Usage of Antibiotics in Agricultural Livestock in the Netherlands in 2017

Trends and benchmarking of livestock farms and veterinarians

September 2018





Preface

This is a copy of the report *Usage of Antibiotics in Agricultural Livestock in the Netherlands in 2017* drawn up by the Netherlands Veterinary Medicines Institute (SDa). With this report, the SDa expert panel provides insight into the usage of antibiotics at Dutch livestock farms for the seventh consecutive year.

A substantial part of this report concerns the SDa's new benchmark thresholds. The process leading up to the introduction of these new benchmark thresholds took almost two years. An initial outline was formulated in 2016, and the SDa's proposals started to take shape over the course of 2017. In December of 2017, the SDa expert panel discussed its proposed changes with a team of national and international consultants, and it would like to thank Rudy Douven (NL), Prof Christina Greko (S), Prof Dik Mevius (NL), Prof Morgan Scott (USA) and Wannes Vanderhaeghen (B) for their constructive criticism and suggested improvements.

The new benchmark thresholds mark the beginning of a new era. For certain types of livestock farms and production categories, the new benchmark thresholds represent a low, acceptable level of antibiotic use, taking into account the current husbandry systems as well as animal health and welfare considerations. Other types of farms or production categories still have some way to go with regard to the amounts of antibiotics used. In those cases, the SDa expert panel has opted to continue its pragmatic benchmarking approach for the time being. Implementation of the new benchmark thresholds is expected to drive further reductions in the amounts of antibiotics used, by focusing primarily on livestock farms with relatively high usage levels. In addition, the new benchmark thresholds should give the majority of livestock farmers in the Netherlands a sense of certainty regarding their targets for the next years.

Utrecht, September 2018

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Conclusions and recommendations

The SDa strives for transparent and prudent usage of antibiotics in the Netherlands. In order to reach this goal, it:

- continuously monitors the amounts of antibiotics used in the veal, cattle, pig, broiler, turkey and meat rabbit farming sectors and at individual livestock farms;
- intermittently assesses the amounts of antibiotics used in other sectors, including the companion animal and horse sectors, by performing surveys every several years;
- assess sales figures to determine the amounts of antibiotics sold;
- benchmarks livestock farms' antibiotic usage levels;
- benchmarks veterinarians' prescription patterns.

Developments in usage levels of monitored livestock sectors

In 2017, the turkey and broiler farming sectors managed to substantially reduce their antibiotic use in terms of defined daily doses animal ($DDDA_{NAT}$). They achieved reductions of 23.7% and 7.8%, respectively. Less prominent reductions of 3.6% and 1.9% were observed for the veal and pig farming sectors, respectively. The cattle farming sector's usage level increased slightly over the 2016-2017 period, by 2.2%.

Many livestock farms throughout the livestock sectors consolidated the low usage levels recorded in previous years and several farms recorded lower usage levels than the year before. The **broiler farming sector** continued the steep decline recorded for 2016 by an additional 7.8% reduction. According to supplementary data provided by the poultry farming sector, this positive development was in part due to a rise in the number of broiler farms with slower growing breeds. The **turkey farming sector** also managed to continue last year's considerable decline in the amount of antibiotics used. Despite usage level increases in 2014 and 2015, the turkey farming sector has managed to achieve a 31.3% reduction over the 2013-2017 period. The **dairy cattle farming sector** and non-dairy cattle farming sector recorded 1.5% and 2.7% increases in their antibiotic use, respectively. For the time being, the SDa considers these increases as a result of natural variation over time. The 2017 usage levels recorded for the dairy and non-dairy cattle farming sectors were still considered to be low and acceptable.
Antibiotic use in the **veal farming sector** declined by 3.6%. This livestock sector has recorded a modest 6.4% reduction over the past five years. To achieve a further reduction in the amount of antibiotics used, so-called critical success factor studies were performed in 2017. The studies were conducted to identify the characteristics separating livestock farms with low usage levels from those with high usage levels. The studies focused on farm- and housing-related characteristics, farm management practices, and farmers' veterinary practice, level of knowledge and attitudes. The findings of the critical success factor study performed in the veal farming sector have provided leads for follow-up analyses. The SDa expert panel is convinced further research will result in interventions that will help veal farmers reduce their usage levels. Similar to 2016, the **pig farming sector** recorded a minor (1.9%) reduction in the amount of antibiotics used. Over the past five years, this livestock sector has reduced its usage level by 12.8%. The **rabbit farming sector** experienced some problems

with the transmission of delivery record data. The problems were associated with software-related issues that affected data transmission between a large veterinary practice and the sector's quality management system. As a result, the rabbit farming sector's usage level data included in this report are provisional in nature.

Sales figures

In 2017, sales of antibiotics in terms of kilograms of active substances amounted to 181,097 kg. The number of kilograms of active substances sold declined by 63.4% between 2009 (the government-specified reference year) and 2017. Compared with 2016, sales rose by 3%. Discrepancies observed between the amounts of antibiotics used according to sales figures and the amounts of antibiotics used according to monitored livestock sectors' delivery records can probably be attributed to stockpiling and fluctuations in the amounts of antibiotics used in unmonitored sectors.

Developments in usage of the main second- and third-choice antibiotics

Use of third-choice antibiotics remained low in most of the livestock sectors. Changes in the amounts of antibiotics used occurring between 2016 and 2017 were generally associated with slight shifts in the relative contributions of first-, second- and third-choice antibiotics. In the turkey farming sector, however, the relative contribution of second-choice agents went up in 2017. The amounts of second-choice antibiotics used in the broiler and turkey farming sectors are still quite high. Colistin sales continued to decline in 2017, to 19% of the 2011 level. Sales of fluoroquinolones fell by 25% in 2017. The usage of fluoroquinolones by the turkey farming sector should be reduced to incidental usage.

Benchmarking of livestock farms

The SDa has defined specific benchmark thresholds for all of the monitored livestock sectors except the rabbit farming sector. These benchmark thresholds are used to assess whether the amount of antibiotics used at a particular livestock farm (its $DDDA_F$ value) falls within the target zone, the signaling zone, or the action zone. The modest reduction in antibiotic use observed for 2017 was associated with livestock farms moving to lower benchmark zones. It should be noted, however, that the numbers of broiler and turkey farms assigned to the various benchmark zones may have been confounded by the recent revision of the calculation methods used for the broiler and turkey farming sectors, as their 2017 usage level data were based on body weight at the time of treatment instead of standardized body weight. Following a revision of the cattle farming sector's benchmarking method, cattle farms are now benchmarked based on just a single (signaling) threshold. Action is required if a cattle farm's usage level has exceeded this signaling threshold two years in a row.

In 2017, no distinct shifts towards lower benchmark zones occurred in the veal farming sector. The veal farming sector has the highest percentage of farms with a signaling or action zone usage level. It also has the highest percentage of farms with structurally high usage levels (i.e. a signaling or action zone usage level for three consecutive years). These farms have shown relatively little or none improvement over the past few years.

The pig farming sector saw an undesirable rise in the percentage of farms with weaner pigs recording action zone usage levels. This development was due to the new benchmark thresholds introduced in 2016.
In each of the livestock sectors, a number of livestock farms recorded usage levels greatly exceeding the average amount of antibiotics used in the sector concerned. The SDa expert panel recommends paying special attention to such outliers.

Benchmarking of veterinarians

For the majority of livestock sectors, the number of veterinarians included in the target zone has increased over the past few years due to the livestock farms reducing their usage levels. All of the livestock sectors except the veal farming sector show a steep decline in the number of veterinarians included in the signaling and action zones. Compared with the veterinarians active in these livestock sectors, veterinarians active in the veal farming sector were more likely to be included in the signaling or action zone based on their prescription patterns. This is associated with the antibiotic usage patterns observed for veal farms.

Revision of the calculation and benchmarking methods

This is the first SDa report in which the broiler and turkey farming sectors' $DDDA_F$ data have been calculated using the animals' average body weight at the time of treatment instead of their standardized body weight.

It is also the first SDa report with $DDDA_F$ data for the veal farming sector that have been based on a 1.5-year period. The veal farming sector's $DDDA_F$ data included in this report were obtained by first determining veal farms' antibiotic use from mid-2016 to the end of 2017 and subsequently calculating the 1-year average. Usage data based on 1.5-year periods are less likely to result in $DDDA_F$ fluctuations over time, as their application mitigates the effect of any year-to-year differences in the number of times a year veal farmers start with raises a new herd of calves.

2017 also was the first year cattle farms were benchmarked based on just a signaling threshold. The performance of this new benchmarking approach for the cattle farming sector will be evaluated in 2019.

New benchmark thresholds

Later this year, the SDa expert panel will present its final proposals regarding a new benchmarking method with just two benchmark zones (a target zone and an action zone), based on either a benchmark threshold representing acceptable use of antibiotics or a provisional benchmark threshold. Benchmark thresholds representing acceptable use are used for livestock sectors or types of farms/production categories that have seen the emergence of usage patterns characterized by regular zero-level use, limited variation between individual livestock farms in the amounts of antibiotics used, and limited usage level fluctuations over time. For livestock sectors or types of farms/production categories characterized by such a usage pattern, benchmark thresholds representing acceptable use of antibiotics can be determined based on the sector's current $DDDA_F$ distribution. Those benchmark thresholds will probably require no or only minor adjustments in the years to come. As these sectors are characterized by just minor structural between-farm differences, prescription patterns of the various veterinarians active within these sectors will show little variation as well. Benchmark thresholds for livestock sectors without such a usage pattern can only be determined based on pragmatic considerations, similar to the SDa expert panel's original benchmarking approach. Those benchmark thresholds are referred to as "provisional benchmark thresholds". They have a shorter lifespan, and regular evaluations will be required to determine whether they need to be adjusted.

The SDa expert panel feels its benchmarking approach should aim to reduce outliers with high usage levels and limit usage level fluctuations over time as much as possible. To meet this objective, more excessive benchmark threshold deviations should be met with stricter corrective measures. Such a proportional approach would be particularly beneficial in the first years following the introduction of the new benchmark thresholds, as livestock farms will need some time to switch to the new benchmarking method.

Summary of old and new benchmark thresholds. Benchmark thresholds representing acceptable use will be valid from 2019 to 2024. Provisional benchmark thresholds will be valid for the 2019-2020 period

		Benchmark thresholds valid until the end of 2018		**Benchmark thresholds valid as of 2019, with specification of the type of threshold**	
Livestock sector	**Type of farm/ production category**	**Signaling threshold**	**Action threshold**	**Type of benchmark threshold**	**Action threshold**
Veal farming sector*	White veal farms	23	39	Provisional	23
	Rosé veal starter farms	67	110	Provisional	67
	Rosé veal fattening farms	1	6	Representing acceptable use	4
	Rosé veal combination farms	12	22	This category will cease to exist	
Pig farming sector	Sows/piglets	10	20	Representing acceptable use	5
	Weaner pigs	20	40	Provisional	20
	Fattening pigs	10	12	Representing acceptable use	5
Poultry farming sector	Broiler farms	15	30	Representing acceptable use	8
	Turkey farms	19	31	Provisional	10[¥]
Rabbit farming sector	Rabbit farms			Provisional	**
Cattle farming sector	Dairy cattle farms	6[§]		Representing acceptable use	6
	Rearing farms	2[§]		Representing acceptable use	2
	Suckler cow farms	2[§]		Representing acceptable use	2
	Beef farms	2[§]		Representing acceptable use	2

* The benchmark thresholds are based on a 1.5-year period
** No benchmark threshold can be determined based on the currently available data
¥ Determined using the new, growth curve-based calculation method
§ Threshold for inclusion in the signaling zone; cattle farms are included in the action zone if their usage level has exceeded the signaling threshold two years in a row

No benchmark thresholds have yet been set for the rabbit farming sector, as the SDa expert panel only has access to provisional 2017 data due to data transmission issues.

Benchmark thresholds for veterinarians will be presented in the second half of 2019. The SDa expert panel first wants to assess the effects of implementing the new benchmark thresholds for livestock farms. Moreover, it is considering revising its benchmarking method for veterinarians, as it would prefer a more intuitive indicator with which to benchmark veterinarians' performance.

Terms and definitions

BCT	"Branchecodetabel", a veterinary medicinal products database used in the Netherlands.
$DDDA_F$	The defined daily dose animal based on the antibiotic usage data of a particular livestock farm. The $DDDA_F$ is determined by first calculating the total number of treatable kilograms at a particular livestock farm for a specific year, and then dividing this number by the average number of kilograms of animal present at the livestock farm concerned. It reflects the amount of antibiotics used at a particular livestock farm, and is used for benchmarking individual livestock farms. This is the unit of measurement used by the SDa since 2011 (see the Standard Operating Procedure *Berekening van de DDD/J voor antimicrobiële middelen door de SDa* [SDa method for calculating the DDDA/Y for antimicrobial agents]). The $DDDA_F$ data of all individual livestock farms within a particular livestock sector are used to determine the mean and the median (*unweighted*, i.e. with all livestock farms contributing equally). The *weighted* mean of the $DDDA_F$ (with weighting based on the value of the denominator, i.e. the number of kilograms of animal) is equal to the mean $DDDA_{NAT}$ based on all livestock farms within the livestock sector concerned. The $DDDA_F$ is expressed in DDDA/animal-year. In some older publications, this parameter was expressed in ADDD/Y.
$DDDA_{NAT}$	The defined daily dose animal based on national antibiotic usage data. The $DDDA_{NAT}$ is determined by first calculating the total number of treatable kilograms within a particular livestock sector for a specific year, and then dividing this number by the average number of kilograms of animal present within the livestock sector concerned. This unit of measurement is used to determine the amount of antibiotics used within a particular livestock sector, irrespective of the types of livestock farms or production categories included in the livestock sector concerned. This parameter is used in other countries as well. It is similar to the parameter DDD per 1,000 person-days used in human medicine when multiplied by 1,000/365. The $DDDA_{NAT}$ is expressed in DDDA/animal-year.
$DDDA_{VET}$	The defined daily dose animal based on the antibiotic prescription pattern of a particular veterinarian in one of the livestock sectors. To determine the $DDDA_{VET}$, the first step is to calculate the total number of treatable kilograms for which a particular veterinarian prescribed antibiotics during a

	specific year (the overall number of treatable kilograms for all livestock farms that had a registered one-to-one relationship with this veterinarian in the year concerned). This number is then divided by the average number of kilograms of animal present based on all of the livestock farms that had a registered one-to-one relationship with the veterinarian concerned. The $DDDA_{VET}$ reflects a particular veterinarian's prescription pattern in absolute terms, and is used to identify inter-veterinarian variability in prescription patterns.
DDD_{VET}	The active substance-based defined daily dose for veterinary medicinal products. The DDD_{VET} is the assumed average dose administered to a particular type of livestock in Europe, in mg/kg body weight. This unit of measurement is used to determine DDD_{VET}/live weight values, which facilitate comparison with $DDDA_{NAT}$ data.
EMA	European Medicines Agency
ESBL	Extended-Spectrum Beta-Lactamase
ESVAC	European Surveillance of Veterinary Antimicrobial Consumption
EUROSTAT	The statistical office of the European Union. Its task is to provide the European Union with statistics at European level that enable comparisons between countries and regions.
Mass balance	An equation for comparing the reported amount (in kilograms, kg) of an active substance sold with the amount (in kg) of the active substance used according to delivery data reported by veterinarians (delivery records).
PCU	Population Correction Unit, a parameter used by the European Medicines Agency representing the number of kilograms of animal in a particular livestock sector. The PCU is calculated using the number of animals present and the number of animals slaughtered for a particular livestock sector in a specific year. As a result, the PCU is more production driven than the denominator in the SDa's $DDDA_{NAT}$ calculations, which also represents the number of kilograms of animal in a particular livestock sector but is based solely on the average number of animals present in the year concerned.
RPR	Relative Prescription Ratio, i.e. the amount of antibiotics used at a particular livestock farm ($DDDA_{F}$) divided by the action threshold applicable to the livestock farm concerned.
Treatable kilograms	The number of kilograms of a particular type of livestock that, according to the package leaflet information, can be treated with a single mass unit of the antibiotic concerned.

