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Australian Pesticides and Veterinary Medicines Authority

QUANTITY OF ANTIMICROBIAL PRODUCTS SOLD FOR VETERINARY USE IN AUSTRALIA

JULY 2005 TO JUNE 2010

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EXECUTIVE SUMMARY

This is the second report the Australian Pesticides and Veterinary Medicines Authority (APVMA) has published on the quantity of veterinary antimicrobial products sold in Australia. It covers the 5 financial years from July 2005 to June 2010 and combines data voluntarily submitted to the APVMA by registrants of veterinary antimicrobial products.

Antimicrobials are important for maintaining the health and welfare of humans and animals. The emergence and spread of antimicrobial resistance (AMR) has led to increasing concerns in Australia and overseas about the use of antimicrobial products to treat disease in humans and animals. There is evidence the use of antimicrobials in animals is not the principal cause of problems encountered when treating humans. Nevertheless, the use of antimicrobials in animals may lead to AMR concerns in humans.

In response, one action of the Australian Government strategy to prevent and contain AMR is to collect information about the quantity of antimicrobial products administered to animals in Australia. It is reasonable to assume a close relationship exists between the quantities of antimicrobials sold and the amounts administered to animals. However, as the APVMA has no control over the quality or completeness of voluntary data provided, data contained in this report is indicative only of overall trends in sales and should not be viewed as accurate.

The sales data does not suggest any significant change in the total quantity of antimicrobial products sold from 2005 to 2010 (Table 1). Quantities sold for use in food animals varied from 482 tonnes to 655 tonnes. Low sales in 2008–09 are likely due to some sales not being reported that year. Levies collected by the APVMA support this assumption: the total levy for 2008–09 was greater than the total levy for 2007–08, but less than 2009–10.

Table 1: Total sales of veterinary antimicrobials (tonnes of active constituent), by animal type as estimated (July 2005 to June 2010)

ANIMAL TYPE	2005-06	2006-07	2007-08	2008-09	2009-10
Food animals	655.0	571.5	580.0	481.5	644.0
Non-food animals	9.7	10.9	12.0	10.6	17.2
Total	**664.8**	**582.4**	**592.0**	**492.0**	**661.2**

An average 98% of the total antimicrobials sold in Australia for animal use from 2005 to 2010 was used in food animals (Table 2, page 2). The remaining 2% was used in non-food animals. Of the total quantity of antimicrobials sold for use in food animals, an average 43% were sold for therapeutic or prophylactic purposes (both are referred to in this report as *therapeutic* purposes).

Of the total quantity of antimicrobials sold for therapeutic purposes for use in food animals, an average 49% were used in poultry and 15% in cattle and sheep. Pigs accounted for 36%. Most antimicrobials were administered in feed (76.4%). Administration in water accounted for 18.4%, while injectable and intramammary administration accounted for 4% and 0.7%, respectively. All other routes of administration averaged 0.6%.

An average 30% of total sales (by weight of active constituent) of antimicrobials used in Australia for therapeutic purposes in food animals consisted of the polypeptide called bacitracin. Macrolides and streptogramins (grouped together) contributed an average 24%. Tetracyclines made up the next largest class, accounting for an average 23% of total sales.

The antimicrobial coccidiostats used to prevent coccidiosis disease in chickens comprised over half of total veterinary antimicrobials sales. Coccidiostats belong to classes of antimicrobials not used in humans and are not considered to contribute to AMR risks in humans.

Growth promotants comprised 4%–7% of the total antimicrobials sold for use in Australian food animals. From 2005 to 2010 an average of 35.3 tonnes of antimicrobials was sold as growth promotants, with quantities across these years ranging from 23.8 tonnes to 47.2 tonnes.

Table 2: Total sales of veterinary antimicrobials (tonnes of active constituent) used in food animals, by purpose and year (July 2005 to June 2010)

PURPOSE	2005-06	2006-07	2007-08	2008-09	2009-10
Coccidiostat	336.2	302.9	279.3	258.5	327.1
Growth promotant	47.2	38.2	38.4	23.8	28.9
Therapeutic	271.6	230.4	262.3	199.1	288.0
Total	**655.0**	**571.5**	**580.0**	**481.5**	**644.0**

The fluoroquinolone antibiotics are classified as ‘antimicrobials of high importance in human medicine’. They are not approved for use in food animals in Australia. An average 0.13 tonnes of fluoroquinolones were sold in Australia for use in non-food animals from 2005 to 2010. Just a single third-generation cephalosporin is approved for use in non-food animals. Sales of this cephalosporin (ceftiofur) averaged 0.09 tonnes from 2005 to 2010.

The APVMA intends to continue to collect and publish this information to assist in tracking antimicrobial use trends and evaluating the effectiveness of actions to prevent or mitigate AMR.

1 INTRODUCTION

Antimicrobial resistance (AMR) is the resistance of a microorganism to an antimicrobial medicine to which it was originally sensitive. Resistant microorganisms include bacteria, fungi, viruses and some parasites and their resistance can mean that antimicrobial medicines such as antibiotics, antifungals and antivirals become ineffective.

AMR is considered a major global public health concern and a potential food safety issue. In veterinary medicine, the use of antimicrobial products has a potential to impact human health, as well as animal health and welfare and the environment. Both the veterinary and medical sectors share the responsibility of minimising the development of AMR.

The emergence and spread of AMR has led to increasing concerns in Australia and overseas about the use of antimicrobial products in humans and animals. In response, the Australian Government has established two committees to oversee the prevention and containment of AMR in Australia:

- The Australian Antimicrobial Resistance Prevention and Containment (AMRPC) Steering Group was established in February 2013 to provide high-level governance and leadership on AMR and to oversee the development and implementation of a coherent national framework for current and future work related to AMR.
- The Antimicrobial Resistance Standing Committee (AMRSC) was established in April 2012 to oversee AMR in Australia, provide expert advice and recommend priorities on issues relating to AMR.

A key component of the national AMR prevention and containment strategy is the surveillance of antimicrobial use in animals. The APVMA is the Australian Government authority responsible for the regulation of pesticides and veterinary medicines up to and including the point of retail sale. The APVMA contributes to the national AMR strategy by collecting information, voluntarily submitted by registrants, on the quantity of antimicrobials sold in Australia.

This report describes sales of veterinary antimicrobials in Australia from July 2005 to June 2010.

It is intended that information in this report is used to:

- facilitate risk analysis for registration and extensions of use applications
- contribute to formal reviews of antimicrobials by regulatory authorities
- assist with the evaluation of the effectiveness of prudent use efforts and mitigation strategies
- assist with the study of trends in antimicrobial usage
- facilitate international reporting and comparisons.

2 COLLECTION OF DATA

Registrants were requested to supply (by posting or emailing sales spreadsheets) the sales of their approved antimicrobial products for the financial years from 1 July 2005 to 30 June 2010. A sample table was supplied, requiring registrants to prepare and submit similar tables that contained:

- product name
- registration number
- active constituent
- active constituent amount (g or kg)
- pack size (ml or g)
- number of specific packs sizes sold
- kilograms of active constituent
- species for which product is approved
- percentage used in each species.

Although submission of data to APVMA was voluntary, compliance with the request was high, with sales from a total of 329 products reported from July 2005 to June 2010.

Many veterinary antimicrobials are approved for use in more than a single species and/or for more than one purpose, and some products are approved for use in both food and non-food animal species (Table 3).

Table 3: Count of approved veterinary antimicrobial products from which sales were reported, by species type and purpose (July 2005 to June 2010, Ther. – Therapeutic, Gr. prom. – Growth promotant, C'stat – Coccidiostat)

	THERAPEUTIC	THER./GR. PROM	GR. PROM.	GR. PROM./C'STAT	COCCIDIOSTAT	TOTAL
Single food animal species	58	9	2	8	18	95
Multiple food animal species	52	11	4	16	0	83
At least one food animal and non-food animal species	52	0	0	0	0	52
One or more non-food animal species	98	0	0	0	1	99
Total	**260**	**20**	**6**	**24**	**19**	**329**

Registrants were subsequently asked to provide estimates of the proportion of products used for growth-promoting purposes, where such products were approved for another purpose (such as anticoccidial, therapeutic or preventive) in addition to growth promotion.

2.1 Limitations

There are several limitations in the collection and analysis of antimicrobial sales data.

The APVMA considers it reasonable to assume a close relationship exists between the quantities of antimicrobials sold and amounts used in animals in Australia. However, as the APVMA has no control over the quality or completeness of the data provided, the results should be regarded as indicative of overall trends in sales, and should not be over-interpreted.

Registrants provided estimates of the proportions of their products used in different species, and of the proportion used in each species for growth-promoting purposes. The APVMA used these proportions to 'distribute' amounts of those products that are labelled for use in multiple species, or for multiple purposes, to individual categories for analysis. It is not possible to assess the accuracy of these estimates.

The data reported does not take into account the relative potencies of the different active ingredients. For example, as much as 10 times the amount of one particular antimicrobial may be required to treat the same disease when compared with an equally efficacious alternative. No adjustments are made in this report for the differences in potency (or intrinsic activity) of antimicrobials.

3 VETERINARY ANTIMICROBIALS

All antimicrobials approved for veterinary uses in Australia are Schedule 4 (prescription-only) drugs, except for tylosin and coccidiostats, neither of which is used in human medicine.

Veterinary antimicrobials are used in Australia in three main contexts[1]:

1. Therapeutic administration under the direction of a veterinarian to individual animals that display evidence of infection (therapeutic).
2. Prophylactic administration under the direction of a veterinarian to healthy animals that are believed to be at risk of developing an infection (prophylactic).
3. Administration via feed or water in low concentrations to increase the efficiency of feed conversion or to prevent disease (growth promotants, coccidiostats). These products are limited to those considered to be low risk to human health, and may be used without veterinary intervention.

For the purposes of this report, no distinction is made between 'therapeutic' and 'prophylactic' uses because it is difficult for registrant companies to estimate the proportions of products used for these purposes. All products with either or both of these indications are categorised as *therapeutic*. Note that all products with coccidiostat or coccidiocidal indications are grouped together as 'coccidiostats' (see Section 6.1, page 23).

Table 4 (page 7) gives a breakdown of veterinary antimicrobials used in Australia from July 2005 to June 2010, indicating the species and purposes for which they are approved.

[1] http://www.apvma.gov.au/news_media/community/2011-02_antibiotics_farming.php

Table 4: Veterinary antimicrobials sold in Australia (July 2005 to June 2010), indicating the species and purposes for which some (or all) of the products containing the constituent may be labelled

CLASS	CONSTITUENT	NON-FOOD ANIMALS	FOOD ANIMALS	THERAPEUTIC	GROWTH PROMOTANT	COCCIDIOSTAT
Aminocoumarins	Novobiocin	X	X	X		
Aminoglycosides	Apramycin		X	X		
	Dihydrostreptomycin		X	X		
	Framycetin	X	X	X		
	Gentamicin	X		X		
	Neomycin	X	X	X		
	Spectinomycin	X	X	X		
	Streptomycin	X	X	X		
Amphenicols	Chloramphenicol	X		X		
	Florfenicol		X	X		
Arsenicals	Roxarsone		X		X	
Benzamides	Dinitolmide		X			X
Carbanilides	Nicarbazin		X			X

CLASS	CONSTITUENT	NON-FOOD ANIMALS	FOOD ANIMALS	THERAPEUTIC	GROWTH PROMOTANT	COCCIDIOSTAT
Cephalosporins	Cefovecin (3rd generation)	X		X		
	Ceftiofur (3rd generation)	X	X	X		
	Cefuroxime (2nd generation)		X	X		
	Cephalexin (1st generation)	X		X		
	Cephalonium (1st generation)	X	X	X		
	Cephapirin (1st generation)		X	X		
Fluoroquinolones	Difloxacin	X		X		
	Enrofloxacin	X		X		
	Marbofloxacin	X		X		
	Orbifloxacin	X		X		
Fusidanes	Fusidic acid	X		X		
Glycophospholipids	Flavophospholipol		X		X	
Lincosamides	Clindamycin	X		X		
	Lincomycin	X	X	X		

CLASS	CONSTITUENT	NON-FOOD ANIMALS	FOOD ANIMALS	THERAPEUTIC	GROWTH PROMOTANT	COCCIDIOSTAT
Macrolides	Erythromycin		X	X		
	Kitasamycin		X		X	
	Oleandomycin		X	X		
	Tilmicosin		X	X		
	Tulathromycin		X	X		
	Tylosin		X	X	X	
Nitrofurans	Nitrofurazone	X		X		
Nitroimidazoles	Dimetridazole	X	X	X		
	Ronidazole	X		X		
Oligosaccharides	Avilamycin		X	X	X	
Others	Amprolium	X				X
	Nystatin	X		X		
	Robenidine		X			X
	Tiamulin		X	X		

CLASS	CONSTITUENT	NON-FOOD ANIMALS	FOOD ANIMALS	THERAPEUTIC	GROWTH PROMOTANT	COCCIDIOSTAT
Penicillins/beta-lactamase inhibitors	Amoxycillin	X	X	X		
	Ampicillin		X	X		
	Benzathine penicillin	X	X	X		
	Clavulanic acid	X	X	X		
	Cloxacillin	X	X	X		
	Penethamate	X	X	X		
	Procaine penicillin	X	X	X		
Polyether ionophores	Lasalacid		X		X	X
	Maduramicin		X			X
	Monensin		X		X	X
	Narasin		X		X	X
	Salinomycin		X		X	X
	Semduramicin		X			X
Polypeptides	Bacitracin	X	X	X		
	Polymixin B	X	X	X		
Quinoxaline	Olaquindox		X	X	X	
Streptogramins	Virginiamycin	X	X	X		

CLASS	CONSTITUENT	NON-FOOD ANIMALS	FOOD ANIMALS	THERAPEUTIC	GROWTH PROMOTANT	COCCIDIOSTAT
Sulfonamides and diaminopyrimidine potentiators	Phthalylsulfathiazole	X		X		
	Sulfacetamide	X		X		
	Sulfadiazine	X	X	X		
	Sulfadimidine	X	X	X		
	Sulfadoxine	X	X	X		
	Sulfaquinoxaline		X			X
	Trimethoprim	X	X	X		
Tetracyclines	Chlortetracycline	X	X	X		
	Doxycycline	X		X		
	Oxytetracycline	X	X	X		
	Tetracycline	X		X		
Triazines	Toltrazuril		X			X

4 TOTAL SALES (TONNES OF ACTIVE CONSTITUENTS) OF VETERINARY ANTIMICROBIALS

The total quantities (in tonnes of active constituents) of veterinary antimicrobials sold from July 2005 to June 2010 are shown, by animal type as labelled, in Table 5. The sales figures do not suggest a significant difference in total quantity of sales from 2005 to 2010. It is thought that lower sales for 2008–09 for food animals may be due to under-reporting.

Table 5: Total sales of veterinary antimicrobials (tonnes of active constituent), by animal type as labelled (July 2005 to June 2010)

ANIMAL TYPE	2005-06	2006-07	2007-08	2008-09	2009-10
Food animals	645.1	560.4	566.8	467.0	625.2
Food and non-food animals	13.9	16.0	18.2	18.5	23.9
Non-food animals	5.7	6.0	7.0	6.5	12.1
Total	**664.8**	**582.4**	**592.0**	**492.0**	**661.2**

Registrant estimates of the proportion of products used in the various species for which they are labelled were used to apportion the amounts in the 'Food and non-food animals' category to 'Food animals' or 'Non-food animals' in Table 6. For the remainder of this report, analyses are based on data apportioned as in Table 6, which indicates that an average 98% (by weight of active constituent) of antimicrobials were sold for administration to food animals.

Table 6: Total sales of veterinary antimicrobials (tonnes of active constituent), by animal type as estimated (July 2005 to June 2010)

ANIMAL TYPE	2005-06	2006-07	2007-08	2008-09	2009-10
Food animals	655.0	571.5	580.0	481.5	644.0
Non-food animals	9.7	10.9	12.0	10.6	17.2
Total	**664.8**	**582.4**	**592.0**	**492.0**	**661.2**

Antimicrobials used in non-food animals are sold for therapeutic purposes, with the exception of small amounts of coccidiostats, as a number of products are approved for this purpose in pigeons or ornamental birds.

Registrant estimates of the proportion of products sold for growth-promotant purposes in each applicable (food animal) species were used to allocate mixed-purpose products to single-purpose categories (therapeutic, growth promotant, coccidiostat). The results (Table 7, page 13) indicate that an average 43% of products sold were used for therapeutic purposes in food animals, 6% were sold for growth-promotant purposes and 51% of products were sold for coccidiostat purposes.

Notably, over half of the quantity of veterinary antimicrobials sold from 2005 to 2010 was used as coccidiostats. These belong to classes of antimicrobials not used in humans and not considered to contribute to AMR risks in humans. About 4% of the quantity of products sold was used for growth-promotant purposes, whilst non-food animals accounted for 1.5%–2.6%.

Table 7: Total sales of veterinary antimicrobials (tonnes of active constituent) used in food animals, by purpose and year (July 2005 to June 2010)

PURPOSE	2005-06	2006-07	2007-08	2008-09	2009-10
Coccidiostat	336.2	302.9	279.3	258.5	327.1
Growth promotant	47.2	38.2	38.4	23.8	28.9
Therapeutic	271.6	230.4	262.3	199.1	288.0
Total	**655.0**	**571.5**	**580.0**	**481.5**	**644.0**

The total amount and percentage of the active ingredients of veterinary antimicrobials used as growth promotants ranged from 47.2 tonnes (7.2%) in 2005–06 to 28.9 tonnes (4.5%) in 2009–10.

The breakdown of veterinary antimicrobial use by food animal species and year is shown in Table 8.

