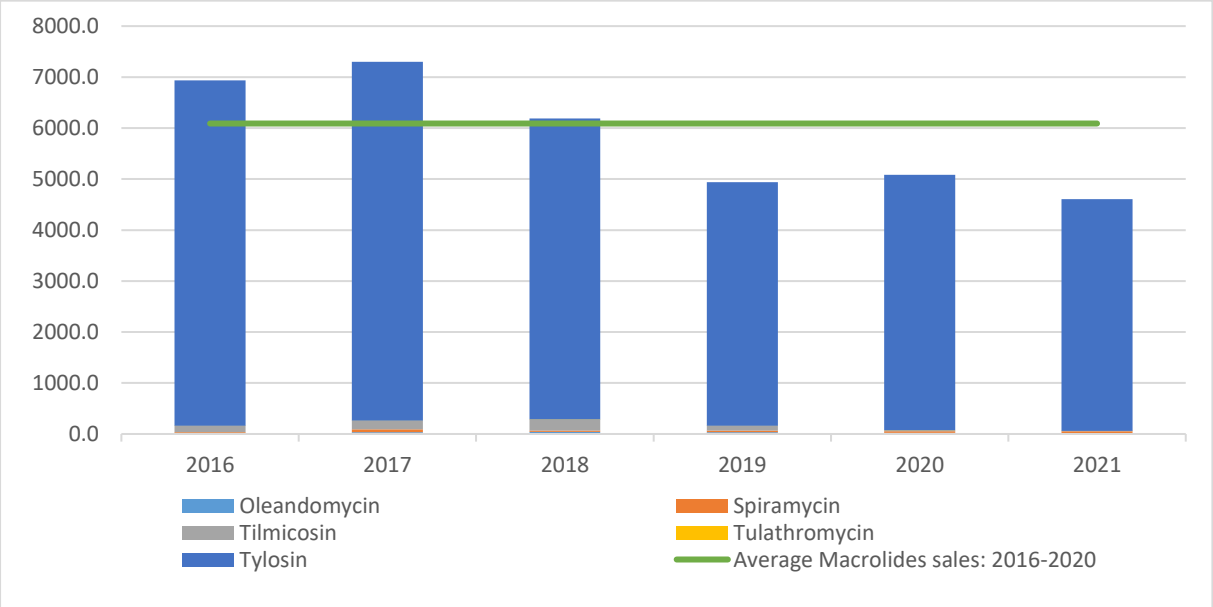
Macrolide sales quantities were lower compared to the previous year with a 9.4% decrease to 4,607 kilograms and a share of total sales decreasing from 9% to 8.6%. Tylosin continued to account for 99% of sales of this critically important class. The other four macrolide compounds registered in New Zealand (oleandomycin, spiramycin, tilmicosin, and tulathromycin) had a combined total decrease of 10 kilograms to 61 kilograms which was mainly due to a 44% decrease in tilmicosin sales. There were also decreases in oleandomycin (27% to 16 kilograms) and tulathromycin (45% to 0.3 kilograms). A 9% increase was reported for spiramycin to 35 kilograms. There were no sales reported for erythromycin in 2021.

Figure 20: 2021 macrolides sales compared to the previous five-year sales trends (in kilograms)



Sales quantities for this class have been comparatively stable for the last three years. A total of 61% of tylosin was sold in multi-production species products, 38% sold in pig and poultry products and 1% sold in cattle-only products. Using registrants estimates and agreed by industry, the amounts of tylosin sold for use in the dairy and poultry industries decreased which was offset by increased use in pigs and to a lesser extent beef cattle in 2021. Around 65% of the tylosin sales were attributed by registrants for use in pigs compared to 50% in 2020; 22% of sales attributed to poultry (16% layer and 6% meat poultry compared to 36% (33% layer and 3% meat poultry) and 5% in dairy cattle (down from 10%) and 7% in beef cattle (increase from 4% in 2020).

Figure 21: Total macrolides sales 2016-2021 (in kilograms)



For the other compounds in this class, oleandomycin sales were mostly attributed for use in dairy cattle, tilmicosin for use in sheep, and tulathromycin for use in beef cattle. Spiramycin is approved for use only in companion animals. Macrolide sales were 16% below the average for the previous five years in 2021.

5.7 Nitrofurans

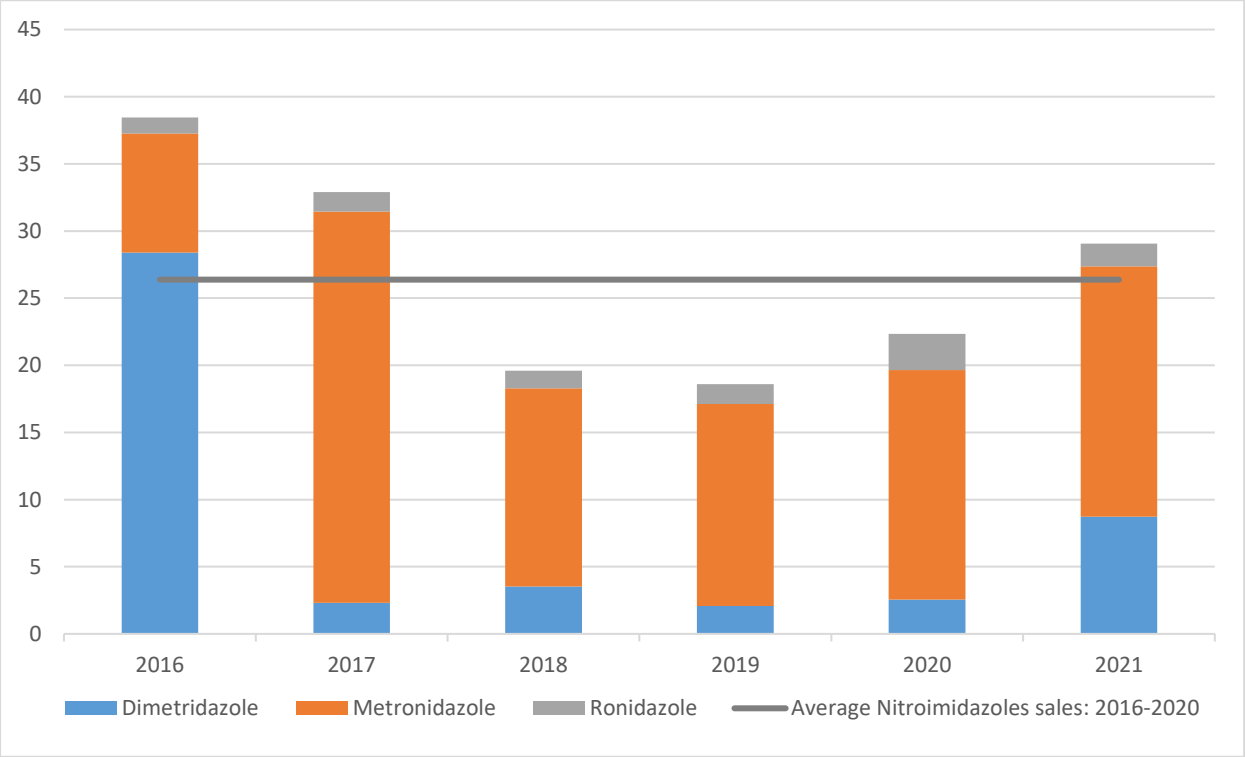
Total sales for the nitrofurans class decreased by 88% and have remained significantly less than one kilogram since 2014. Nitrofurazone is registered for the treatment of skin infections in aquarium fish only.

5.8 Nitroimidazoles

Overall sales for nitroimidazoles increased by 30% to just over 29 kilograms in 2021 and accounted for 0.05% of the total sales. Metronidazole quantities increased by 9% to 19 kilograms however their share of class sales fell from 76% to 64%. The reason for the lower contribution to total sales was a marked increase in dimetridazole sales to just under 9 kilograms in 2021 compared to 2.6 kilograms in 2020. The dimetridazole share of class sales increased from 11% to 30%. Ronidazole sales decreased by 37% to 1.7 kilograms.

Dimetridazole is sold for use in pigeons and game birds. Sales for other antibiotics in the nitroimidazoles class are registered for the treatment of companion and non-production animal species. Metronidazole is used for the treatment of local and systemic infections in cats and dogs, while ronidazole is used for the treatment of trichomoniasis in pigeons.

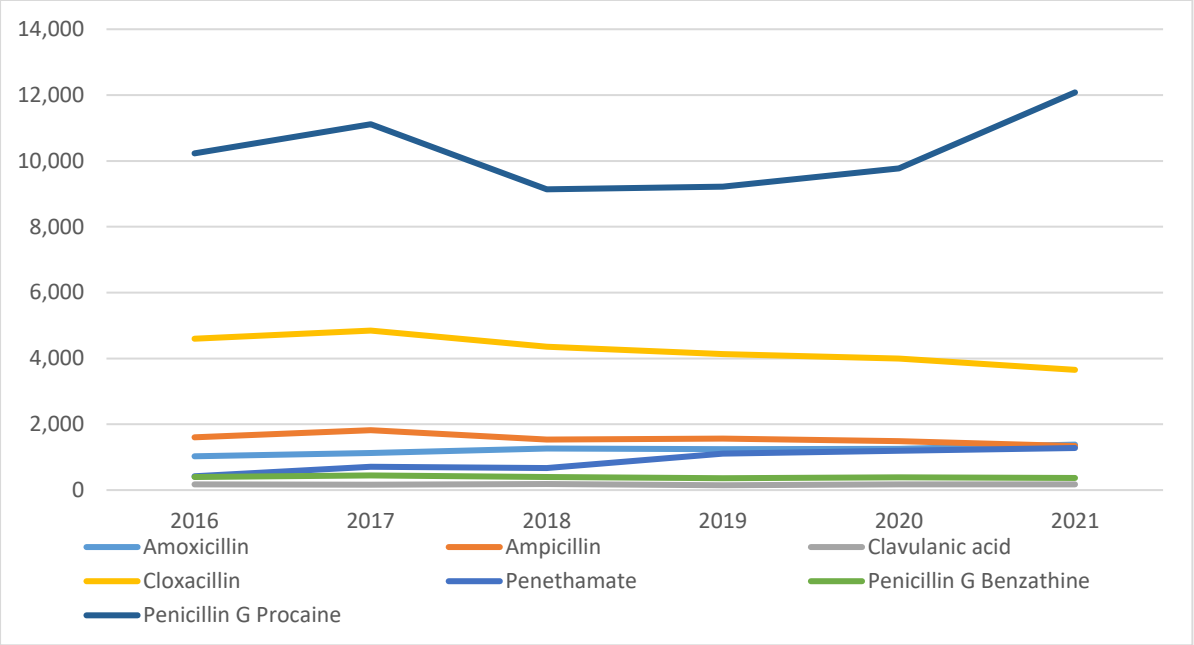
Figure 22: Total nitroimidazoles sales, 2016-2021 (in kilograms)



5.9 Penicillins and clavulanic acid

Sales increased by 11% to 20,276 kilograms from 18,262 kilograms with the penicillins becoming the highest selling class of antibiotic in 2021. The penicillins accounted for 38% of total antibiotic sales compared to 31% in 2020.

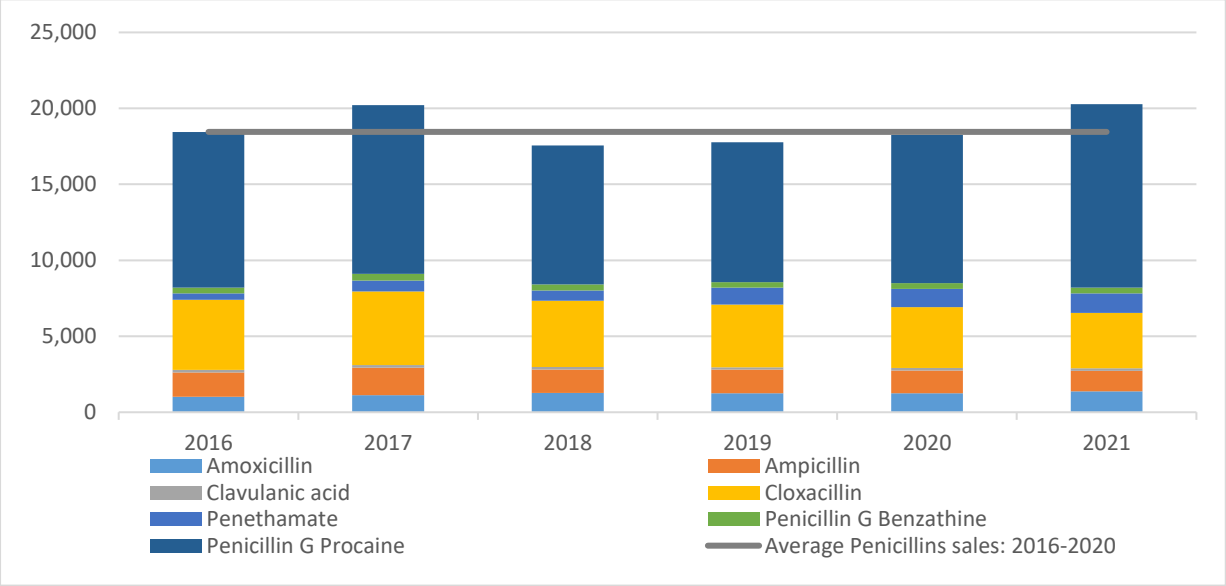
Figure 23: 2021 penicillins and clavulanic acid sales compared to the previous five-year sales trends (in kilograms)



The seven penicillin compounds in this class are approved for use in all production animal species (excluding poultry and deer) and companion animals. Most penicillin sales were attributed by registrants for use in dairy cattle, including penicillin G procaine, penicillin G benzathine, cloxacillin, ampicillin and penethamate. Amoxicillin and amoxicillin combined with clavulanic acid, were sold in multi-production species products attributed for use in dairy cattle, and in companion animal products.

Injectable penicillin G procaine products accounted for 60% of total class sales (compared to 53% in 2020) with a 23% increase to 12,080 kilograms. Most sales of this compound (79%) were in multiple-species products with 21% in cattle-only (93% dairy and 7% beef cattle) and less than 1% in sheep-only products. Over 70% of the multi-species volume was attributed by registrants as sold for use in dairy cattle, 8% sold for use in beef cattle and 8% in sheep. The remaining 13% were attributed as sold for use in companion animals (7%), horses (4%) and pigs (2%). A shift away from both cloxacillin and ampicillin was also observed with cloxacillin quantities decreasing by 9% to 3,652 kilograms and a 4% reduction in total class sales to 18% from 22% in 2020. Ampicillin sales were 10% below their 2020 level at 1,337 kilograms and 7% of total class sales (compared to 8% in 2020). Most penicillin G procaine products were sold in multi-species products whereas cloxacillin and ampicillin remained the most common antibiotics in intramammary preparations. The move toward injectable formulations was also indicated by a 7% increase in penethamate sales to 1,278 kilograms. Penicillin G benzathine volumes decreased by 4% to 369 kilograms with most being sold in multi-species products. Quantities of penicillins sold have increased each year since 2018 and were 10% above the five-year sales average in 2021.

Figure 24: Total penicillins sales 2016-2021 (in kilograms)



The move away from using critically important antibiotics such as 3rd/4th generation cephalosporins and macrolides has been credited to the increased use of penicillins and clavulanic acid in their stead.

5.10 PLEUROMUTILINS

Tiamulin is the sole pleuromutilin registered in New Zealand and is used in the treatment of respiratory disease in poultry and respiratory and gastrointestinal disease in pigs. Sales in 2021 decreased by 59% to 83 kilograms. This decrease follows a peak sales volume of 202 kilograms in 2020 and probably reflects the pattern of increases and decreases typical of in-feed products over time, rather than a true change in use. The overall sales for this group remain low, at less than 0.5% of total 2021 sales.