VBI	Veterinary Benchmark Indicator. A veterinarian's VBI expresses the probability that livestock farms for which the veterinarian concerned is responsible will fall within the action zone for livestock farms based on their antibiotic use. A veterinarian's VBI is based on the distribution of the RPRs of the livestock farms for which he or she is responsible.

Introduction

2017 is the seventh year for which the SDa publishes antibiotic usage data. The layout of the current report is largely in line with that of last year's report.

The SDa has been monitoring the amounts of antibiotics used at Dutch livestock farms since 2011, by comparing livestock farms' usage levels to benchmark thresholds that have been defined for a particular type of farm or production category in the livestock sector concerned. In the spring of 2014, the SDa also introduced and published a benchmarking method to be used for veterinarians. Using data provided by the various livestock sectors, the SDa is able to:

- Report on developments in usage of antibiotics in the Dutch livestock sector;
- Define benchmark thresholds, and benchmark livestock farms and veterinarians accordingly;
- Compare data on the amounts of antibiotics used with data on the amounts sold.

Once analyzed, the data also show whether a particular livestock farm's usage level or a particular veterinarian's prescription pattern has been persistently high or low for several years.

This year's report also describes the how and why of the SDa's plan to revise its benchmarking approach and the associated benchmark thresholds. As the SDa expects the livestock sectors are about to transition to this new benchmarking method, benchmarking results based on currently applicable benchmark thresholds are not discussed as elaborately as in previous reports.

Trends in usage and sales of antibiotics

Developments in usage and sales of antibiotics are analyzed based on the following two reporting methods: 1) delivery records for each livestock sector, and 2) national sales figures.

1. Usage of antimicrobial agents is assessed based on all farm-level delivery records for antimicrobial agents. The delivery records are transferred to the SDa through the databases of the various livestock sectors, and provide detailed information on the amounts of antibiotics used in each sector.
2. Sales figures are provided by FIDIN, the federation of the Dutch veterinary pharmaceutical industry. The agents sold are categorized in accordance with the Dutch "Branchecodetabel" (BCT) as at April 5, 2018. Differentiation of sales figures according to livestock sector is only possible for a very small number of products.

For each of the livestock sectors, the annual overall number of defined daily doses animal for the entire livestock sector ($DDDA_{NAT}$) has been determined, based on all of the delivery records and the average number of kilograms of animal present within the sector concerned. The $DDDA_{NAT}$ has been selected as the general trend indicator for antibiotic use in the various Dutch livestock sectors over several years. $DDDA_{NAT}$ data are in line with the MARAN data previously reported by the Agricultural Economic Institute (LEI) of Wageningen University & Research centre (Wageningen UR). From 2012 onwards, all delivery record data pertaining to veal calves, pigs and cattle have been reported to the SDa by the respective livestock sectors. This has enabled the SDa to analyze $DDDA_{NAT}$ trends over the 2012-2017 period for the veal, pig and cattle farming sectors. As only part of the 2012 delivery record data for the broiler farming sector had been provided to the SDa, the SDa decided to estimate this livestock sector's 2012 usage levels based on the 2012 data that were available. Antibiotic use in the turkey farming sector has been reported on since 2013. 2016 was the first year for which delivery record data for all rabbit farms were included in the SDa report.

In order to determine the $DDDA_{NAT}$ values, the SDa had to obtain data on the numbers of animals present in the Netherlands. Data from Statistics Netherlands (CBS) and EUROSTAT were used to this end. For each type of livestock within the various livestock sectors, the number of kilograms of animal present in the Netherlands was calculated using the numbers of animals included in Table A1 (CBS data were used for the veal, poultry and rabbit farming sectors, and EUROSTAT data were used for the other livestock sectors).

Number of kilograms of animal present in the Netherlands

Table 1. Live weight (x1,000 kg) of agricultural livestock in the Netherlands from 2013 to 2017*

Livestock sector	2013	2014	2015	2016	2017
Broiler farming sector	44,242	47,020	49,107	48,378	48,237
Turkey farming sector	5,046	4,763	5,178	4,572	4,023
Pig farming sector	710,802	704,937	706,025	686,638	690,093
Dairy cattle farming sector	958,200	966,000	1,030,200	1,076,400	999,000
Veal farming sector	159,547	158,828	156,751	164,890	163,935
Non-dairy cattle farming sector	573,800	649,000	649,800	600,100	542,000
Rabbit farming sector	830	860	1,004	948	901

** The 2013 figures were provided by LEI Wageningen UR. 2014, 2015, 2016 and 2017 figures for the pig and cattle farming sectors were provided by EUROSTAT. Figures for the rabbit, veal and poultry farming sectors were provided by Statistics Netherlands (CBS).*

Developments in usage of antibiotics based on delivery record data

Antibiotic usage data were provided by the various livestock sectors. In the event of livestock farms with high delivery record results, the data were checked to see whether they were correct. Only a small proportion of delivery records yielded high results. Some of these findings were due to errors in the data file. In those cases, the data were resubmitted. The delivery record data were used to determine the number of treatable kilograms of animal for each of the livestock sectors. These numbers were then divided by the number of kilograms of animals present within the livestock sector concerned, in order to obtain sector-specific $DDDA_{NAT}$ values. The $DDDA_{NAT}$ values for the 2013-2017 period are included in Table 2.

The **broiler farming sector** managed to continue the $DDDA_{NAT}$ reduction achieved in 2016 by recording a further 7.8% reduction for 2017. Additional data provided by the poultry farming sector showed a rise in the percentage of slower growing breeds, which may have contributed to the 2017 $DDDA_{NAT}$ reduction. The amount of antibiotics used in the **turkey farming sector** dropped by 23.7% in 2017. This means the turkey farming sector has achieved an overall decline of 31.3% since 2013, the first year it was subjected to monitoring.

The **pig farming sector** recorded a 1.9% reduction for 2017, resulting in a $DDDA_{NAT}$ value of 8.7.

The amount of antibiotics used in the **dairy cattle farming sector** rose by 1.5% in 2017. The non-dairy cattle farming sector also recorded an increase, of 2.7%. Nevertheless, usage levels in the cattle farming sector are still low, and the SDa expert panel considers the 2017 increases to be the result of natural variation over time.

The **veal farming sector** managed to reduce the amount of antibiotics used by 3.6%, to a $DDDA_{NAT}$ value of 20.1 for 2017.

2017 was the second year the **rabbit farming sector** was subjected to annual monitoring. There were some issues with automated transmission of the 2017 data, which may have been related to many rabbit farms switching veterinary practices. The delayed data provision meant the SDa was unable to verify the findings. This should be taken into account when interpreting the data. Due to these circumstances, the SDa has decided not to include the rabbit farming sector's data in its figures and tables. The rabbit farming sector's provisional $DDDA_{NAT}$ figure for 2017 is 30.1.

Figure 1. DDDA$_{NAT}$ figures for the 2013-2017 period, by livestock sector (broiler, turkey, pig, dairy cattle, veal and non-dairy cattle farming sectors) and pharmacotherapeutic group

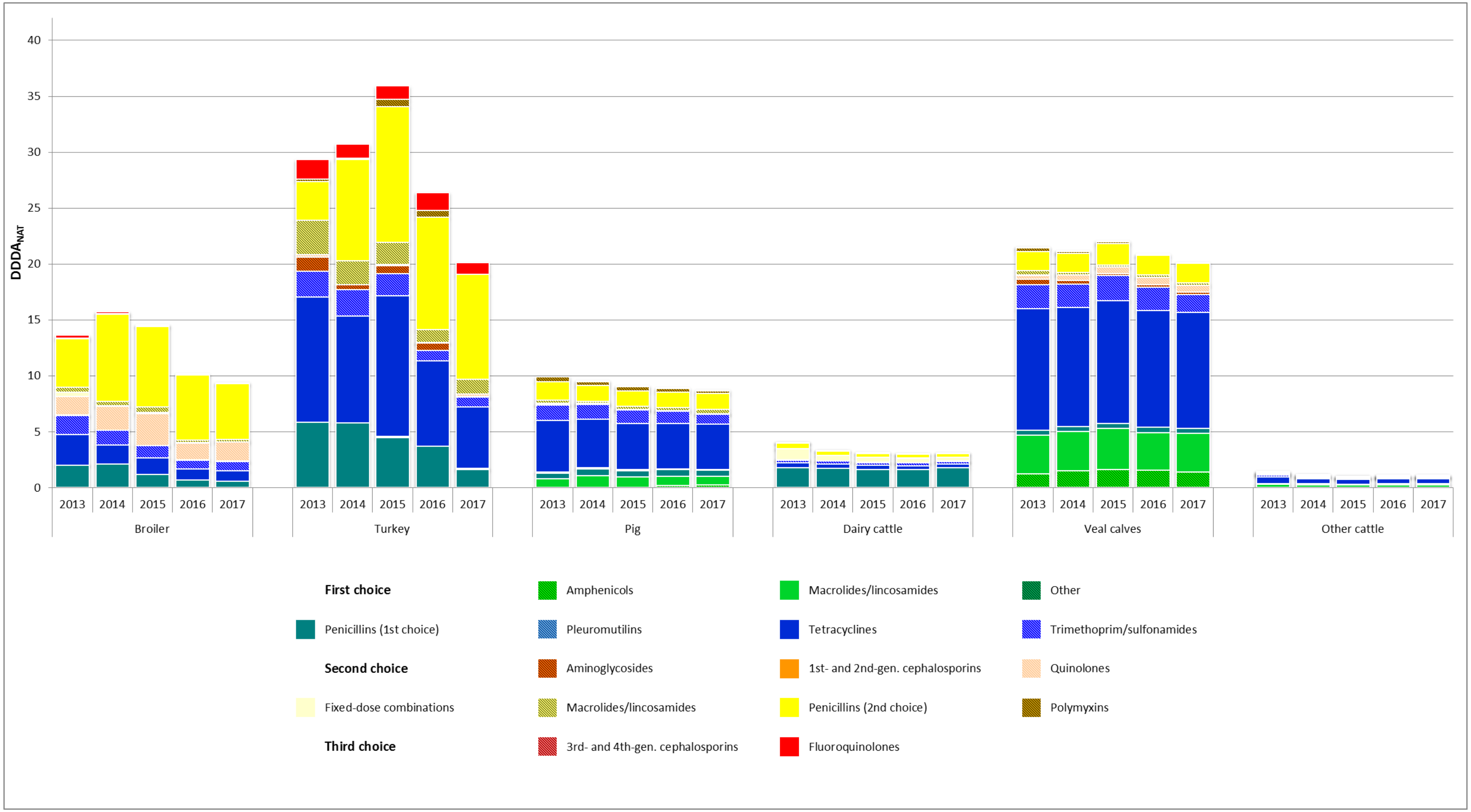


Table 2. $DDDA_{NAT}$ figures for the 2013-2017 period, by livestock sector (broiler, turkey, pig, dairy cattle, veal and non-dairy cattle farming sectors) and pharmacotherapeutic group