Table 8: Total sales of veterinary antimicrobials (tonnes of active constituent) used in food animals, by species and year (July 2005 to June 2010)

SPECIES	2005-06	2006-07	2007-08	2008-09	2009-10
Cattle and sheep	163.8	149.7	125.0	106.9	133.3
Poultry	385.0	318.6	351.9	276.4	406.4
Pigs	106.1	103.1	103.0	98.0	104.2
Other food animal species	0.0	0.1	0.1	0.1	0.2
Total	**655.0**	**571.5**	**580.0**	**481.5**	**644.0**

4.1 Livestock holdings and slaughter data

To assist in placing into context the antimicrobial sales data described in this report, Australia's livestock holdings and slaughterings are shown in Figure 1 and Figure 2 (page 14). With the exception of sheep, the numbers of which have steadily declined, the sizes of the national herds and flocks were relatively constant from June 2005 to July 2010. The pattern of slaughterings shows a similar trend, with the exception of an annual increase in the number of chickens slaughtered.

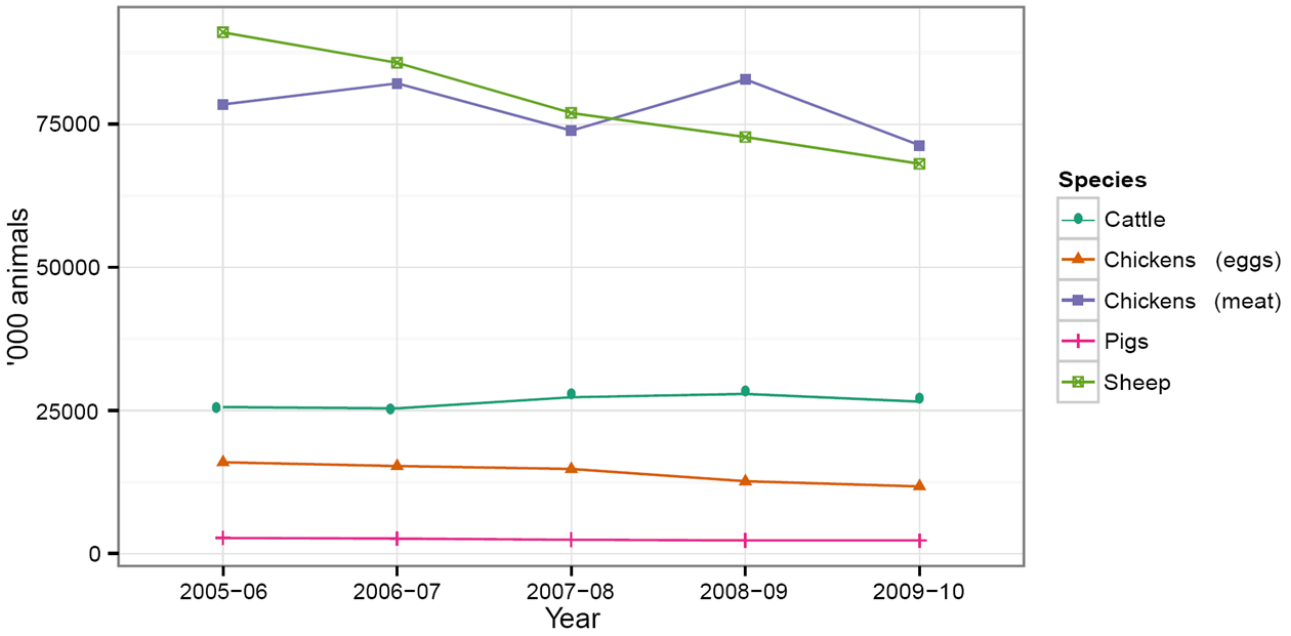

Figure 1: Numbers (in thousands of animals) of Australian cattle, sheep, pigs and chickens (July 2005 to June 2010)

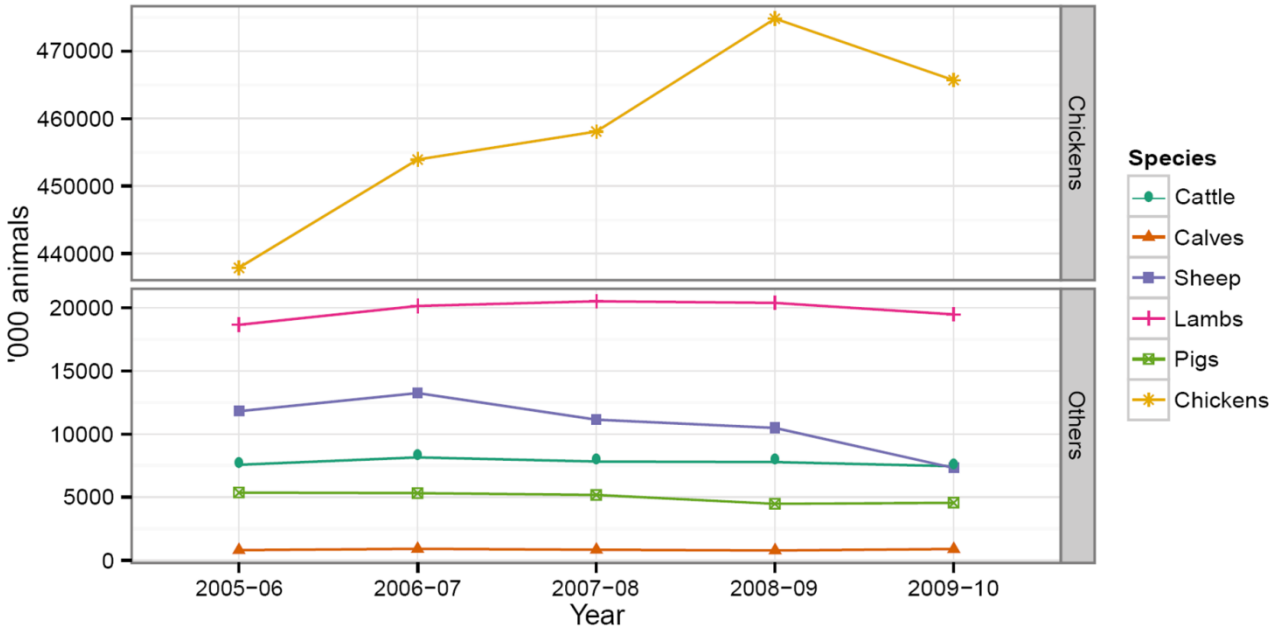

Figure 2: Slaughter numbers (in thousands of animals) of Australian cattle, calves, sheep, lambs, pigs and chickens (July 2005 to June 2010)

5 SALES (TONNES OF ACTIVE CONSTITUENT) OF VETERINARY ANTIMICROBIALS USED FOR THERAPEUTIC PURPOSES

5.1 Food animals

Data presented here are restricted to those products approved for use in food animals and used for therapeutic purposes. Total sales (tonnes of active constituent) are shown by antimicrobial class from July 2005 to June 2010, in Figure 3, page 16) and Table 9 (page 17).

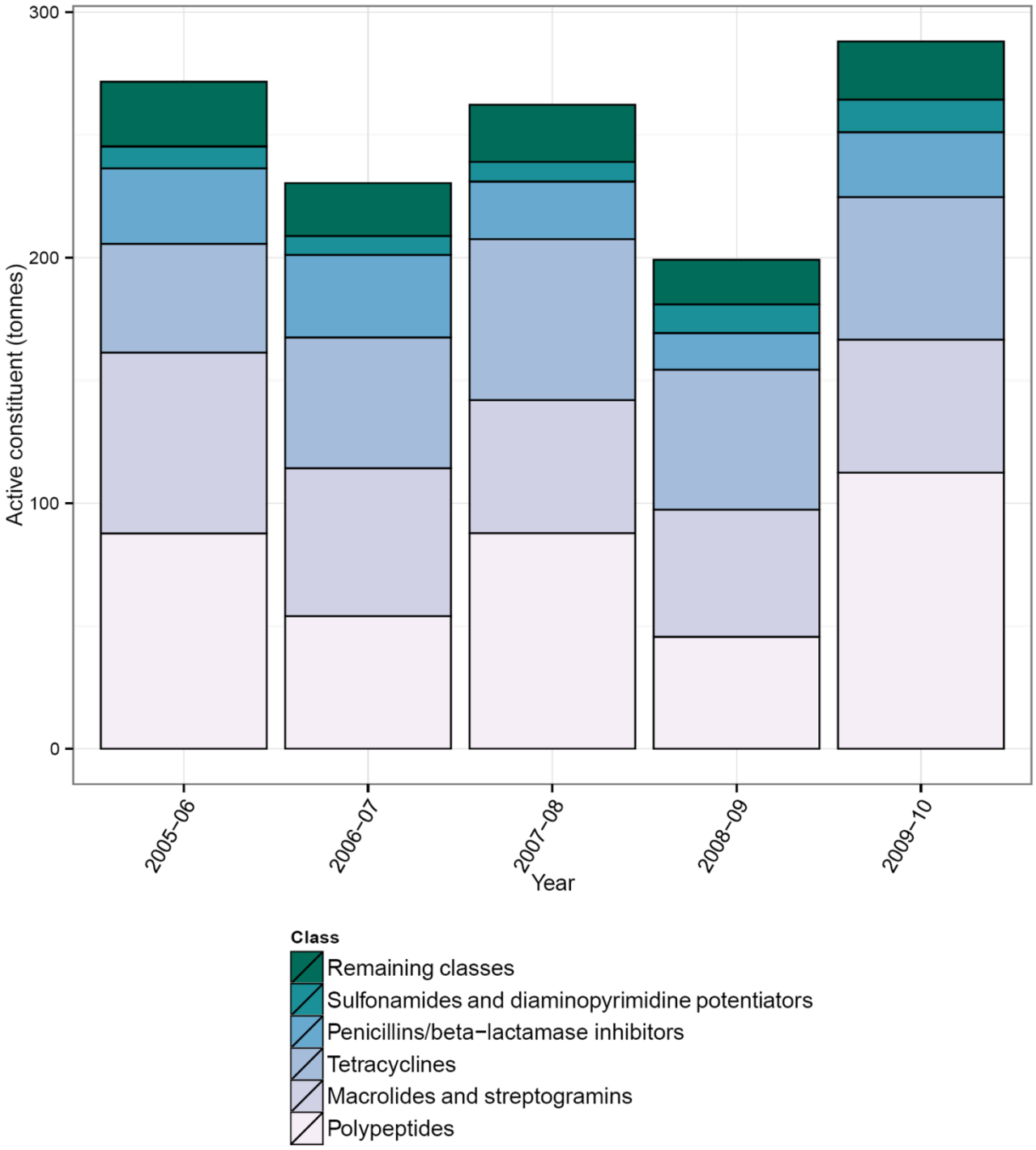

Figure 3: Chart of quantity (tonnes of active constituent) of antimicrobials used for therapeutic purposes in food animals, by antimicrobial class (July 2005 to June 2010; Remaining classes (in decreasing order of quantities): Oligosaccharides, Aminoglycosides, Lincosamides, Quinoxaline, Nitroimidazoles, Others, Amphenicols, Cephalosporins, and Aminocoumarins)

Table 9: Total sales of veterinary antimicrobials used for therapeutic purposes in food animals (tonnes of active constituent, % column total), by antimicrobial class (July 2005 to June 2010)

	2005-06		2006-07		2007-08		2008-09		2009-10	
CLASS	TONNES	%	TONNES	%	TONNES	%	TONNES	%	TONNES	%
Aminocoumarins	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aminoglycosides	7.2	2.7	6.3	2.7	5.5	2.1	6.3	3.2	5.6	2.0
Amphenicols	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.3
Cephalosporins	0.0	0.0	0.1	0.0	0.2	0.1	0.2	0.1	0.3	0.1
Lincosamides	3.2	1.2	3.7	1.6	5.4	2.1	2.9	1.5	6.4	2.2
Macrolides and streptogramins	73.6	27.1	60.1	26.1	54.2	20.7	51.8	26.0	54.2	18.8
Nitroimidazoles	4.2	1.5	0.7	0.3	2.4	0.9	0.4	0.2	2.4	0.8
Oligosaccharides	5.8	2.1	7.4	3.2	6.8	2.6	5.8	2.9	5.3	1.8
Others	1.2	0.4	1.4	0.6	1.3	0.5	1.1	0.6	1.2	0.4
Penicillins/beta-lactamase inhibitors	30.7	11.3	33.6	14.6	23.5	8.9	14.9	7.5	26.4	9.2
Polypeptides	87.7	32.3	54.1	23.5	87.8	33.5	45.6	22.9	112.5	39.1
Quinoxaline	4.7	1.7	2.0	0.9	1.5	0.6	1.3	0.6	1.5	0.5
Sulfonamides and diaminopyrimidine potentiators	8.9	3.3	7.7	3.3	8.0	3.1	11.7	5.9	13.3	4.6
Tetracyclines	44.3	16.3	53.3	23.1	65.6	25.0	57.0	28.6	58.0	20.1
Total	**271.6**	**100.0**	**230.4**	**100.0**	**262.3**	**100.0**	**199.1**	**100.0**	**288.0**	**100.0**

Figures are rounded to the nearest 0.1 tonne.
A value of '0.0' indicates that the quantity sold was less than 50 kg.
Macrolides and streptogramin quantities have been combined to protect commercially-confidential information provided by the one registrant of the streptogramin virginiamycin.

An average 30% of total sales (by weight of active constituent) of antimicrobials used for therapeutic purposes in food animals over the 5 years from July 2005 to June 2010 consisted of the polypeptide called bacitracin. Bacitracin is used for the treatment and/or prevention of necrotic enteritis due to *Clostridium perfringens* types A and C in poultry, and is administered in the feed. The macrolides and streptogramins (grouped together) contributed an average 24% whilst the tetracyclines were the next largest class, accounting for an average 23% of sales. Most of the macrolides are administered in food or water to pigs and poultry; the streptogramins are administered on a prescription-only basis in the feed to reduce the risk of acidosis due to high grain diets (cattle and sheep), and for the prevention of necrotic enteritis in broiler chickens caused by *Clostridium perfringens* sensitive to virginiamycin (Figure 4, page 19). The tetracyclines comprise numerous products, and have a varied species range and routes of administration. Most products containing tetracyclines are administered in the feed (Figure 5, page 20) and are typically used in pigs, poultry and (to a limited extent), calves, for the prevention and treatment of diseases caused by microorganisms susceptible to the active constituent.

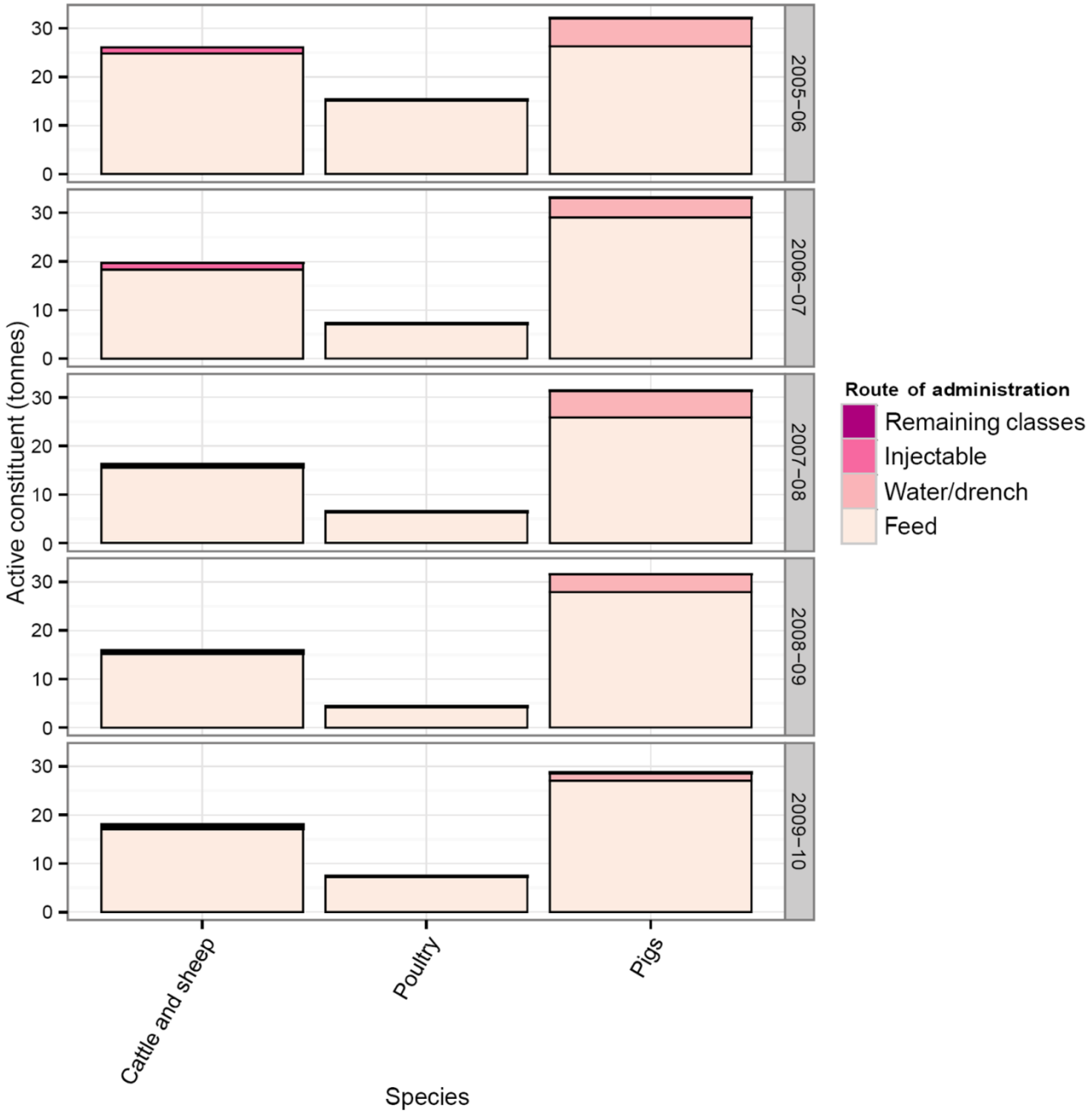

Figure 4: Chart of quantity (tonnes of active constituent) of macrolide and streptogramin products used for therapeutic purposes in food animals, by species and route of administration (July 2005 to June 2010)