5.11 POLYPEPTIDES

5.11.1 Polymyxin

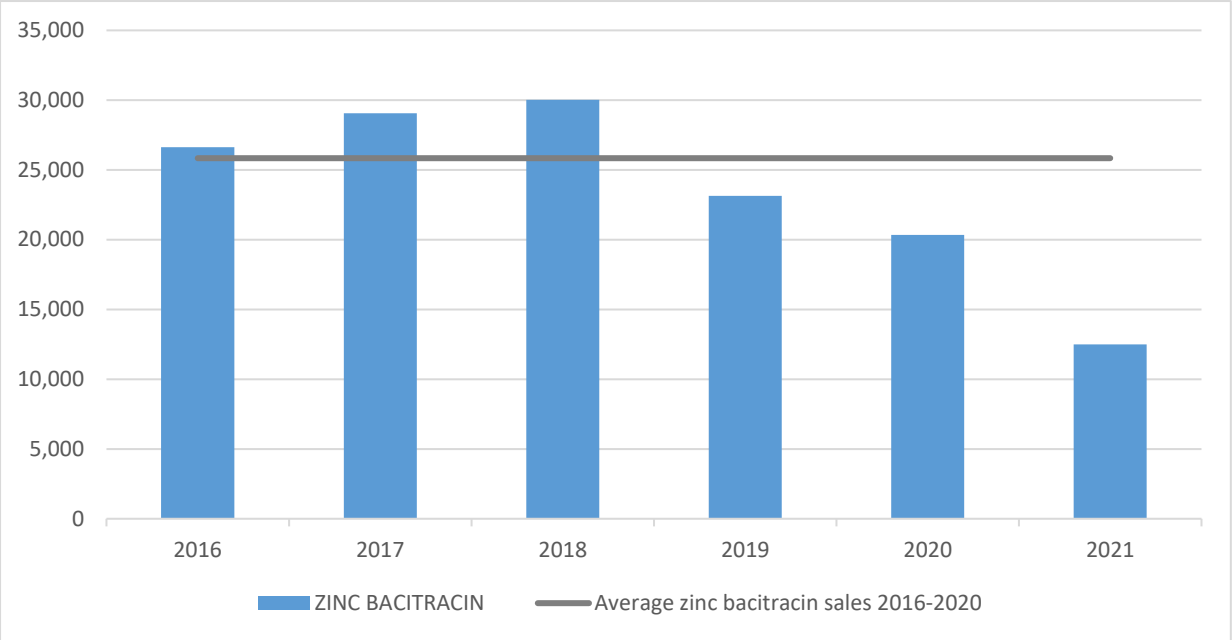
Polymyxin sales remained a very small proportion of overall antibiotic sales in 2021, at less than one kilogram and 0.001% of the sales total. Although sales of this critically important compound increased by 12% between 2020 and 2021, this is likely to be reflective of normal year-to-year variation rather than any true increases in use. Sales of polymyxin have remained less than one kilogram in all reporting periods. Products containing polymyxin are registered for topical ear and eye treatments in companion animals and horses. In 2021 all polymyxin sales were attributed by registrants for use in companion animals.

5.11.2 Zinc bacitracin

The 39% decrease in zinc bacitracin sales to 12,507 kilograms was the most significant sales reduction reported in 2021. This was the third substantial consecutive reduction in sales quantities from 30,030 kilograms in 2018 following decreases of 23% in 2019 (6,888 kilograms) and 12% in 2020 (2,802 kilograms).

As with other compounds sold in bulk for administration in feed, zinc bacitracin sales can fluctuate significantly from year to year owing to the propensity for these products to be purchased in large volumes for use over time, rather than being purchased immediately prior to use. The substantial year-on-year decline is more likely to be reflective of the poultry industries efforts to phase out zinc bacitracin and is regarded as a true reduction in use. Usage of zinc bacitracin by the pork industry ceased in 2019.
Zinc bacitracin sales in 2021 were 52% below the sale average for the previous five years.

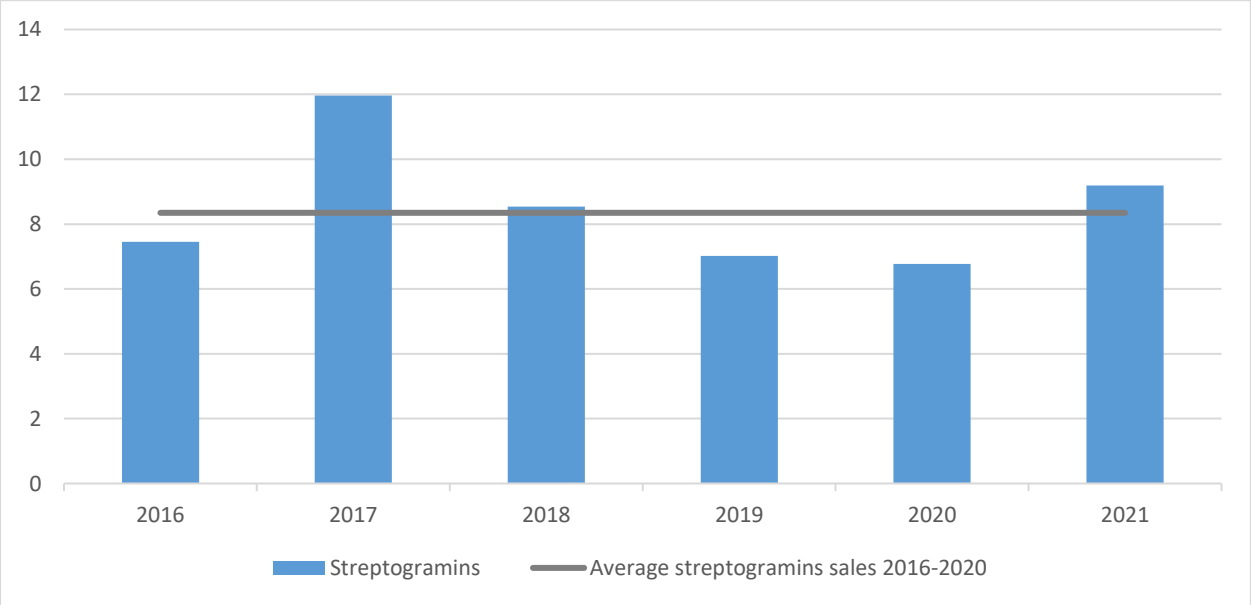
Figure 25: Total zinc bacitracin sales 2016-2021 (in kilograms)



5.12 Streptogramins

Virginiamycin is the only active ingredient in the streptogramins class. This compound is used for the treatment of enteritis in broiler chickens, and for the treatment of laminitis in horses. Virginiamycin sales increased by 35.7% to 9 kilograms, which was 10% above the previous five-year sales average. The higher total is thought to be more reflective of sales fluctuating from year to year at around 7 to 9 kilograms rather than a true increase in use.

Figure 26: Total streptogramins sales 2016-2021 (in kilograms)



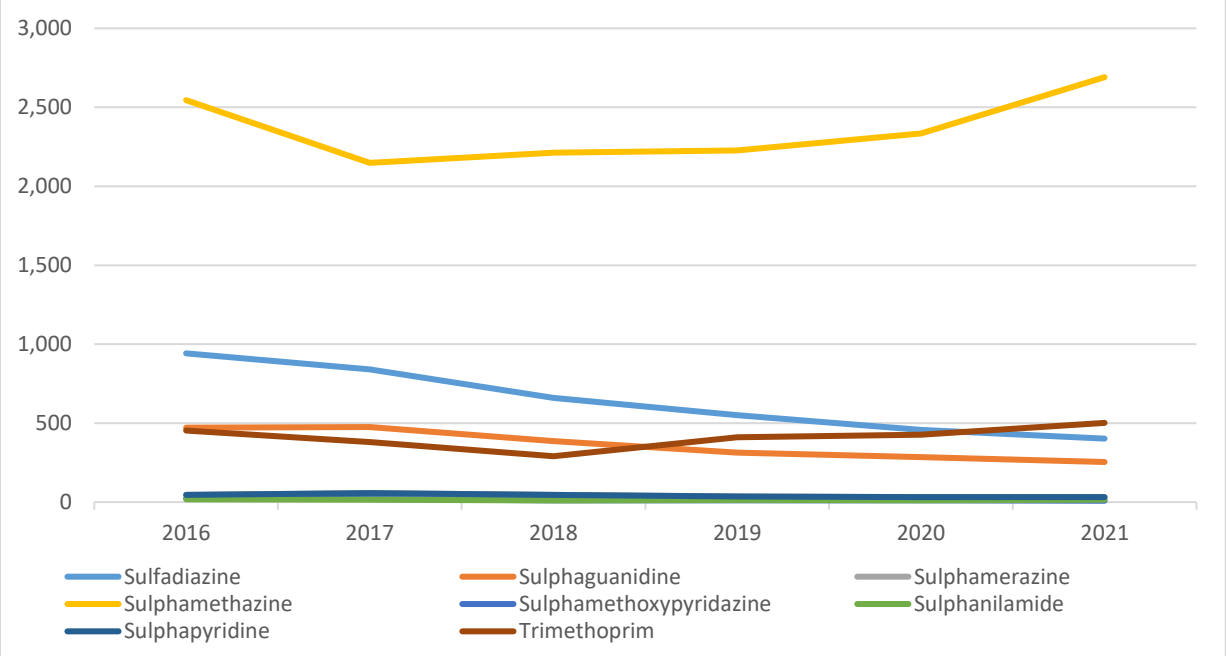
5.13 Sulphonamides and trimethoprim

Sulphonamides and trimethoprim sales increased by 10% to 3,934 kilograms and comprised 7% of the total sales volume compared to 6% in the previous year.

Products in this class are generally formulated as multi-active combinations of antibiotics, most commonly including trimethoprim with one, two, or three sulphonamides. A total of 19 products were registered in this class with sales reported for 13. There were eight trimethoprim-sulphamethazine products, one trimethoprim-sulfadiazine product, one quadruple-active trimethoprim/sulphonamide combination product, a triple-active sulphonamide without trimethoprim, one sulphamethoxypyridazine-trimethoprim product and a single-active sulphanilamide product. The sulphonamides, with or without potentiation by trimethoprim, are used to treat a wide variety of infections given their broad spectrum of activity and therapeutic potential. Registrants' estimates attributed most of the sales for use in horses (71%) and dairy calves (25%) with smaller amounts used in beef cattle, pigs, sheep, and goats. Less than 1% of sales were used in treatments for companion animals.

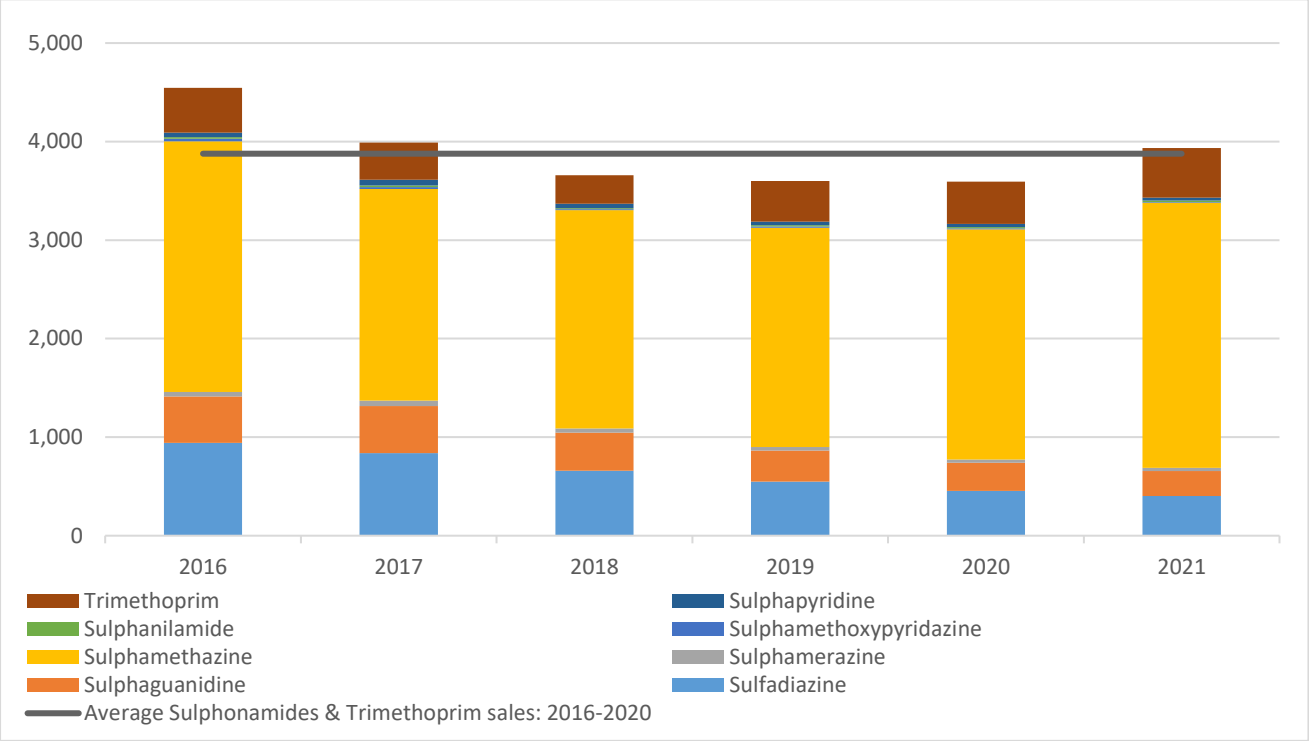
Sulphamethazine accounted for 68% of class sales with a total of 2,690 kilograms. This antibiotic is present in most of the registered multi-active products in the class and has a proportionally higher active concentration per formulation, typically at 400 mg per millilitre or gram of product, compared to 100-200 mg or less for other sulphonamides. Sales of sulphamethazine increased by 15% from 2,334 kilograms in 2020 (63% of class sales).

Figure 27: 2021 sulphonamides and trimethoprim sales compared to the previous five-year sales trends (in kilograms)



The largest percentage increases were noted for sulphanilamide (25%) to 15 kilograms and trimethoprim (17%) to 502 kilograms, mostly due to higher sales of co-formulated products registered for use in horses. Sulfadiazine and sulphaguanidine sales decreased by 54.5% (to 402 kilograms) and 32% (to 254 kilograms) respectively due to lower sales for co-formulated multi-species or horse-only products. The proportionately higher decrease in sulfadiazine is reflective of this compound being included in a relatively larger number of formulations. Minor decreases in sales were reported for the remaining antibiotics in this class, namely sulphapyridine (3% to 31 kilograms), sulphamerazine (3% to 31 kilograms) and sulphamethoxypyridazine (27% to 9 kilograms)).