	Broiler farming sector					Turkey farming sector					Pig farming sector				
	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Pharmacotherapeutic group															
1st-choice antibiotics	**6.47**	**5.16**	**3.76**	**2.49**	**2.36**	**19.40**	**17.75**	**19.18**	**12.29**	**8.11**	**7.42**	**7.45**	**6.97**	**6.88**	**6.61**
As a proportion of overall AB use	**47.36%**	**32.72%**	**25.79%**	**24.42%**	**25.08%**	**66.07%**	**57.73%**	**53.37%**	**46.49%**	**40.22%**	**74.46%**	**78.22%**	**77.10%**	**77.54%**	**75.99%**
Amphenicols	*	*	*	*	*	0.02	*	*	*	*	0.09	0.17	0.18	0.24	0.25
Macrolides/lincosamides	*	*	*	*	*	*	*	*	*	*	0.71	0.92	0.78	0.82	0.76
Penicillins	2.05	2.12	1.20	0.70	0.59	5.86	5.80	4.49	3.70	1.64	0.52	0.61	0.57	0.58	0.55
Pleuromutilins	0.00	*	*	*	*	*	*	0.12	*	0.10	0.12	0.09	0.08	0.07	0.09
Tetracyclines	2.71	1.70	1.49	1.01	0.95	11.19	9.58	12.57	7.63	5.51	4.58	4.34	4.14	4.07	4.05
Trimethoprim/sulfonamides	1.71	1.34	1.07	0.78	0.82	2.33	2.37	2.01	0.95	0.86	1.40	1.33	1.20	1.10	0.90
2nd-choice antibiotics	**6.94**	**10.43**	**10.75**	**7.63**	**6.99**	**8.20**	**11.71**	**15.56**	**12.54**	**10.99**	**2.54**	**2.07**	**2.07**	**1.99**	**2.09**
As a proportion of overall AB use	**50.81%**	**66.15%**	**73.73%**	**74.86%**	**74.34%**	**27.92%**	**38.08%**	**43.29%**	**47.45%**	**54.50%**	**25.54%**	**21.76%**	**22.89%**	**22.45%**	**24.01%**
Aminoglycosides	0.04	0.03	0.02	0.01	0.03	1.24	0.40	0.71	0.69	0.05	0.00	0.01	0.01	0.00	0.01
1st- and 2nd-gen. cephalosporins	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Quinolones	1.67	2.13	2.86	1.51	1.72	0.23	0.02	0.10	0.01	0.26	0.03	0.05	0.03	0.02	0.03
Fixed-dose combinations	0.36	0.06	0.11	0.05	0.01	*	*	*	*	*	0.10	0.05	0.04	0.03	0.02
Macrolides/lincosamides	0.44	0.35	0.48	0.25	0.20	3.07	2.12	1.98	1.18	1.30	0.31	0.17	0.25	0.26	0.37
Penicillins	4.35	7.80	7.23	5.78	5.00	3.48	9.09	12.13	10.05	9.37	1.66	1.45	1.36	1.39	1.41
Polymyxins	0.08	0.05	0.06	0.04	0.03	0.18	0.08	0.63	0.61	*	0.44	0.34	0.38	0.28	0.26
3rd-choice antibiotics	**0.25**	**0.18**	**0.07**	**0.07**	**0.05**	**1.76**	**1.29**	**1.20**	**1.60**	**1.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
As a proportion of overall AB use	**1.83%**	**1.13%**	**0.48%**	**0.72%**	**0.58%**	**6.01%**	**4.19%**	**3.34%**	**6.06%**	**5.28%**	**0.00%**	**0.02%**	**0.00%**	**0.00%**	**0.00%**
3rd- and 4th-gen. cephalosporins	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Fluoroquinolones	0.25	0.18	0.07	0.07	0.05	1.76	1.29	1.20	1.60	1.06	*	0.00	0.00	0.00	0.00
Overall antibiotic use	**13.66**	**15.76**	**14.59**	**10.19**	**9.40**	**29.36**	**30.74**	**35.94**	**26.42**	**20.16**	**9.96**	**9.52**	**9.03**	**8.87**	**8.70**

0.00 means use was below 0.005 $DDDA_{NAT}$; * means no use was reported

	Dairy cattle farming sector					Veal farming sector					Non-dairy cattle farming sector				
	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
Pharmacotherapeutic group															
1st-choice antibiotics	**2.47**	**2.39**	**2.27**	**2.23**	**2.35**	**18.15**	**18.23**	**18.99**	**17.94**	**17.30**	**1.14**	**0.95**	**0.86**	**0.91**	**0.92**
As a proportion of overall AB use	**61.23%**	**72.56%**	**73.06%**	**74.03%**	**76.94%**	**84.41%**	**86.20%**	**86.09%**	**85.90%**	**85.90%**	**81.59%**	**82.60%**	**86.00%**	**84.95%**	**84.19%**
Amphenicols	0.05	0.06	0.06	0.06	0.05	1.23	1.52	1.63	1.59	1.44	0.11	0.10	0.10	0.11	0.11
Macrolides/lincosamides	0.05	0.09	0.09	0.06	0.05	3.49	3.53	3.70	3.35	3.43	0.19	0.18	0.15	0.15	0.16
Penicillins	1.72	1.62	1.50	1.52	1.69	0.41	0.43	0.42	0.48	0.46	0.09	0.09	0.09	0.10	0.11
Pleuromutilins	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Tetracyclines	0.42	0.39	0.37	0.35	0.32	10.87	10.66	11.01	10.47	10.35	0.59	0.47	0.42	0.44	0.45
Trimethoprim/sulfonamides	0.22	0.24	0.25	0.24	0.24	2.14	2.08	2.22	2.05	1.61	0.16	0.11	0.10	0.10	0.09
2nd-choice antibiotics	**1.55**	**0.90**	**0.83**	**0.78**	**0.70**	**3.33**	**2.90**	**3.04**	**2.92**	**2.80**	**0.26**	**0.20**	**0.14**	**0.16**	**0.17**
As a proportion of overall AB use	**38.60%**	**27.30%**	**26.79%**	**25.83%**	**22.94%**	**15.47%**	**13.71%**	**13.80%**	**13.97%**	**13.90%**	**18.32%**	**17.36%**	**13.95%**	**15.01%**	**15.72%**
Aminoglycosides	0.00	0.00	0.01	0.01	0.01	0.53	0.34	0.19	0.23	0.23	0.02	0.01	0.01	0.01	0.01
1st- and 2nd-gen. cephalosporins	0.03	0.02	0.02	0.03	0.03	*	*	*	*	*	0.00	0.00	0.00	0.00	0.00
Quinolones	0.00	0.00	0.00	0.00	0.00	0.30	0.49	0.58	0.66	0.57	0.01	0.03	0.02	0.03	0.02
Fixed-dose combinations	1.01	0.48	0.42	0.38	0.34	0.09	0.01	0.00	0.00	0.01	0.08	0.04	0.03	0.03	0.04
Macrolides/lincosamides	0.01	0.01	0.01	0.01	0.01	0.35	0.19	0.18	0.19	0.23	0.03	0.02	0.01	0.02	0.02
Penicillins	0.48	0.38	0.37	0.34	0.31	1.69	1.71	1.91	1.77	1.75	0.10	0.09	0.07	0.06	0.08
Polymyxins	0.02	0.01	0.01	0.01	0.00	0.36	0.15	0.19	0.07	0.02	0.01	0.01	0.01	0.00	0.00
3rd-choice antibiotics	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.03**	**0.02**	**0.02**	**0.03**	**0.04**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
As a proportion of overall AB use	**0.18%**	**0.14%**	**0.15%**	**0.14%**	**0.11%**	**0.12%**	**0.09%**	**0.11%**	**0.13%**	**0.19%**	**0.09%**	**0.04%**	**0.05%**	**0.05%**	**0.09%**
3rd- and 4th-gen. cephalosporins	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*	*	*	0.00	0.00	0.00	0.00	0.00
Fluoroquinolones	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.02	0.03	0.04	0.00	0.00	0.00	0.00	0.00
Overall antibiotic use	**4.03**	**3.30**	**3.11**	**3.01**	**3.06**	**21.50**	**21.15**	**22.05**	**20.88**	**20.13**	**1.40**	**1.15**	**1.00**	**1.07**	**1.10**

0.00 means use was below 0.005 $DDDA_{NAT}$; * means no use was reported

Usage of critically important antibiotics

Over the past few years, all of the monitored livestock sectors managed to reduce their overall amount of antibiotics used. There has also been a shift in the relative contributions of first-, second- and third-choice antibiotics to overall antibiotic use. In general, this has resulted in a relative increase in livestock sectors' use of first-choice antibiotics, and a relative decline in their use of second- and third-choice antibiotics, including critically important antibiotics. As a result of the implemented policy, all livestock sectors except the broiler and turkey farming sectors saw a rise in the relative contribution of first-choice antibiotics over the past years. In the broiler and turkey farming sectors, first-choice antibiotics have been the main driver for the recorded overall antibiotic use reduction. Changes in the amounts of first-, second- and third-choice antibiotics used that occurred between 2016 and 2017 were generally associated with slight shifts in the respective relative contributions to overall antibiotic use. In the turkey farming sector, however, the relative contribution of second-choice antibiotics went back up in 2017. This rise is not desirable and should be addressed by turkey farmers and their veterinarians. Use of second-choice antibiotics in the broiler farming sector seems to have stabilized, with second-choice antibiotics and first-choice antibiotics currently accounting for approximately 75% and 25% of overall antibiotic use, respectively. In absolute terms, use of second-choice antibiotics in the broiler and turkey farming sectors is still quite high. Due to first-choice penicillins' narrow spectrum of activity and trimethoprim/sulfonamides' relatively high level of toxicity in poultry, veterinarians more readily opt for a second-choice antibiotic when treating broilers or turkeys. This is something to keep an eye on in the next few years. The indications these antibiotics have been prescribed for, which are already being recorded by the poultry farming sector, should be analyzed to gain insight into this matter.

For the majority of second-choice antibiotics, their administration is a key driver for selection of ESBL-producing Enterobacteriaceae and macrolide-resistant *Campylobacter* species, which means it could affect the probability of future treatment success. Therefore, they should be used prudently, and the SDa expert panel feels livestock sectors should limit their use of second-choice antibiotics as much as possible.

The SDa expert panel compared each livestock sector's colistin use with the EMA benchmark thresholds of 1 mg/PCU and 5 mg/PCU (EMA 2016). A similar comparison was included in last year's report. The Population Correction Unit (PCU) represents the number of kilograms of animal per livestock sector. The PCU values were determined using the EMA's calculation method. Each livestock sector's 2017 colistin use turned out to be below the most stringent EMA benchmark threshold. Colistin use was highest in the pig farming sector, although this livestock sector did achieve a 12.3% reduction compared with its 2016 level. The other livestock sectors also managed to reduce their colistin use in 2017, even though their levels had been low to begin with.

Table 3. Colistin use in mg/PCU from 2015 to 2017, by livestock sector

Livestock sector	2015	2016	2017
Broiler farming sector	0.027	0.019	0.017
Pig farming sector	0.814	0.558	0.490
Dairy cattle farming sector	0.033	0.025	0.018
Veal farming sector	0.675	0.233	0.060
Non-dairy cattle farming sector	0.075	0.039	0.008
Cattle farming sector as a whole	0.044	0.029	0.012

Although use of quinolones in the veal farming sector had been steadily increasing over the years, it dropped to the 2015 level in 2017. Aminoglycoside use remained at the 2016 level, while the veal farming sector's polymyxin use showed an even steeper decline than its quinolone use. Quinolone use in the broiler and turkey farming sectors was on the rise again in 2017. Use of aminoglycosides and polymyxins fell substantially in the turkey farming sector and was low in the broiler farming sector.

Long-term developments in the amounts of antibiotics used in monitored livestock sectors

The SDa expert panel has analyzed long-term developments in the amounts of antibiotics used. By integrating LEI Wageningen UR and SDa data, it could calculate the reductions achieved over the 2009-2017 period in the veal, broiler, pig and dairy cattle farming sectors.
The veal farming sector managed to reduce its usage level (in $DDDA_{NAT}$) by 40% between 2009 and the end of 2017. Over the 2007-2017 period, it achieved a 49% reduction. With a reduction of just 6.4% over the past five years, improvements in the veal farming sector seem to be stagnating. The veal farming sector's performance during this period was characterized by minor upward and downward fluctuations (see Figure 1 and Figure 2). This is supported by usage data recorded for the various veal farming subsectors (see the "Benchmarking of livestock farms" section of this report).
The turkey farming sector has recorded steep declines for the past two years. The SDa expert panel hopes the sector will be able to continue this trend over the coming years.
Table 4 shows the $DDDA_{NAT}$ reductions from the levels recorded for 2009, the government-specified reference year.

Figure 2. Long-term developments in antibiotic use according to LEI Wageningen UR data (in DD/AY, as published in MARAN reports until 2010) and SDa data (in $DDDA_{NAT}$, from 2011 onwards), as a spline with 95% CI point estimates for each year. See the appendices for the computational basis. Purple: turkey farming sector; blue: veal farming sector; orange: broiler farming sector; light green: pig farming sector; dark green: dairy cattle farming sector

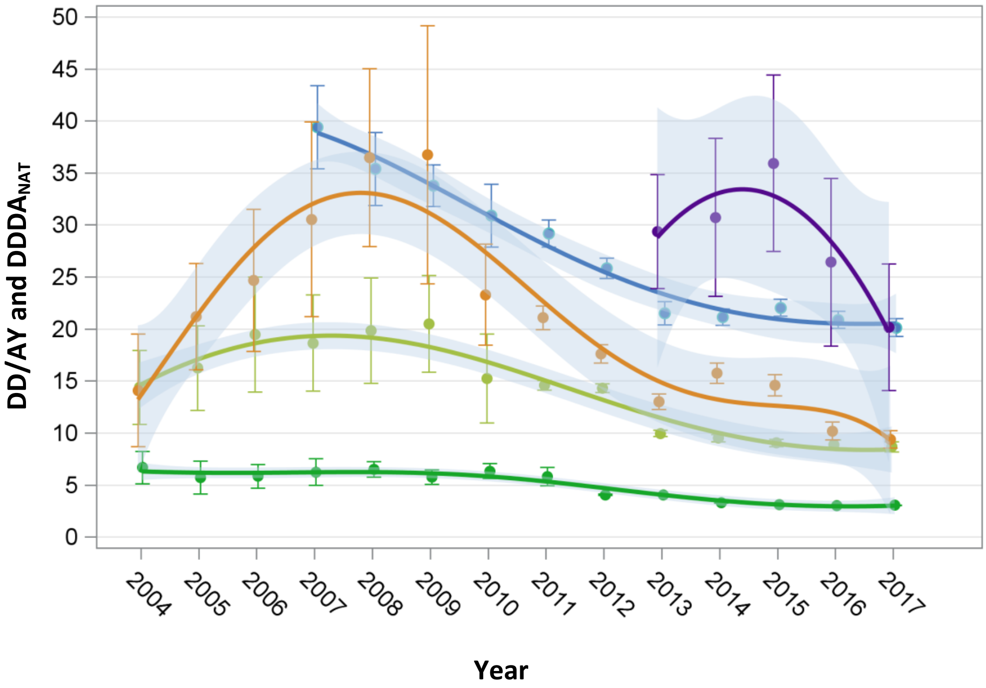


Table 4. Reductions in the amount of antibiotics used in agricultural livestock, compared to 2009 levels

	$DDDA_{NAT}$	Reduction from the 2009 level, in %							
Livestock sector	2009	2010	2011	2012	2013	2014	2015	2016	2017
Broiler farming sector	36.76	37	43	52	65	57	60	72	74
Pig farming sector	20.51	26	29	30	51	54	56	57	58
Dairy cattle farming sector	5.78	-10	-1	30	30	43	46	48	47
Veal farming sector	33.80	9	14	24	36	37	35	38	40

All veal and dairy cattle farming sector data relating to the observation period have been adjusted for the dosage-related changes implemented in the "Diergeneesmiddelenstandaard" database in 2014. Turkey and rabbit farming sector data have not been included in this table, as there were no 2009 usage levels with which to compare the more recent usage levels.