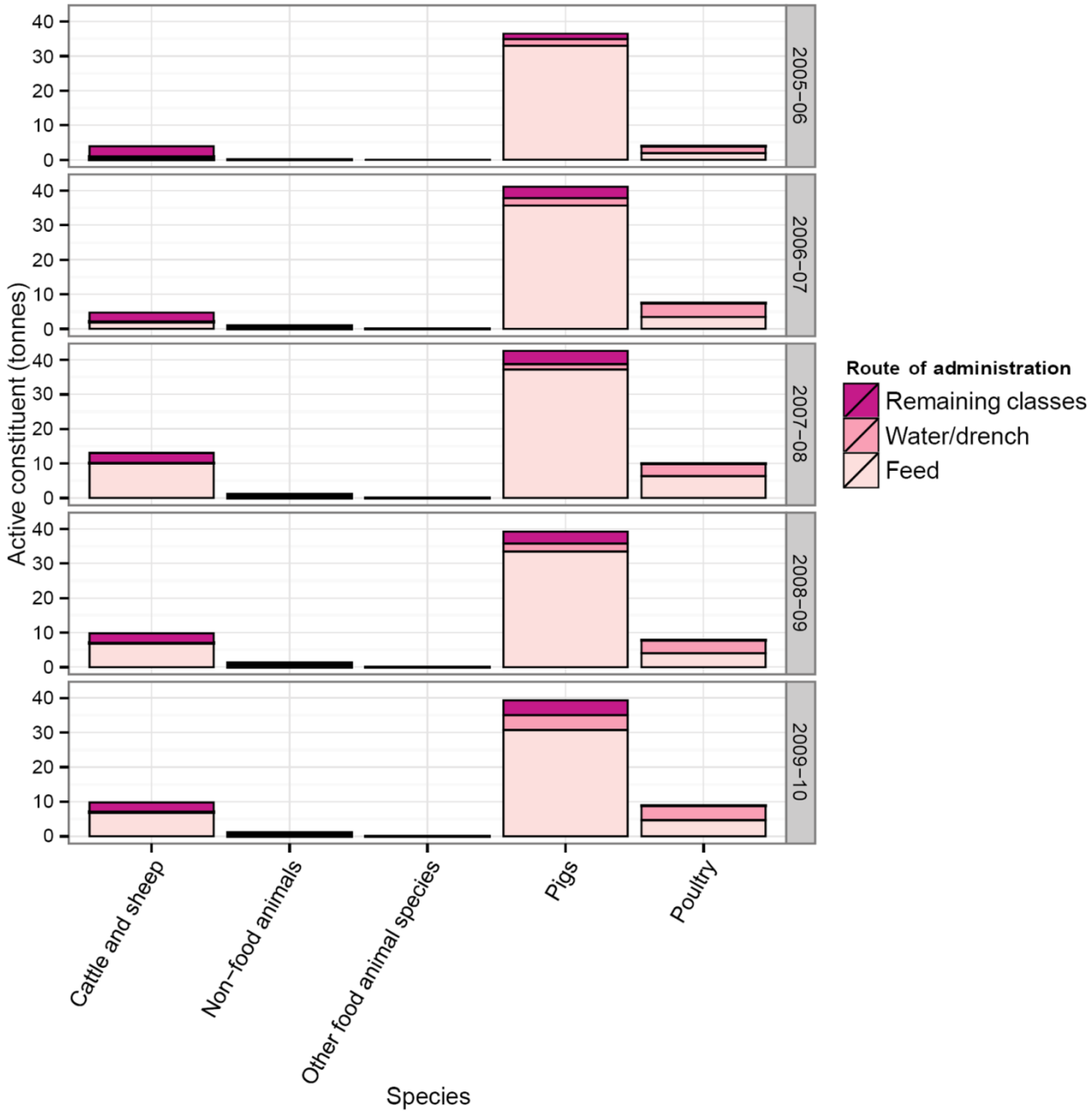

Figure 5: Chart of quantity (tonnes of active constituent) of tetracyclines used for therapeutic purposes in food animals, by species and route of administration (July 2005 to June 2010)

Penicillins/beta-lactamase inhibitors made up the next largest class. The vast majority of sales in this class were of products containing amoxycillin that were administered in water to poultry for the treatment of chronic respiratory disease, disease caused by Escherichia coli, and organisms susceptible to amoxycillin (Figure 6, page 21).

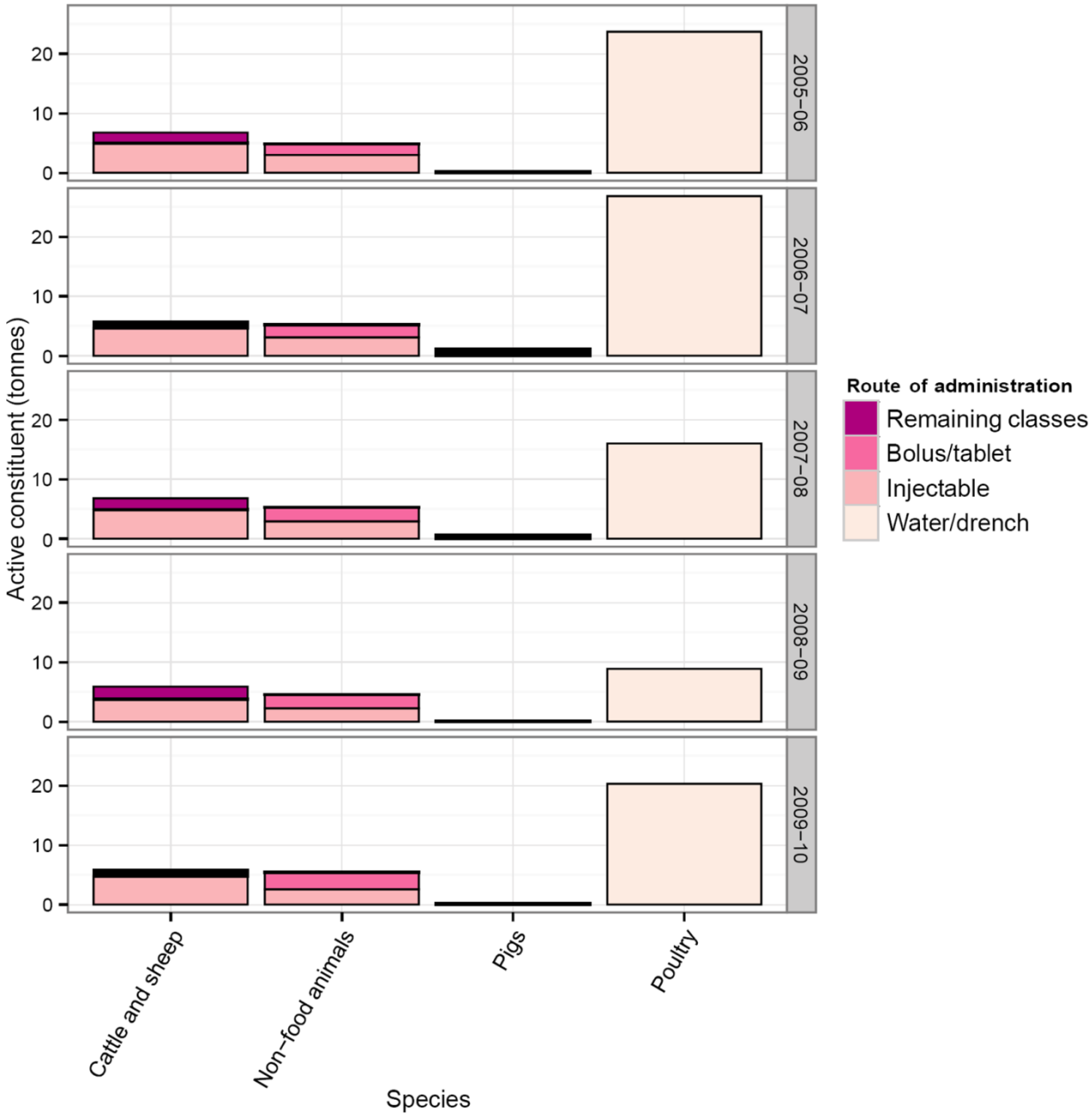

Figure 6: Chart of quantity (tonnes of active constituent) of penicillin/beta-lactamase inhibitors used for therapeutic purposes in food animals, by species and route of administration (July 2005 to June 2010)

The remaining antimicrobials administered to food animals for therapeutic purposes (Table 9, page 17) comprised less than 10% of the total (in 2009–10) and are not discussed further here.

5.2 Non-food animals

The classes and amounts of antimicrobials used in non-food animals for therapeutic purposes are listed in Table 10. The figures indicate increased sales in 2009–10, although this appears largely due to under-reporting in 2008–09. Increased sales were reported in the 'Sulfonamides and diaminopyrimidine potentiators' class in 2009–10, largely attributable to sales of three products containing sulfadimidine and trimethoprim and used to treat respiratory infections in horses. No sales for these products were reported before 2009–10.

Table 10: Quantity of veterinary antimicrobials (tonnes of active constituent) used in non-food animals, by antimicrobial class (July 2005 to June 2010)

CLASS	2005-06	2006-07	2007-08	2008-09	2009-10
Aminocoumarins	0.00	0.01	0.02	0.02	0.01
Aminoglycosides	0.36	0.35	0.31	0.26	0.28
Amphenicols	0.00	0.00	0.00	0.00	0.00
Cephalosporins	2.04	2.07	2.26	2.51	3.00
Fluoroquinolones	0.13	0.11	0.14	0.12	0.14
Fusidanes	0.00	0.01	0.00	0.00	0.00
Lincosamides	0.02	0.05	0.08	0.07	0.08
Macrolides and streptogramins	0.18	0.19	0.21	0.20	0.25
Nitrofurans	0.01	0.00	0.01	0.00	0.00
Nitroimidazoles	0.01	0.01	0.22	0.09	0.21
Others	0.00	0.01	0.01	0.01	0.01
Penicillins/beta-lactamase inhibitors	4.83	5.24	5.31	4.59	5.43
Polypeptides	0.00	0.00	0.00	0.00	0.00
Sulfonamides and diaminopyrimidine potentiators	2.07	1.96	2.36	1.45	6.73
Tetracyclines	0.07	0.89	1.07	1.21	1.01
Total	**9.72**	**10.89**	**12.01**	**10.54**	**17.16**

6 SALES (TONNES OF ACTIVE CONSTITUENTS) OF VETERINARY ANTIMICROBIALS USED FOR OTHER PURPOSES IN FOOD ANIMALS

6.1 Coccidiostats

The quantities (by weight of active constituents) of antimicrobials used for coccidiostat purposes in food animals from 2005 to 2010 are shown in Figure 7 (page 24). The great majority of coccidiostats are administered in the feed (Figure 8, page 28) to poultry (Figure 9, page 30).

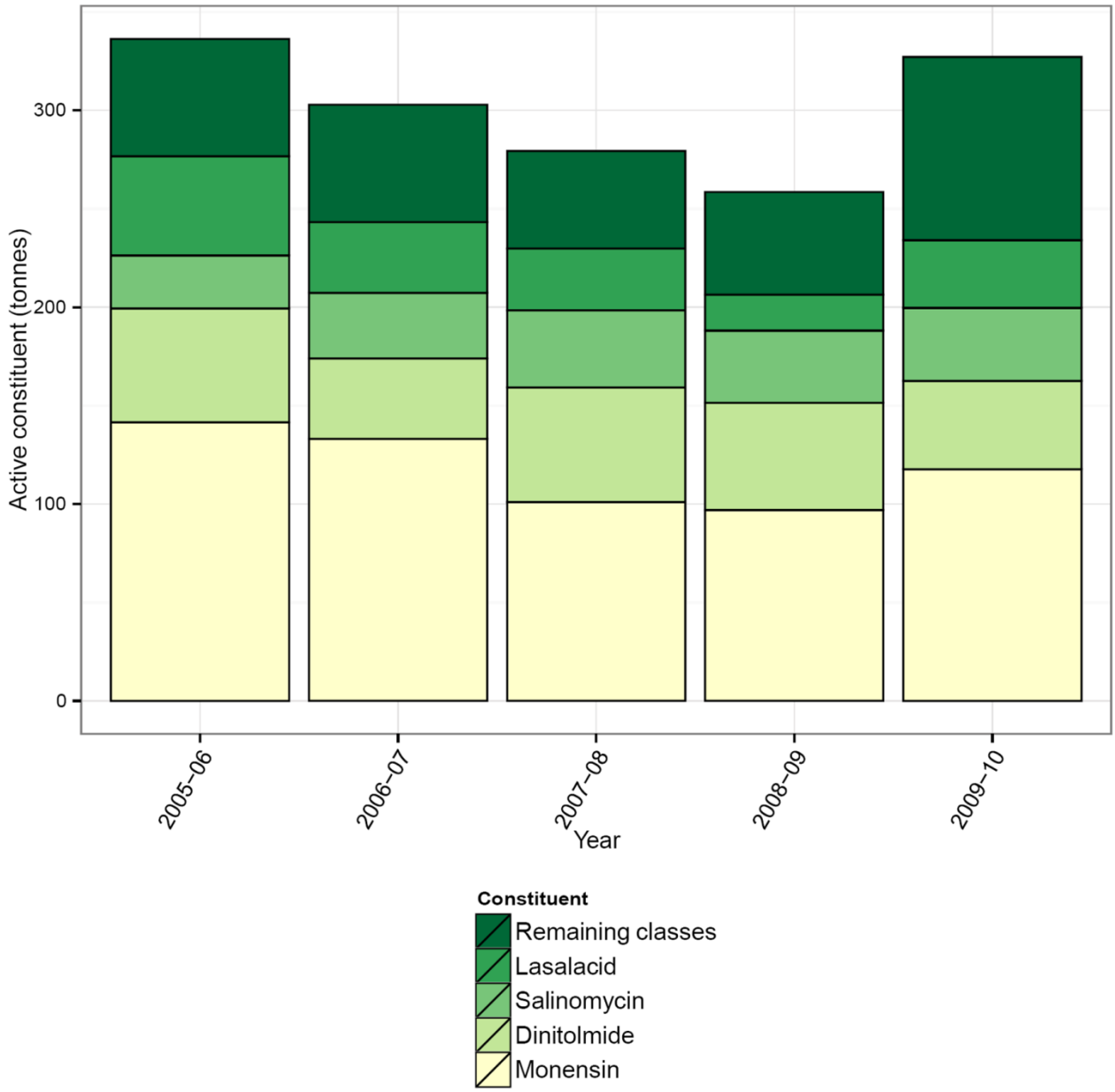

Figure 7: Chart of quantity (tonnes of active constituent) of antimicrobials sold for coccidiostat uses in food animals, by active constituent (July 2005 to June 2010; Remaining classes (in decreasing order of quantities): Nicarbazin, Narasin, Sulfaquinoxaline, Semduramicin, Robenidine, Maduramicin, and Toltrazuril)

6.2 Growth promotants

The pattern of sales (tonnes of active constituent) of veterinary antimicrobials used for growth-promoting purposes changed over time, with no sales of the arsenical (labelled for use in non-egg producing chickens and turkeys for growth promotion and improved feed conversion) reported after the financial year 2007–08

(Table 11, page 26). Sales figures for the other classes of growth promotants do not suggest any significant increase from 2005 to 2010. Growth promotants are administered in the feed (Figure 8, page 28) and used only in food animals (Figure 9, page 30).

Table 11: Total sales of veterinary antimicrobials (tonnes of active constituent, % column total) sold for growth-promotant purposes in food animals, by active constituent (July 2005 to June 2010)

	2005-06		2006-07		2007-08		2008-09		2009-10	
CLASS	TONNES	%	TONNES	%	TONNES	%	TONNES	%	TONNES	%
Arsenicals	14.4	30.5	8.5	22.2	13.8	36.0	0.0	0.0	0.0	0.0
Glycophospholipids	1.3	2.7	2.9	7.7	1.6	4.2	0.3	1.4	1.0	3.5
Macrolides	6.7	14.2	7.3	19.1	5.9	15.5	7.8	32.8	10.7	37.1
Oligosaccharides	2.5	5.3	3.2	8.3	2.9	7.6	2.5	10.4	1.6	5.4
Polyether ionophores	12.7	26.8	11.9	31.1	10.1	26.2	10.2	42.6	11.7	40.3
Quinoxaline	9.7	20.6	4.5	11.7	4.0	10.5	3.1	12.8	3.9	13.7
Total	**47.2**	**100.0**	**38.2**	**100.0**	**38.4**	**100.0**	**23.8**	**100.0**	**28.9**	**100.0**

7 ROUTES OF ADMINISTRATION OF VETERINARY ANTIMICROBIALS TO FOOD ANIMALS FOR THERAPEUTIC PURPOSES

7.1 Overview

The routes of administration used for veterinary antimicrobial products in food animals are: feed, water/drench, injectable, bolus/tablet, feed/water, intramammary, oral, external, and intrauterine. For the purposes of this analysis, antimicrobials with route of administration listed as 'feed/water' are grouped with those having 'feed' as their route of administration, and those with 'water/drench' have been re-coded as 'water'. In addition, antimicrobials with routes of administration other than feed, water/drench, injectable and intramammary are coded as 'other'.