Figure 28: Total sulphonamides and trimethoprim sales 2016-2021 (in kilograms)

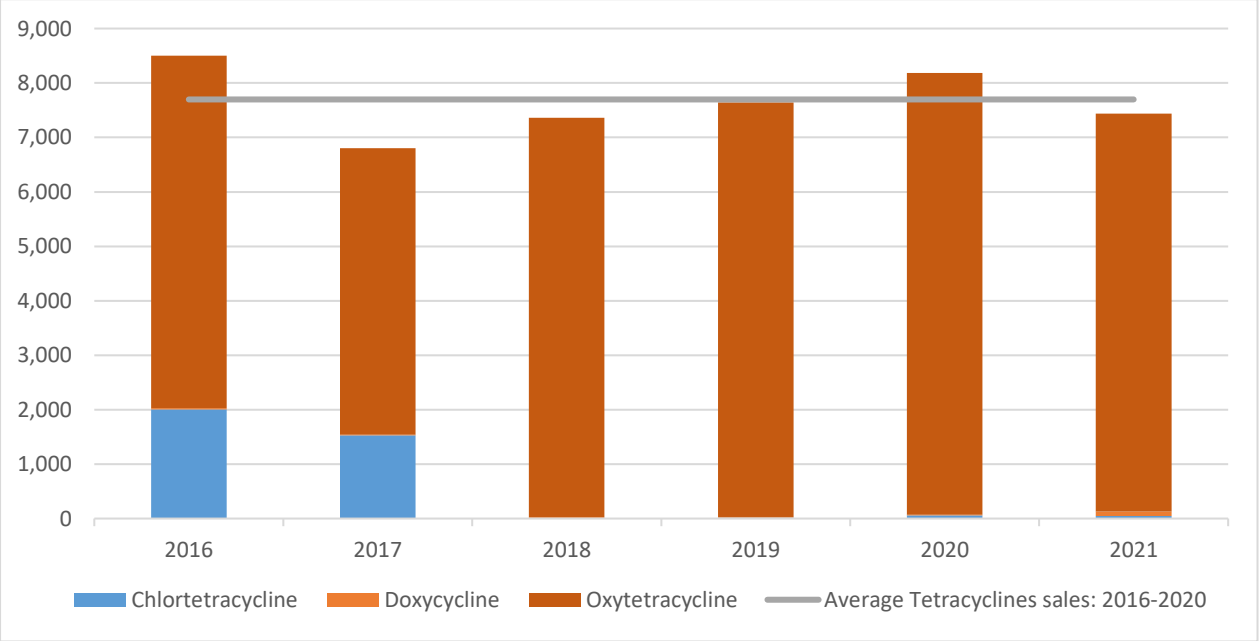


Overall sales for this class were 1.5% above the average for the previous five years.

5.14 Tetracyclines

Tetracyclines sales decreased by 7% to 7,596 kilograms due to lower volumes of oxytetracycline, which accounted for 98% of class sales (7,465 kilograms). The majority of oxytetracycline products were registered for use in dairy cattle and pigs for in-feed delivery. The volume of oxytetracyclines delivered in-feed decreased from 66% in 2020 to 56% in 2021. In contrast, sales for oxytetracycline products administered by injection in multiple production species products rose by 9% to 37%.

Figure 29:Total tetracyclines sales 2016-2021 (in kilograms)



Sales for doxycycline, which is registered for use solely in dogs, cats, caged birds, and pigeons, increased markedly from 13 kilograms in 2020 to 82 kilograms in 2021. Total chlortetracycline sales decreased by 9% to 48 kilograms mainly sold in topical and intra-uterine applications. The chlortetracycline total was markedly below the pre-2018 levels when sales for an in-feed product containing this antibiotic ceased. Tetracyclines sales were 1% below the average for the previous five years.

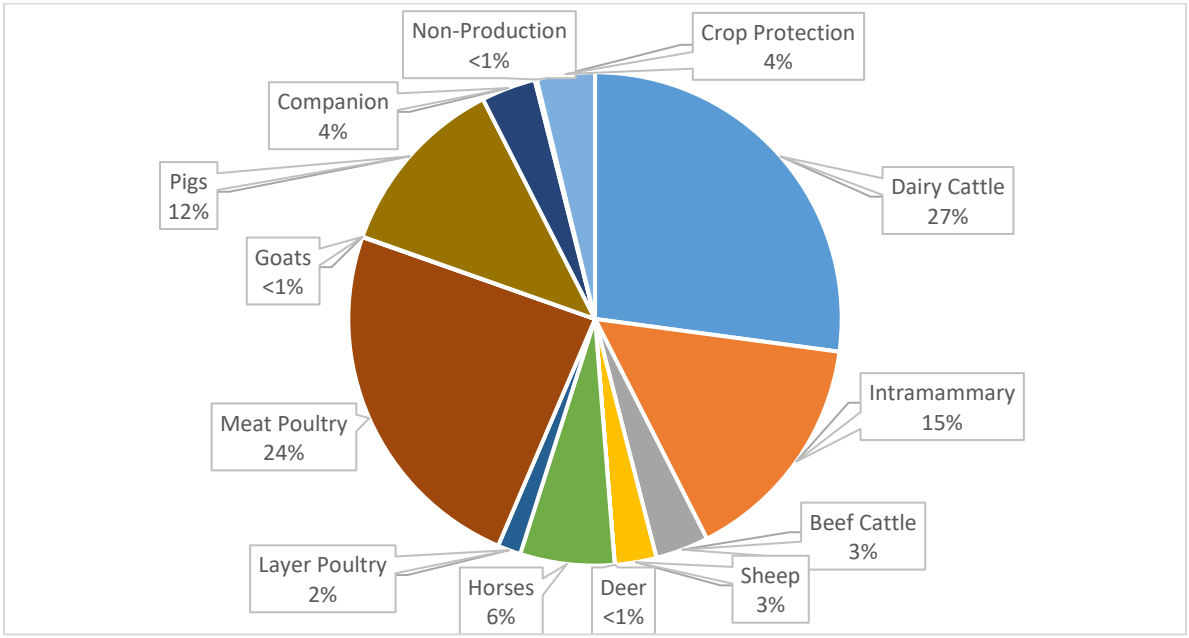
6 Veterinary antibiotic sales by species group

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 29 below: for example, products approved for use only in horses are classed as horse products because their sales are intended for use solely in that species. 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 nitrofurans for companion and non-production animals or 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 of each multi-species and multiple production species product to provide insight on how these products are likely to be used in practice.

Figure 30: Distribution of antibiotic sales in 2021 based on registrant estimates and volumes from species-specific products



6.2 Multi-species products

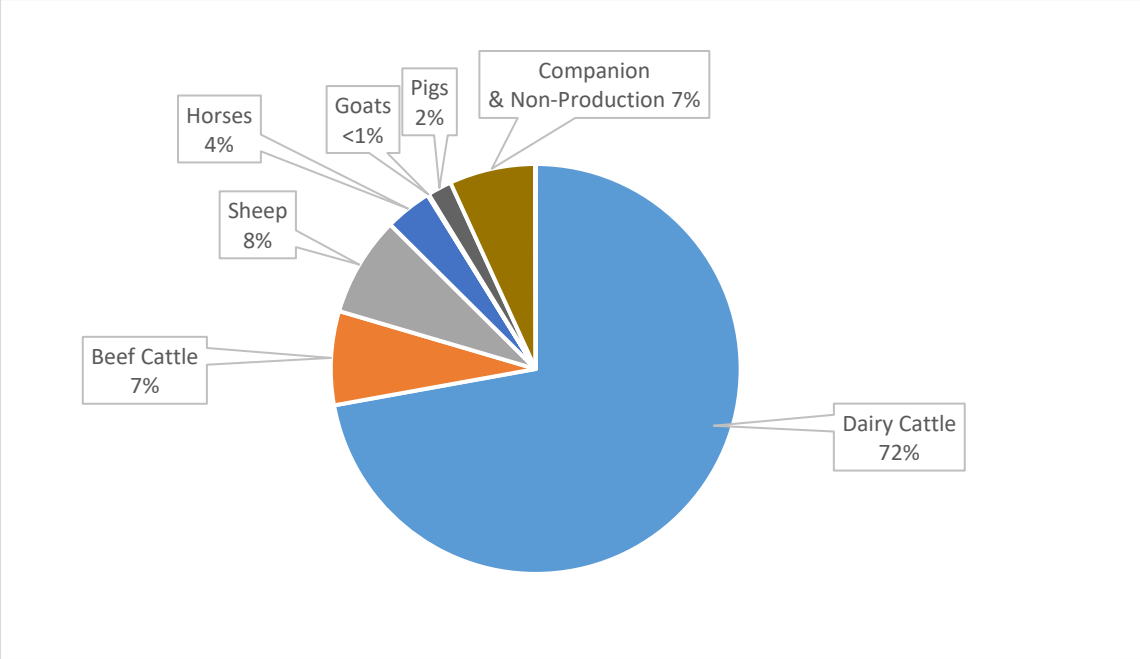
Multi-species products are approved for use in companion animals, production animals, and other species such as zoo animals and birds. Most of the compounds in this category contain penicillins (with or without clavulanic acid), comprising 89% of total multi-species sales, with a further 9% of the total from sulphonamides and trimethoprim and 2% from tetracyclines. Multi-species antibiotic sales

increased by 22% in 2021 to 11,583 kilograms accounting for 19% of total sales and 14% of all trade name products sold.

The largest sales increases were for penicillins and clavulanic acid (26% higher to 10,329 kilograms) and tetracyclines (42% increase to 178 kilograms). The quantity of nitroimidazoles also increased to 9 kilograms compared to 2020 (a 240% increase). An increase in polypeptides sales was also reported however the total for this class in multi-species products remained under one kilogram.

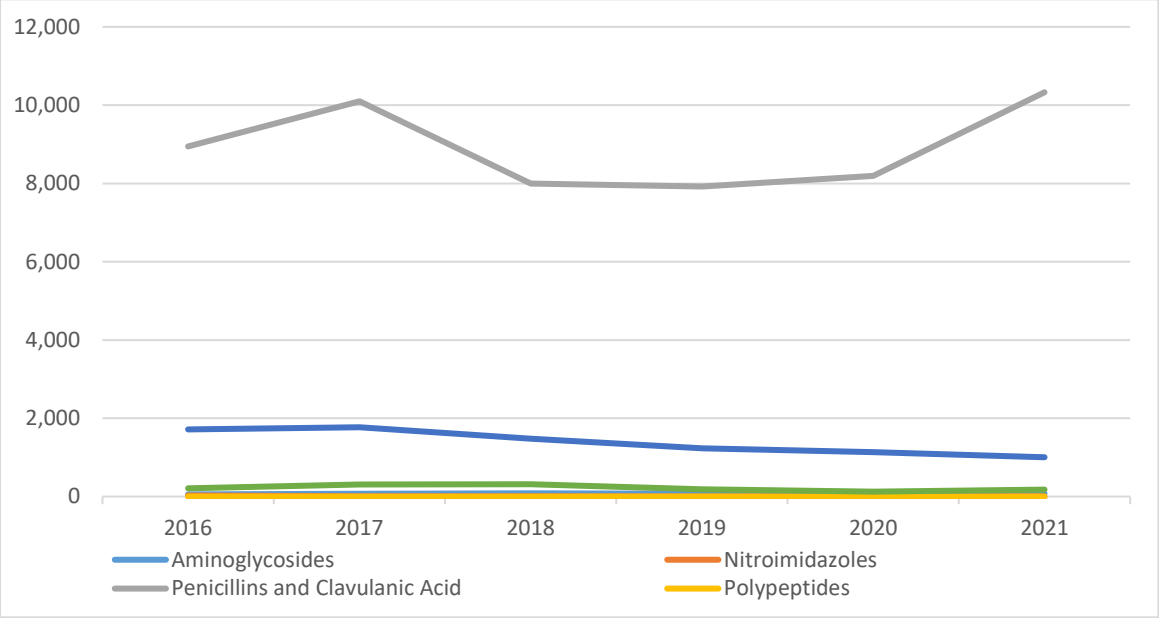
Sulphonamides and trimethoprim class sales were 12% lower at 1,003 kilograms which resulted in their overall contribution to this group falling below 9% continuing, the downward trend in sales since 2017. Sales for the aminoglycosides decreased by 3% to 63 kilograms, which was the third successive reduction with totals 20% lower than 2018.

Figure 31: Distribution of multi-species product sales by animal species/class



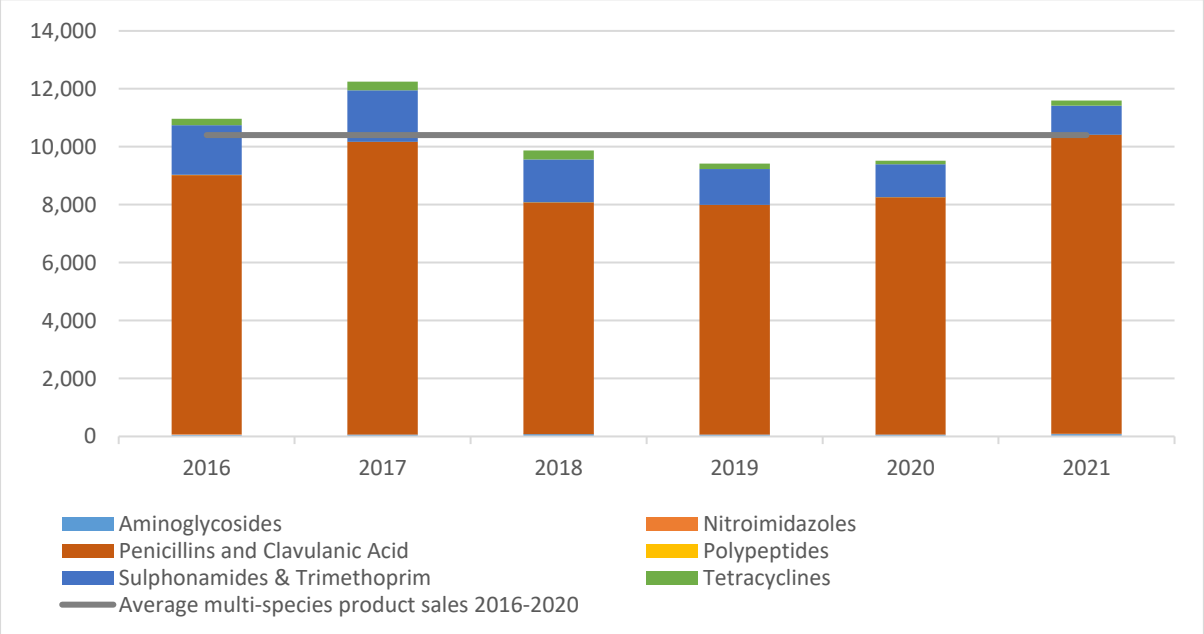
Based on registrant estimates a total of 72% of multi-species products were sold for use in dairy cattle, with over 82% of these products containing penicillin G procaine-based formulations. Most of this compound was sold for use in beef cattle, sheep, horses, and pigs. Sulphonamides and trimethoprim continued to be the primary treatment for goats. No multi-species products were approved for use in either poultry or deer.

Figure 32: Multi-species product antibiotic sales 2021 compared to previous five-year sales trends (in kilograms)



Critically important antibiotic quantities in multi-species products consisted of polymyxin, neomycin, and gentamicin with a combined total of 63 kilograms or 0.54% of multi-species product sales. Most sales (97%) were for gentamicin-based products intended for use in horses, with just under 3% attributed by registrants for use in companion animals together with small amounts of neomycin and polymyxin.

Figure 33: Total antibiotic sales in multi-species products 2016-2021 (in kilograms)



Quantities of antibiotics in multiple species products were 11% above the average for the previous five years.

6.3 Intramammary products – dry cow and lactating cow therapies

6.3.1 Overall intramammary sales

A total of 47 intramammary products were registered for use in dairy cattle in 2021, with 25 reporting sales. Intramammary products with sales accounted for 16% of all products with sales, and 15% of total sales volume. Sales of antibiotics contained in intramammary products were consistent with the previous year at 8,215 kilograms compared to 8,254 kilograms (decrease of 0.5% in 2021).

There are two types of intramammary products used for the treatment of mastitis in cattle: dry cow therapy (DCT) used through the non-lactation period, and lactating cow therapy (LCT) administered during lactation. Of the 25 products sold, 14 were DCT products responsible for 70% of total sales and 11 LCT products accounting for the remaining 30%. In 2020 the DCT share was 75% and LCT 25% of the total intramammary product sales.