Antibiotic use in kilograms in each of the livestock sectors and all livestock sectors combined (2017 mass balance)

Using all delivery data recorded by the livestock sectors, the total number of kilograms of active substances used within each livestock sector was calculated. Just like $DDDA_{NAT}$ data, the numbers of kilograms of veterinary medicinal products used in the various livestock sectors are reported for each category of antibiotics (i.e. first-, second- and third-choice agents), and further specified by pharmacotherapeutic group. All macrolides used in poultry are classified as second-choice antibiotics, while other livestock sectors make a distinction between first- and second-choice macrolides. In Table 5, data on macrolide use in poultry have been included in the first-choice category, as the sales figures for first-choice macrolides will include the sales of macrolides to be used in poultry. The numbers of kilograms used in the various livestock sectors are shown in Table 5. Table 5 also includes the numbers of kilograms sold. The sales figures were provided by FIDIN. Certain products are exclusively authorized for use in companion animals and/or horses, these products are shown in a separate column.

Other poultry farming subsectors

For the year 2017, the SDa also obtained data on the use of antibiotics at rearing and production farms in the broiler supply chain, and data on the use of antibiotics at layer farms and farms earlier in the layer supply chain. This resulted in detailed information on the amounts of antibiotics used in the broiler and layer supply chains in 2017. It was the first time that separate data were obtained for laying hen farms, rearing farms for laying hens, rearing farms for layer parent/grandparent stock, production farms for layer parent/grandparent stock, rearing farms for broiler parent/grandparent stock, and production farms for broiler parent/grandparent stock. Some poultry farming subsectors, such as the duck, guinea fowl, ostrich and quail farming sectors, are exempt from having their antibiotic usage data recorded in the central registry used by the Dutch poultry farming sector (the "Centrale Registratie Antibiotica" or CRA), which means these smaller poultry farming subsectors have not contributed to the data in the "Other poultry farming subsectors" column in Table 5.

Companion animal and horse sectors

Sales of veterinary antimicrobial agents only authorized for use in companion animals and/or horses have declined steadily since 2014, the first year all sales data concerning these veterinary medicinal products seemed to have been recorded. This steady decline not only relates to the absolute number of kilograms sold, but also to estimated overall use in terms of DDDA (for companion animals and horses combined). In terms of DDDA, the following developments have occurred:

- Over the 2014-2017 period, the companion animal and horse sectors have recorded a 20% decline for all antibiotics combined, with a 15% reduction in sales of first- and second-choice antibiotics, and a 71% reduction in sales of third-choice antibiotics. For the past three years, annual reductions of 30-40% have been recorded for use of third-choice antibiotics, while reductions in second-choice antibiotics have ranged from 0% to 10% and reductions in first-choice antibiotics have gradually declined (from an 8% reduction in 2015 to 5% and 2% reductions in 2016 and 2017, respectively). This shows that the relative contributions of first-, second- and third-choice antibiotics have shifted in favor of first-choice antibiotics.
- Regarding first-choice antibiotics, sales of metronidazole and clindamycin in particular have increased both in relative and absolute terms.
- In 2014, third-choice antibiotics still accounted for 8.6% of all antibiotics sold, while their relative contribution was just 3.1% in 2017. In 2017, the relative contributions of first- and second-choice antibiotics were 42% and 55%, respectively, in terms of DDDA. In terms of the number of kilograms sold, first-choice antibiotics accounted for over 67% of overall antibiotic use.

- Amoxicillin, with or without clavulanic acid, was still the most popular antibiotic, even though its relative contribution to the second-choice antibiotics category did drop to 79%. In 2017, amoxicillin accounted for 43% of the overall DDDA value for all antibiotics sold.

Several livestock sectors, such as the mink, sheep and goat farming sectors, are not subjected to antibiotic monitoring and were not surveyed by the SDa either.

Table 5. Antibiotic use in kg (by livestock sector and for all livestock sectors combined) and sales figures for 2017, by pharmacotherapeutic group

	According to delivery records									According to sales figures	
Pharmacotherapeutic group	**Broiler farming sector**	**Turkey farming sector**	**Pig farming sector**	**Dairy cattle farming sector**	**Veal farming sector**	**Non-dairy cattle farming sector**	**Rabbit farming sector**	**Other poultry farming subsectors**	**All livestock sectors combined**	**Companion animal + horse sectors**	**Overall sales**
1st-choice antibiotics	**3,656**	**1,114**	**57,716**	**9,841**	**48,980**	**8,410**	**243**	**2,597**	**132,558**	**2,842**	**142,885**
As a proportion of overall AB use/sales	**40.94**	**63.86**	**81.59**	**85.60**	**84.11**	**84.88**	**75.61**	**84.37**	**80.60**	**67.14**	**78.90**
Amphenicols	0	0	1,315	501	2,363	596	0	0	4,775	22	4,708
Fixed-dose combinations	0	0	0	0	0	0	0	0	0	389	389
Macrolides/lincosamides	452	316	7,175	352	13,720	2,173	17	829	25,033	109	24,201
Other	0	0	0	0	0	0	64	0	64	528	528
Penicillins	472	110	4,834	3,141	543	331	0	539	9,970	38	10,716
Pleuromutilins	0	13	660	0	0	0	25	17	716	0	770
Tetracyclines	917	555	30,598	1,731	25,121	3,972	102	708	63,705	606	67,708
Trimethoprim/sulfonamides	1,815	120	13,135	4,116	7,233	1,338	36	504	28,297	1,149	33,864
2nd-choice antibiotics	**5,250**	**588**	**13,027**	**1,644**	**9,226**	**1,496**	**77**	**397**	**31,704**	**1,382**	**37,964**
As a proportion of overall AB use/sales	**58.78**	**33.68**	**18.41**	**14.30**	**15.84**	**15.10**	**23.96**	**12.90**	**19.28**	**32.64**	**20.96**
Aminoglycosides	109	1	32	207	314	80	77	0	819	24	1,070
1st- and 2nd-gen. cephalosporins	0	0	0	26	0	0	0	0	27	452	484
Quinolones	832	11	223	9	1,689	214	0	64	3,040	0	3,160
Fixed-dose combinations	28	0	546	672	14	217	0	0	1,477	1	2,037
Macrolides/lincosamides	0	0	95	4	15	5	0	0	118	0	124
Penicillins	4,275	576	11,364	715	7,182	979	0	253	25,343	904	30,128
Polymyxins	5	0	767	12	13	2	0	80	880	1	962
3rd-choice antibiotics	**25**	**43**	**0**	**11**	**26**	**2**	**1**	**84**	**193**	**9**	**248**
As a proportion of overall AB use/sales	**0.28**	**2.45**	**0.00**	**0.10**	**0.05**	**0.02**	**0.44**	**2.73**	**0.12**	**0.22**	**0.14**
3rd- and 4th-gen. cephalosporins	0	0	0	0	0	0	0	0	0	0	1
Fluoroquinolones	25	43	0	11	26	2	1	84	193	9	247
Overall	**8,932**	**1,745**	**70,743**	**11,497**	**58,232**	**9,907**	**322**	**3,077**	**164,456**	**4,233**	**181,097**

***** Although macrolides/lincosamides used in poultry are regarded as second-choice antibiotics, the amounts of macrolides/lincosamides used in the various poultry farming sectors have been recorded under first-choice antibiotics to facilitate comparison with sales figures, as sales figures cannot be categorized by livestock sector.

Trend analysis based on national sales figures

Sales data

Sales data were provided by FIDIN. The annual figures deviate slightly from the quarterly figures recorded by FIDIN, as a number of changes to the “Branchecodetabel” (BCT) that became effective in 2017 were implemented in 2018.

Developments in sales of antibiotics

In 2017, the overall number of kilograms of antimicrobial agents sold increased by 3%. The number of kilograms sold (181,097 kg) was relatively high compared with the number of kilograms used according to monitored livestock sectors’ delivery records and survey data on the companion animal and horse sectors (168,689 kg). Part (approximately 7,000 kg) of this 13,000 kg discrepancy can be attributed to antibiotic use in unmonitored livestock sectors (the goat, sheep and mink farming sectors) and the companion animal and horse sectors. Stockpiling will have accounted for the rest. In 2016, the number of kilograms sold (175,813 kg) was almost fully accounted for by recorded use in monitored livestock sectors (171,047 kg) and sales of products only authorized for use in companion animals and/or horses (4,381 kg). Antibiotic use in other livestock sectors (the other poultry farming subsectors including rearing and production farms for parent and grandparent stock, and the sheep, goat and mink farming sectors) and use of products authorized for use in both livestock and companion animals and/or horses were estimated to have amounted to 10,000 kg. These figures indicate that sales in 2016 were relatively low compared with the amounts used. Looking back, this was probably largely due to administration of products that had been stockpiled prior to 2016. The minor increase recorded for the 2016-2017 period is within the normal range of variability associated with year-to-year fluctuations in the amounts used and in stock.

Third-choice antibiotics

The number of kilograms of third-choice antibiotics sold decreased by 25%, from 331 kg in 2016 to 248 kg in 2017. Fluoroquinolones were the only third-choice antibiotic recording sales of over 0 kg. Of the 248 kg of third-choice antibiotics sold in 2017, 19% (46 kg) could not be attributed to a particular sector, similar to the discrepancy observed for 2016. Use of third-choice antibiotics in the turkey farming sector and the other poultry farming subsectors declined in 2017. This decline even exceeded the extent of the decline in overall antibiotic use reported for these livestock sectors. Fluoroquinolone use in the veal farming sector increased, even though this livestock sector reduced its overall use of antimicrobial agents.

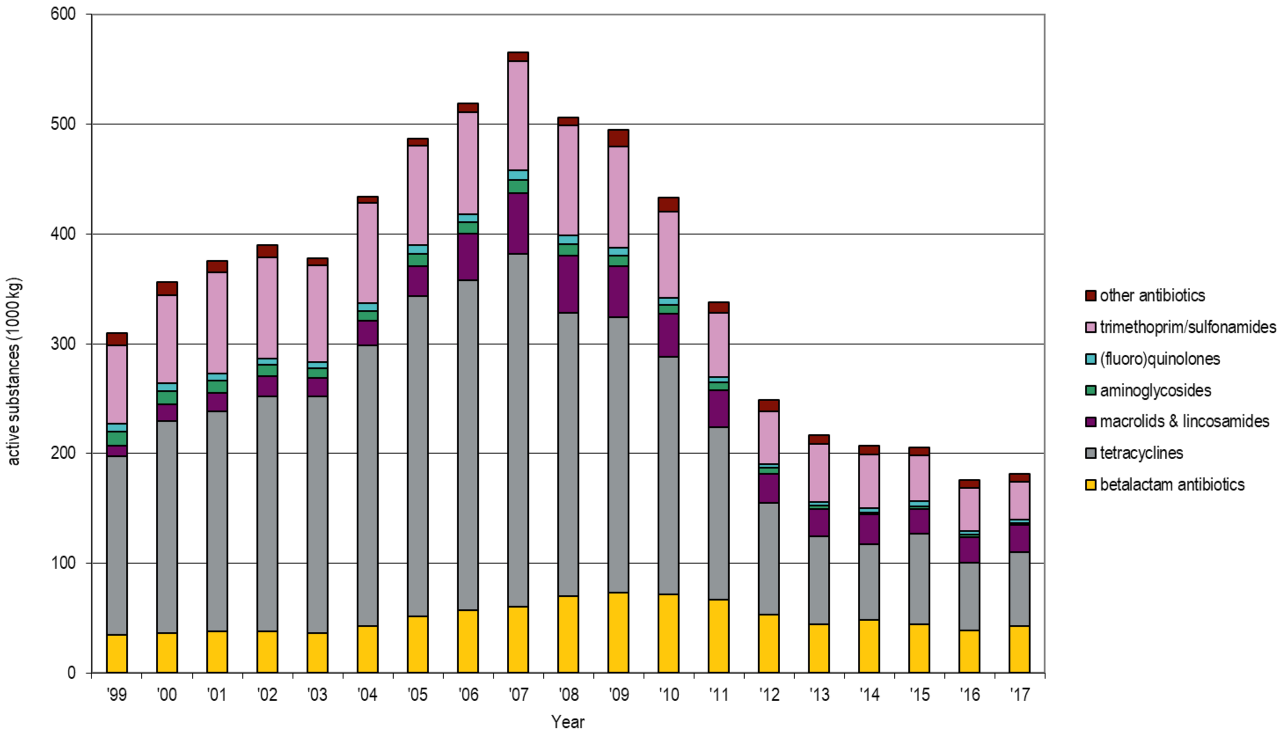
Second-choice antibiotics

Use of injectable second-choice macrolides has been on the rise for several years. With 124 kg in 2017, these products recorded a 41% increase compared with the 2016 level of 88 kg, and a 148% increase compared with the 2015 level of 50 kg. The most prominent increases were observed for the pig farming sector (a 66% increase compared with the 2016 level) and the veal farming sector (a 25% increase compared with the 2016 level). Due to the long half-life of these veterinary medicinal products, treatment with injectable second-choice macrolides consists of just a single injection, which offers practical as well as compliance-related benefits. At this time, there is no clear consensus regarding their effect with regard to selection of resistant pathogens. However, the risk of selection associated with injectable second-choice macrolides will exceed the risk associated with intermittent administration of antibiotics. In light of this risk of selection of resistant micro-organisms, long half-life products should be used with caution.

First-choice antibiotics

2017 saw the launch of first-choice mastitis injectors. These products are a welcome addition to the existing second-choice mastitis injectors that are allowed to be included in farm-specific treatment protocols if no first-choice antibiotics are available. Their launch might explain the dairy cattle farming sector's minor $DDDA_{NAT}$ increase recorded for first-choice antibiotics. First-choice mastitis injectors contain either benzylpenicillin or cloxacillin. Benzylpenicillin and cloxacillin are beta-lactam antibiotics with a narrow spectrum of activity. They are active against some of the mastitis-causing pathogens but have no efficacy against Gram-negative pathogens.