Figure 8 (page 28) provides an overview of the quantity of sales of veterinary antimicrobials used in food animals, by active constituent, route of administration, year, and purpose. The intent of this chart is to show the relative amounts of all veterinary antimicrobials by route of administration; it is not intended that precise amounts of very small quantities should be read from Figure 8. However, the routes of administration of the veterinary antimicrobials sold for therapeutic use are discussed in more detail in this section, and summarised in Table 19 (page 52). As coccidiostats and growth promotants are predominantly administered in the feed, they are not discussed further here. More detail about coccidiostats and growth promotants is provided in Sections 6.1 and 6.2 (pages 23 and 24, respectively).

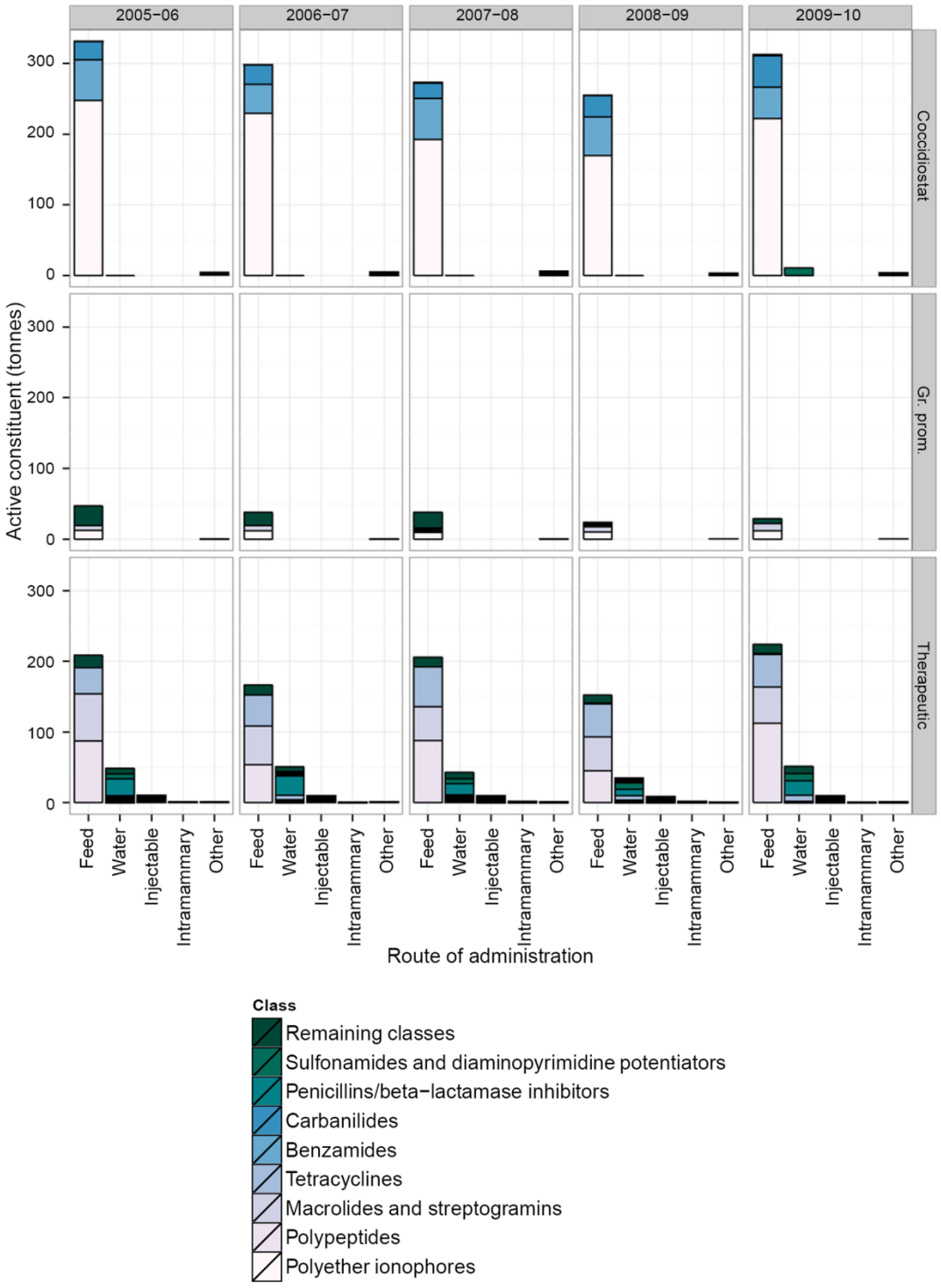

Figure 8: Chart of quantity (tonnes of active constituent) of antimicrobials sold for use in food animals, by route of administration, purpose, and antimicrobial class (July 2005 to June 2010; Remaining classes (in decreasing order of quantities): Oligosaccharides, Arsenicals, Quinoxaline, Aminoglycosides, Lincosamides, Others, Nitroimidazoles, Glycophospholipids, Amphenicols, Cephalosporins, Aminocoumarins, and Triazines)

7.2 Administration in the feed

An average 76% of the total quantity of antimicrobials sold for therapeutic purposes in food animals from July 2005 to June 2010 was administered in the feed. The polypeptide bacitracin comprised 29.9%–50.2% (by weight of active constituent) of veterinary antimicrobials administered in the feed for therapeutic purposes (Table 20, page 53). The combined macrolide and streptogramins and the tetracyclines classes made similar contributions to sales, averaging 28.3% and 24.7% respectively (Figure 9, page30).

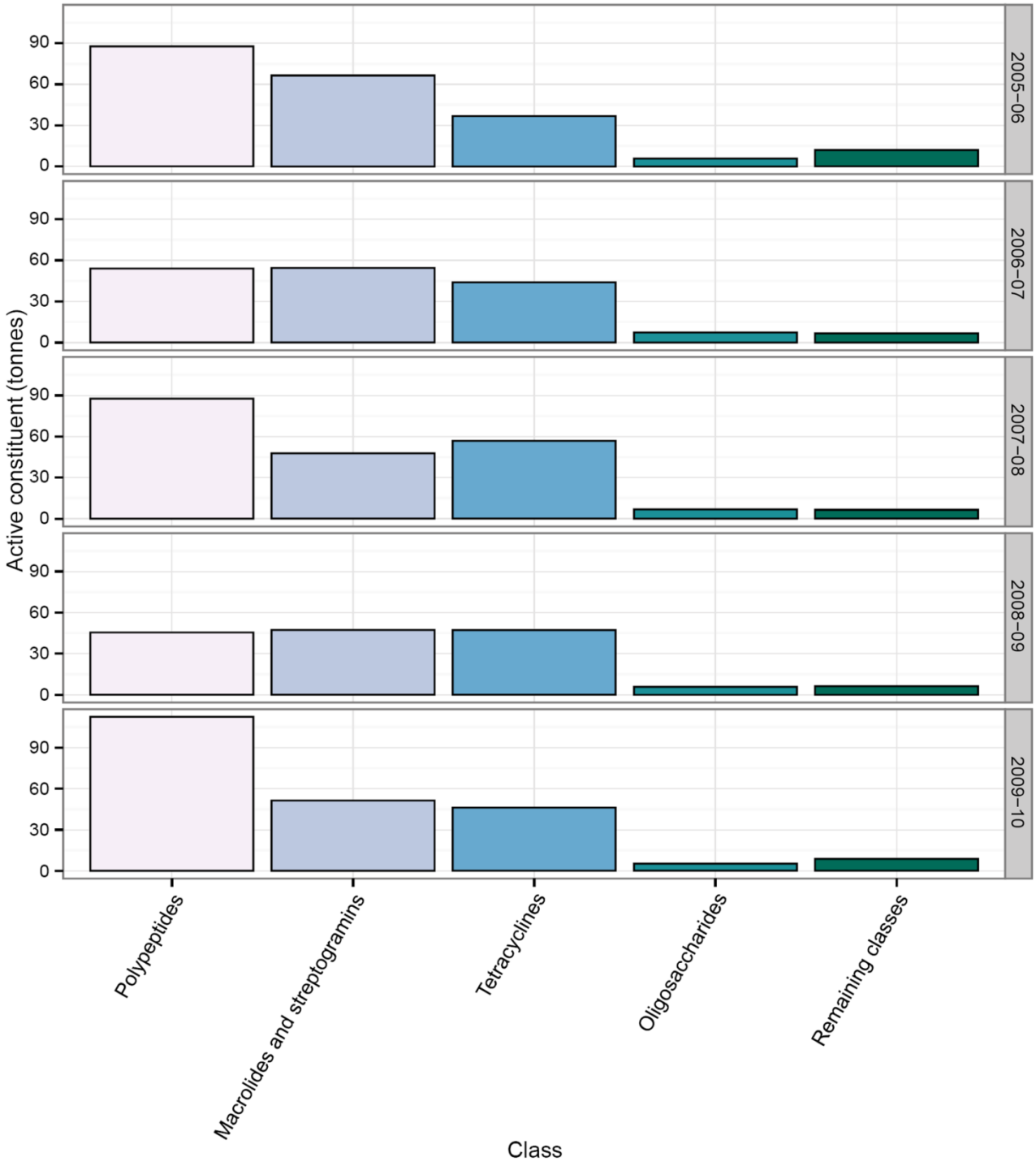

Figure 9: Chart of quantity (tonnes of active constituent) of antimicrobials sold for use in food animals for therapeutic purposes and administered in the feed, by antimicrobial class (July 2005 to June 2010; Remaining classes (in decreasing order of quantities): Aminoglycosides, Quinoxaline, Nitroimidazoles, Others, Sulfonamides and diaminopyrimidine potentiators, Lincosamides, and Amphenicols)

7.3 Administration in water

An average 18% of the total quantity of antimicrobials sold for therapeutic purposes in food animals from July 2005 to June 2010 was administered in water. The penicillins/beta-lactamase inhibitors contributed 25.5%–54.1% (by weight of active constituent) to the sales of veterinary antimicrobials administered in water to food animals for therapeutic purposes (Table 21, page 54). All these products contained amoxycillin, and were administered to poultry. Sulfonamides and diaminopyrimidine potentiators comprised an average 18.1% of sales, tetracyclines 6% and macrolides averaged 9.6% of sales; the relative contributions of these classes fluctuated from 2015 to 2010 (Figure 10, page 32).

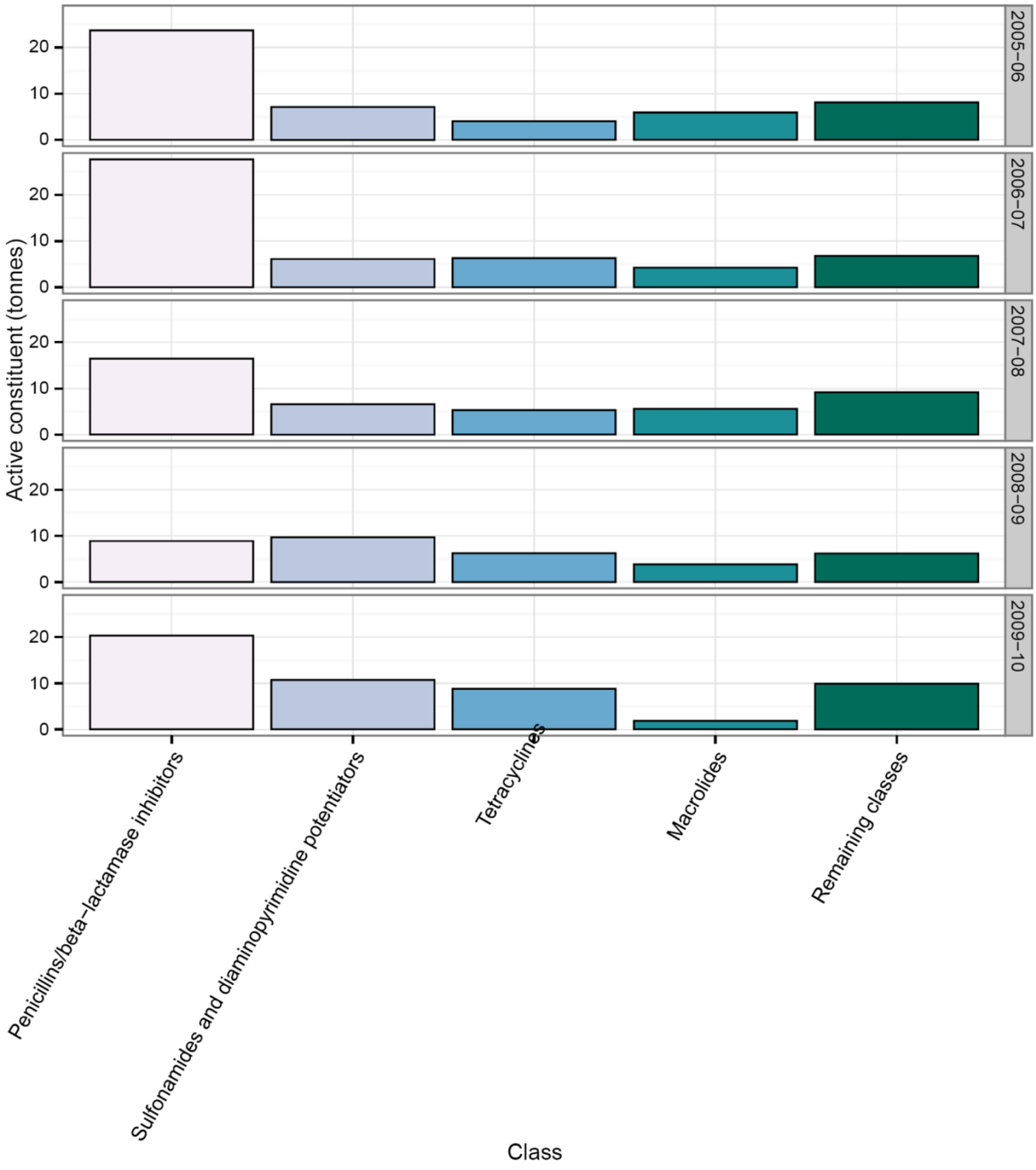

Figure 10: Chart of quantity (tonnes of active constituent) of antimicrobials sold for use in food animals for therapeutic purposes and administered in water, by antimicrobial class (July 2005 to June 2010; Remaining classes (in decreasing order of quantities): Lincosamides, Aminoglycosides, Nitroimidazoles, Others, and Amphenicols)

7.4 Administration via injection

An average 4% (by weight of active constituent) of veterinary antimicrobials used for therapeutic purposes in food animals were administered by injection. The major contributors were the penicillins/beta-lactamase inhibitors (averaging 48.9% of sales by weight of active constituent), followed by the tetracyclines (32.4%, Figure 11).

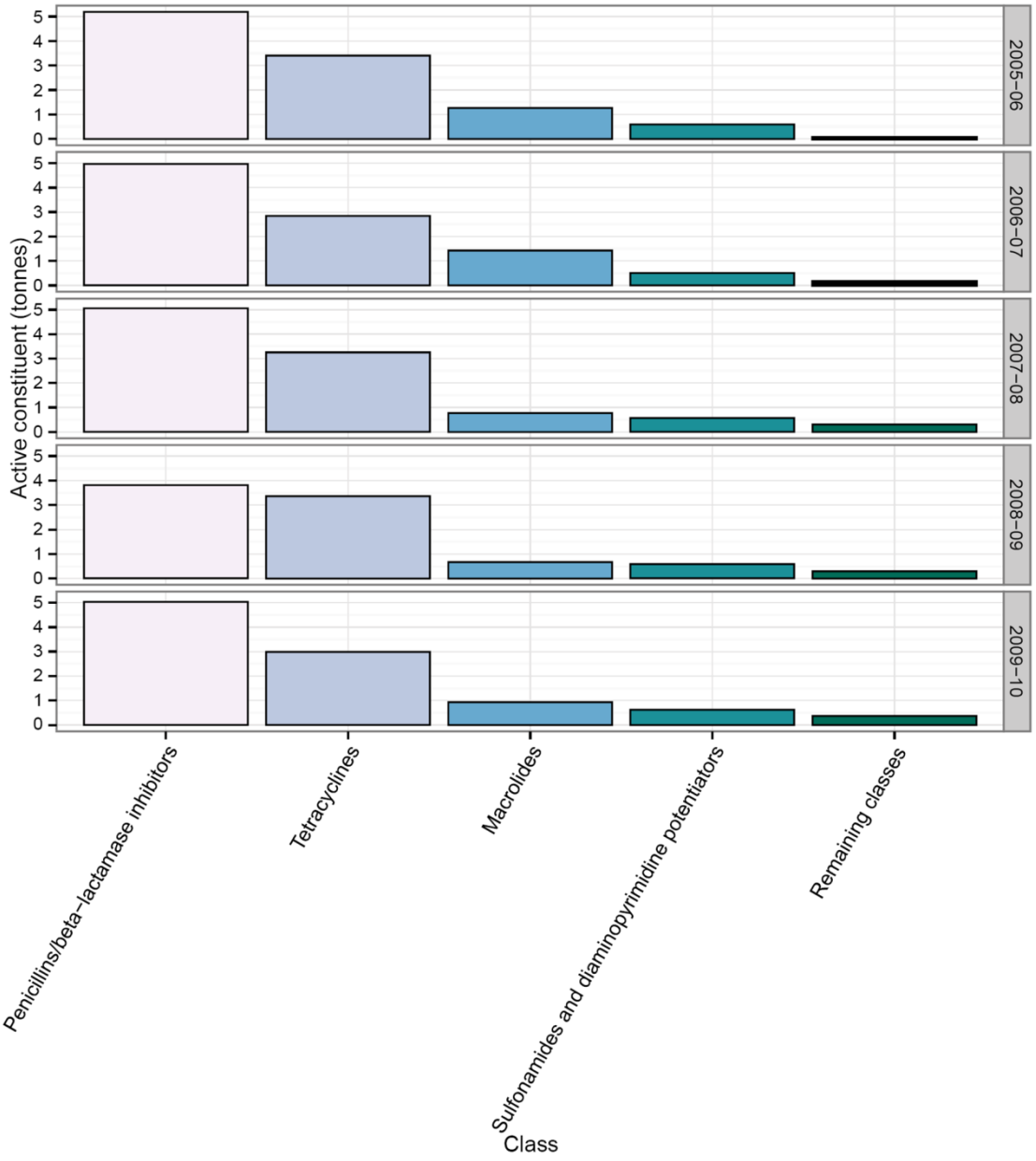

Figure 11: Chart of quantity (tonnes of active constituent) of antimicrobials sold for use in food animals for therapeutic purposes and administered by injection, by antimicrobial class (July 2005 to June 2010; Remaining classes (in decreasing order of quantities): Cephalosporins, Aminoglycosides, Lincosamides, and Amphenicols)

7.5 Administration via intramammary infusion

Intramammary infusions accounted for a very small amount of veterinary antimicrobials administered to food animals for therapeutic purposes (averaging 0.7% by weight of active constituent). Penicillins/beta-lactamase inhibitors made the largest contribution, although this decreased from 99.6% of sales in 2005–06 to 63.3% in 2009–10 (Table 23, page 56). Differences were observed with the pattern of sales, with a wider range of antimicrobial classes administered via intramammary infusion in 2009–10 compared with earlier years (Figure 12, page 35).