Figure 34: 2021 Intramammary product sales for DCT/LCT (in kilograms)

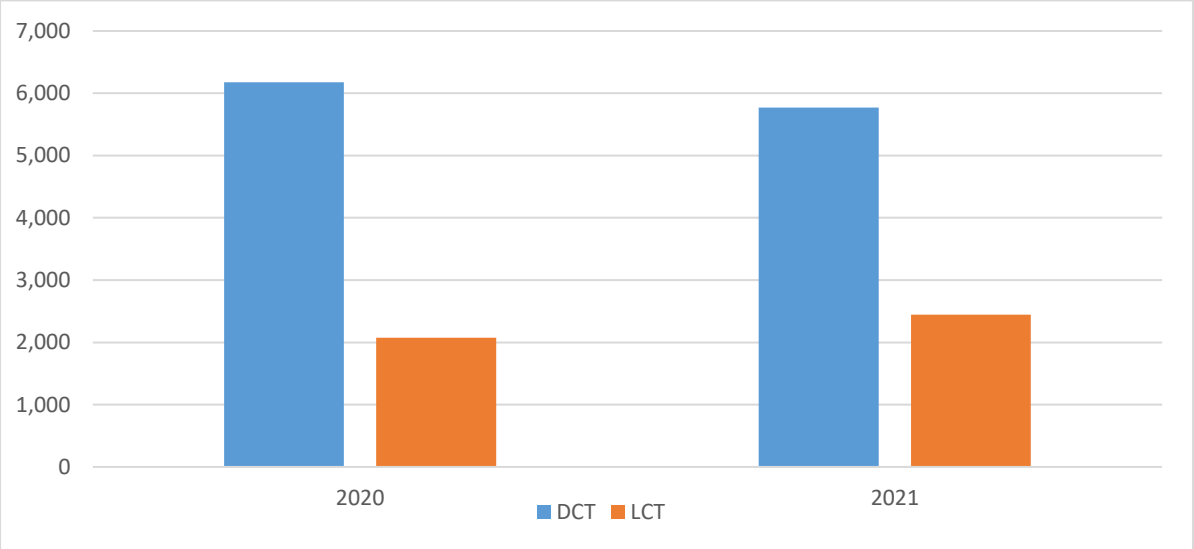
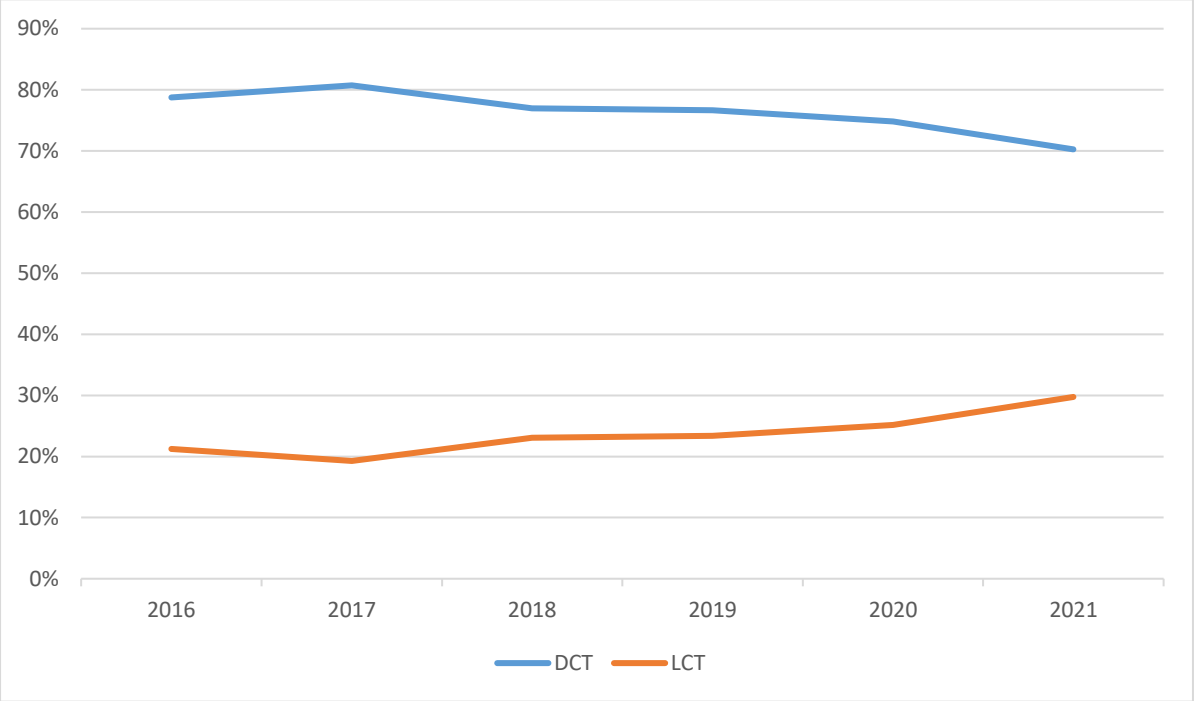
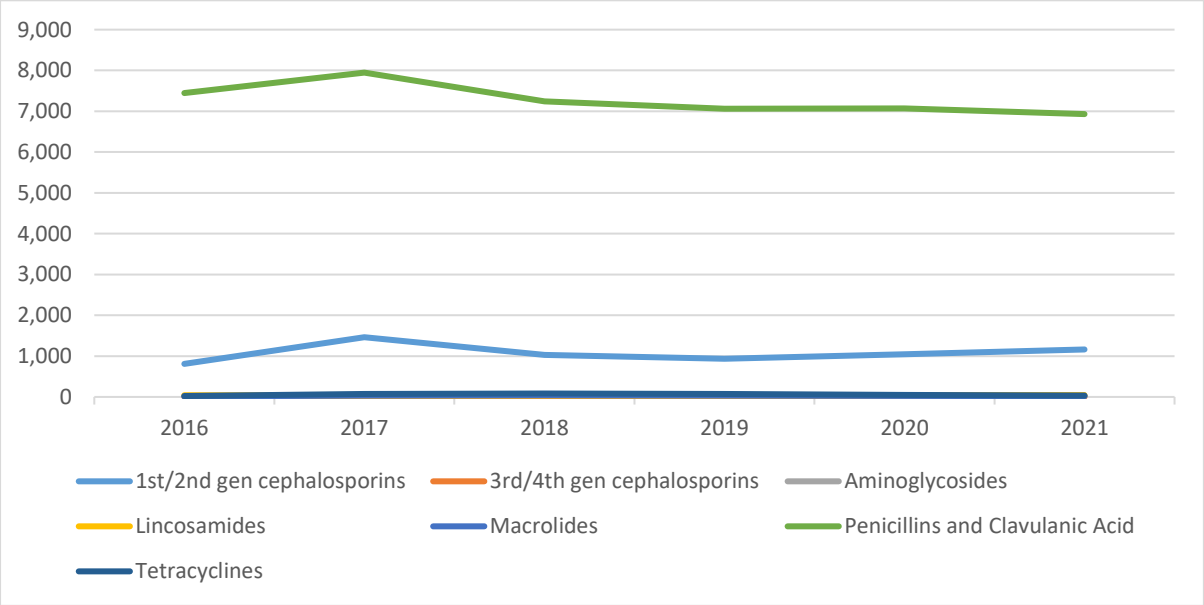


Figure 35: DCT and LCT treatments percentage trend 2016-2021



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

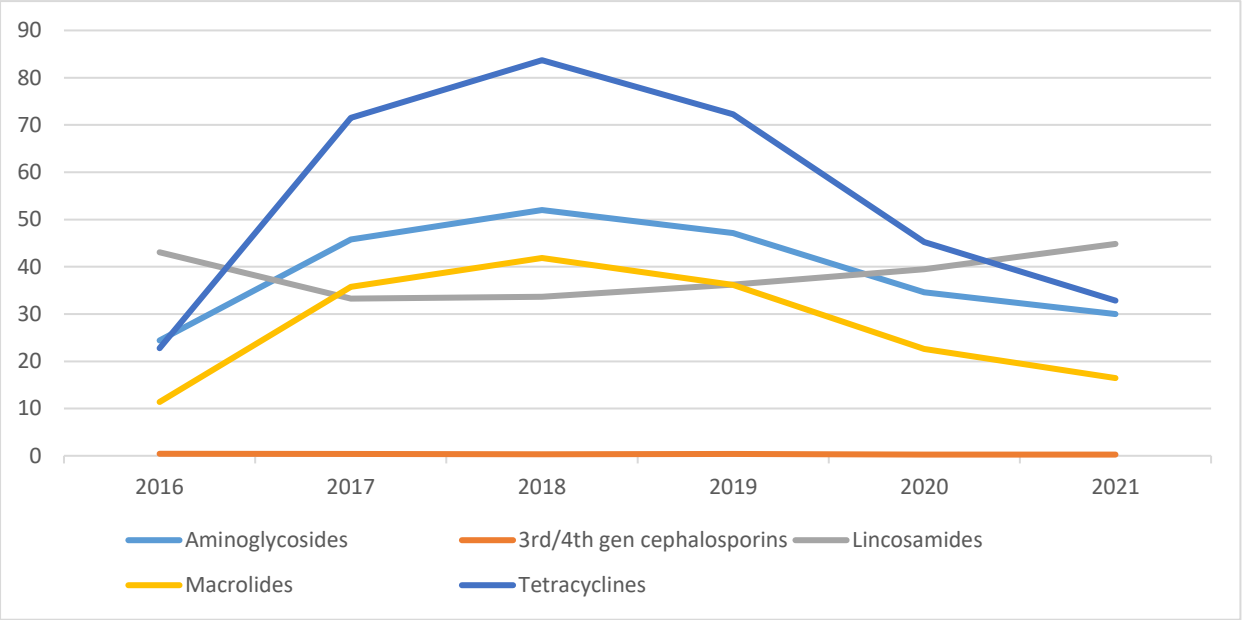
Figure 36: Total intramammary product sales compared to the previous five-year sales trends in kilograms)



Penicillins and clavulanic acid continued to dominate intramammary product sales with 84% of the total quantity sold, followed by the first and second generation cephalosporins with 14%. Sales of penicillins and clavulanic acid decreased by 2% compared to 2020, and the first and second generation cephalosporins increased by 11%. Penicillins and clavulanic acids and first and second generation cephalosporins are found in both DCT and LCT products.

"Low volume" intramammary antibiotic products consist of five classes which are only found in DCT treatments. Sales for four of these classes decreased in 2021 with the exception being the lincosamides which increased by 13.5% to 46 kilograms. Low volume intramammary sales decreases were 44% for both the macrolides (to 14 kilograms) and tetracyclines (to 28 kilograms). Quantities of aminoglycosides decreased by 16% (to 28 kilograms) and the third and fourth generation cephalosporins sales decreased by 5% remaining at under one kilogram.

Figure 37: Low volume intramammary product sales over time (DCT/LCT) in kilograms



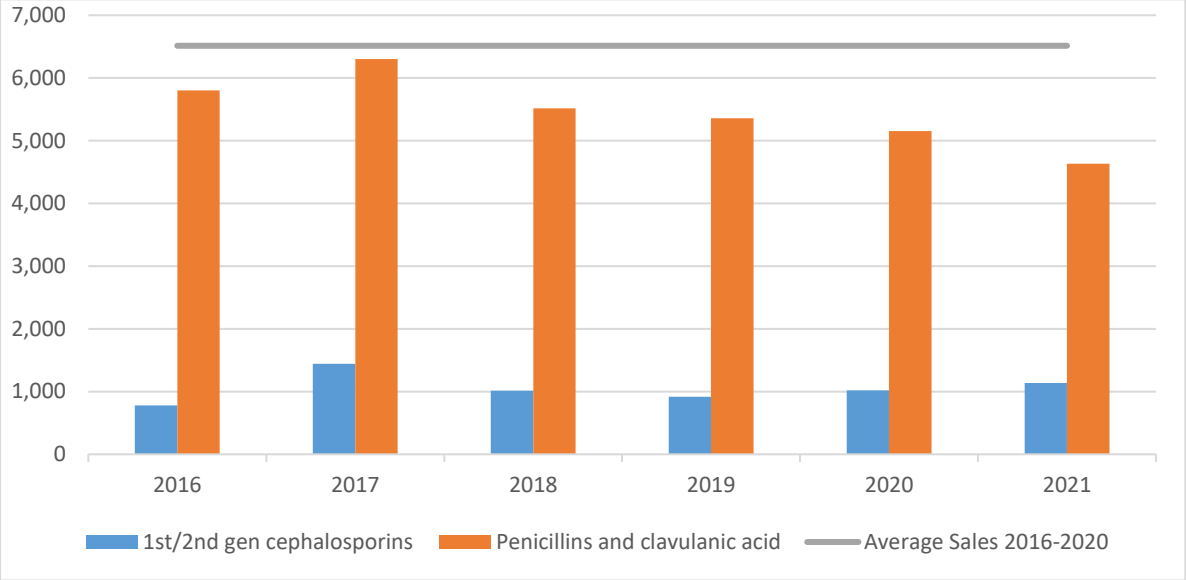
Three of the four intramammary low volume sales classes with decreasing sales contained critically important antibiotics with a total contribution of 46 kilograms which was 23% less than 2020.

6.3.2 Dry cow therapies (DCT)

Dry cow therapy (DCT) products contain two classes of antibiotics with 80% of the sales quantity consisting of penicillins and clavulanic acids and 20% first and second generation cephalosporins. Total DCT quantities decreased by 6.6% in 2021 compared to 2020 (down to 5,771 kilograms from 6,177 kilograms) mainly driven by an 11% reduction in penicillins and clavulanic acids to 4,635 kilograms.

In contrast, sales of first and second generation cephalosporins increased by 10% to 1,136 kilograms with cephapirin being the main contributor with a 61% increase to 283 kilograms, accounting for 5% of DCT antibiotic sales compared to 3% in 2020. Cephalonium was also sold for use in DCT products however the volume reported was relatively unchanged with a 0.4% decrease to 853 kilograms. Total DCT sales were 11% below the average for the previous five years.

Figure 38: DCT antibiotic sales over time (in kilograms)

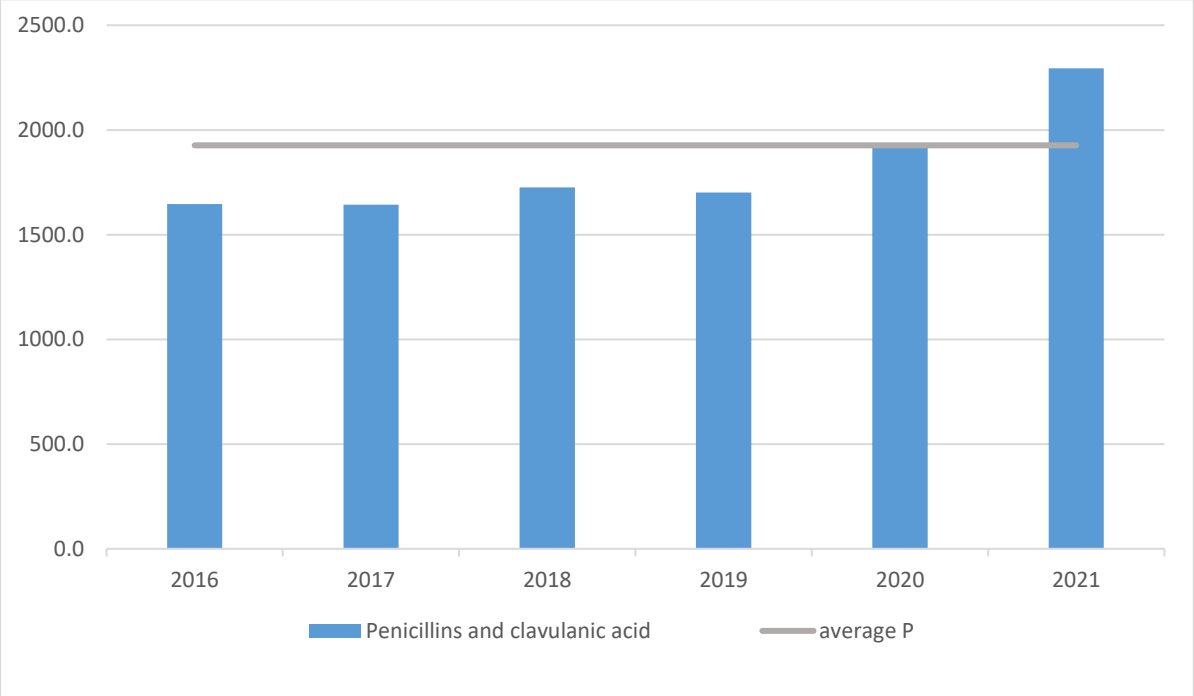


The total number of DCT syringes sold in 2021 decreased by 355,560 to 10,630,716 compared to 10,986,276 in 2020. For the two antibiotic classes found in DCT treatments the number of syringes containing penicillins decreased by 737,400 whereas for the first and second generation cephalosporins the number of syringes increased by 381,840 (396,520 increase in syringes with cephapirin and 14,680 decrease in syringes with cephalonium). Translating syringe sales into four-quarter treatment of an animal at drying off, this decrease equates to almost 184,350 fewer cows treated with penicillins and 95,460 more cows treated with first- and second-generation cephalosporins at the end of lactation. This also suggests that 2.6 million cows were treated with antibiotics at dry-off which is 55% of the national herd.