Figure 3. Developments in sales of antimicrobial agents between 1999 and 2017, in number of kilograms of active substances sold (x1,000) (source: FIDIN), by main pharmacotherapeutic group



Benchmarking of livestock farms

The amounts of antibiotics used at livestock farms ($DDDA_F$)

The SDa expert panel uses the parameter $DDDA_F$ for expressing the defined daily dose animal at farm level. Usage level distributions based on all livestock farms in a particular livestock sector can be found in the appendices. Many of the livestock sectors have seen substantial changes in the shape of their distributions. Although the proportion of livestock farms with low usage levels has increased over the years, current long-tailed distributions indicate that some of the farms still recorded high usage levels for 2017. The changes observed in the veal farming sector's usage level distributions, have generally been less pronounced.

Table 6. 2017 annual defined daily doses animal ($DDDA_F$) for the broiler, turkey, pig, veal and cattle farming sectors and their respective production categories or types of farms. Provided parameters are the mean, median (Med.), 75th percentile (P75) and 90th percentile (P90)

Livestock sector	Production category/type of farm	N	Mean	Med.	P75	P90
Broiler farming sector*	All broiler farms combined	852	10.3	4.4	14.4	27.1
	Broiler farms with conventional breeds	487	13.9	9.3	19.5	33.3
	Broiler farms with alternative breeds	493	4.1	0.0	5.0	12.6
Turkey farming sector		45	18.7	10.4	25.5	59.8
Pig farming sector**	Sows/suckling piglets	1,853	3.7	2.2	4.7	8.2
	Weaner pigs	2,037	21.7	10.6	25.5	52.9
	Fattening pigs	4,580	3.8	1.7	5.4	9.8
Veal farming sector	White veal farms	838	23	22.2	27	33.1
	Rosé veal starter farms	238	83	83.1	102	113.3
	Rosé veal fattening farms	580	3.0	1.6	4.1	7.8
	Rosé veal combination farms	212	12.8	12.6	17.3	22.6
Cattle farming sector	Dairy cattle farms	17,121	2.1	2.1	2.9	3.8
	Rearing farms	520	1	0	0	1.6
	Suckler cow farms	9,351	0.5	0	0.6	1.7
	Beef farms	2,919	1.3	0	0.3	2.3

* The sum of the number of broiler farms with conventional breeds and the number of broiler farms with alternative breeds exceeds the N recorded for all broiler farms combined, as some broiler farmers keep both conventional and alternative breeds

** In the case of the pig farming sector, N represents the number of farms with the indicated production category

For the categories "Broiler farms with conventional breeds" and "Broiler farms with alternative breeds", N represents both specialized farms (i.e. broiler farms with only the indicated type of breeds) and non-specialized farms (i.e. broiler farms with both conventional and alternative breeds). Analysis of data from specialized farms alone (i.e. broiler farms with only conventional breeds and broiler farms with only alternative breeds) would have yielded similar results. Specialized broiler farms' mean antibiotic use turned out to be about 10-15% lower than non-specialized broiler farms' mean antibiotic use. Median antibiotic use turned out to be similar for non-specialized broiler farms and broiler farms with only alternative breeds, while broiler farms with only conventional breeds had a 3% higher median $DDDA_F$ value.

The SDa obtained usage data from 49 rabbit farms. Mean antibiotic use in the rabbit farming sector was 25.4 $DDDA_F$ (median: 21.7 $DDDA_F$). The P75 and P90 values recorded for this livestock sector were 37.9 $DDDA_F$ and 49.4 $DDDA_F$, respectively. With 76%, first-choice antibiotics were the main contributor to the rabbit farming sector's overall antibiotic use. The most prominent (67%) reduction compared with the rabbit farming sector's 2016 usage level concerned third-choice antibiotics, while 28.5% and 38.5% reductions were recorded for second- and first-choice antibiotics, respectively. As mentioned earlier in this report, the rabbit farming sector's data are provisional in nature.
As was the case in 2016, usage levels in the pig farming sector differed between specialized pig farms (farms with a single production category - i.e. either sows/suckling piglets, weaner pigs or fattening pigs - accounting for >90% of its pig population) and pig farms with several production categories. Mean and median $DDDA_F$ values recorded for specialized pig farms with weaner pigs exceeded those recorded for non-specialized pig farms with weaner pigs. There is no obvious explanation for this difference in usage levels, but it is conceivable that antibiotics administered at non-specialized pig farms are not always assigned to the correct production category.

Table 7. 2017 annual defined daily doses animal ($DDDA_F$) for specialized and non-specialized pig farms. Provided parameters are the mean, median (Med.) and 90th percentile (P90)

	Production category	N	Mean	Med.	P90
Specialized pig farms	Sows/suckling piglets	132	5.54	2.26	8.39
	Weaner pigs	150	28.94	17.41	62.07
	Fattening pigs	3,009	4.39	2.48	11.05
Non-specialized pig farms	Sows/suckling piglets	1,721	3.60	2.18	8.05
	Weaner pigs	1,887	21.15	10.24	51.44
	Fattening pigs	1,572	2.77	0.27	7.32

2017 was the first year for which the SDa obtained usage data from other poultry farming subsectors. These subsectors include laying hen farms, rearing farms for laying hens, rearing farms for layer parent/grandparent stock, production farms for layer parent/grandparent stock, rearing farms for broiler parent/grandparent stock, and production farms for broiler parent/grandparent stock. The $DDDA_F$ values recorded for these other poultry farming subsectors are set out in Table 8. Except for rearing farms for broiler parent stock, these subsectors are characterized by low usage levels and a large proportion (over 40%) of farms recording a $DDDA_F$ value of 0. The SDa expert panel will discuss the amounts of antibiotics used at rearing farms for broiler parent stock with the sector concerned.

Table 8. 2017 annual defined daily doses animal ($DDDA_F$) for other poultry farming subsectors. Provided parameters are the mean, median (Med.), 75th percentile (P75) and 90th percentile (P90)

Livestock sector	Type of farm	N	Mean	Med.	P75	P90
Layer farming sector	Laying hen farms	875	0.9	0.0	0.0	3.1
	Production farms for grandparent stock	7	0.9	0.0	2.6	3.6
	Production farms for parent stock	36	3.7	0.0	6.3	10.0
	Rearing farms for grandparent stock	3	0.0	0.0	0.0	0.0
	Rearing farms for parent stock	17	4.8	0.0	9.0	13.5
	Rearing farms for laying hens	187	2.4	0.0	3.6	5.9
Broiler farming sector	Production farms for grandparent stock	20	5.2	3.1	7.7	16.8
	Production farms for parent stock	230	2.6	0.0	3.4	9.0
	Rearing farms for grandparent stock	12	3.9	1.0	7.8	11.1
	Rearing farms for parent stock	104	14.3	9.1	18.2	29.9

The 2017 benchmark thresholds for the various livestock sectors are listed in the table below. No benchmark thresholds have yet been defined for the rabbit farming sector.

Distribution of livestock farms over the various benchmark zones

Table 9. 2017 signaling and action thresholds for the various livestock sectors and the associated production categories and types of farms, based on $DDDA_F$ values

Livestock sector	Type of farm/production category	Signaling threshold	Action threshold
Poultry farming sector	Broiler farms	15	30
	Turkey farms*	19	31
Pig farming sector	Sows/suckling piglets	10	20
	Weaner pigs	20	40
	Fattening pigs	10	12
Veal farming sector	White veal farms	23	39
	Rosé veal starter farms	67	110
	Rosé veal fattening farms	1	6
	Rosé veal combination farms	12	22
Cattle farming sector	Dairy cattle farms	6	A usage level that has exceeded the signaling threshold two years in a row
	Rearing farms	2	
	Suckler cow farms	2	
	Beef farms	2	

* Please refer to the SDa report *Usage of Antibiotics in Agricultural Livestock in the Netherlands in 2013*.
** The signaling threshold for dairy cattle farms is based on the P80 value. The signaling thresholds for all other types of farms/production categories except fattening pigs refer to the P50 value minus 20%.

Table 10 shows how livestock farms were distributed over the various benchmark zones. In some of the livestock sectors, a large percentage (sometimes even over 90%) of farms recorded target zone usage levels for 2017. Many of these livestock sectors managed to reduce their overall antibiotic use in 2017, indicated by a larger number of zero-level users and many of the livestock farms being included in the target zone. This development was associated with fewer farms recording signaling or action zone usage levels. Nevertheless, a number farms appear to have underperformed in comparison to the other farms within their livestock sector. Practically all livestock sectors have long-tailed distributions, indicating there are still several livestock farms with action zone usage levels. The sector showing the most room for improvement in this regard is the veal farming sector. This also becomes apparent when looking at the number of veal farms included in the signaling and action zones.

Table 10. Distribution of livestock farms over the various benchmark zones in 2017

Livestock sector	Type of farm/production category	Target zone N	Target zone %	Signaling zone N	Signaling zone %	Action zone N	Action zone %
Poultry farming sector	Broiler farms	646	76	138	16	68	8
	Turkey farms	29	64	7	16	9	20
Pig farming sector	Sows/suckling piglets	1,717	93	119	6	17	1
	Weaner pigs	1,397	69	332	16	308	15
	Fattening pigs	4,141	90	130	3	309	7
Veal farming sector	White veal farms	459	55	346	41	33	4
	Rosé veal starter farms	58	24	145	61	35	15
	Rosé veal fattening farms	244	42	248	43	88	15
	Rosé veal combination farms	97	46	91	43	24	11
Cattle farming sector	Dairy cattle farms	17,027	99	78	0	16	0
	Rearing farms	474	91	40	8	6	1
	Suckler cow farms	8,572	92	761	8	18	0
	Beef farms	2,599	89	172	6	148	5

The livestock sectors have agreed with the SDa to not only address livestock farmers with action zone usage levels, but livestock farmers with structurally high usage levels who are assigned to the signaling zone as well. It is each livestock sector’s responsibility to implement this more stringent approach. An implementation schedule is to be agreed upon in consultation with the Ministry of Agriculture, Nature and Food Quality.

Table 11. Developments in the distribution of livestock farms over the various benchmark zones between 2013 and 2017

Livestock sector	Type of farm/ production category	% in target zone					% in signaling zone					% in action zone				
	Year 20..	13	14	15	16	17	13	14	15	16	17	13	14	15	16	17
Poultry farming sector	Broiler farms	68	66	70	81	76	25	21	20	14	16	6	13	10	5	8
	Turkey farms	50	51	50	70	64	25	22	20	13	16	25	27	30	17	20
Pig farming sector	Sows/suckling piglets	66	72	85	94	93	24	19	11	5	6	11	8	4	1	1
	Weaner pigs	-	-	73	66	69	-	-	20	24	16	-	-	8	9	15
	Fattening pigs	83	86	90	90	90	6	6	3	3	3	11	8	7	7	7
Veal farming sector	White veal farms	49	48	46	50	55	41	44	46	44	41	10	8	9	6	4
	Rosé veal starter farms	39	33	21	25	24	48	56	63	63	61	13	11	16	12	15
	Rosé veal fattening farms	46	48	50	52	42	33	34	36	32	43	21	19	14	16	15
	Rosé veal combination farms	60	50	54	55	46	30	40	37	38	43	10	10	9	7	11
Cattle farming sector	Dairy cattle farms	55	91	93	94	99	42	8	6	6	0	3	1	1	0	0
	Rearing farms	83	84	85	89	91	6	6	6	4	8	11	9	9	7	1
	Suckler cow farms	80	84	80	81	92	6	6	10	10	8	14	9	10	9	0
	Beef farms	79	79	82	84	89	10	10	5	4	6	11	10	12	12	5

Some of the livestock sectors still had a relatively large percentage of farms recording signaling and action zone usage levels for 2017, which shows it is still necessary to address persistently high usage levels.

Table 12. The proportion of livestock farms that stayed in the same benchmark zone throughout the 2015-2017 period, and the proportion of livestock farms that never left the signaling and action zones throughout the 2015-2017 period

Livestock sector	Type of farm/ production category	Number of livestock farms with available data for the 2015-2017 period	Livestock farms that stayed in the same benchmark zone(s) (%)			
			Green	Orange	Red	Orange/ red
Poultry farming sector	Broiler farms	765	56.5%	2.0%	0.8%	8.0%
	Turkey farms	35	51.4%	0.0%	8.6%	22.9%
Pig farming sector	Sows/suckling piglets	1,776	77.8%	0.9%	0.0%	1.4%
	Weaner pigs	1,918	47.2%	2.2%	5.4%	17.2%
	Fattening pigs	4,178	77.2%	0.0%	1.4%	2.2%
Veal farming sector	White veal farms	799	7.9%	11.4%	1.1%	30.7%
	Rosé veal starter farms	197	2.0%	6.6%	3.0%	69.0%
	Rosé veal fattening farms	506	19.8%	11.7%	4.2%	32.8%
	Rosé veal combination farms	149	16.8%	9.4%	0.7%	38.9%
Cattle farming sector	Dairy cattle farms	16,859	86.0%	0.9%	0.0%	1.4%
	Rearing farms	109	67.9%	0.0%	6.4%	7.3%
	Suckler cow farms	7,007	67.7%	1.2%	3.8%	10.6%
	Beef farms	2,373	75.6%	0.6%	8.7%	8.7%

Benchmarking of veterinarians

The benchmarking method for veterinarians was introduced in March of 2014. All veterinarians can retrieve their VBIs by accessing the quality management systems.

The number of veterinarians with whom livestock farms had a registered one-to-one relationship in 2017 (1,253) was similar to the number recorded for 2016 (1,278). A veterinarian's VBI is livestock sector specific and can range from 0 to 1. The VBI reflects the probability of livestock farms with which the veterinarian has a one-to-one relationship recording action zone usage levels. A VBI of 0.22 therefore means that 22% of the livestock farms with which the veterinarian concerned has a one-to-one relationship are included in the action zone. As the VBI is sector specific, a veterinarian active in various livestock sectors will be assigned several VBIs.