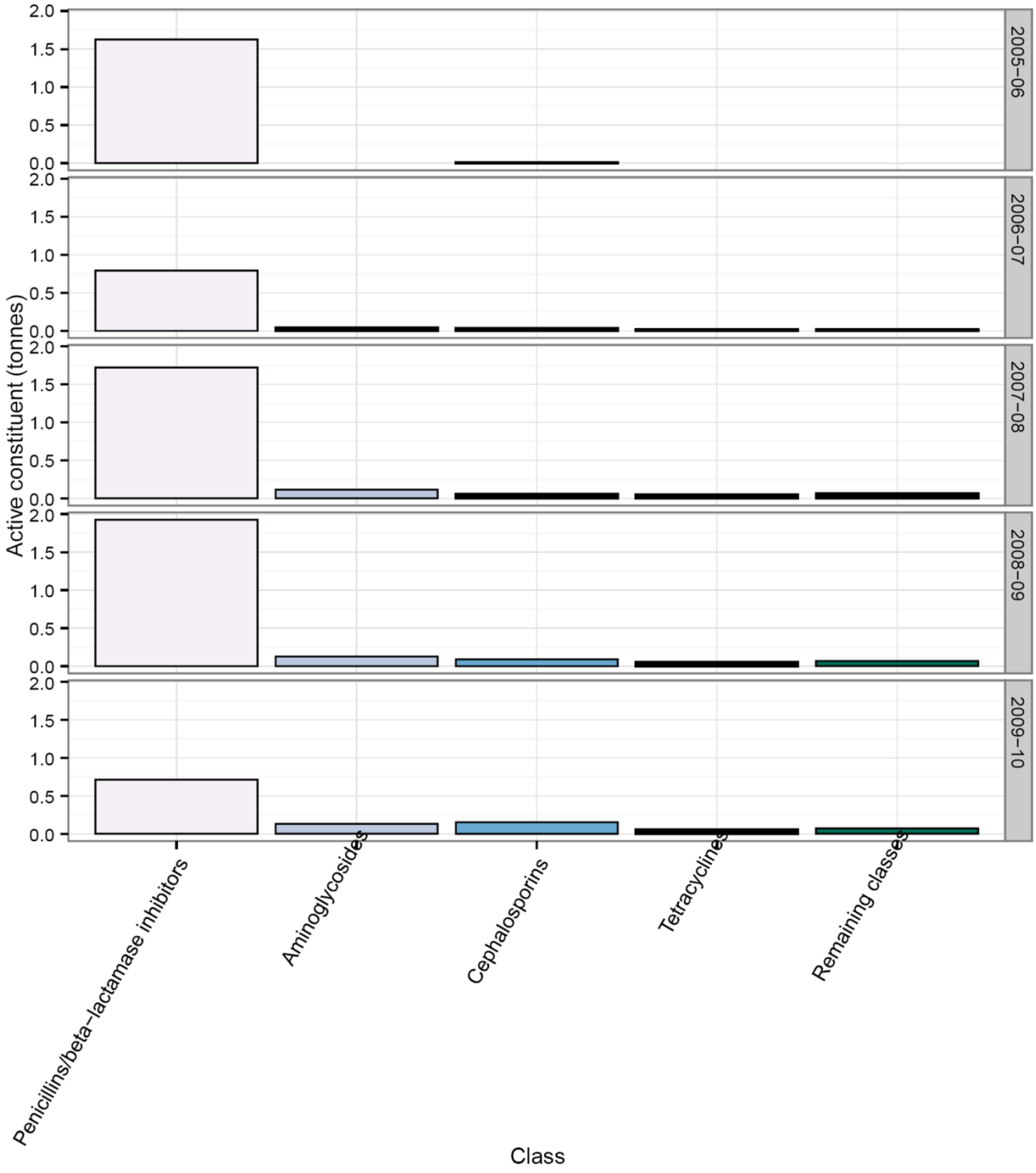

Figure 12: Chart of quantity (tonnes of active constituent) of antimicrobials sold for use in food animals for therapeutic purposes and administered by intramammary infusion, by antimicrobial class (July 2005 to June 2010; Remaining classes (in decreasing order of quantities): Aminocoumarins, and Macrolides)

8 QUANTITY OF SALES BY FOOD ANIMAL SPECIES

8.1 Overview

A list of veterinary antimicrobials and the food animal species in which they are used is provided in Table B.1 (page 57).

Figure 13 (page 37) provides an overview of the quantity of sales of veterinary antimicrobials in food animals, by active constituent, species, year, and purpose. The intent of this chart is to show the relative amounts of all veterinary antimicrobials by species to which they are administered. It is not intended the precise amounts of very small quantities should be read from this chart. The administration of veterinary antimicrobials for therapeutic use is discussed in more detail in this section by each food animal species, and summarised in Table 24 (page 60). The species breakdown of sales is not discussed further for coccidiostats or growth promotants. More information about sales of these products is provided in Sections 6.1 and 6.2 (pages 23 and 24).

It is clear from Figure 13 (page 37) the majority of veterinary antimicrobial products sold in Australia are used for therapeutic and coccidiostat purposes in poultry.

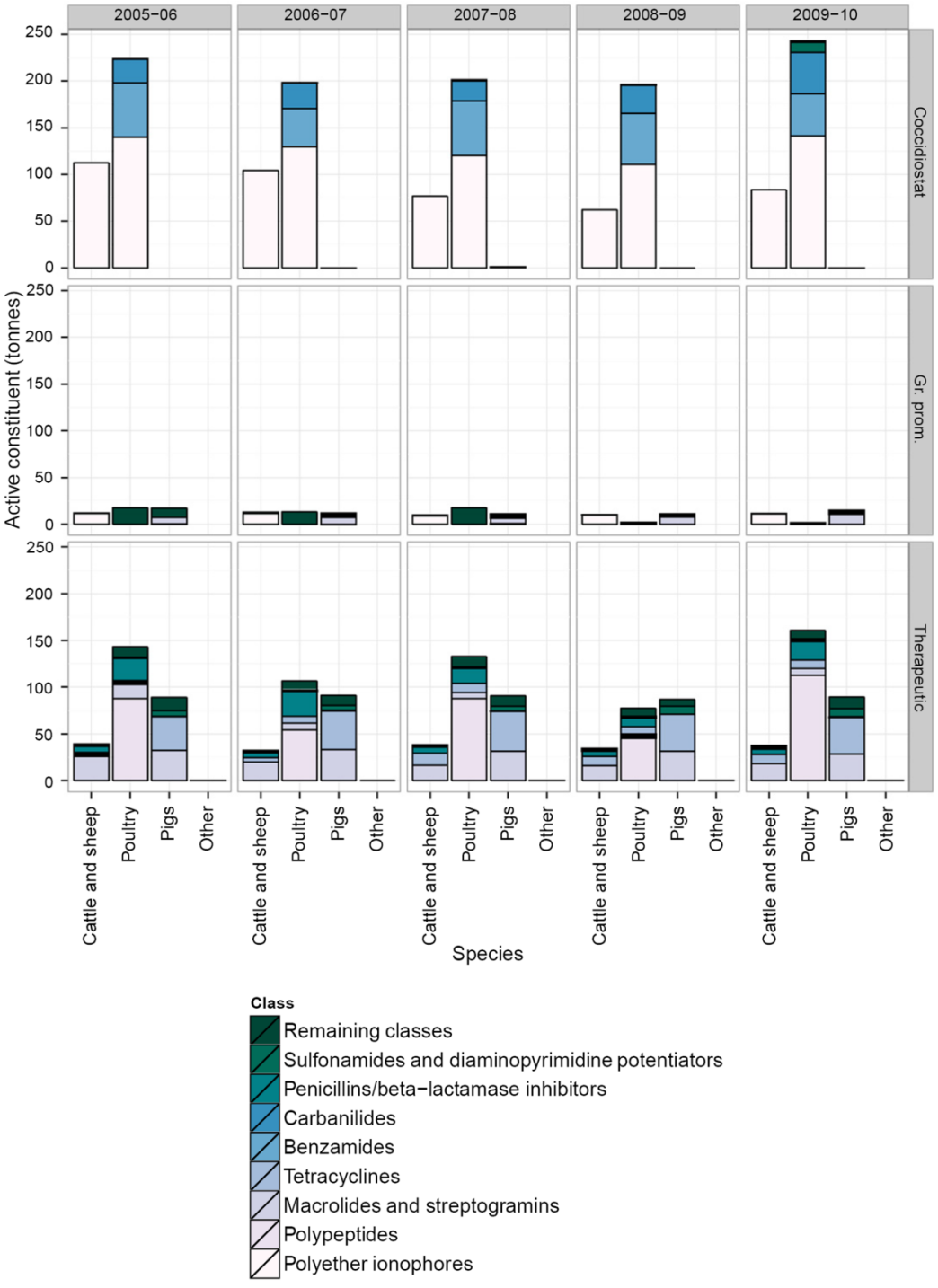

Figure 13: Chart of quantity (tonnes of active constituent) of antimicrobials sold for use in food animals, by species, purpose, and antimicrobial class (July 2005 to June 2010; Gr. prom. – Growth promotant; Remaining classes (in decreasing order of quantities): Oligosaccharides, Arsenicals, Quinoxaline, Aminoglycosides, Lincosamides, Others, Nitroimidazoles, Glycophospholipids, Amphenicols, Cephalosporins, Aminocoumarins, and Triazines)

8.2 Cattle and sheep

An average 64% (by weight active constituent) of veterinary antimicrobials administered to cattle and sheep were for coccidiostat purposes (Figure 14 and Table 27, page 61). These products were all polyether ionophores. Of antimicrobials administered for therapeutic purposes to cattle and sheep, 67% (by weight of active constituent) were administered in the feed and 24% by injection (Table 29, page 62).

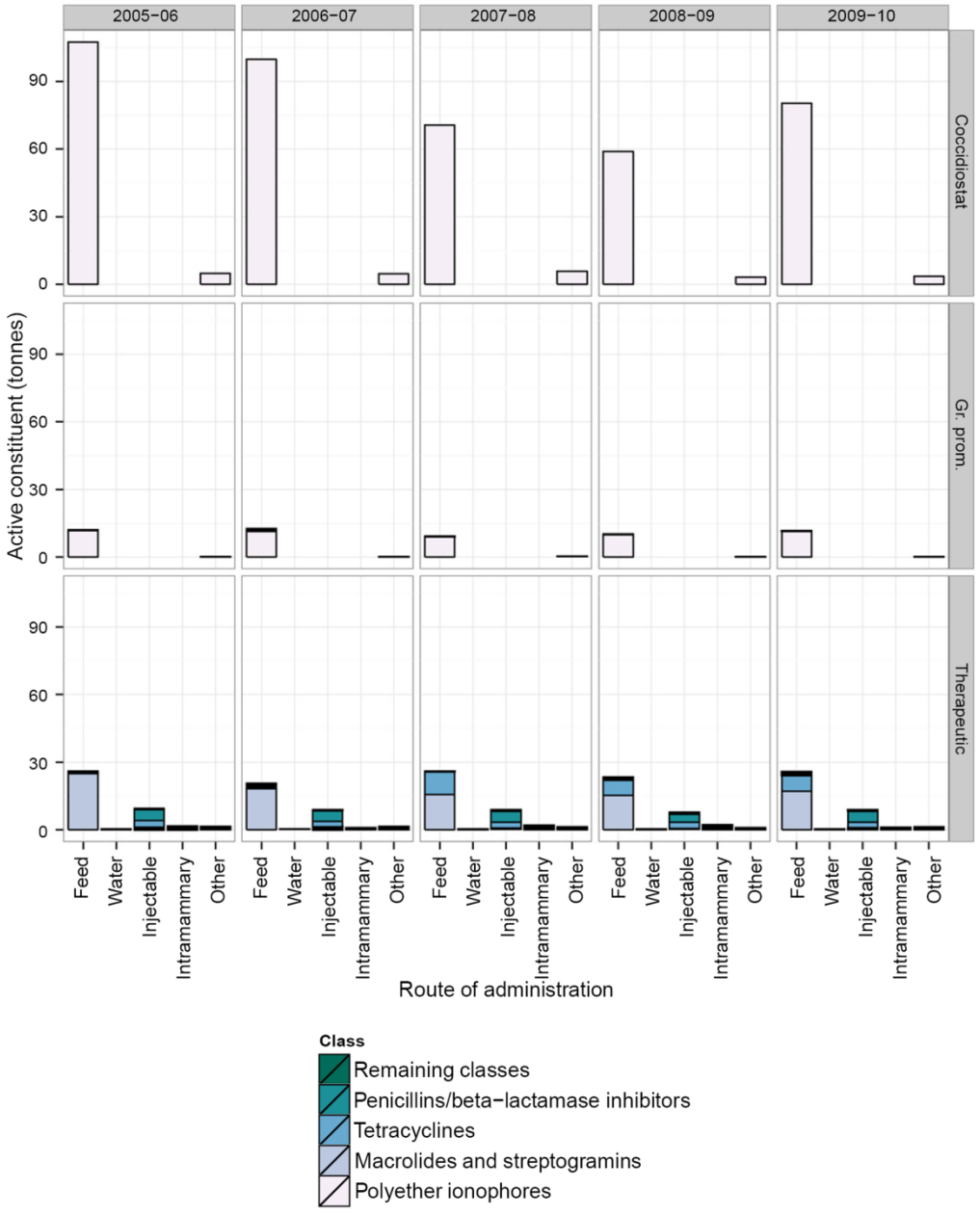

Figure 14: Chart of quantity (tonnes of active constituent) of antimicrobials sold for use in cattle and sheep, by route of administration, purpose, and antimicrobial class (July 2005 to June 2010; Gr. prom. – Growth promotant; Remaining classes (in decreasing order of quantities): Sulfonamides and diaminopyrimidine potentiators, Aminoglycosides, Glycophospholipids, Cephalosporins, Aminocoumarins, and Amphenicols)

8.3 Poultry

An average 62% (by weight of active constituent) of veterinary antimicrobials used in poultry were administered in the feed as coccidiostats (Figure 15 and Table 27, page 61). A further 35% were administered for therapeutic purposes. Of these, 77% were administered in the feed (mostly polypeptides), with the remainder (predominantly penicillins/beta-lactamase inhibitors) administered by water (Table 28, page 62).