6.3.3 Lactating cow therapies (LCT)

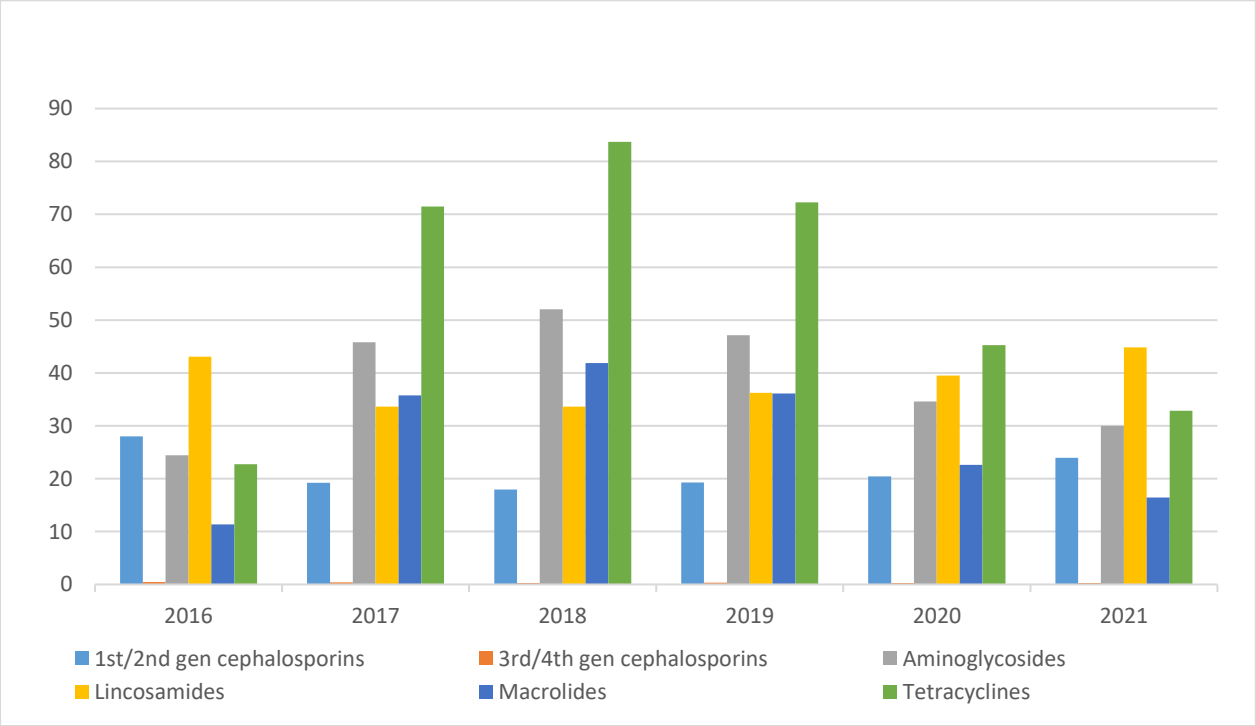
Lactating cow therapy (LCT) products contain antibiotics from seven classes, including three which are critically important. The penicillins and clavulanic acids contributed 94% of the total, 2% from lincosamides, 1% each from first and second generation cephalosporins and tetracyclines. The remaining 2% consisted of critically important antibiotics including aminoglycosides, macrolides and third and fourth generation cephalosporins. The quantity of antibiotics sold in LCT products increased by 18% mainly driven by higher quantities of penicillins which were 20% above their 2020 level with amounts of amoxicillin, cloxacillin and clavulanic acid increasing by an average of 9% and penicillin G procaine by 22%.

Figure 39: Penicillins sales volume in LCT treatments 2016-2021 (in kilograms)



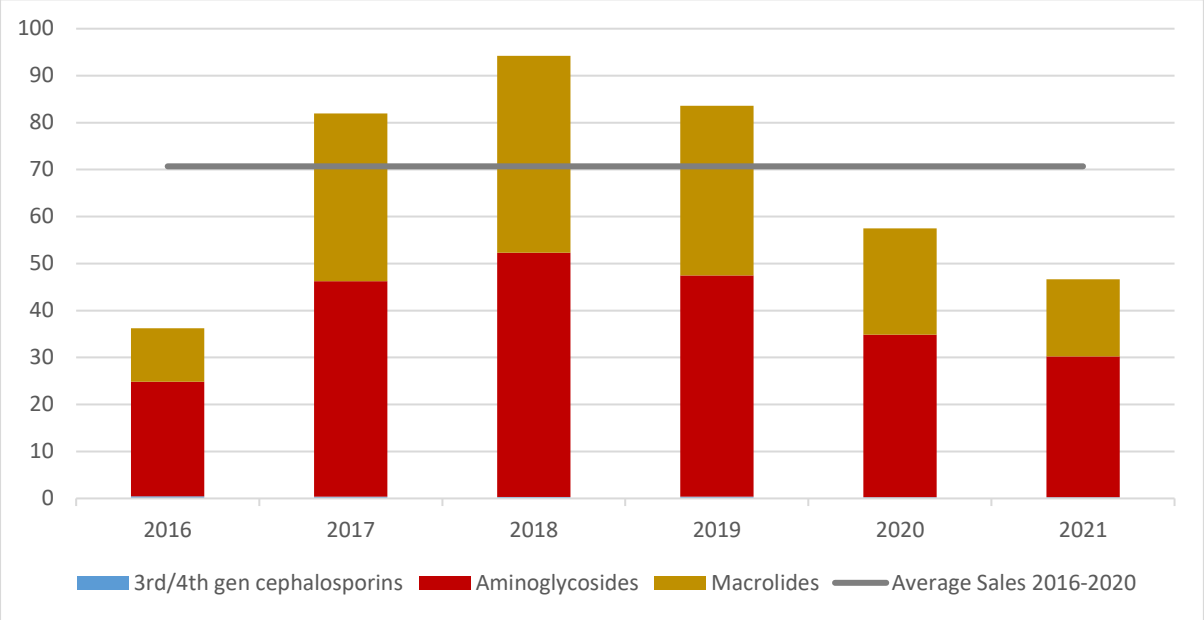
The next largest contributors to LCT antibiotics sold in 2021 were the lincosamides (lincomycin) with a 14% increase in sales to 45 kilograms and the tetracyclines (oxytetracycline) at 32 kilograms with a 27% decrease in sales.

Figure 40: LCT Sales 2016-2021 - all other classes (in kilograms)



Quantities of critically important antibiotics used in LCT products decreased by 18% to 46 kilograms in 2021, mainly driven by decreases in neomycin, oleandomycin and to a lesser extent in cefquinome volumes and were 34% below the sales average for the previous five years.

Figure 41: LCT sales volumes for Critically Important Antibiotics 2016-2021(in kilograms)



The total number of syringes sold for LCT increased to 2,980,000 which was 336,000 (17.6%) more than 2020. The main contributor to the increase were the penicillins and clavulanic acids with a 371,000 increase in syringe numbers consisting mainly of penicillin g procaine and a co-formulated penicillin g procaine and cloxacillin combination. Syringe numbers for first and second generation cephalosporins increased by 15% to just under 85,740. The number of syringes containing critically important antibiotics decreased in number by 64,000 (32% decrease).
This equates to an additional 92,735 cattle receiving penicillin and clavulanic acid treatments as four-quarter LCT, and a reduction of 12,000 cattle receiving syringes with critically important antibiotics.

6.4 Pig- and poultry-specific products

Twelve products were registered for specific use in pigs, poultry, or both, of which four had sales reported in 2021. Five classes of antibiotics are present in these products (of which two are critically important) with a total reported sales volume of 14,506 kilograms which accounted for 27% of all antibiotics sold compared to 20,339 kilograms in 2020 (38% of sales volume).

Volumes of all classes of antibiotics sold in pig and poultry specific products decreased in 2021. The polypeptide zinc bacitracin was the main contributor to the decrease with a 39% reduction in volume to 12,506 kilograms (86% of all antibiotics in this group). Based on registrant estimates and information from industry, all zinc bacitracin was sold for use in meat poultry.

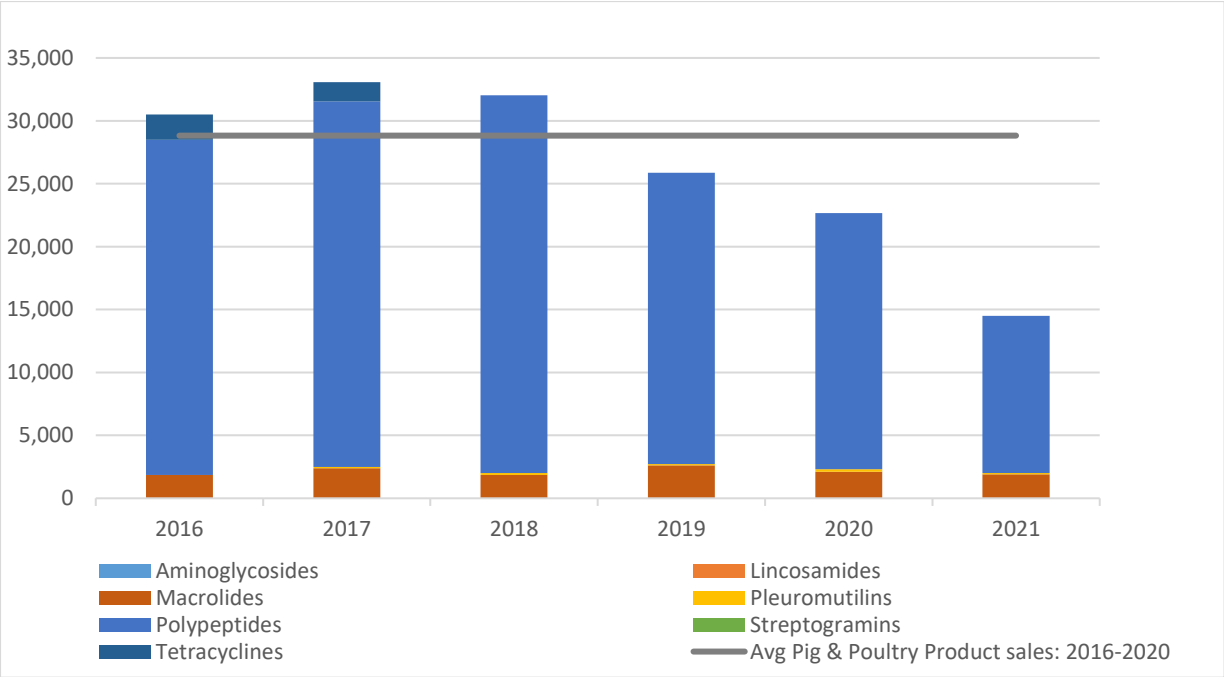
The critically important antibiotic tylosin was the next largest contributor to pig and poultry product sales with 1,908 kilograms which was 9% lower than the previous year. Tylosin was sold for use in layer poultry, meat poultry and pigs. Despite the overall decrease in volume the percentage contribution made by tylosin to pig and poultry specific product sales increased to 13% compared to 9% in the previous year. The other critically important antibiotic in pig and poultry specific products is the aminoglycoside spectinomycin which decreased in volume from 6.3 kilograms to 5.8 kilograms (7% decrease) in 2021 and was sold for use in layer poultry and pigs.

Sales for tiamulin (the only pleuromutilin registered for use in New Zealand) in pig and poultry-specific products and sold for use in layer poultry and pigs decreased to 83 kilograms, which was a 59% reduction from the 202 kilograms in the previous year. The remaining class in pig and poultry-specific products was the lincosamides which remained stable at just under 3 kilograms.

There were no sales reported for tetracyclines, streptogramins and amphenicols in this group and no products specifically registered for pig and/or poultry use containing cephalosporins, fluoroquinolones, fusidic acid, nitrofurans, penicillins and clavulanic acid, or sulphonamides and trimethoprim.

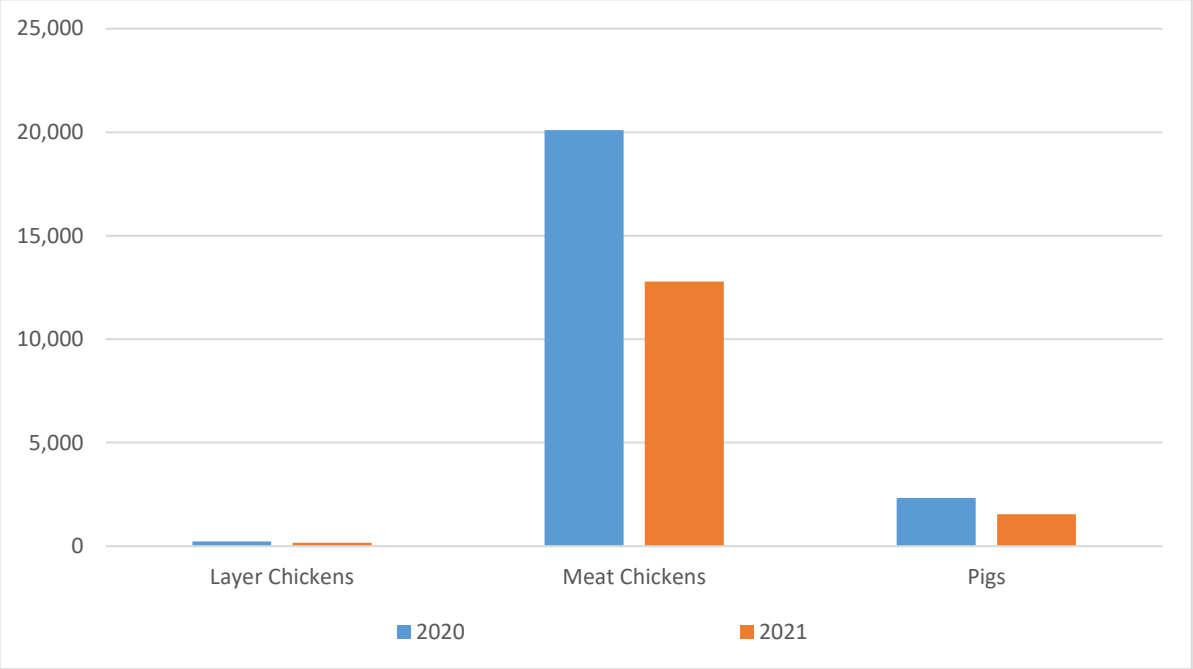
In addition to those products specifically registered for pig and poultry use, registrants estimated that an additional 648 kilograms of multiple production species and 4 kilograms of multi-species products were sold for use in poultry and 4681 kilograms of multiple production species products, and 222 kilograms of multi-species products were sold for use in pigs. Taking this additional amount into consideration the total estimated volume of antibiotics used in pig and poultry treatments is approximately 20,060 kilograms or 38% of all antibiotics sold in 2021. As these additional totals are based on registrant estimates, only those products sold exclusively for pig and poultry use will be considered in this analysis.