Table 13. 2017 annual defined daily doses animal ($DDDA_{VET}$) for veterinarians active in the broiler, turkey, pig, dairy cattle, veal and non-dairy cattle farming sectors. Provided parameters are the mean, 50th percentile (median), 75th percentile (P75) and 90th percentile (P90)

Livestock sector	N	Mean	Median	P75	P90
Broiler farming sector	84	7.80	6.89	11.53	16.03
Turkey farming sector	9	9.97	9.25	12.08	29.57
Pig farming sector	263	5.21	4.78	6.77	9.33
Dairy cattle farming sector	728	2.26	2.23	2.55	2.93
Veal farming sector	133	12.46	10.53	21.11	27.00
Non-dairy cattle farming sector	721	0.72	0.49	0.86	1.43

Table 14. Number of veterinarians per benchmark zone in 2017, by livestock sector; specified for veterinarians responsible for several farms per livestock sector and veterinarians responsible for a single farm per livestock sector

Livestock sector	Number of veterinarians with several farms per livestock sector who fall within the target, signaling or action zone based on their Veterinary Benchmark Indicator (VBI)			Number of veterinarians with a single farm per livestock sector who fall within the target, signaling or action zone based on the usage level of the farm concerned		
	Target zone	Signaling zone	Action zone	Target zone	Signaling zone	Action zone
	≤0.10	(0.10<VBI≤0.30)	(VBI>0.3)	-	-	-
Broiler farming sector	50	22	2	9	1	0
Turkey farming sector	3	0	2	4	0	0
Pig farming sector	183	66	2	12	0	0
Veal farming sector	45	65	3	13	6	1
Cattle farming sector (veal farming sector not included)	573	153	4	33	0	1
- Dairy cattle farming sector	595	99	3	30	0	1
- Non-dairy cattle farming sector	491	161	14	49	4	2

Veterinarians' distribution over the three benchmark zones basically parallels the distribution of livestock farms over the various benchmark zones. Although the proportion of veterinarians in the action zone is small, several livestock sectors are characterized by a substantial proportion of veterinarians being included in the signaling zone.

Table 15. 2017 VBIs for veterinarians active in the broiler, turkey, pig, dairy cattle, veal and non-dairy cattle farming sectors. Provided parameters are the mean, 50th percentile (median), 75th percentile (P75) and 90th percentile (P90)

Livestock sector	**N**	**Mean**	**Median**	**P75**	**P90**
Broiler farming sector	74	0.06	0.02	0.12	0.19
Turkey farming sector	5	0.29	0.15	0.36	0.72
Pig farming sector	263	0.07	0.06	0.10	0.14
Dairy cattle farming sector	697	0.06	0.05	0.08	0.11
Veal farming sector	113	0.13	0.12	0.19	0.23
Non-dairy cattle farming sector	666	0.07	0.04	0.11	0.19

Revision of the $DDDA_F$ calculation method and subsequent benchmark threshold adjustment

The benchmarking method for livestock farms was developed in 2012 and since its introduction, considerable experience has been gained in the benchmarking of livestock farms. Over the years, several bottlenecks and limitations have been identified by the SDa expert panel and the livestock sectors. The SDa is always looking for ways to improve upon its benchmarking method. Several livestock sectors have offered suggestions for improving the calculation method, in particular to make sure the actual number of production cycles is taken into account and in order to help avoid confounding of DDDA figures due to variations in how individual farms' livestock populations are made up. When changes are made to the calculation method, the benchmark thresholds have to be adjusted as well. *Calculation method-related benchmark threshold adjustments are unrelated to any general benchmark threshold revisions.* The changes implemented for the various livestock sectors can be summarized as follows:

Poultry farming sector: As of January 2017, body weight at the time of treatment is used to determine poultry farms' antibiotic usage levels in terms of defined daily doses animal. The $DDDA_F$ calculation method is set out in a Standard Operation Procedure (SOP). In addition, the SDa has started integrating growth curves in its calculations.
The calculation method for the turkey farming sector has been updated as well and now also incorporates body weight at the time of treatment instead of standardized body weight.

Pig farming sector: In 2015, a new method was introduced for calculating usage levels and associated benchmark thresholds for the pig farming sector. This method makes a distinction between three production categories: sows and suckling piglets, weaner pigs, and fattening pigs. Generally speaking, the implementation of the new calculation method went well. As of January 1, 2016, the signaling and action thresholds for farms with weaner pigs have been 20 $DDDA_F$ and 40 $DDDA_F$, respectively.

As there have been indications of some inaccuracies regarding production category specification in the delivery records, the SDa expert panel wants the quality assurance bodies to reiterate that the correct production category must be specified each time antibiotics are recorded in the delivery records. In 2017, the SDa examined the calculation method for this livestock sector more closely. A comparison of the two quality management systems performed by the SDa expert panel revealed differences in the usage patterns recorded. The discrepancies were observed over several years. They may have been caused by minor differences between the quality management systems' calculation methods. The SDa expert panel will keep an eye this issue.
It expects the $DDDA_F$ calculation method to be specified shortly after the introduction of the new benchmark thresholds.

Veal farming sector: The number of times veal farms start with a new herd of young calves (either once or twice a year) may vary from year to year. Such year-to-year variations result in fluctuating usage levels. As a result, the SDa and the veal farming sector have agreed that as of January 2017,

veal farms' usage levels will be calculated over 1.5-year periods. The results of these calculations will be used to determine an annual average for the amounts of antibiotics used.
The SDa will also examine possibilities for incorporating veal calve growth curves in the $DDDA_F$ calculations. It aims for the revised calculation method to be specified shortly after the presentation of the new benchmark thresholds.

Cattle farming sector: The SDa and the cattle farming sector decided to implement a revised benchmarking method as of 2017. The SDa will evaluate the performance of the revised benchmarking method in 2019.

Rabbit farming sector: This is the second SDa report with data on the amounts of antibiotics used in the rabbit farming sector. Prior to the rabbit farming sector's inclusion in the annual SDa reports, this sector and the SDa had talked about usage level monitoring for years. In the months to come, the SDa wants to decide on a set of provisional benchmark thresholds in consultation with the rabbit farming sector.

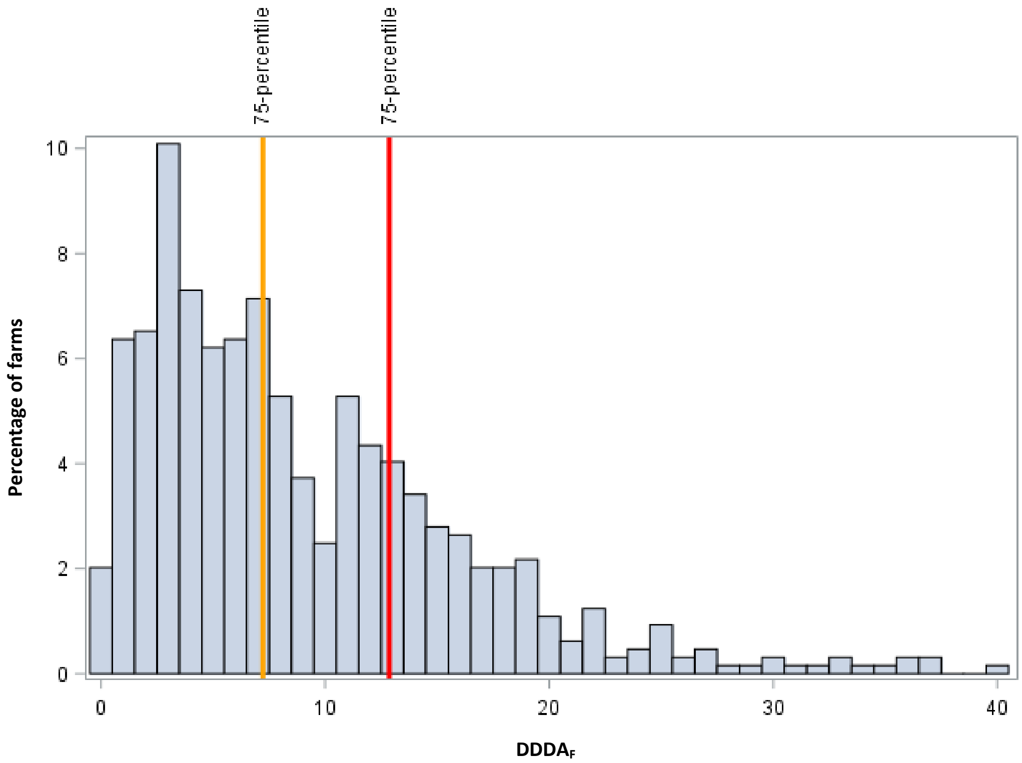
The new SDa benchmarking method

Rationale for the new SDa benchmarking method

The amounts of antibiotics used in agricultural livestock have declined significantly over the past years. The various livestock sectors have achieved average annual reductions ranging from 4.9% (veal farming sector, 2007-2017 period) to 9.3% (poultry farming sector, 2009-2017 period). Due to these achievements, the current benchmark thresholds no longer challenge the majority of livestock sectors to reduce their antibiotic use to a level that represents acceptable use and minimizes the risk of resistance associated with administration of antibiotics.

With the current benchmarking method, livestock farms are assigned to one of three usage level categories (benchmark zones) based on whether or not their usage level exceeds a particular signaling and/or action threshold. The current thresholds were set based on the initial antibiotic usage data the livestock sectors provided to the SDa. For most livestock sectors, the benchmark thresholds were derived from the 50th and 75th percentiles of their baseline $DDDA_F$ distribution. The baseline distributions reflected how, at that time, the individual farms within a particular livestock sector performed in terms of the amount of antibiotics used.

Figure 4. A hypothetical $DDDA_F$ distribution illustrating the original benchmarking method, which includes a signaling threshold (equal to the 50th percentile: 50% of farms have a usage level below this threshold and 50% of farms have a usage level exceeding this threshold) and an action threshold (equal to the 75th percentile: 25% of farms have a usage level exceeding this threshold)



For the majority of livestock sectors, the current benchmark thresholds were set with the 20% reduction in mind that was imposed by the Dutch government at the time. Most benchmark thresholds have not been adjusted since. If benchmark thresholds were adjusted, this usually was related to a revision of the calculation method or a change in how antibiotic usage data for a particular livestock sector should be categorized (i.e. by type of farm or by production category). The SDa expert panel took its first steps towards a general revision of its benchmarking method as early as 2015 (see the SDa report on usage of antibiotics in 2016). In 2017, it decided to opt for a method based on two instead of three benchmark zones, in order to simplify the benchmarking process.

Determining the new benchmark thresholds

Antibiotic usage and resistance are clearly associated. However, exactly how antibiotic use affects the prevalence of resistant micro-organisms is a complicated matter and despite having performed comprehensive analyses, the SDa expert panel has not been able to define any resistance-informed benchmark thresholds (see the SDa report on usage of antibiotics in 2016). Consequently, the expert panel decided to continue to base its benchmark threshold on detailed analysis of usage pattern developments and usage level distributions, which show how the individual farms within a monitored livestock sector have performed in terms of the amounts of antibiotics used.

In order to define new benchmark thresholds, the SDa expert panel examined the shape of each livestock sector's $DDDA_F$ distribution and the extent of systematic between-farm usage level differences over time. It subsequently drafted its initial proposals for new benchmark thresholds.

In the autumn of 2017, the new benchmarking approach and benchmark threshold proposals were presented to the livestock sectors and discussed during consultations between the SDa board, the Chairman of the SDa expert panel and the livestock sectors.

On December 1, 2017, the SDa expert panel presented a more elaborate plan and its benchmark threshold proposals to several national and international experts in the fields of animal husbandry, veterinary medicine, antimicrobial resistance and benchmarking. The experts responded generally favorably to the approach proposed by the SDa expert panel and offered some suggestions for additional improvements.

While the SDa expert panel was in the process of updating its benchmark thresholds, three of the livestock sectors were the subject of studies aimed at identifying critical success factors. Once the critical success factor studies were completed, the SDa expert panel compared the findings to the results of its own analyses. It wanted to check whether the study findings were in line with the analysis results based on annual usage data provided to the SDa through the various livestock sectors' databases. The SDa feels the critical success factor study results will be particularly helpful in informing new policy measures, as they suggest certain actions through which farmers in the livestock sector concerned could reduce their antibiotic use. However, further research is needed to determine how the study results should be put into practice. Potential ways in which farmers might be able to reduce their usage levels were not taken into consideration when the SDa expert panel was determining its proposed new benchmark thresholds.

Basic principles of the new benchmark thresholds

Prudent usage of antibiotics is characterized by, among other things, accurate prior diagnosis, usage being limited to specific indications, affected animals receiving adequate and timely treatment, and not resorting to herd or flock treatment when individual treatment is possible. Disease prevention and hygiene are cornerstones of prudent usage of antibiotics. Movement of livestock between farms and the level of contact between groups of livestock at a particular farm are governed by how the livestock sector concerned is designed and organized. They can affect a farm's performance in terms of disease prevention and hygiene, and greatly determine what is considered to be a low usage level indicative of prudent usage of antibiotics. Animal husbandry and the production of animal products will always involve administration of antibiotics, as livestock farmers can never fully prevent the introduction of pathogens.

The SDa expert panel's new benchmarking method is based on two different types of benchmark thresholds: benchmark thresholds representing acceptable use, and provisional benchmark thresholds. Benchmark thresholds that represent acceptable use of antibiotics will remain valid for years, while provisional benchmark thresholds will have to be adjusted more frequently.

Benchmark thresholds representing acceptable use

The SDa expert panel previously noted that several livestock sectors or types of farms/production categories have seen the emergence of usage patterns characterized by regular zero-level use, limited variation between individual livestock farms in the amounts of antibiotics used, and limited usage level fluctuations over time. The long-tailed 2017 $DDDA_F$ distributions observed for some of these sectors indicate that several farms in the sectors concerned still recorded high usage levels for 2017. For livestock sectors or types of farms/production categories characterized by such a relatively favorable usage pattern, benchmark thresholds representing acceptable use of antibiotics can be determined based on the sector's current $DDDA_F$ distribution. Those benchmark thresholds will probably require no or only minor adjustments in the years to come. As such livestock sectors are characterized by just minor structural between-farm differences, prescription patterns of the various veterinarians active within these sectors will show little variation as well.

The benchmark thresholds used for such sectors are referred to as "benchmark thresholds representing acceptable use". Although "acceptable use" might be construed as a value judgment that is prescriptive in nature, the SDa expert panel is aware that its benchmark thresholds will almost never be truly prescriptive. After all, they always relate to low usage levels within the context of a particular husbandry system. The husbandry systems for which the SDa expert panel is defining these benchmark thresholds, are currently characterized by regular zero- or low-level use.