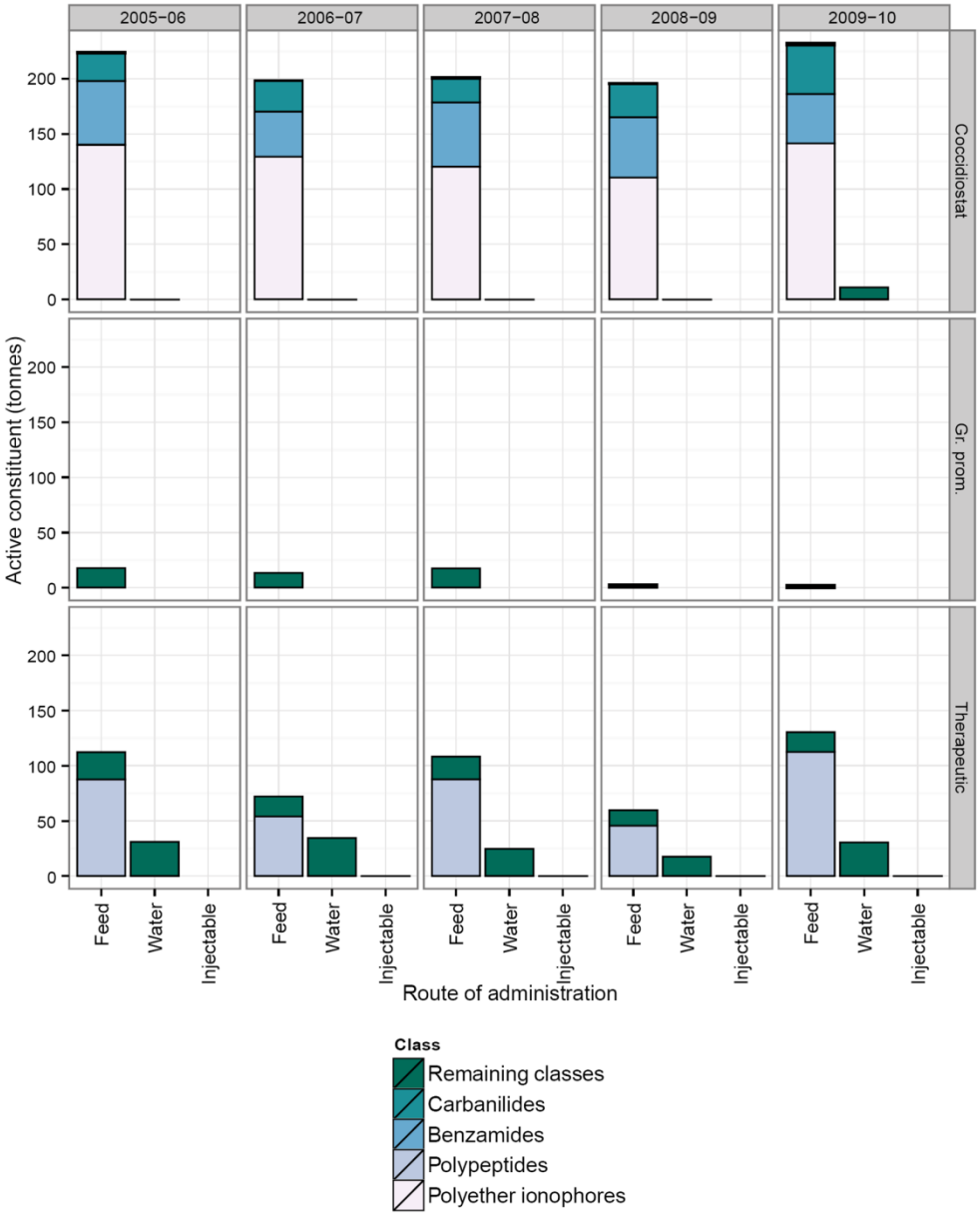

Figure 15: Chart of quantity (tonnes of active constituent) of antimicrobials sold for use in poultry, by route of administration, purpose, and antimicrobial class (July 2005 to June 2010; Gr. prom. - Growth promotant; Remaining classes (in decreasing order of quantities): Penicillins/beta-lactamase inhibitors, Oligosaccharides, Macrolides and streptogramins,

Tetracyclines, Arsenicals, Sulfonamides and diaminopyrimidine potentiators, Aminoglycosides, Nitroimidazoles, Others, Glycophospholipids, and Lincosamides)

8.4 Pigs

An average 87% (by weight of active constituent) of veterinary antimicrobials administered to pigs was for therapeutic purposes (Figure 16, page 41 and Table 29, page 62). Antimicrobials for therapeutic use were administered through the feed and water for an average 79 (20%) of products (by weight of active ingredient) (Table 30, page 63).

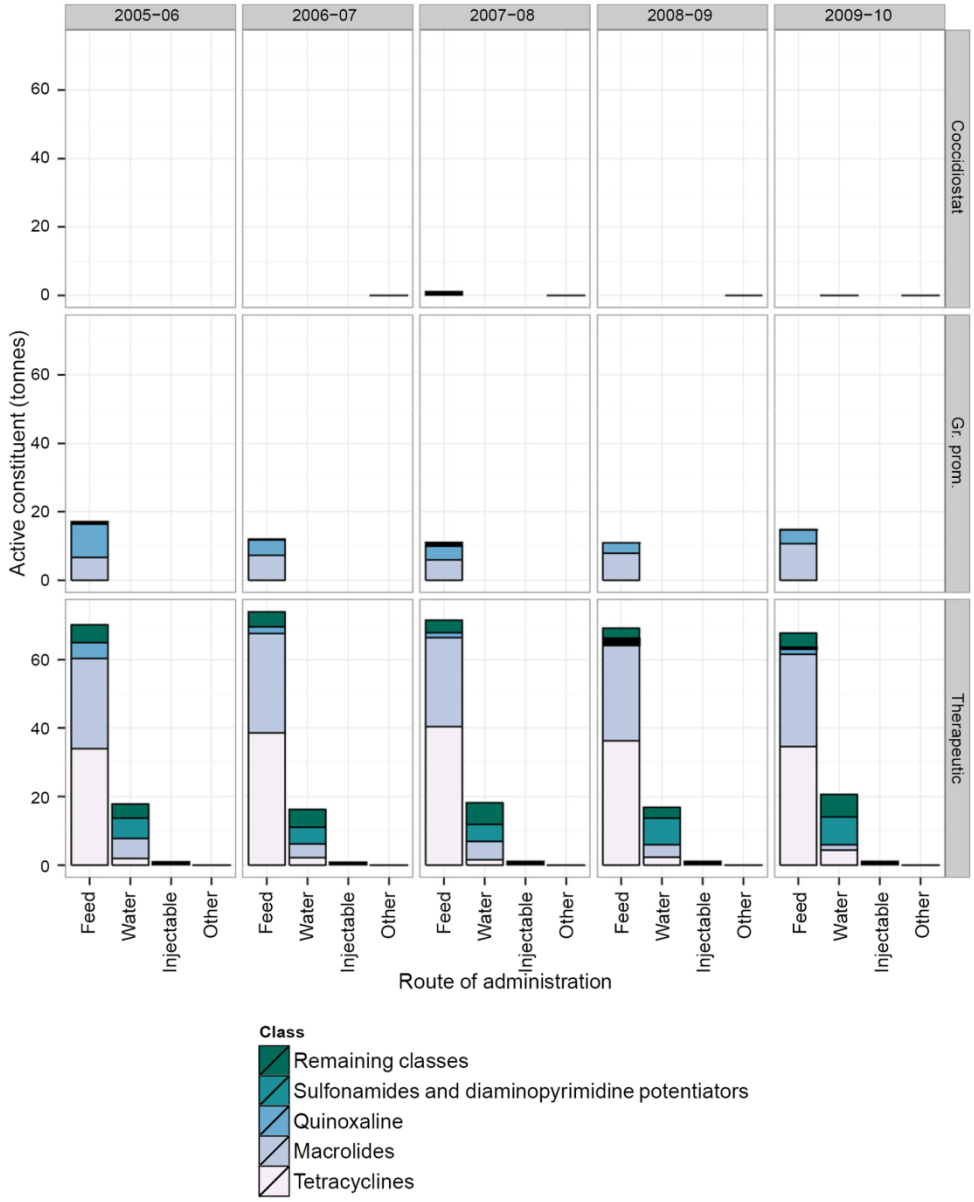

Figure 16: Chart of quantity (tonnes of active constituent) of antimicrobials sold for use in pigs, by route of administration, purpose, and antimicrobial class (July 2005 to June 2010; Gr. prom. – Growth promotant; Remaining classes (in decreasing order of quantities): Lincosamides, Aminoglycosides, Others, Nitroimidazoles, Polyether ionophores, Penicillins/beta-lactamase inhibitors, Amphenicols, Glycophospholipids, and Triazines)

9 VETERINARY ANTIMICROBIALS WITH ANALOGUES OF SIGNIFICANCE TO HUMAN HEALTH

9.1 EAGAR Importance Ratings

The Expert Advisory Group on Antimicrobial Resistance (EAGAR) of the National Health and Medical Research Council (NH&MRC) prepared a report titled EAGAR Importance Rating and Summary of Antibiotic Uses in Humans in Australia in 2003 and updated it in 2006 [3]. The 2006 report is provided in Appendix C and includes a table (page 65) that summarises the importance of the various antimicrobial agents (then) available for human use in Australia. If the importance of an antibiotic is classified as 'high', it implies that if AMR develops, there will be very limited or in some cases no alternatives available to treat serious bacterial infections. It is acknowledged that importance ratings may change (in either direction) as circumstances change; thus, importance ratings should be subject to periodic reassessment.

The following antimicrobial classes contain antimicrobials that were assigned 'medium' or 'high' importance ratings in human medicine by EAGAR in 2006 and that have members (rated or not) that are used in veterinary medicine in Australia:

- aminoglycosides
- cephalosporins
- fluoroquinolones
- fusidanes
- lincosamides
- nitroimidazoles
- penicillins and beta-lactamase inhibitors
- sulfonamides and diaminopyrimidine potentiators
- streptogramins.

Note the antimicrobials approved for growth-promotant or coccidiostat purposes in Australia do not have EAGAR ratings, or are rated 'low'. All veterinary antimicrobials with EAGAR 'medium' or 'high' ratings are for therapeutic uses.

9.2 Aminoglycosides

Neither of the two aminoglycosides with 'high' EAGAR ratings (netilmicin, amikacin) is approved for veterinary use in Australia. Two antimicrobials with 'medium' rating (gentamicin and spectinomycin) are used in small quantities in non-food and food animals, respectively (Table 12, page 43). The veterinary aminoglycoside with the highest sales (neomycin) is used predominantly in food animals, and has a 'low' EAGAR rating.

9.3 Cephalosporins

The EAGAR-listed cephalosporins are rated[2] as 'medium' or 'high'. The cephalosporin with highest sales amongst veterinary antimicrobials is cephalexin, used in non-food animals (Table 13, page 45). The third-generation cefovecin was approved in 2008–09 for use in non-food animals. Sales in 2009–10 (12.7 kg) were almost double those recorded in 2008–09 (6.8 kg). The cephalosporin most widely used in food animals is now the third-generation ceftiofur, which is administered by injection, with sales averaging 88 kg/year from July 2005 to June 2010. Other antimicrobials in this group include cefuroxime (intramammary preparations) and cephapirin (intrauterine pessaries), which are second and first-generation cephalosporins, respectively.

Table 12: Total sales of veterinary aminoglycoside products approved for therapeutic use in Australia (tonnes of active constituent, % class total), by active constituent and animal type (July 2005 to June 2010)

CONSTITUENT	ANIMAL TYPE	YEAR	2005-06	2006-07	2007-08	2008-09	2009-10
Apramycin	Cattle and sheep		0.07	0.07	0.08	0.09	0.07
	Poultry		0.04	0.03	0.04	0.04	0.03
	Pigs		0.73	0.81	0.82	0.89	0.46
	Non-food animals		0.00	0.00	0.00	0.00	0.00
Dihydrostreptomycin	Cattle and sheep		0.06	0.07	0.08	0.07	0.08
	Poultry		0.00	0.00	0.00	0.00	0.00
	Pigs		0.00	0.00	0.00	0.00	0.00
	Non-food animals		0.00	0.00	0.00	0.00	0.00
Framycetin	Cattle and sheep		0.00	0.00	0.00	0.00	0.00
	Poultry		0.00	0.00	0.00	0.00	0.00
	Pigs		0.00	0.00	0.00	0.00	0.00
	Non-food animals		0.00	0.00	0.00	0.00	0.00

[2] The AMRSC is in the process of reviewing these ratings.

CONSTITUENT	ANIMAL TYPE	YEAR	2005-06	2006-07	2007-08	2008-09	2009-10
Gentamicin	Cattle and sheep		0.00	0.00	0.00	0.00	0.00
	Poultry		0.00	0.00	0.00	0.00	0.00
	Pigs		0.00	0.00	0.00	0.00	0.00
	Non-food animals		0.07	0.07	0.07	0.09	0.07
Neomycin	Cattle and sheep		0.54	0.48	0.70	1.35	1.22
	Poultry		3.52	2.02	2.68	2.69	2.70
	Pigs		2.10	2.47	0.50	0.84	0.31
	Non-food animals		0.24	0.24	0.20	0.17	0.17
Spectinomycin	Cattle and sheep		0.00	0.00	0.00	0.00	0.00
	Poultry		0.00	0.02	0.11	0.07	0.08
	Pigs		0.00	0.16	0.39	0.27	0.53
	Non-food animals		0.00	0.00	0.00	0.00	0.00
Streptomycin	Cattle and sheep		0.18	0.14	0.14	0.00	0.14
	Poultry		0.00	0.00	0.00	0.00	0.00
	Pigs		0.00	0.00	0.00	0.00	0.00
	Non-food animals		0.05	0.04	0.04	0.00	0.03
Total	**Cattle and sheep**		**0.85**	**0.77**	**1.00**	**1.51**	**1.51**
	Poultry		**3.55**	**2.08**	**2.83**	**2.79**	**2.81**
	Pigs		**2.83**	**3.44**	**1.71**	**2.00**	**1.30**
	Non-food animals		**0.36**	**0.35**	**0.31**	**0.26**	**0.28**

Table 13: Total sales of veterinary cephalosporin products approved for therapeutic use in Australia (tonnes of active constituent), by active constituent and animal type (July 2005 to June 2010)

CONSTITUENT	ANIMAL TYPE	YEAR	2005-06	2006-07	2007-08	2008-09	2009-10
1st generation: Cephalexin	Cattle and sheep		0.00	0.00	0.00	0.00	0.00
	Non-food animals		2.04	2.06	2.25	2.49	2.98
1st generation: Cephalonium	Cattle and sheep		0.00	0.00	0.00	0.05	0.10
	Non-food animals		0.00	0.00	0.00	0.00	0.00
1st generation: Cephapirin	Cattle and sheep		0.01	0.01	0.01	0.01	0.01
	Non-food animals		0.00	0.00	0.00	0.00	0.00
2nd generation: Cefuroxime	Cattle and sheep		0.01	0.03	0.05	0.04	0.06
	Non-food animals		0.00	0.00	0.00	0.00	0.00
3rd generation: Cefovecin	Cattle and sheep		0.00	0.00	0.00	0.00	0.00
	Non-food animals		0.00	0.00	0.00	0.01	0.01
3rd generation: Ceftiofur	Cattle and sheep		0.00	0.05	0.12	0.14	0.13
	Non-food animals		0.00	0.00	0.01	0.01	0.00
Total	**Cattle and sheep**		**0.02**	**0.09**	**0.19**	**0.25**	**0.31**
	Non-food animals		**2.04**	**2.07**	**2.26**	**2.51**	**3.00**

9.4 Fluoroquinolones

While some fluoroquinolones are rated by EAGAR as having 'high' importance for human therapy, and are used in humans, these are not approved for use in any animals in Australia. Where a fluoroquinolone is approved for veterinary use in Australia, it is not included in the EAGAR listing and is only approved for use in non-food animals[3] (Table 14, page 46).

[3] http://www.apvma.gov.au/news_media/community/2011-02_antibiotics_farming.php

Table 14: Total sales of veterinary fluoroquinolone antimicrobials (tonnes of active constituent) sold for therapeutic purposes in non-food animals, by active constituent (July 2005 to June 2010)

CONSTITUENT	YEAR	2005-06	2006-07	2007-08	2008-09	2009-10
Difloxacin		0.03	0.00	0.02	0.01	0.02
Enrofloxacin		0.10	0.10	0.12	0.11	0.11
Marbofloxacin		0.00	0.00	0.01	0.00	0.01
Orbifloxacin		0.00	0.00	0.00	0.00	0.00
Total		**0.13**	**0.11**	**0.14**	**0.12**	**0.14**

9.5 Fusidanes

Sodium fusidate (fusidic acid) has a 'high' EAGAR rating and in human medicine is used in combination therapy with rifampicin for treatment of methicillin-resistant *Staphylococcus aureus* infections. Due to concerns about development of antibiotic resistance, rifampicin is not approved for veterinary use in Australia, although it may occasionally be used under permit in combination with erythromycin for treatment of *Rhodococcus equi* infections in foals[4]). Fusidic acid is approved for external use in non-food animals and annual quantities sold are small (ranging from 0.86 kg/year to 5.07 kg/year from 2005 to 2010).

9.6 Lincosamides

Clindamycin and lincomycin both have 'medium' EAGAR ratings and both are used for therapeutic purposes in veterinary medicine in Australia; clindamycin in non-food animals and lincomycin predominantly in food animals (Table 15, page 47).

[4] http://www.apvma.gov.au/news_media/media_releases/2012/mr2012-06.php

Table 15: Total sales of veterinary lincosamide antimicrobials (tonnes of active constituent) sold for therapeutic purposes, by active constituent and animal type (July 2005 to June 2010)

CONSTITUENT	ANIMAL TYPE	2005-06	2006-07	2007-08	2008-09	2009-10
Clindamycin	Poultry	0.00	0.00	0.00	0.00	0.00
	Pigs	0.00	0.00	0.00	0.00	0.00
	Non-food animals	0.02	0.05	0.08	0.07	0.08
Lincomycin	Poultry	0.00	0.01	0.06	0.03	0.04
	Pigs	3.22	3.73	5.38	2.87	6.39
	Non-food animals	0.00	0.00	0.00	0.00	0.00
Total	**Poultry**	**0.00**	**0.01**	**0.06**	**0.03**	**0.04**
	Pigs	**3.22**	**3.73**	**5.38**	**2.87**	**6.39**
	Non-food animals	**0.02**	**0.05**	**0.08**	**0.07**	**0.08**

9.7 Nitroimidazoles

Nitroimidazoles are listed as having a 'medium' EAGAR rating. However, dimetridazole, the only member of this class that is approved for use in veterinary medicine in Australia, is not rated. The APVMA cancelled the use of dimetridazole in food-producing animals in July 2007 because its use posed potential risk to human health. Permits were issued (expiring in 2009) to enable the use of existing batches of affected product during the phase-out period[5]. This report covers the period from July 2005 to June 2010, so dimetridazole has been used in food-producing animals during this time (Table 16).

Table 16: Total sales of veterinary dimetridazole antimicrobials (tonnes of active constituent) sold for therapeutic purposes in non-food animals, by animal type (July 2005 to June 2010)

ANIMAL TYPE	YEAR	2005-06	2006-07	2007-08	2008-09	2009-10
Poultry		2.09	0.35	1.22	0.22	1.22
Pigs		2.09	0.35	1.22	0.22	1.22
Non-food animals		0.00	0.00	0.21	0.08	0.20
Total		**4.18**	**0.70**	**2.66**	**0.51**	**2.64**

[5] http://www.apvma.gov.au/products/review/completed/dimetridazole_history.php

9.8 Penicillins and beta-lactamases

Most members of this class with EAGAR ratings are rated 'low', with the exception of piperacillin (which is rated 'high' and is not approved for veterinary use in Australia) and the amoxycillin-clavulanate combinations (rated 'medium'). Table 17 lists the penicillins (excluding amoxycillin-clavulanic acid combinations) approved for animal use in Australia. Table 18 (page 49) tabulates the amounts of amoxycillin-clavulanic acid combinations sold. While only a small proportion of the amoxycillin-clavulanic acid combinations were used in food animals, more than 90% of cloxacillin (with a 'medium' EAGAR rating) was used in food animals.