Figure 42: Total Sales of pig and poultry products 2016-2021 (in kilograms)



If 2020 and 2021 are stratified by registrant use estimates, lower sales quantities are evident across all three sub-populations for pig and poultry specific products. This includes a 36% decrease of antibiotic sales intended for meat poultry to 12,792 kilograms, consisting of two antibiotics- zinc bacitracin and tylosin. Zinc bacitracin volume reduced by 7,426 kilograms (37%) to 12,506 kilograms offset slightly by an increase in tylosin volume of 118 kilograms (70%) to 286 kilograms.

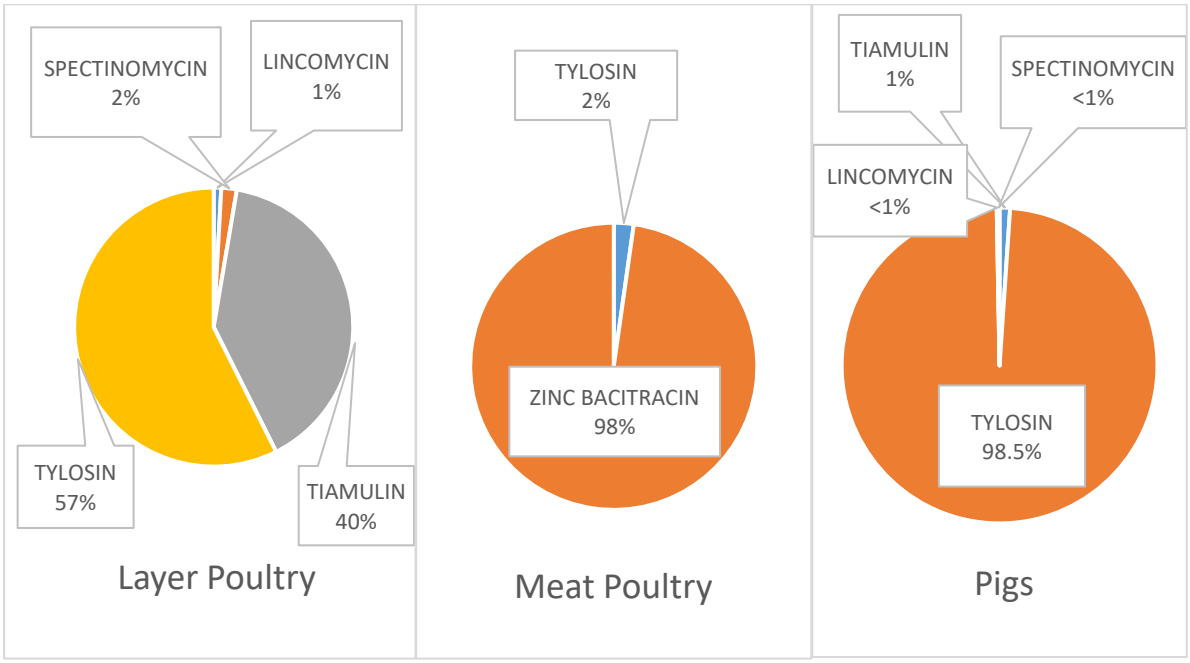
Figure 43: Estimates of pig/poultry product sales 2020/2021 stratified by target species or class (in kilograms)



The quantity of antibiotics in pig and poultry-specific products sold for use in layer poultry decreased by 27% to 166 kilograms based on registrant estimates. The largest reduction for an individual antibiotic was for tiamulin which decreased from 181 kilograms to 66 kilograms (63% reduction). The quantity of tylosin attributed for use in layer poultry also increased from 42 kilograms to 95 kilograms (126% increase).

The combined quantity of the four antibiotics contained in these products attributed by registrants as sold for use in pigs decreased from 2,236 kilograms to 1,547 kilograms in 2021. Nearly all the decrease was due to the 368-kilogram reduction of the amount of tylosin from 1,894 kilograms to 1,526 kilograms. The volume of tiamulin also decreased by 18% to 16 kilograms and there were minor decreases in lincomycin and spectinomycin of less than 1% of a total volume of 4.5 kilograms. Registrants attributed zero sales of zinc bacitracin for use in pigs for the second successive year.

Figure 44: Estimates of use stratified by target species or class for pig and poultry specific products



Taking registrant estimates into consideration 88% of pig and poultry specific products (12,793 kilograms) were sold for use in meat poultry, 11% for use in pigs and 1% sold for use in layer poultry. Antibiotics used in meat poultry consisted mostly of zinc bacitracin (98%) whereas tylosin was the most common antibiotic (98.5%) in pig and poultry specific products used in pigs. In layer poultry tylosin accounted for 57% of sales with tiamulin contributing 40%.

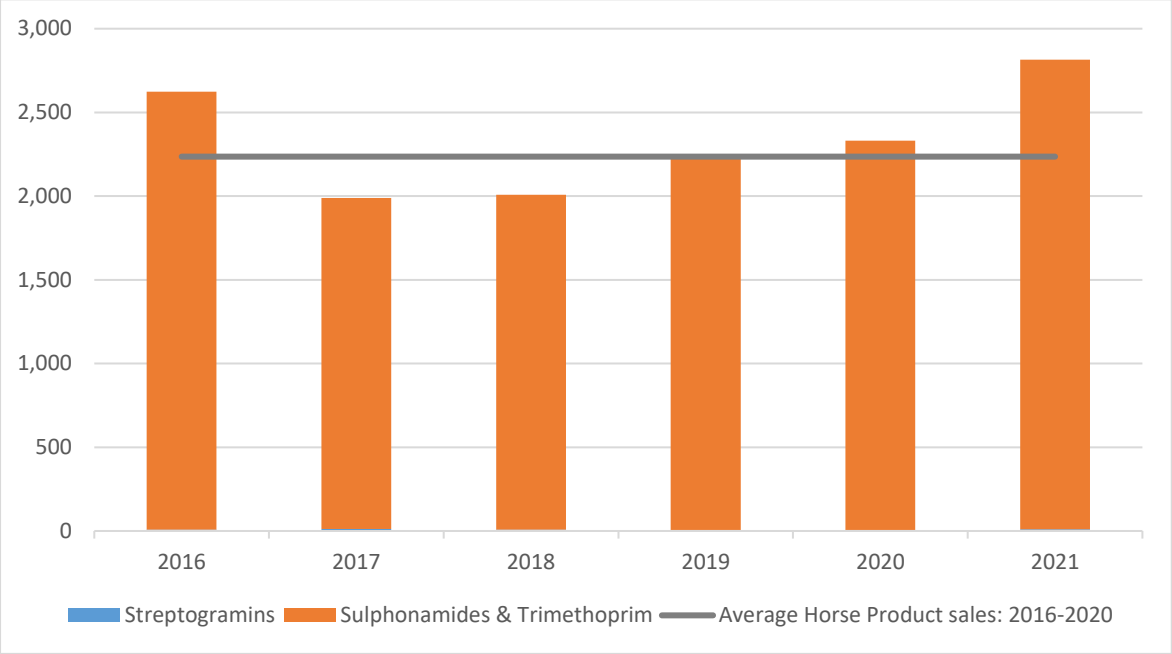
6.5 Horse-specific products

Products sold for use solely in horses contained two classes of antibiotics: sulphonamides and trimethoprim, and streptogramins with a total combined volume of 2,814 kilograms (5% of total sales). A total of 10 horse-specific products were registered with 9 having sales reported, accounting for 6% of products with sales. Over 99% of the quantity of antibiotics in horse-specific products contain antibiotics from the sulphonamide-and trimethoprim class.

Registrants estimated that an additional 494 kilograms of multi-species and multiple production animal products were also used in horses making a total of 3,300 kilograms and 6% of total antibiotic sales. Because this additional volume is based on estimates rather than product-specific sales data, only those products sold exclusively for use in horses will be considered further.

Overall horse-specific product antibiotic sales increased by 21% with sulphonamides and trimethoprim quantities increasing to 2,805 kilograms. Streptogramins volumes increased by 35% to 9 kilograms which was their highest level since 2018. From 2018-2020 the average increase for these two classes was only 5%. Total sales of antibiotics in horse-specific products were 25% above the average for the previous five years.

Figure 45: Total horse product antibiotic sales over time (in kilograms)



6.6 Companion animals and non-production species products

A total of 66 products containing 14 antibiotic classes as either single or multi-active products were registered for use solely in companion animals and non-production species in 2021 of which 46 had sales reported (containing 13 antibiotic classes). Companion and non-production animal products are intended to treat dogs, cats, cage birds, pigeons, and aquarium fish, and represented 30% of the registered products with sales but only 2% of the antibiotic sales volume with 1,187 kilograms in 2021. This represents a 15% increase compared the quantity reported in 2020.

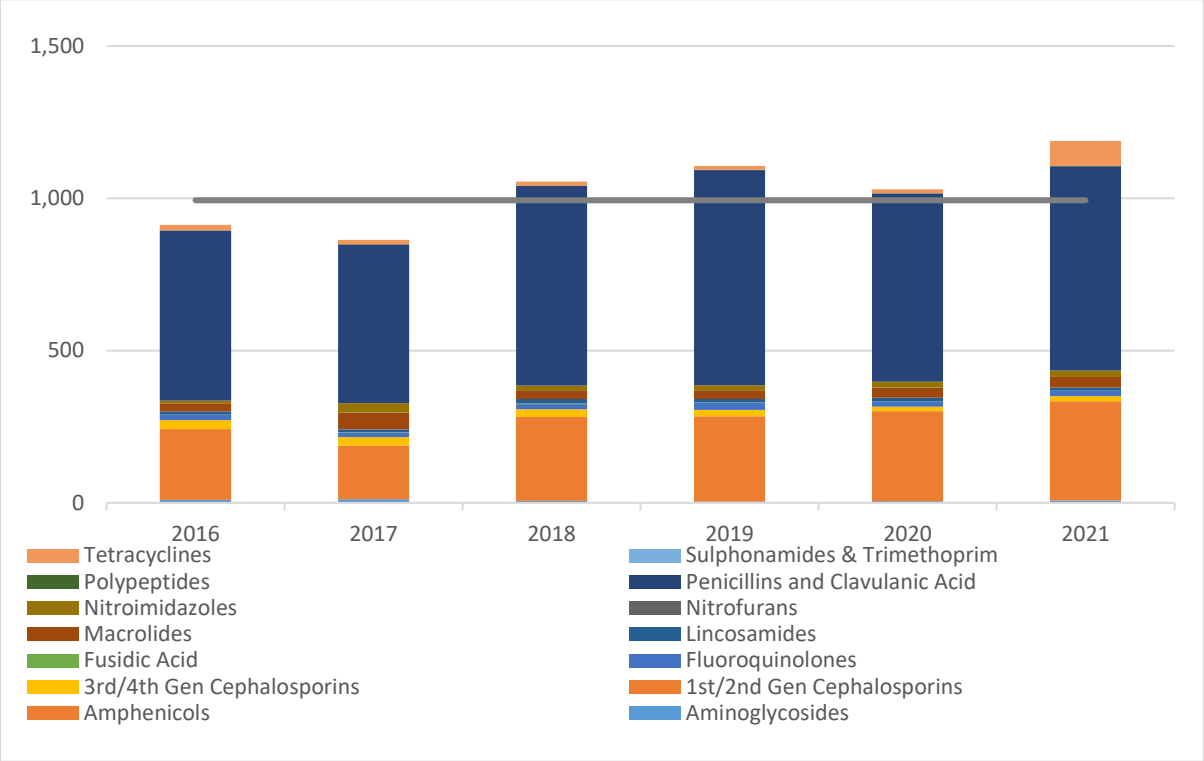
Based on registrant estimates, the total quantity of multi-species products used in companion and non-production animals is approximately 795 kilograms across multiple compounds, resulting in total antibiotics sold of 1,982 kilograms. As this additional volume is based on registrant estimates rather than specific sales data, this analysis will be limited to those products sold exclusively in companion and non-production species.

Increased sales were reported for 11 of the 13 classes in companion animal and non-production species products. The largest increases were for tetracyclines (increase of 69 kilograms to 82 kilograms), penicillins and clavulanic acids (increase of 53 kilograms to 670 kilograms) and for first and second generation cephalosporins (increase of 30 kilograms to 325 kilograms). The volume for the other nine classes with higher sales accounted for just under 10 kilograms of the companion and non-production animal sales total.

The two classes with lower sales were lincosamides which decreased by 20% to 10 kilograms and nitrofurazones which decreased by 88% to 0.1 kilogram.

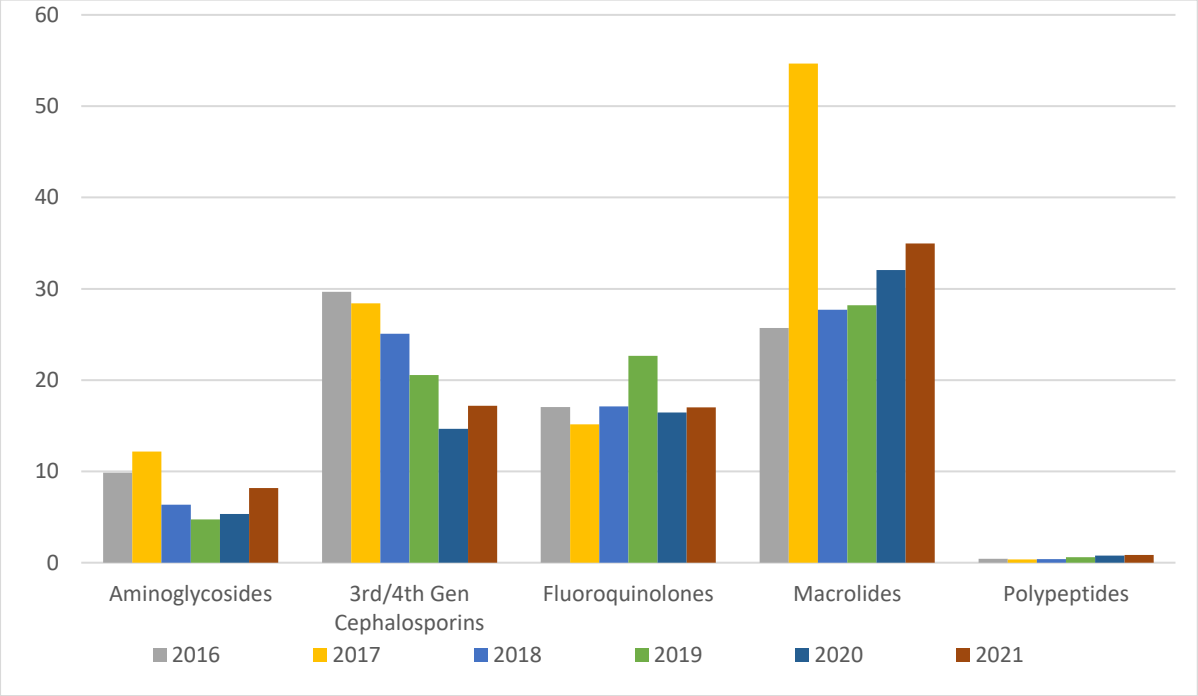
There were no registered companion animal or non-production species products containing sulphonamides and trimethoprim.

Figure 46: Total companion and non-production species products antibiotic sales 2016-2021 (in kilograms)



Penicillins and clavulanic acids accounted for 57% of the sales total (670 kilograms) with the next largest being first and second generation cephalosporins (324 kilograms and 27% of sales) with both classes mostly sold in oral treatments. The next largest class were the tetracyclines at 7% (70 kilograms), most of which were sold in in-water treatments. The remaining 9% was made up of 11 different antibiotic classes including five containing critically important antibiotics.