For the livestock sectors or the types of farms/production categories concerned, the SDa expert panel will set a single benchmark threshold which will be applied for the next five years. This will create a sense of certainty about the targets livestock farmers should meet. If a sector's antibiotic use continues to normalize, the sector will see a growing number of farms recording usage levels below its benchmark threshold. Its resulting usage pattern will then be characterized by the vast majority of its livestock farms recording near-optimal usage levels.

Application of benchmark thresholds representing acceptable use does, however, not prohibit occasional use of antibiotics. After all, administration of antibiotics will be unavoidable in case of certain infections, for instance. This should, however, always be incidental in nature.

As the vast majority of farms in livestock sectors or subsectors eligible for a benchmark threshold representing acceptable use have already achieved low (target-zone) usage levels, the SDa expert panel assumes these sectors already know how to strike a balance between optimizing animal health and limiting the amounts of antibiotics used.

Provisional benchmark thresholds

A provisional benchmark threshold is used if the SDa expert panel is not yet able to derive a benchmark threshold representing acceptable use from a particular sector's or subsector's current usage level distribution.

This will happen if the livestock sector or the type of farm or production category concerned still has a relatively wide distribution indicative of substantial (structural) differences between individual livestock farms and veterinarians and a relatively high degree of variation over time within individual livestock farms. In these cases, it is going to take some time before the usage patterns will allow for determination of benchmark thresholds representing acceptable use. The livestock sectors and subsectors concerned still have to increase their efforts in order to reduce the amounts of antibiotics used.

Benchmark thresholds for livestock farms in these sectors and subsectors can only be determined based on pragmatic considerations and will need adjusting after two to three years. These benchmark thresholds are referred to as provisional benchmark thresholds.

Action to be taken by livestock sectors in case of usage levels exceeding their benchmark thresholds

Even livestock sectors with a very low mean $DDDA_F$ value and up to over 50% of farms recording a $DDDA_F$ value of 0, still have several farms with usage levels amounting to tens of $DDDA_F$. As these outliers can be a decisive factor with regard to continued presence and spread of resistant micro-organisms, the SDa expert panel feels livestock sectors can no longer justify some of their farms repeatedly recording high usage levels. If its benchmark threshold is exceeded, the sector should take measures against the livestock farms concerned and the sector's quality assurance body should verify the farms' subsequent compliance. The SDa expert panel advises livestock sectors to apply stricter measures in case of more excessive benchmark deviations. It is in favor of a proportional approach in relation to corrective measures. Such an approach would be particularly beneficial in the first years following the introduction of the new benchmark thresholds, as livestock farms will need some time to switch to the new benchmarking method. The objective is to reduce the number of outliers in usage level distributions and limit usage level fluctuations over time as much as possible.

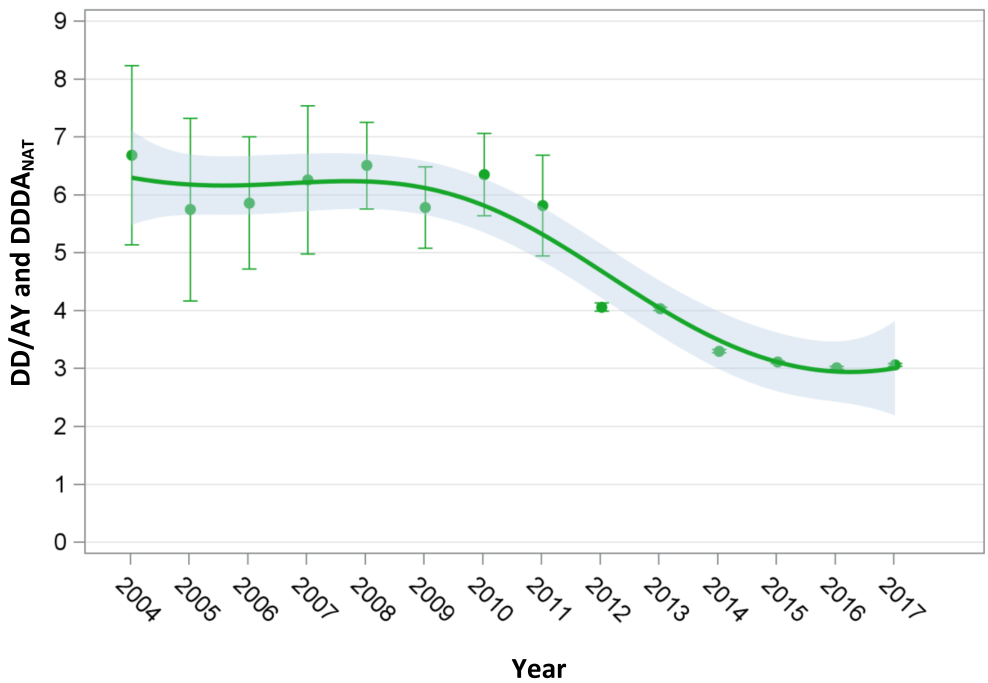
A summary of the current state of affairs in the various livestock sectors and the proposed new benchmark thresholds

Cattle farming sector

Current state of affairs

Although the cattle farming sector was characterized by low usage levels to begin with, cattle farms still managed to reduce the amounts of antibiotics used over the 2009-2017 period. One of the contributing factors was the publication of a guideline on the application of selective dry-cow therapy. The SDa expert panel feels the cattle farming sector has now reached a desirable usage level. Only minor structural differences can be observed between individual cattle farms and individual veterinarians, and the sector currently has a near-normal (Gaussian) usage level distribution.

Figure 5. Long-term developments in the amount of antibiotics used in the dairy cattle farming sector, as a spline with 95% CI point estimates for each year



Considerations regarding current benchmark thresholds

In its report on usage of antibiotics in 2016, the SDa expert panel presented its revision of the benchmarking method for the cattle farming sector. It explained that the cattle farming sector's narrow distributions and small number of farms with structurally high usage levels allowed for a benchmarking method based on just a signaling threshold. This was the reason why this livestock sector was not included in the critical success factor studies. Based on its own evaluations, the SDa expert panel decided on a signaling threshold of 6 DDDA$_F$ for dairy cattle farms, and a signaling threshold of 2 DDDA$_F$ for the other types of cattle farms. At the time these signaling thresholds were defined by the SDa, they approximated the P95 values for the respective types of farms. The SDa expert panel also determined at the time that action would be required if a cattle farm's usage level had exceeded the signaling threshold (i.e. the farm had been included in the signaling zone) for two consecutive years.

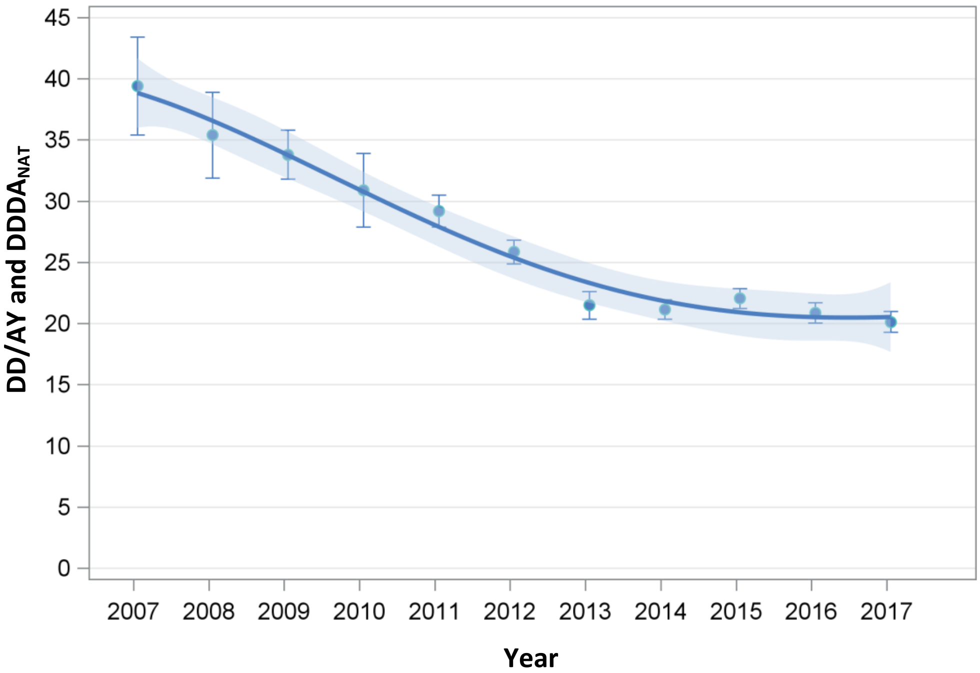
This 2016 revision of the cattle farming sector's benchmarking method differs slightly from the benchmarking method the SDa expert panel eventually decided to opt for in 2017. Although the cattle farming sector has already transitioned to a method based on two benchmark zones separated by a single benchmark threshold, with the current method farms are included in the action zone if they have exceeded the signaling threshold two years in a row. Due to the differences with the SDa's new proposals, the cattle farming sector's current benchmarking method will be evaluated in 2019. In consultation with the cattle farming sector, the SDa expert panel will assess whether some minor technical adjustments are required in order to harmonize its benchmarking approach.

Veal farming sector

Current state of affairs

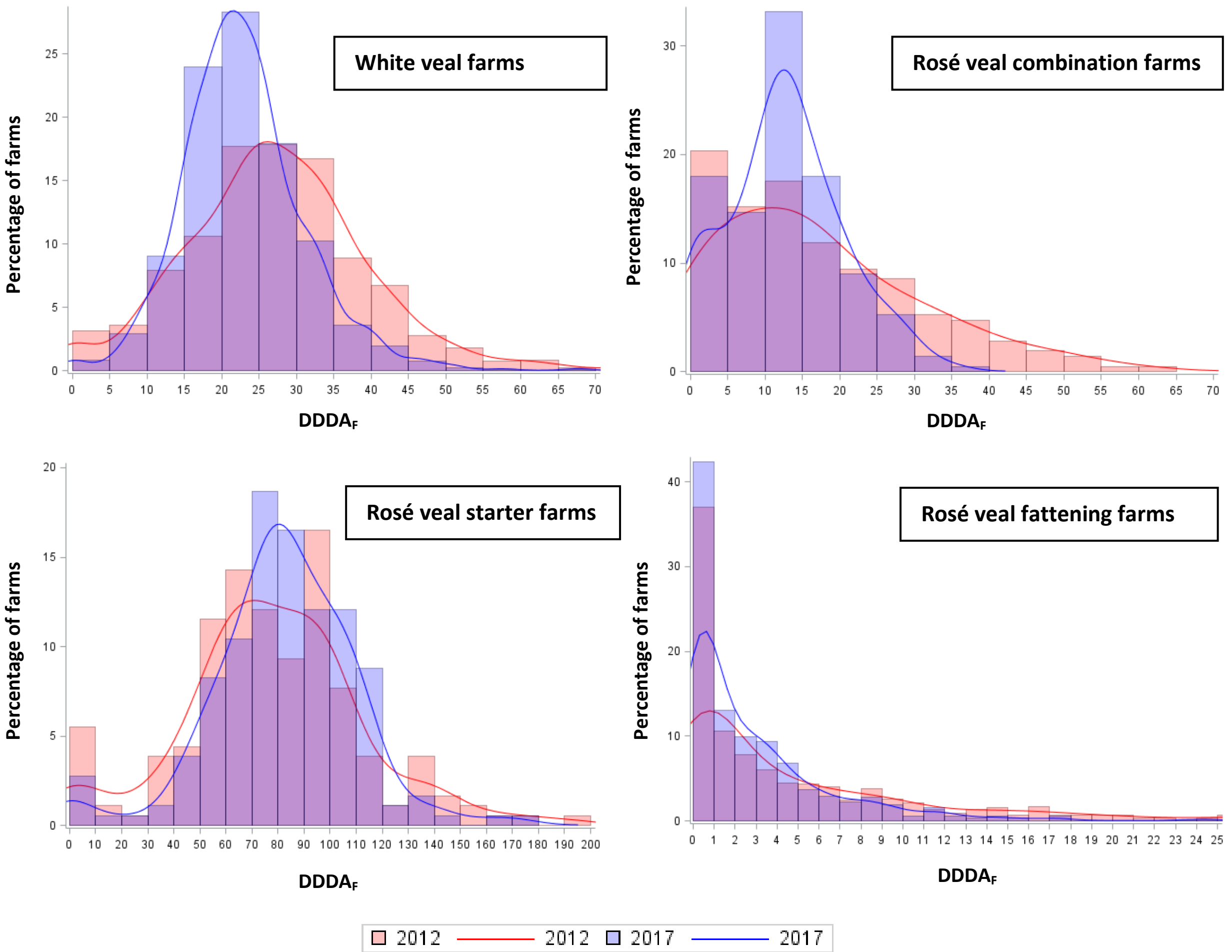
Usage levels in the veal farming sector have declined by approximately 5% per year, regardless of the selected baseline (2007 or 2009).

Figure 6. Long-term developments in the amount of antibiotics used in the veal farming sector, as a spline with 95% CI point estimates for each year (for the veal farming sector as a whole)



The overall amount of antibiotics used has been quite consistent over the past five years. For the veal farming sector as a whole, usage levels have fluctuated by 5-15% over the past four years. The 2017 $DDDA_F$ distributions for veal farms and the $DDDA_{VET}$ distributions for veterinarians active in the veal farming sector turned out to be very wide. In general, the number of veal farms in the action zone (red) declined, while the number of veal farms with signaling zone usage levels either remained the same or increased (in the case of rosé veal starter and combination farms). $DDDA_F$ distributions for the veal farming sector only underwent minor changes in shape, unlike other livestock sectors' usage level distributions. This also becomes apparent when visually comparing distributions for different years (Figure 7). Unlike the other livestock sectors, the veal farming sector is not characterized by narrow, long-tailed distributions that peak at low usage levels. Rosé veal fattening farms, however, are the exception within this livestock sector, as their usage level distribution is relatively narrow and indicative of relatively low usage levels. The veal farming sector has almost no zero-level users, and is characterized by wide distributions that show a relatively high percentage of farms with high usage levels. The number of white veal, rosé veal starter and rosé veal combination farms with structurally high usage levels (a signaling or action zone usage level for three consecutive years) is high. Prescription patterns of veterinarians active in the veal farming sector also show a relatively large amount of variation. The fact that veal calves are not purpose bred and basically are a by-product of another livestock sector will have contributed significantly to these findings.