Table 17: Total sales of veterinary penicillin products (excluding amoxycillin-clavulanic acid combinations) approved for therapeutic use in Australia (tonnes of active constituent), by active constituent and animal type (July 2005 to June 2010)

CONSTITUENT	ANIMAL TYPE	2005-06	2006-07	2007-08	2008-09	2009-10
Amoxycillin	Cattle and sheep	0.29	0.27	0.23	0.25	0.31
	Poultry	23.70	26.82	16.01	8.88	20.29
	Pigs	0.02	0.88	0.45	0.02	0.02
	Other f. an. species	0.00	0.00	0.00	0.00	0.00
	Non-food animals	0.66	0.60	0.56	0.45	0.53
Ampicillin	Cattle and sheep	0.14	0.08	0.14	0.12	0.07
	Poultry	0.00	0.00	0.00	0.00	0.00
	Pigs	0.00	0.00	0.00	0.00	0.00
	Other f. an. species	0.00	0.00	0.00	0.00	0.00
	Non-food animals	0.00	0.00	0.00	0.00	0.00
Benzathine penicillin	Cattle and sheep	0.26	0.22	0.23	0.11	0.21
	Poultry	0.00	0.00	0.00	0.00	0.00
	Pigs	0.06	0.05	0.05	0.02	0.05
	Other f. an. species	0.00	0.00	0.00	0.00	0.00
	Non-food animals	0.12	0.10	0.10	0.05	0.09
Cloxacillin	Cattle and sheep	1.56	0.69	1.63	1.86	0.73
	Poultry	0.00	0.00	0.00	0.00	0.00
	Pigs	0.00	0.00	0.00	0.00	0.00
	Other f. an. species	0.00	0.00	0.00	0.00	0.00

CONSTITUENT	ANIMAL TYPE	2005-06	2006-07	2007-08	2008-09	2009-10
	Non-food animals	0.04	0.00	0.01	0.01	0.03
Penethamate	Cattle and sheep	0.40	0.45	0.59	0.60	0.67
	Poultry	0.00	0.00	0.00	0.00	0.00
	Pigs	0.00	0.00	0.00	0.00	0.00
	Other f. an. species	0.00	0.00	0.00	0.00	0.00
	Non-food animals	0.01	0.01	0.01	0.01	0.01
Procaine penicillin	Cattle and sheep	3.99	3.73	3.79	2.72	3.58
	Poultry	0.00	0.00	0.00	0.00	0.00
	Pigs	0.17	0.23	0.16	0.10	0.19
	Other f. an. species	0.00	0.00	0.00	0.00	0.00
	Non-food animals	2.68	2.81	2.56	1.94	2.21
Total	**Cattle and sheep**	**6.65**	**5.43**	**6.60**	**5.66**	**5.58**
	Poultry	**23.70**	**26.82**	**16.01**	**8.88**	**20.29**
	Pigs	**0.25**	**1.16**	**0.66**	**0.14**	**0.25**
	Other f. an. species	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	Non-food animals	**3.51**	**3.53**	**3.24**	**2.47**	**2.87**

Table 18: Total sales of veterinary amoxycillin-clavulanic acid products approved for therapeutic use in Australia (tonnes of active constituent), by active constituent and animal type (July 2005 to June 2010)

CONSTITUENT	ANIMAL TYPE	2005-06	2006-07	2007-08	2008-09	2009-10
Amoxycillin	Cattle and sheep	0.10	0.17	0.15	0.18	0.20
	Non-food animals	1.06	1.42	1.66	1.70	2.05
Clavulanic acid	Cattle and sheep	0.02	0.04	0.04	0.04	0.05
	Non-food animals	0.26	0.29	0.41	0.42	0.51
Total	**Cattle and sheep**	**0.12**	**0.21**	**0.19**	**0.22**	**0.25**
	Non-food animals	**1.32**	**1.71**	**2.07**	**2.12**	**2.56**

9.9 Sulfonamides and diaminopyrimidine potentiators

Sulfonamides listed in this class are rated ‘low’, with the exception of trimethoprim-sulfamethoxazole (rated ‘medium’), which is not approved for veterinary use in Australia. This class is thus not discussed further.

9.10 Streptogramins

Streptogramins are a class whose listed constituents (quinupristin with dalfopristin) have a ‘high’ EAGAR rating. While particular antimicrobials are not used in veterinary medicine in Australia, the streptogramin virginiamycin is used as a prescription-only feed additive to reduce the risk of acidosis resulting from high grain diets in cattle and sheep, and to prevent necrotic enteritis due to *Clostridium perfringens* in poultry (broiler chickens). The use of virginiamycin in food-producing animals has been reviewed by the APVMA. As a result, labels of the products concerned now bear mandatory prudent use statements[6].

[6] http://www.apvma.gov.au/products/review/completed/virginiamycin.php

APPENDICES

APPENDIX A - ROUTES OF ADMINISTRATION OF VETERINARY ANTIMICROBIALS TO FOOD ANIMALS FOR THERAPEUTIC PURPOSES

A.1 - Overview

Table 19: Total sales of veterinary antimicrobials (tonnes of active constituent, % column total) sold in food animals for therapeutic use, by route of administration (July 2005 to June 2010)

	2005-06		2006-07		2007-08		2008-09		2009-10	
ROUTE OF ADMINISTRATION	TONNES	%	TONNES	%	TONNES	%	TONNES	%	TONNES	%
Feed	208.7	76.8	166.7	72.4	205.8	78.5	152.2	76.4	224.0	77.8
Water	49.0	18.0	51.2	22.2	43.1	16.4	34.9	17.5	51.5	17.9
Injectable	10.5	3.9	9.9	4.3	10.0	3.8	8.7	4.4	10.0	3.5
Intramammary	1.6	0.6	0.9	0.4	2.0	0.8	2.3	1.1	1.1	0.4
Other	1.8	0.7	1.6	0.7	1.4	0.5	1.0	0.5	1.5	0.5
Total	**271.6**	**100.0**	**230.4**	**100.0**	**262.3**	**100.0**	**199.1**	**100.0**	**288.0**	**100.0**

A.2 – Feed

Table 20: Total sales of veterinary antimicrobials (tonnes of active constituent, % column total) sold in food animals for therapeutic use and administered in the feed, by antimicrobial class (July 2005 to June 2010)

	2005-06		2006-07		2007-08		2008-09		2009-10	
CLASS	TONNES	%	TONNES	%	TONNES	%	TONNES	%	TONNES	%
Aminoglycosides	3.0	1.4	3.5	2.1	1.7	0.8	2.7	1.8	1.9	0.8
Amphenicols	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.3
Lincosamides	0.0	0.0	0.2	0.1	0.5	0.3	0.4	0.3	0.7	0.3
Macrolides and streptogramins	66.4	31.8	54.4	32.7	47.8	23.2	47.3	31.1	51.4	22.9
Nitroimidazoles	3.2	1.5	0.0	0.0	1.6	0.8	0.0	0.0	1.6	0.7
Oligosaccharides	5.8	2.8	7.4	4.4	6.8	3.3	5.8	3.8	5.3	2.3
Others	1.2	0.6	1.2	0.7	1.2	0.6	1.1	0.7	1.1	0.5
Polypeptides	87.7	42.0	54.1	32.4	87.8	42.7	45.6	29.9	112.5	50.2
Quinoxaline	4.7	2.2	2.0	1.2	1.5	0.7	1.3	0.8	1.5	0.7
Sulfonamides and diaminopyrimidine potentiators	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.5	1.2	0.5
Tetracyclines	36.8	17.6	44.0	26.4	56.9	27.6	47.2	31.0	46.1	20.6
Total	**208.7**	**100.0**	**166.7**	**100.0**	**205.8**	**100.0**	**152.2**	**100.0**	**224.0**	**100.0**

A.3 – Water

Table 21: Total sales of veterinary antimicrobials (tonnes of active constituent, % column total) sold in food animals for therapeutic use and administered in water, by antimicrobial class (July 2005 to June 2010)

	2005-06		2006-07		2007-08		2008-09		2009-10	
CLASS	TONNES	%	TONNES	%	TONNES	%	TONNES	%	TONNES	%
Aminoglycosides	3.9	7.9	2.4	4.7	3.4	7.9	3.3	9.6	3.3	6.4
Amphenicols	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
Lincosamides	3.2	6.6	3.5	6.8	4.8	11.2	2.4	6.9	5.6	10.9
Macrolides	5.9	12.1	4.3	8.3	5.6	13.0	3.8	11.0	1.8	3.5
Nitroimidazoles	1.0	2.1	0.7	1.4	0.9	2.0	0.4	1.2	0.9	1.7
Others	0.0	0.0	0.2	0.4	0.1	0.2	0.0	0.0	0.0	0.1
Penicillins/beta-lactamase inhibitors	23.7	48.4	27.7	54.1	16.4	38.1	8.9	25.5	20.3	39.4
Sulfonamides and diaminopyrimidine potentiators	7.2	14.6	6.1	12.0	6.6	15.3	9.7	27.9	10.7	20.8
Tetracyclines	4.1	8.3	6.3	12.4	5.3	12.3	6.3	17.9	8.8	17.0
Total	**49.0**	**100.0**	**51.2**	**100.0**	**43.1**	**100.0**	**34.9**	**100.0**	**51.5**	**100.0**

A.4 – Injectables

Table 22: Total sales of veterinary antimicrobials (tonnes of active constituent, % column total) sold in food animals for therapeutic use and administered by injection, by antimicrobial class (July 2005 to June 2010)

	2005-06		2006-07		2007-08		2008-09		2009-10	
CLASS	TONNES	%	TONNES	%	TONNES	%	TONNES	%	TONNES	%
Aminoglycosides	0.1	0.6	0.1	0.8	0.1	0.9	0.1	0.9	0.1	0.8
Amphenicols	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.6
Cephalosporins	0.0	0.0	0.0	0.5	0.1	1.2	0.1	1.6	0.1	1.3
Lincosamides	0.0	0.0	0.0	0.4	0.1	0.9	0.1	0.8	0.1	1.0
Macrolides	1.3	12.1	1.4	14.4	0.8	7.8	0.7	7.7	0.9	9.5
Penicillins/beta-lactamase inhibitors	5.2	49.4	5.0	50.1	5.1	50.7	3.8	43.7	5.0	50.6
Sulfonamides and diaminopyrimidine potentiators	0.6	5.6	0.5	5.2	0.6	5.8	0.6	6.7	0.6	6.2
Tetracyclines	3.4	32.3	2.8	28.7	3.3	32.6	3.4	38.5	3.0	30.0
Total	**10.5**	**100.0**	**9.9**	**100.0**	**10.0**	**100.0**	**8.7**	**100.0**	**10.0**	**100.0**

A.5 – Intramammary infusion

Table 23: Total sales of veterinary antimicrobials (tonnes of active constituent, % column total) sold in food animals for therapeutic use and administered by intramammary infusion, by antimicrobial class (July 2005 to June 2010)

	2005-06		2006-07		2007-08		2008-09		2009-10	
CLASS	TONNES	%	TONNES	%	TONNES	%	TONNES	%	TONNES	%
Aminocoumarins	0.0	0.0	0.0	1.4	0.0	1.8	0.0	1.7	0.0	3.7
Aminoglycosides	0.0	0.0	0.0	4.5	0.1	5.8	0.1	5.6	0.1	11.9
Cephalosporins	0.0	0.4	0.0	3.7	0.1	2.7	0.1	4.0	0.2	13.7
Macrolides	0.0	0.0	0.0	1.1	0.0	1.4	0.0	1.3	0.0	2.6
Penicillins/beta-lactamase inhibitors	1.6	99.6	0.8	87.5	1.7	85.9	1.9	85.0	0.7	63.3
Tetracyclines	0.0	0.0	0.0	2.0	0.1	2.5	0.1	2.4	0.1	4.8
Total	**1.6**	**100.0**	**0.9**	**100.0**	**2.0**	**100.0**	**2.3**	**100.0**	**1.1**	**100.0**

APPENDIX B - FOOD ANIMAL SPECIES TO WHICH VETERINARY ANTIMICROBIALS ARE ADMINISTERED

B.1 - Overview

CLASS	CONSTITUENT	CATTLE AND SHEEP	PIGS	POULTRY
Aminocoumarins	Novobiocin	X		
Aminoglycosides	Apramycin	X	X	X
	Dihydrostreptomycin	X		
	Framycetin	X		
	Neomycin	X	X	X
	Spectinomycin		X	X
	Streptomycin	X		
Amphenicols	Florfenicol	X	X	
Arsenicals	Roxarsone			X
Benzamides	Dinitolmide			X
Carbanilides	Nicarbazin			X
Cephalosporins	Ceftiofur	X		
	Cefuroxime	X		
	Cephalonium	X		
	Cephapirin	X		
Glycophospholipids	Flavophospholipol	X	X	X
Lincosamides	Lincomycin		X	X
Macrolides	Erythromycin	X	X	X
	Kitasamycin		X	
	Oleandomycin	X		
	Tilmicosin	X	X	
	Tulathromycin	X	X	
	Tylosin	X	X	X

CLASS	CONSTITUENT	CATTLE AND SHEEP	PIGS	POULTRY
Nitroimidazoles	Dimetridazole		X	X
Oligosaccharides	Avilamycin			X
Others	Robenidine			X
	Tiamulin		X	X
Penicillins/beta-lactamase inhibitors	Amoxycillin	X	X	X
	Ampicillin	X		
	Benzathine penicillin	X	X	
	Clavulanic acid	X		
	Cloxacillin	X		
	Penethamate	X	X	
	Procaine penicillin	X	X	
Polyether ionophores	Lasalacid	X		X
	Maduramicin			X
	Monensin	X		X
	Narasin	X		X
	Salinomycin	X	X	X
	Semduramicin			X
Polypeptides	Bacitracin	X		X
	Polymixin B	X		
Quinoxaline	Olaquindox		X	
Streptogramins	Virginiamycin	X		X
Sulfonamides and diaminopyrimidine potentiators	Sulfadiazine	X	X	X
	Sulfadimidine	X	X	X
	Sulfadoxine	X	X	
	Sulfaquinoxaline			X
	Trimethoprim	X	X	X

CLASS	CONSTITUENT	CATTLE AND SHEEP	PIGS	POULTRY
Tetracyclines	Chlortetracycline	X	X	X
	Oxytetracycline	X	X	X
Triazines	Toltrazuril		X	

Table 24: Total sales of veterinary antimicrobials (tonnes of active constituent, % column total) sold for therapeutic use in food animals, by species, July 2005 to June 2010)

	2005-06		2006-07		2007-08		2008-09		2009-10	
SPECIES	TONNES	%	TONNES	%	TONNES	%	TONNES	%	TONNES	%
Cattle and sheep	39.3	14.5	32.4	14.1	38.6	14.7	34.5	17.3	37.6	13.0
Poultry	143.3	52.7	106.7	46.3	132.8	50.6	77.4	38.9	160.9	55.9
Pigs	89.0	32.8	91.2	39.6	90.8	34.6	87.1	43.7	89.4	31.0
Other food animal species	0.0	0.0	0.1	0.0	0.1	0.0	0.1	0.1	0.2	0.1
Total	**271.6**	**100.0**	**230.4**	**100.0**	**262.3**	**100.0**	**199.1**	**100.0**	**288.0**	**100.0**

B.2 – Cattle and sheep

Table 25: Total sales of veterinary antimicrobials (tonnes of active constituent, % column total) sold for use in cattle and sheep, by purpose, July 2005 to June 2010)

	2005-06		2006-07		2007-08		2008-09		2009-10	
PURPOSE	TONNES	%	TONNES	%	TONNES	%	TONNES	%	TONNES	%
Coccidiostat	112.3	68.5	104.5	69.8	76.6	61.3	62.2	58.2	83.8	62.9
Gr. prom.	12.3	7.5	12.8	8.6	9.8	7.8	10.2	9.6	11.9	8.9
Therapeutic	39.3	24.0	32.4	21.6	38.6	30.9	34.5	32.2	37.6	28.2
Total	**163.8**	**100.0**	**149.7**	**100.0**	**125.0**	**100.0**	**106.9**	**100.0**	**133.3**	**100.0**

Table 26: Total sales of veterinary antimicrobials (tonnes of active constituent, % column total) sold for therapeutic use in cattle and sheep, by route of administration, July 2005 to June 2010)

	2005-06		2006-07		2007-08		2008-09		2009-10	
ROUTE OF ADMINISTRATION	TONNES	%	TONNES	%	TONNES	%	TONNES	%	TONNES	%
Feed	26.1	66.5	20.6	63.5	26.1	67.6	23.3	67.5	25.8	68.6
Water	0.2	0.5	0.3	1.1	0.3	0.8	0.2	0.7	0.3	0.9
Injectable	9.6	24.4	9.0	27.7	8.8	22.9	7.7	22.3	8.9	23.8
Intramammary	1.6	4.2	0.9	2.8	2.0	5.2	2.3	6.6	1.1	3.0
Other	1.8	4.5	1.6	4.9	1.4	3.5	1.0	2.9	1.4	3.8
Total	**39.3**	**100.0**	**32.4**	**100.0**	**38.6**	**100.0**	**34.5**	**100.0**	**37.6**	**100.0**