Figure 47: Critically important antibiotic sales for companion and non-production animals 2016-2021(in kilograms)



Sales of critically important antibiotics in companion and non-production animal products increased by 13% in 2021 to 78 kilograms. The largest increase in percentage terms was for the aminoglycosides with sales 53% above the 2020 level to just over 8 kilograms (neomycin accounted for 91% of this total). The largest increase in quantity was 3 kilograms (9%) for the macrolides to 35 kilograms (all spiramycin). Sales of third and fourth generation cephalosporins also increased by 17% to 17 kilograms with the main contributor being cefpodoxime which accounted for 88% of the volume for this class.

6.7 Multiple production species products

Multiple production species products include those intended for use in cattle, sheep, pigs, poultry, and horses. For the purposes of this analysis this section excludes products which are specifically registered for use in cattle-only (including intramammary treatments), pig and poultry-specific, horse-specific products and sheep-only products. The key difference between this group and the multi-species products group is that multiple production species products are exclusively registered for use in production animals, whereas multi-species products can be used in either production or companion animals.

A total of 57 products were registered for use in multiple production species of which 32 had sales reported (21% of products sold). Multi-production species products accounted for just under a quarter (23%) of the total annual sales volume with 12,181 kilograms (compared to 13,049 kilograms in 2020) and contained 7 antibiotic classes of which four are critically important.

Critically important antibiotics accounted for 27% of the total reported for these products with quantities 5.8% lower at 3,284 kilograms compared to 3,485 kilograms in 2020. Sales of macrolides decreased by 9% to 2,594 kilograms, consisting of over 99% tylosin (2,585 kilograms) with less than 1% (9 kilograms) of tilmicosin. Tylosin multi-production product sales decreased by 9% whereas tilmicosin volumes decreased by 44% compared to 2020. Aminoglycoside quantities increased by 11% to 565 kilograms with higher sales of both dihydrostreptomycin and streptomycin. Quantities for the other two critically important classes decreased with fluoroquinolone volumes decreasing by 21% to 11 kilograms and the third and fourth generation cephalosporins decreasing by 0.3% to 113 kilograms.

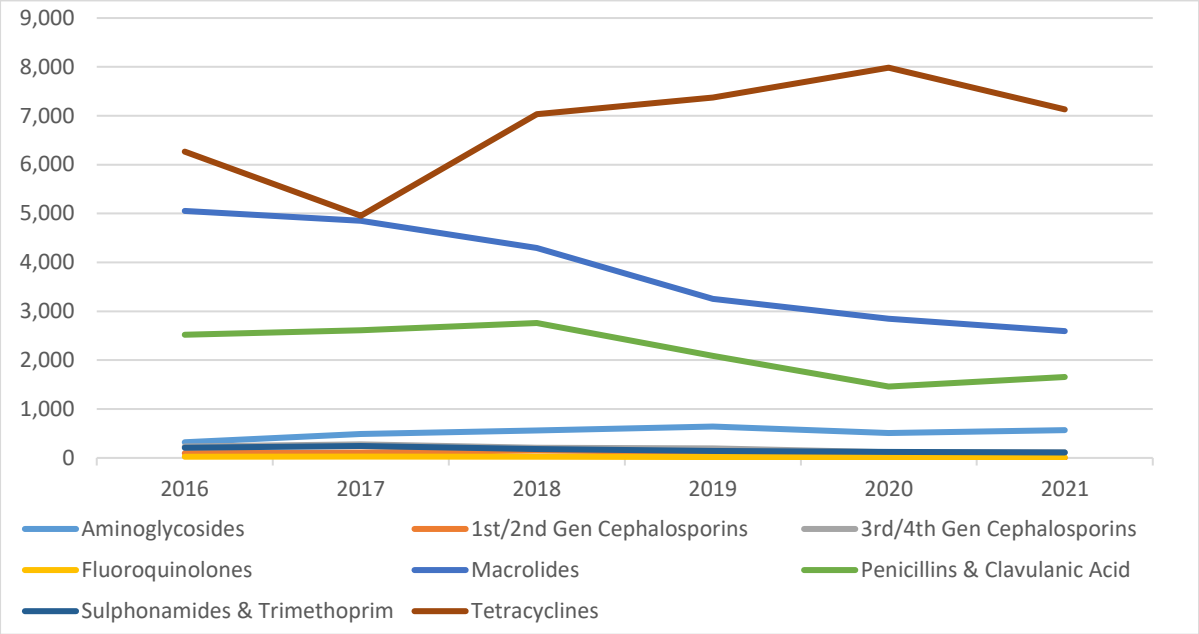
Over half of the sales in this group (59%) consisted of tetracycline-based products (down from 61% in 2020) consisting oxytetracycline (99%) and 1% chlortetracycline. A further 21% of sales contained macrolide-based products (unchanged from 21% in 2020), penicillin-based products (13% down from 17% in 2020) and 4.6% aminoglycosides (4% in 2020); clavulanic acid was not present in any multiple production species products. The remaining five classes in this group collectively accounted for just over 2% of group sales. There were no registered multiple production species products containing amphenicols, fusidic acid, lincosamides, nitrofurans, nitroimidazoles, pleuromutilins, polypeptides, or streptogramins.

Overall antibiotic quantities in multi-production species products decreased by 7% in 2021 with increased sales for 2 of the 7 classes (including one critically important).

The largest decrease in multi-production products class sales was for the tetracyclines with a reduction of 852 kilograms (10.7%) to 7,132 kilograms in 2021 with lower quantities being reported for both oxytetracycline (11% decrease) and chlortetracycline (8.4% decrease). The quantity of sulphonamides and trimethoprim decreased by 7.7% to 110 kilograms which accounted for less than 1% of the total sales of antibiotics in multi-production species products.

Penicillins and clavulanic acids had the largest increase in percentage terms with sales 13% higher at 1,654 kilograms compared to 2020 with 1,654 kilograms. This class was represented by penethamate hydriodide (75%) and amoxicillin (25%) which both decreased by 9% and 26% respectively.

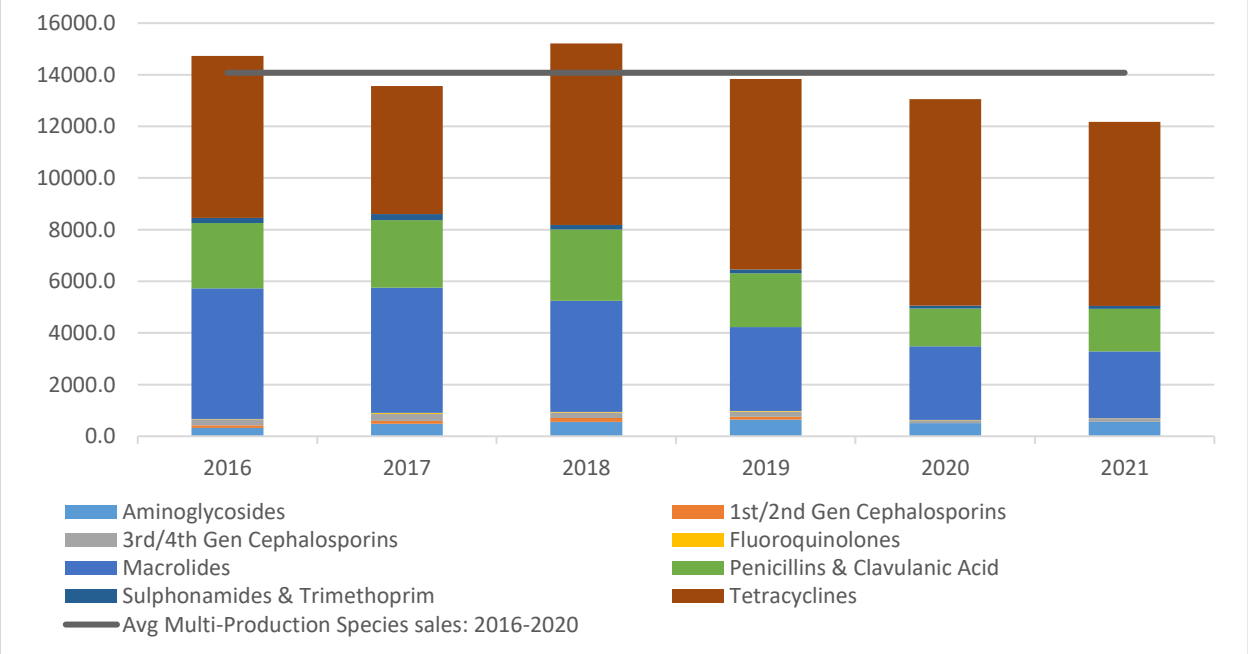
Figure 48: Total Multiple Production Species Product Antibiotic Sales 2016-2021 (in kilograms)



Almost 54% of antibiotics included in multiple production species products were administered as in-feed products with a further 43% in injectable formulations and the remaining 3% by oral, intrauterine, in water or by topical methods. Oxytetracycline made up 65% of the in-feed volume and 50% of antibiotics delivered by injection.

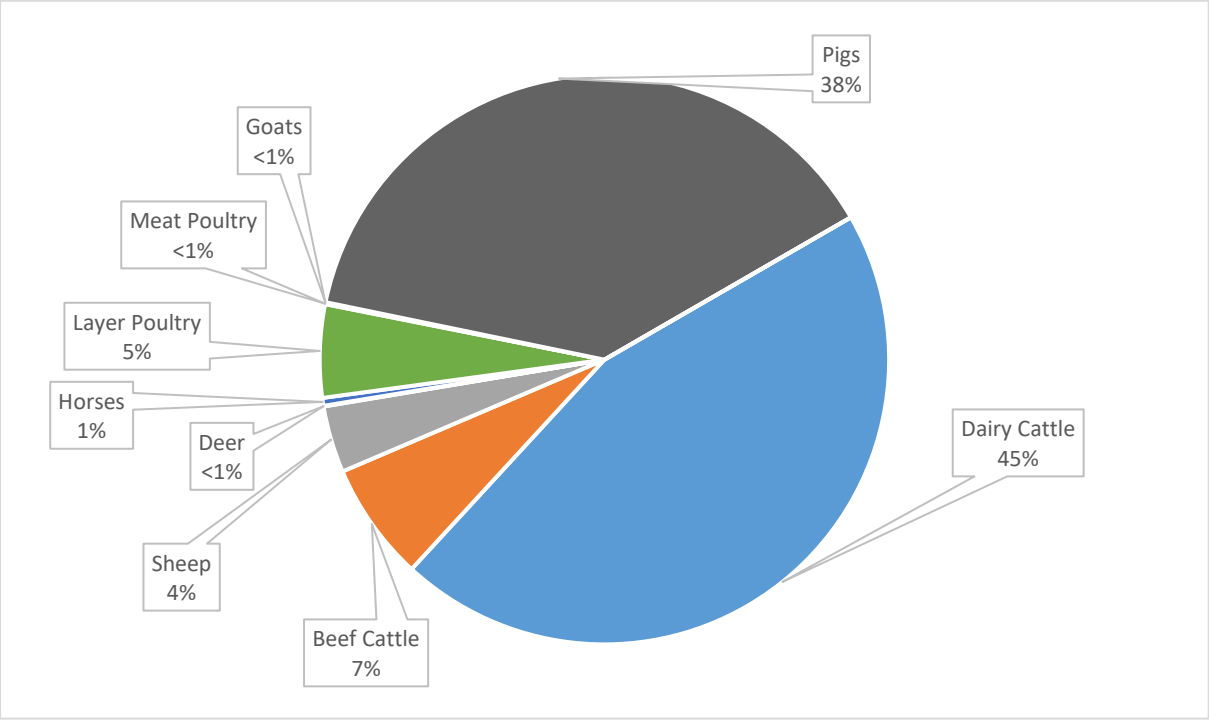
Annual sales of tetracyclines in multi-production species products increased from just under 5,000 kilograms in 2017 to 7,030 kilograms in 2018, since then quantities have remained over 7,000 kilograms. In contrast, macrolide sales have decreased from an average of over 5,000 kilograms prior to 2018 to 2,594 kilograms in 2021. The antibiotic sales quantity in multi-production products in 2021 was 13% below the five-year sales average.

Figure 49: Multiple Production Species Product antibiotic sales compared to previous five-year sales trend (in kilograms)



Registrants estimated a total of 45% of multi-production product antibiotics were sold for use in dairy cattle (43% in 2020), followed by 38% used in pigs (34% in 2020), 7% in beef cattle (7% in 2020) and 5% in layer poultry (11% in 2020). Other species (meat poultry, deer, horses, sheep) collectively accounted for just under 5% of sales.

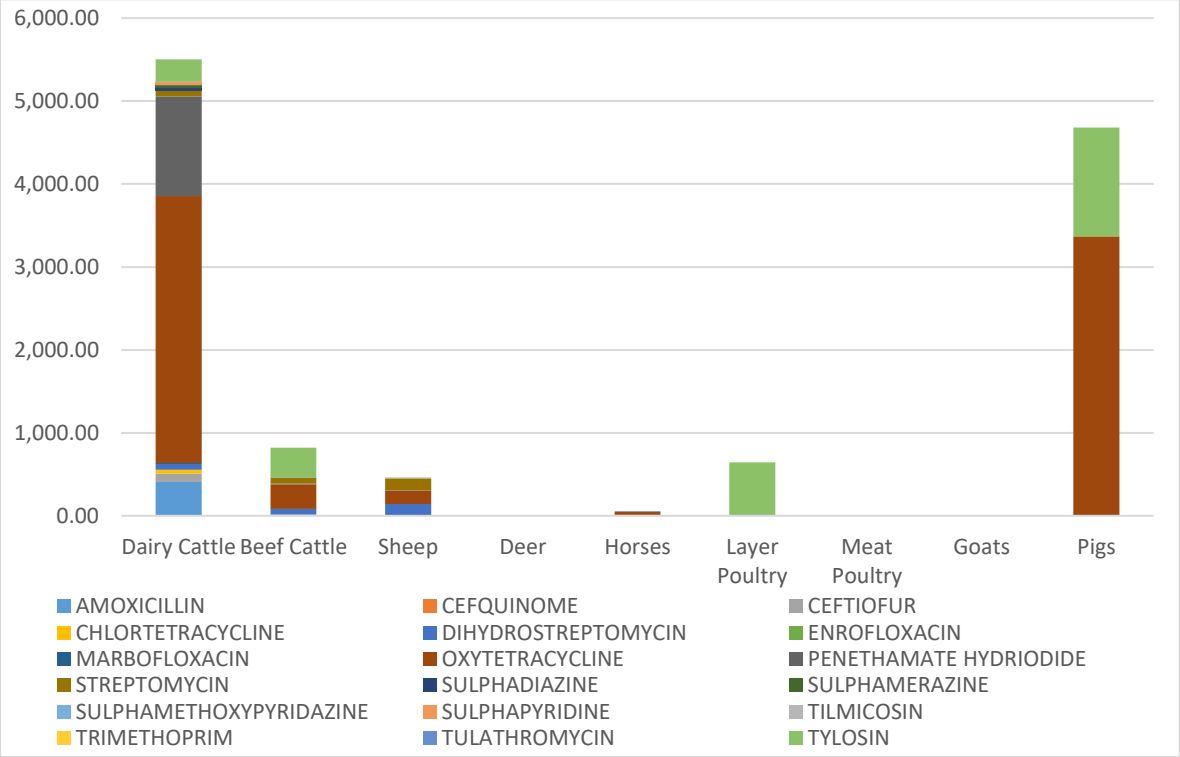
Figure 50: Distribution of sales for multiple production species products by target species or group in 2021



Oxytetracycline in multi-production products accounted for 58% of the total quantity sold for use in dairy cattle followed by penethamate hydriodide (22%), and tylosin (5%) according to registrant estimates. For beef cattle registrants estimated that oxytetracycline accounted for 35% of sales, tylosin 44% and penethamate hydriodide 2%. Poultry sales were dominated by two antibiotics, with registrants and industry attributing tylosin in multi-production species products as being sold for use in layer poultry and oxytetracycline attributed as sold for use in meat poultry.

Based on registrants estimates agreed by industry, oxytetracycline accounted for 72% of antibiotics sold for use in pigs in multi-production species products with 28% from tylosin compared to 87% and 13% respectively for each antibiotic in 2020.

Figure 51: Sales of multi-production products by active ingredient and species class 2021 (in kilograms)



6.8 Cattle-only and sheep-only products

A total of 14 cattle-only and sheep-only products were registered in 2021 of which 12 had sales reported (8% of products with sales). The total antibiotic quantity in these products was 906 kilograms (2% of 2021 sales total) compared to 1,152 kilograms in 2020. Six antibiotic classes were present in these products of which two are classed as critically important.

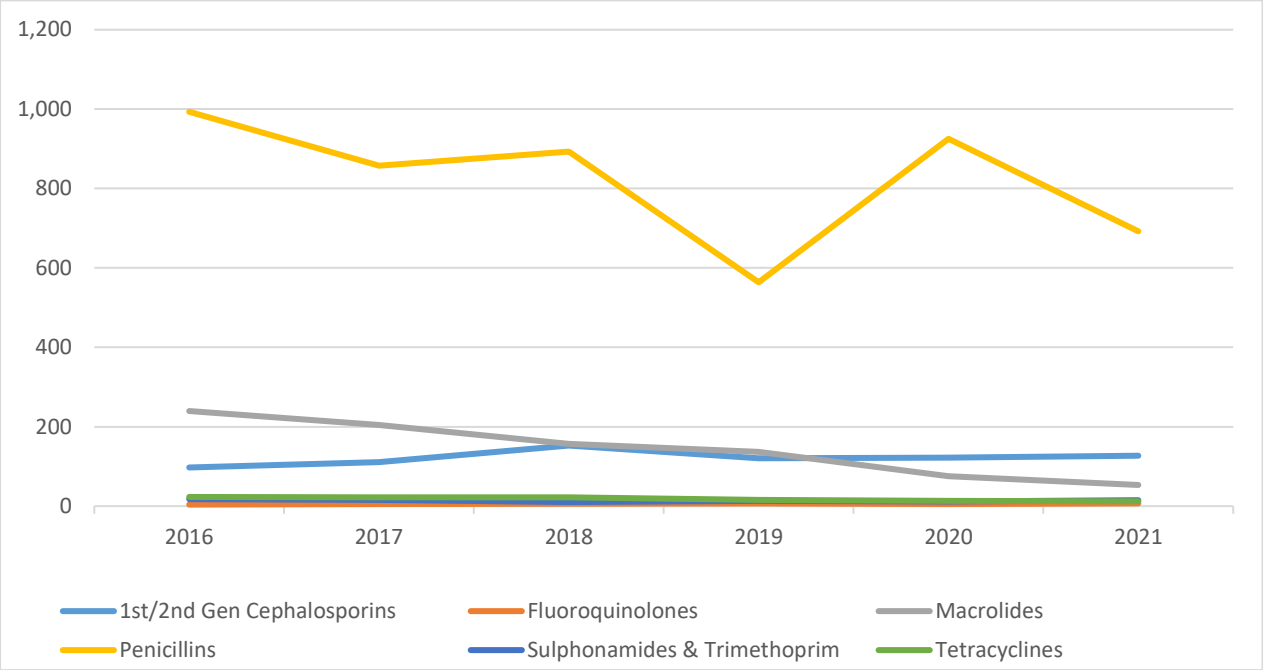
In addition to cattle- and sheep-only products, registrants estimated that an additional 16,903 kilograms of multi-species and multiple production animal products were also used in cattle and sheep resulting in a total of 17,812 kilograms applied to these species (81% in dairy cattle, 10% in beef cattle and 8% in sheep) accounting for 33% of total antibiotic sales. Because this additional quantity 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.

For the two critically important classes, the quantity of macrolides in these products decreased by 22% in 2021 to 53 kilograms and accounted for 6% of antibiotics present. The fluoroquinolones increased by just under 2 kilograms to 7 kilograms and accounted for 1% of the sales total.

Penicillins and clavulanic acids accounted for most of the antibiotics contained in these products with 692 kilograms (76% of the sales volume) and amounts sold have been variable in recent years with a high of 924 kilograms in 2020, a low of 563 kilograms in 2019, and an average of 846 kilograms. The next largest contributor to the sales total were the first and second generation cephalosporins with a 4% increase to 127 kilograms and 14% of the sales total.

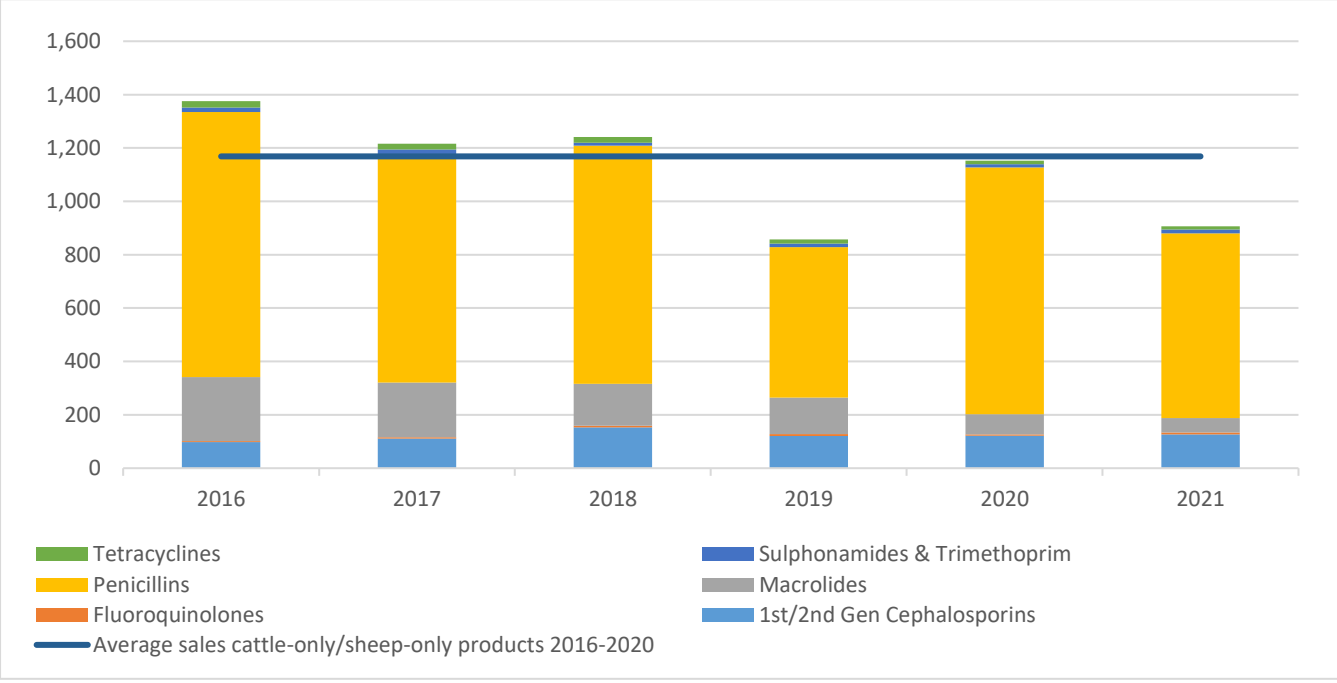
Over 83% of antibiotics included in cattle-only and sheep-only products were injectable formulations,15% were intrauterine formulations and 2% were topical formulations.

Figure 52: 2021 Total cattle-only and sheep-only product antibiotic sales 2016-2021 (in kilograms)



Comparing the 2021 and 2016 sales, macrolide quantities decreased by 80%, whereas penicillin and clavulanic acid decreased by 30%. Antibiotics in cattle-only and sheep-only products were 22% below the sales average for the previous five years.

Figure 53: Antibiotic sales in cattle-only and sheep-only products compared to previous five-year sales trend (in kilograms)

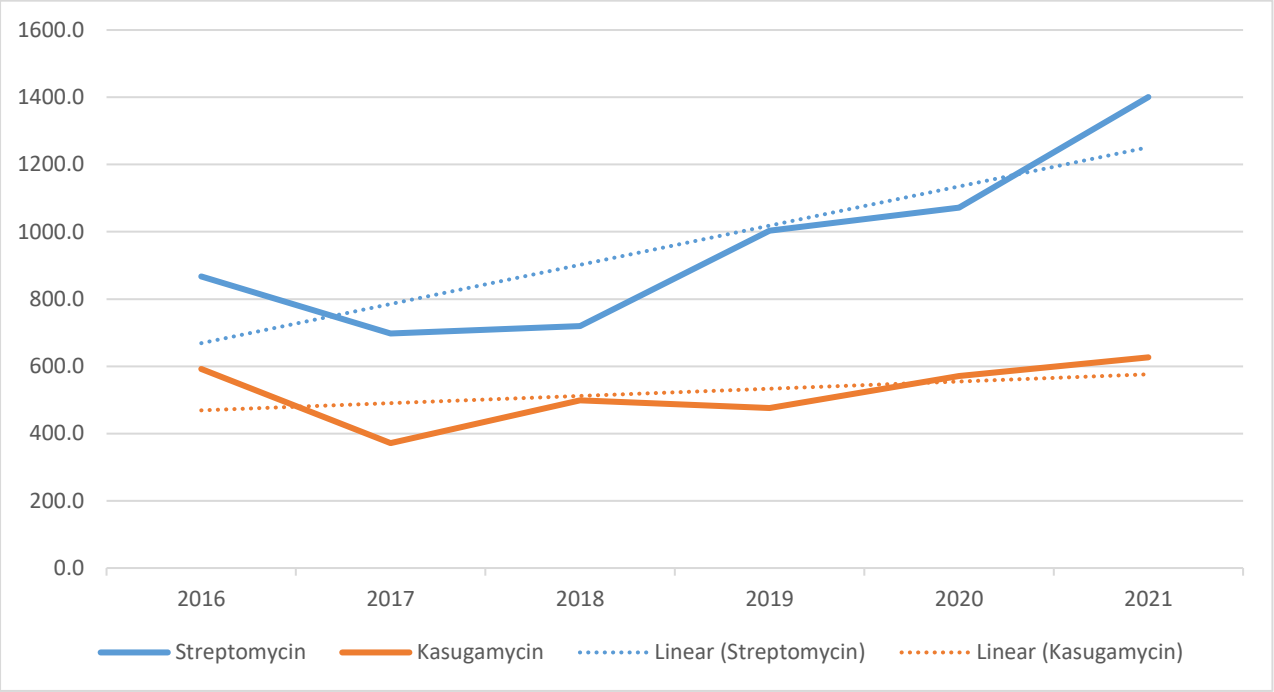


6.9 Crop protection antibiotics

Two antibiotic compounds are used for crop protection in New Zealand, both of which are aminoglycosides: the critically important streptomycin, used in kiwifruit, pome fruit and stone fruit; and the highly important kasugamycin, used only on kiwifruit. Sales of antibiotics for crop protection increased by 23% in 2021 following an 11% increase in the previous year.

Streptomycin sales increased by 31% to 1,400 kilograms compared to 1,042 kilograms in 2020 which was 61% higher than the five-year sales average for this compound. Kasugamycin sales also increased by 10% to 626 kilograms which was 25% higher than the five-year average for this compound. According to Zespri, kasugamycin may have been bought by growers and kept in storage as weather conditions may have prevented application on kiwifruit crops. Registrants estimated that 75% of streptomycin was sold for use on pome fruit (apples and pears), with 15% sold for use on kiwifruit and 10% on stone fruit.

Figure 54: Crop protection aminoglycosides sales 2016-2021 (with trend line) in kilograms



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 wet weather events coinciding with bloom periods.

7 Conclusions

Overall antibiotic sales quantities have decreased for the last four reporting periods and were approximately 25% less than the volume reported in 2017.

The magnitude of the decline in 2021 is largely due to the substantial decrease in sales of zinc bacitracin. This reduction would have had a considerably larger impact on the sales total but was offset by increased quantities of penicillins and clavulanic acid. Sales quantities for the fifteen classes excluding polypeptides has consistently been around 40,000 kilograms each year with amounts sold 4% higher than 2020 and 7.7% higher than in 2019.

Using registrant estimates of use in addition to species-specific product sales, antibiotics used in dairy cattle increased to 27% of the sales total compared to 22% in 2020, antibiotics used in meat poultry were 10% lower at 24% compared to 2020 (largely attributed to the much lower volumes of zinc bacitracin sold). The volume of antibiotics used in pigs was relatively unchanged at 12%.

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 6% of the sales total.

The quantity of antibiotics sold in intramammary treatments was relatively unchanged compared to the previous year at 8,215 kilograms (15% of the sales total), however, there is an increasing trend towards using LCT products compared to DCT products over time.

Critically important antibiotic quantities decreased by 1.4% in 2021 mainly due to lower macrolide sales offset by higher sales of aminoglycosides (crop protection and veterinary).

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 bought in advance of use, 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 a full course of treatment may not be completed. 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 93% of the 2021 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 2021, Statistics New Zealand population data year to June 2021, has been used to estimate 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 Appendix 1.

Based on a total production animal New Zealand PCU of **6,832,703,668** kilograms and the veterinary antibiotic sales total of 51,395 kilograms, the 2021 New Zealand AMU is **7.522 milligrams antibiotic per kilogram liveweight biomass.**

In 2020 the respective numbers were 6,748,196,893 (PCU) and 8.594 milligrams antibiotic per kilogram liveweight biomass (AMU) with a veterinary sales total of 57,994 kilograms.

In relative terms the PCU for New Zealand increased by 1.25% in 2021 and the AMU decreased by 12.5%.

Although there are no 2021 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)

Appendix 1: Antimicrobial use data 2021

	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	475
2021 Population - Raw	4,025,000	4,025,000	4,025,000	6,282,000	6,282,000	6,282,000	25,730,000	25,730,000	841,993	841,993	625,086	32,000	4,600,000	120,439 000	250,000	93,606	148,362
2021 Population - Stratified	1,207,500	1,207,500	1,610,000	628,200	628,200	5,025,600	18,011,000	7,719,000	378,897	463,096	625,086	32,000	4,600,000	120,439,000	250,000	93,606	148,362
PCU (subset class)	241,500,000	567,525,000	837,200,000	113,076,000	270,126,000	3,015,360,000	990,605,000	501,735,000	22,733,811	50,940,577	42,626,920	6,720,000	10,580,000	120,439,000	500,000	5,616,360	70,471,950

Total PCU (kilograms)	**6,832,703,668**
Total 2021 Sales (kilograms)	51,395
AMU (kg)	0.00000752
AMU (mg antibiotic/kg)	7.522

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
- 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

Appendix 2: Antimicrobial Use Data 2020 (Amended)

Includes revised population data for turkeys and sales total (excludes crop protection kgs)

	Beef			Dairy			Sheep		Deer		Pigs[1]		Poultry[1]			Goats	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	500
2020 Population - Raw	3,883,000	3,883,000	3,883,000	6,200,000	6,200,000	6,200,000	26,029,000	26,029,000	833,000	833,000	624,421	31,000	5,105,462	118,702,000	500,000	93,606	72,000
2020 Population - Stratified	1,164,900	1,164,900	1,553,200	620,000	620,000	4,960,000	18,220,300	7,808,700	374,850	458,150	624,421	31,000	5,105,462	118,702,000	500,000	93,606	72,000
PCU (subset class)	232,980,000	547,503,000	807,664,000	111,600,000	266,600,000	2,976,000,000	1,002,116,500	507,565,500	22,491,000	50,396,500	43,709,470	6,510,000	11,742,563	118,702,000	1,000,000	5,616,360	36,000,000

Total PCU (kilograms)	**6,748,196,893**
Total 2020 Sales (kilograms)	57,994
AMU (kg)	0.00000859
AMU (mg antibiotic/kg)	8.5940