B.3 – Poultry

Table 27: Total sales of veterinary antimicrobials (tonnes of active constituent, % column total) sold for use in poultry, by purpose, July 2005 to June 2010)

	2005-06		2006-07		2007-08		2008-09		2009-10	
PURPOSE	TONNES	%	TONNES	%	TONNES	%	TONNES	%	TONNES	%
Coccidiostat	223.9	58.2	198.3	62.3	201.5	57.3	196.3	71.0	243.3	59.9
Gr. prom.	17.8	4.6	13.5	4.2	17.6	5.0	2.7	1.0	2.2	0.5
Therapeutic	143.3	37.2	106.7	33.5	132.8	37.7	77.4	28.0	160.9	39.6
Total	**385.0**	**100.0**	**318.6**	**100.0**	**351.9**	**100.0**	**276.4**	**100.0**	**406.4**	**100.0**

Table 28: Total sales of veterinary antimicrobials (tonnes of active constituent, % column total) sold for therapeutic use in poultry, by route of administration, July 2005 to June 2010)

	2005-06		2006-07		2007-08		2008-09		2009-10	
ROUTE OF ADMINISTRATION	TONNES	%	TONNES	%	TONNES	%	TONNES	%	TONNES	%
Feed	112.4	78.4	72.2	67.6	108.2	81.5	59.7	77.1	130.5	81.1
Water	30.9	21.6	34.6	32.4	24.6	18.5	17.7	22.9	30.4	18.9
Injectable	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**143.3**	**100.0**	**106.7**	**100.0**	**132.8**	**100.0**	**77.4**	**100.0**	**160.9**	**100.0**

B.4 – Pigs

Table 29: Total sales of veterinary antimicrobials (tonnes of active constituent, % column total) sold for use in pigs, by purpose, July 2005 to June 2010)

	2005-06		2006-07		2007-08		2008-09		2009-10	
PURPOSE	TONNES	%	TONNES	%	TONNES	%	TONNES	%	TONNES	%
Coccidiostat	0.0	0.0	0.0	0.0	1.2	1.2	0.0	0.0	0.0	0.0
Gr. prom.	17.1	16.1	11.9	11.6	11.0	10.7	10.9	11.1	14.8	14.2
Therapeutic	89.0	83.9	91.2	88.4	90.8	88.1	87.1	88.9	89.4	85.8
Total	**106.1**	**100.0**	**103.1**	**100.0**	**103.0**	**100.0**	**98.0**	**100.0**	**104.2**	**100.0**

Table 30: Total sales of veterinary antimicrobials (tonnes of active constituent, % column total) sold for therapeutic use in pigs, by route of administration, July 2005 to June 2010)

	2005-06		2006-07		2007-08		2008-09		2009-10	
ROUTE OF ADMINISTRATION	TONNES	%	TONNES	%	TONNES	%	TONNES	%	TONNES	%
Feed	70.2	78.9	74.0	81.1	71.5	78.8	69.2	79.5	67.7	75.7
Water	17.8	20.0	16.3	17.9	18.1	20.0	16.8	19.3	20.7	23.1
Injectable	0.9	1.1	0.9	1.0	1.1	1.2	1.0	1.2	1.0	1.1
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**89.0**	**100.0**	**91.2**	**100.0**	**90.8**	**100.0**	**87.1**	**100.0**	**89.4**	**100.0**

Australian Government
National Health and Medical Research Council

APPENDIX C – EAGAR IMPORTANCE RATINGS AND SUMMARY OF ANTIBIOTIC USES IN HUMANS IN AUSTRALIA

Background

The Expert Advisory Group on Antimicrobial Resistance (EAGAR) of the National Health and Medical Research Council (NHMRC) provides advice to Australian governments and their agencies on risk minimisation strategies for controlling antibiotic resistance in Australia. As part of this activity, EAGAR provides advice on risk assessments for new antibiotics and extensions of indications of currently registered antibiotics. The importance of the antibiotic or class of antibiotics in human medicine is taken into account in these risk assessments.

Purpose

This table is intended to provide guidance to clinicians and the pharmaceutical industry (human and animal) about the importance of the various antibacterial agents available for human use in Australia. If an antibiotic is classified as 'High', it implies that if resistance develops there will be very limited or in some cases no alternatives available to treat serious bacterial infections. It is based on a table published originally in the JETACAR report (Joint Expert Technical Advisory Committee on Antibiotic Resistance).

Details are also given on the current ways in which all antibiotics are used in humans. This list is for guidance only, and does not include every use of the agent or class. All agents with significant antibacterial activity are included in the table, even if their primary use is for other than treatment of bacterial infections (e.g. pyrimethamine, a dihydrofolate reductase inhibitor whose main role is treatment of malaria and toxoplasmosis, but with the same antibacterial activity as trimethoprim).

EAGAR uses this information as a guide in providing advice to regulatory agencies and government committees including the APVMA (Australian Pesticides and Veterinary Medicines Authority), TGA (Therapeutic Goods Administration), NDPSC (National drugs and Poisons Schedule Committee) and the PBAC (Pharmaceutical Benefits Authority Committee), as a method of assessing the risk to human health after exposure of susceptible humans to an antibiotic or antibiotic-resistant bacteria. In risk assessment terms, this table is relevant to the "severity of impact' which is an important element to overall risk characterisation. As an example, if an antibiotic is rated as 'High', EAGAR would consider that the severity of impact caused by bacteria resistant to that antibiotic is high, as there are few or no alternatives to many infections. Rating in this table does not affect other parts of risk assessment including hazard, exposure, impact or probability of disease as a result of exposure.

EAGAR ratings will change over time as resistance levels change, new drugs are introduced, and optimum drug choices alter because of new medical evidence. Consequently the table will be updated at regular intervals.

Updated by EAGAR 6 November 2006

ANTIBIOTIC	EAGAR IMPORTANCE RATING[7]	USES P, T, R	COMMENTS
NARROW-SPECTRUM PENICILLINS			
Benzylpenicillin (pen G) and phenoxymethylpenicillin (pen V)	Low	P2, T3, R1	Primary agents in pneumococcal and streptococcal infection.
Procaine penicillin	Low	P2, T3, R1	Intramuscular – occasional substitute for benzylpenicillin.
Benzathine penicillin	Low	P3, T3, R1	Intramuscular – syphilis treatment and rheumatic fever prophylaxis.
MODERATE-SPECTRUM PENICILLINS			
Amoxycillin and ampicillin	Low	P2, T3, R1	Principal role in respiratory tract infections; widespread IV hospital use in combination for a range of moderate and serious infections. Surgical and endocarditis prophylaxis.
ANTIPSEUDOMONAL PENICILLINS			
Piperacillin	High	P1, T3, R3	Primary agent for Pseudomonas aeruginosa.
ANTISTAPHYLOCOCCAL PENICILLINS			
Cloxacillin, dicloxacillin and flucloxacillin (methicillin)	Medium	P3, T3, R1	Standard treatment for Staphylococcus aureus infections (not MRSA). Surgical prophylaxis, especially orthopaedics.
ß-LACTAMASE INHIBITOR COMBINATIONS			
Amoxycillin-clavulanate	Medium	P1, T3, R1	Second line agent for respiratory tract infections; role in certain types of skin/soft tissue infections and mixed staphylococcal/Gram-negative infections and aerobic/anaerobic infections.
Ticarcillin-clavulanate and Piperacillin-tazobactam	High	P1, T2, R2	Valuable agents for a range of severe mixed aerobic-anaerobic infections including intra-abdominal infections, aspiration pneumonia, skin/soft tissue infections. Neutropenic sepsis.

[7] The importance of the drug class to the treatment of infections in humans, and the seriousness of the consequences of emergence of resistance.

ANTIBIOTIC	EAGAR IMPORTANCE RATING[7]	USES P, T, R	COMMENTS
1ST GENERATION CEPHALOSPORINS			
Cephalexin, cephalothin and cephazolin	Medium	P3, T3, R1	Treatment of minor and staphylococcal infections in penicillin allergic patients. Prophylaxis in orthopaedic and other surgery.
2ND GENERATION CEPHALOSPORINS			
Cefaclor and cefuroxime-axetil	Medium	P0, T2, R1	Treatment of respiratory infections in penicillin-allergic patients.
CEPHAMYCINS			
Cefoxitin a	Medium	P3, T1, R2	Useful anti-anaerobic activity, major role in surgical prophylaxis.
3RD GENERATION CEPHALOSPORINS			
Ceftriaxone	High	P2, T3, R2	Major agent in severe pneumonia and meningitis. Used in selected cases for treatment of gonorrhoea and alternative for prophylaxis of meningococcal infection.
Cefotaxime	High	P0, T3, R2	Major agent in severe pneumonia and meningitis.
4TH GENERATION CEPHALOSPORINS (AND ANTI PSEUDOMONAL)			
Ceftazidime, cefpirome and cefepime	High	P1, T3, R3	Restricted role in pseudomonal infection and neutropenic sepsis.
CARBAPENEMS			
Imipenem, meropenem and ertapenem	High	P0, T3, R4	Very broad-spectrum reserve agents for serious Gram-negative infections.
MONOBACTAMS			
Aztreonam	High	P0, T3, R4	Reserve agents for resistant Gram-negative infections or patients with severe ß-lactam allergy.
TETRACYCLINES			
Doxycycline, minocycline, and tetracycline (demeclocycline)	Low	P2, T3, R1	Major agents for minor respiratory tract infections and acne. Supportive role in pneumonia for treating Mycoplasma and Chlamydia pneumoniae. Malaria prophylaxis (doxycycline).
GLYCYLCYCLINES			
Tigecycline	High	P0, T1, R4	Reserve agent for multi-resistant gram-positives and some multi- resistant gram-negatives.

ANTIBIOTIC	EAGAR IMPORTANCE RATING[7]	USES P, T, R	COMMENTS
GLYCOPEPTIDES			
Vancomycin	High	P2, T3, R2	Drug of choice for serious methicillin-resistant staphylococcal infections. Reserve agent for enterococcal infection when there is resistance or penicillin allergy.
Teicoplanin	High	P1, T1, R4	Substitute for vancomycin if intolerance or outpatient IV therapy.
AMINOGLYCOSIDES			
Neomycin (including framycetin)	Low	P1, T2, R1	Topical agent for skin infection and gut suppression.
Gentamicin and tobramycin	Medium	P2, T3, R1	Standard agents in combination for serious and pseudomonal infection. Gentamicin used in combination for endocarditis.
Netilmicin, amikacin	High	P0, T2, R4	Reserve agents for Gram-negatives resistant to gentamicin and tobramycin.
Spectinomycin	Medium	P0, T2, R1	Spectinomycin only used for gonorrhoea (infrequently).
Streptomycin	Low	P0, T1, R4	Rare use in treatment of TB and enterococcal endocarditis.
Capreomycin	Low	P0, T1, R4	Rare use in TB.
Paromomycin	Low	P0, T1, R4	Rare use for Cryptosporidium infection.
SULFONAMIDES AND DHFR INHIBITORS			
Sulfadiazine	Low	P0, T3, R4	Treatment of acute toxoplasmosis.
Trimethoprim	Low	P2, T3, R1	Treatment and prophylaxis of UTI.
Trimethoprim-sulfamethoxazole (co-trimoxazole)	Medium	P2, T3, R1	Minor infections, especially treatment and prophylaxis of UTI. Standard for treatment and prophylaxis of Pneumocystis carinii infection and nocardiasis. Important for community-acquired MRSA infections.
Sulfadoxine-pyrimethamine	Low	P1, T1, R3	Treatment and prophylaxis of malaria.
Proguanil	Low	P2, T1, R3	Malaria prophylaxis.
OXAZOLIDINONES.			
Linezolid	High	P0, T1, R4	Treatment of multi-resistant Gram-positive infections, especially MRSA and VRE.

ANTIBIOTIC	EAGAR IMPORTANCE RATING[7]	USES P, T, R	COMMENTS
MACROLIDES			
Azithromycin	Low	P3, T3, R2	Treatment of Chlamydia trachomatis infections. Major agent for treatment and suppression of atypical mycobacterial infection.
Clarithromycin	Low	P2, T2, R1	Treatment of minor Gram-positive infections. Major agent for treatment and suppression of atypical mycobacterial infection.
Erythromycin and roxithromycin	Low	P1, T3, R1	Treatment of minor Gram-positive, Chlamydia and Mycoplasma infections.
LINCOSAMIDES			
Clindamycin and lincomycin	Medium	P1, T3, R2	Reserved for Gram-positive and anaerobic infections in penicillin- allergic patients. Clindamycin topical used for acne.
NITROIMIDAZOLES			
Metronidazole and tinidazole	Medium	P2, T3, R1	Major agents for the treatment and prevention of anaerobic Infections in hospitals. Principal agents for the treatment of giardiasis and trichomoniasis.
QUINOLONES			
Nalidixic acid	Medium	P1, T2, R1	Use confined to treatment and prophylaxis of UTI.
FLUOROQUINOLONES			
Norfloxacin	High	P1, T3, R2	Treatment and prevention of complicated UTI.
Ciprofloxacin	High	P2, T3, R3	Major oral agent for the treatment of Gram-negative infections resistant to other agents. Minor role in meningococcal prophylaxis.
Moxifloxacin	High	P0, T3, R4	Restricted role in the management of serious respiratory infections, especially pneumonia in patients with severe penicillin allergy.
Ofloxacin	High	P0, T2, R3	Topical treatment of severe eye infections.
STREPTOGRAMINS			
Quinupristin with dalfopristin	High	P0, T1, R4	Reserve agent for multi-resistant Gram-positive infections (MRSAand vancomycin-resistant Enterococcus faecium).
ANTIMYCOBACTERIALS			
Isoniazid	High	P2, T3, R4	Primary agent for treatment and prevention of tuberculosis.

ANTIBIOTIC	EAGAR IMPORTANCE RATING[7]	USES P, T, R	COMMENTS
Ethambutol and pyrazinamide Cycloserine,	High	P1, T3, R4	Primary agent for treatment of TB.
p-aminosalicylic acid, and prothionamide	High	P0, T1, R4	Reserve agents for complicated or resistant TB.
ANTILEPROTICS			
Clofazimine and dapsone	High	P0, T3, R4	Usage predominantly for treatment of leprosy.
ANSAMYCINS (RIFAMYCINS)			
Rifampicin (Rifampin)	High	P3, T3, R2	Meningococcal and H. influenzae type b prophylaxis; Standard part of TB regimens; Important oral agent in combination for MRSA infections.
Rifabutin	High	P3, T2, R4	Treatment and prophylaxis of Mycobacterium avium complex infections.
POLYPEPTIDES			
Bacitracin, gramicidin,	Low	P0, T2, R1	Topical agents with Gram-positive activity.
Polymyxin B	Low	P0, T2, R1	Topical agent with Gram-negative activity.
Colistin	High	P0, T1, R2	Reserve agent for very multi-resistant gram-negative infection (both inhaled and intravenous).
AMPHENICOLS			
Chloramphenicol	Low	P0, T2, R1	Usage largely as topical eye preparation. Occasional need for the treatment of bacterial meningitis.
NITROFURANS			
Nitrofurantoin	Low	P2, T2, R1	Treatment and prophylaxis of urinary tract infections only.
FUSIDANES			
Sodium fusidate	High	P0, T3, R2	Used in combination therapy with rifampicin for MRSA.
T-RNA SYNTHESIS INHIBITORS			
Mupirocin	Medium	P1, T3, R1	Topical treatment of skin infections and clearance of S. aureus nasal carriage (including MRSA).

Antibacterial drug classes which are not used in humans and with no cross-resistance known to classes of antibacterials used in humans include arsenicals, bambermycins (flavophospholipol), ionophores, orthosomycins, quinoxalines and nisin. Pleuromutulins for human use are undergoing development.

Abbreviations:

UTI = urinary tract infections

TB = tuberculosis

MRSA = methicillin-resistant Staphylococcus aureus

VRE = vancomycin resistant Enterococcus species

LEGEND for TABLE

EAGAR Importance Rating

High

These are essential antibiotics for treatment of human infections where there are few or no alternatives for many infections. Also have been called ‘critical’, ‘last-resort’ or ‘last line’ antibiotics.

Medium

There are other alternatives available but less than for those classified as ‘Low’.

Low

There are a reasonable number of alternative agents in different classes are available to treat most infections even if antibiotic resistance develops.

Human uses

These reflect the current use of these antibiotics in Australia in human medicine. It does not necessarily reflect what EAGAR believes should be the uses of these agents or what restrictions should apply to their use.

P: prophylactic use

0 = not recommended for prophylactic use

1 = rarely used

2 = moderate

3 = frequent or major use

T: therapeutic use

1 = infrequently used for listed indications

2 = moderate use for listed indications

3 = used frequently for listed indications

R = Restriction on use (Pharmaceutical Benefits Scheme or hospitals)

1 = readily available

2 = some extra rules on use e.g. ‘Restricted benefit’ in the Pharmaceutical Benefits Scheme (PBS) or not listed on the PBS and therefore not subsidised

3 = higher level of restriction e.g. needs an ‘Authority required’ prescription on the PBS or not listed on the PBS and therefore not subsidised; often restricted use in hospitals

4 = use severely restricted (e.g. not available for prescription under PBS, available in major hospitals but only with permission from microbiologist or infectious diseases consultant, or in a special clinic).

Reference

Therapeutic Guidelines – Antibiotic. Version 13, 2006. Therapeutic Guidelines Limited, Melbourne (www.tg.com.au)

ABBREVIATIONS

AMR	antimicrobial resistance
AMRPC	Australian Antimicrobial Resistance Prevention and Containment
AMRSC	Antimicrobial Resistance Standing Committee
APVMA	Australian Pesticides and Veterinary Medicines Authority
EAGAR	Expert Advisory Group on Antimicrobial Resistance
NH&MRC	National Health and Medical Research Council

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