Figure 7. 2012 (pink) and 2017 (blue) $DDDA_F$ distributions for the four types of veal farms



The SDa expert panel has realized that its benchmarking method has not yielded the desired result in the veal farming sector. The desired result would have been achieved if, due to fewer farms recording signaling and action zone usage levels, the percentage of farms included in the target zone had by now substantially exceeded the expected 50% of farms.

Considerations regarding current benchmark thresholds

The SDa expert panel calculated that, based on $DDDA_{NAT}$ values, antibiotic usage for white veal farms exceeds rosé veal farms' antibiotic usage by 55%. The expert panel has discussed this finding extensively with representatives of the veal farming sector. They asked themselves whether this 55% difference represents differences between the actual amounts of antibiotics used, or whether it is the result of differences between the average body weights used in the $DDDA_{NAT}$ calculations. They also considered whether the difference in antibiotic usage necessitates the introduction of separate benchmark thresholds for the two production chains in the new benchmarking method. In general, the SDa expert panel prefers to use similar benchmark thresholds for a particular type of livestock, possibly adjusted for any husbandry system-related differences in production cycle length or average body weight at the time of treatment. The SDa expert panel and the veal farming sector's representatives could not agree on an answer to these questions, in part due to a lack of detailed information on the matters concerned. Elaborate analysis also suggested differences between white and rosé veal farms, but a multitude of factors could have contributed to such differences and the currently available data do not allow for precise quantification.

For the time being, the SDa expert panel decided against adjusting the benchmark thresholds for both types of veal farms in response to this finding. After all, most of the proposed new benchmark thresholds for the veal farming sector are provisional in nature, and these provisional benchmark thresholds will already pose quite an ambitious challenge to this livestock sector. In due time, considerations regarding actual usage level differences between white and rosé veal farms might help inform the respective benchmark thresholds, but for now, no further discussions on this matter will take place between the SDa expert panel and the veal farming sector.

The SDa expert panel decided to base its usage level calculations for the veal farming sector on 1.5-year periods, in order to avoid any within-farm fluctuations in annual usage data caused by year-to-year differences in the number of times a year veal farmers start with a new herd of calves. The calculated usage will be expressed as an annual figure, by multiplying veal farms' 1.5-year usage levels by 2/3. The SDa expert panel is aware that using averages based on these longer periods may affect mean and median $DDDA_F$ values and between-farm variations. This has been taken into account when determining the benchmark thresholds.

The critical success factor study

The critical success factor study showed various factors associated to antibiotic usage at the farm. The associations identified during the study suggest individual veal farmers have significant power to further reduce the amount of antibiotics used at their farm. For the SDa expert panel, however, the key takeaway with regard to these associations is that they indicate heterogeneity between individual veal farms, which will have contributed to the usage level differences observed by the expert panel. According to the study, veal calf management in the first weeks of a new production cycle, group size, veal calves' country of origin, veal calf quality, the percentage of females and body weight at the start of the production cycle all have a significant effect on the amount of antibiotics used. Some of these variables are farm-specific factors that can be controlled by veal farmers, but factors like veal calves' country of origin, veal calf quality and body weight at the start of the production cycle all have a significant external component and are influenced by the dairy cattle farming sector. The various farm-specific determinants of antibiotic use mean that proper analysis of veal farms' usage levels would require evaluating numerous distributions and subdistributions. The critical success factor study results support the SDa expert panel's conclusion that except for rosé veal fattening farms, the veal farming sector currently does not allow for the application of benchmark thresholds representing acceptable usage levels. As the SDa expert panel is unable to define benchmark thresholds representing acceptable use for white veal farms, rosé veal starter farms and rosé veal combination farms and therefore suggests the application of provisional benchmark thresholds, it feels the veal farming sector would benefit from additional efforts aimed at reducing veal farms' antibiotic usage levels. It would like to gain more insight into the factors contributing to veal farms' heterogeneity. After all, once the controllable contributing factors are known, it might be possible to introduce sector-wide and farm-based measures that would help reduce the amounts of antibiotics used.

Concluding remarks on the new benchmark thresholds

For the majority of veal farms, the SDa expert panel is not able to define benchmark thresholds representing acceptable use. As a result, it will have to use provisional benchmark thresholds for all veal farms except rosé veal fattening farms. It had already been agreed that veal farms structurally recording signaling zone usage levels should be included in the action zone. The SDa expert panel recommends for the current signaling zone to become the new benchmarking method's action zone. As the current benchmarking process has not yet yielded the desired homogeneous $DDDA_F$ distributions for the veal farming sector, additional action is required. Veal farms should be strongly encouraged to aim for target-zone usage levels, and usage levels exceeding the benchmark thresholds should be met with corrective actions that will result in the desired changes with regard to preventive measures and the amounts of antibiotics used at the veal farms concerned.

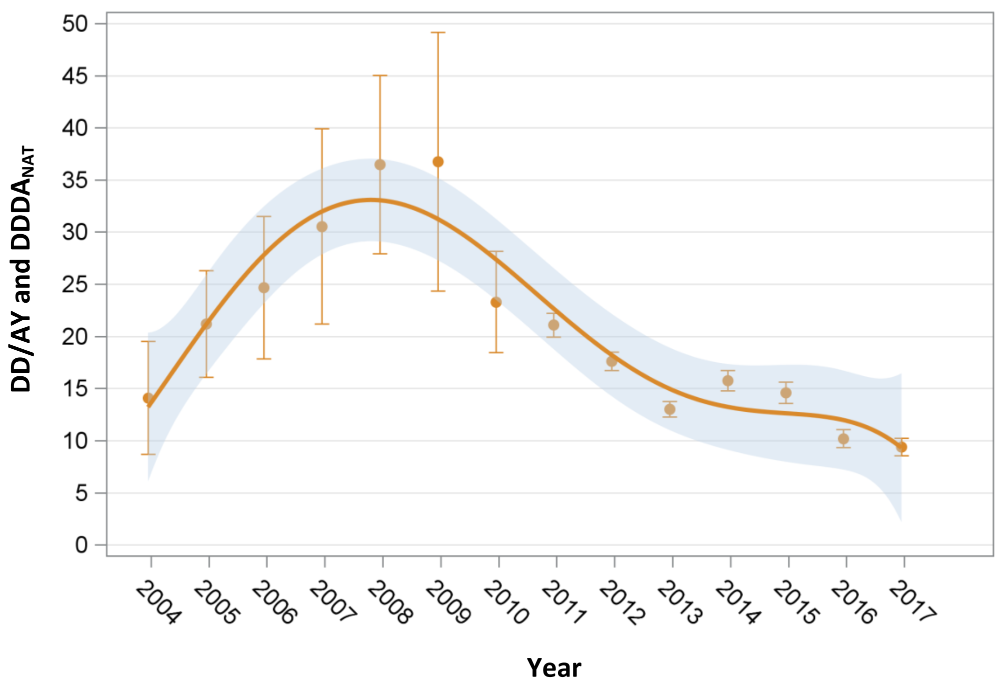
Poultry farming sector

Current state of affairs

The broiler farming sector is the livestock sector that has achieved the most extreme reduction in its overall amount of antibiotics used, with a 74% reduction since 2009 (corresponding to just over 10% a year). Its $DDDA_{NAT}$ value also showed a relatively steep decline over the past two years. Although the introduction of slow growing breeds for the Dutch marked contributed to this recent usage level reduction, broiler farms with conventional breeds also managed to further reduce the amounts of antibiotics used. As a result of these developments, broiler farms are now categorized based on type of breed. Many of the farms producing broilers for the Dutch market have started using slow growing breeds instead of conventional breeds, which has had consequences for the number of animals per m^2. Broiler farms producing for foreign markets have not undergone a similar development.

Regardless of the type of breed present, positive changes have occurred in the distributions for broiler farms and veterinarians active in the broiler farming sector. At the start of the monitoring and benchmarking era, the broiler farming sector was characterized by a very wide distribution with very high $DDDA_F$ values, but over time its $DDDA_F$ distribution has become substantially narrower, although still including a long tail. According to the 2017 data, over a third of broiler farms recorded a usage level of 0 $DDDA_F$ and about 80% recorded a usage level below 15 $DDDA_F$. Currently, only relatively minor structural differences exist between individual broiler farms with a particular type of breed and, consequently, between individual veterinarians active at the farms concerned.

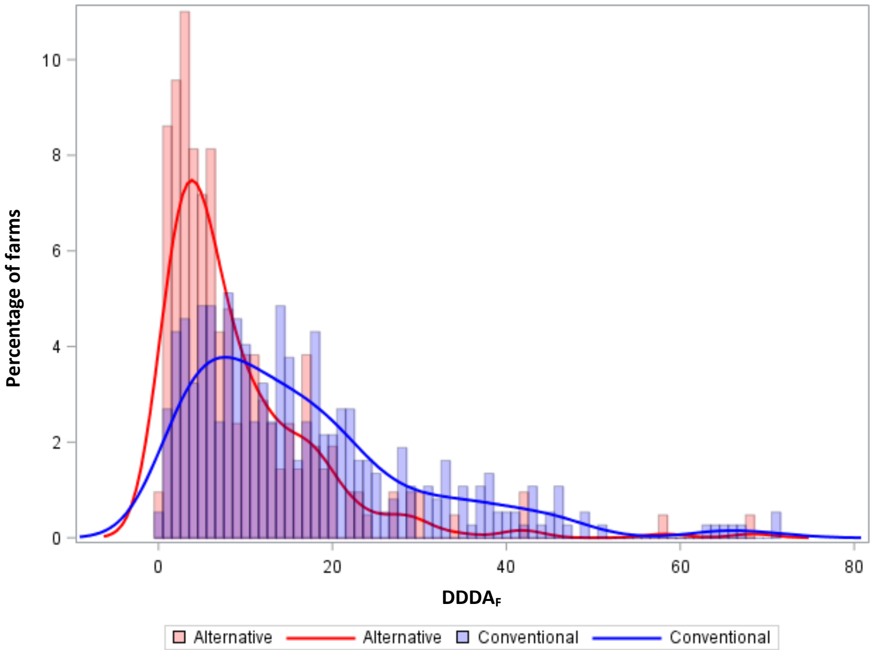
Figure 8. Long-term developments in the amount of antibiotics used in the broiler farming sector, as a spline with 95% CI point estimates for each year



Considerations regarding current benchmark thresholds
The broiler farming sector's current signaling and action thresholds of 15 $DDDA_F$ and 30 $DDDA_F$, respectively, are quite high considering the sector's current usage level distribution.

The critical success factor study
One of the main technical factors associated with the amount of antibiotics used in the broiler farming sector, is the type of breed present at broiler farms. The study has shown that broiler farms with only conventional breeds exceed broiler farms with only slower growing breeds in terms of the overall amount of antibiotics used and the frequency with which antibiotics are used. Careful animal management in the first week of the production cycle turned out to be an important factor with regard to usage levels. Broiler farmers could also try to reduce their usage level by either sending an entire flock to slaughter at the same time or by improving their thinning procedure and hygiene measures when sending only part of the flock to slaughter.

Figure 9. 2017 $DDDA_F$ distributions for broiler farms with conventional breeds and broiler farms with alternative breeds (zero-level broiler farms not included)



Concluding remarks on the new benchmark thresholds
Figure 9 shows the usage level distributions for broiler farms with conventional breeds and broiler farms with alternative breeds that recorded antibiotic use for 2017 (i.e. broiler farms with a $DDDA_F$ value of 0 have not been included in this graph). The broiler farming sector would prefer the application of a benchmark threshold representing acceptable use for both types of broiler farms. After careful analysis of broiler farms' usage data and the results of the critical success factor study performed in the broiler farming sector, the SDa expert panel has opted for the following.

The SDa expert panel has decided on 8 $DDDA_F$ as the broiler farming sector's benchmark threshold representing acceptable use. In practice, this means that broiler farmers with about seven production cycles a year are able to perform flock treatments approximately twice a year without exceeding their benchmark threshold. As the production cycle length differs between broiler farms with conventional breeds and those with alternative breeds, this has to be accounted for in the respective calculation methods.

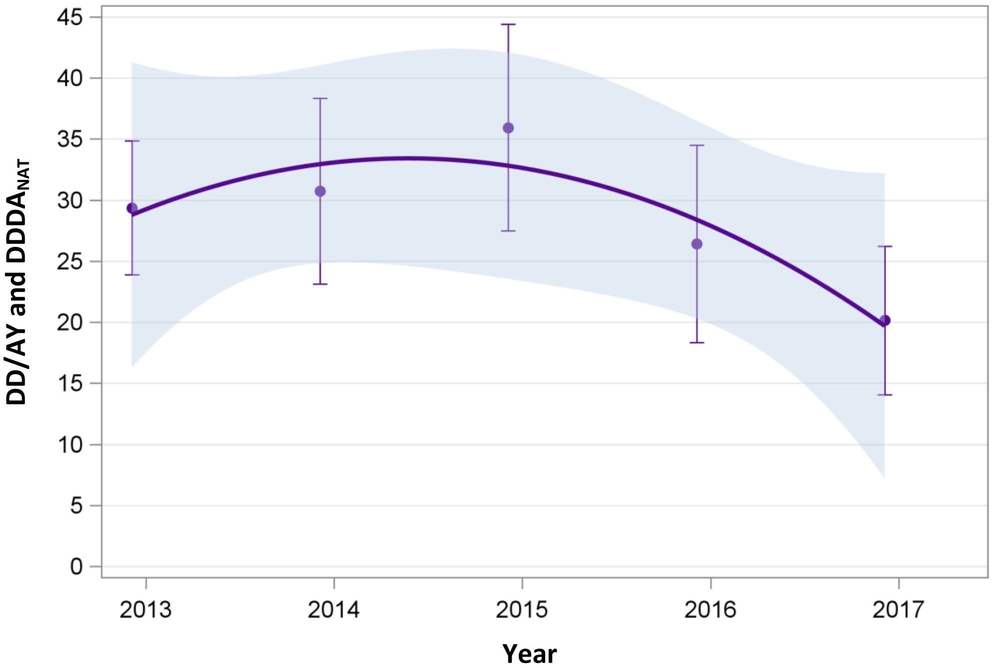
The SDa expert panel realizes that its proposed benchmark threshold will present quite a challenge for broiler farms with conventional breeds in particular. It would like to see a transitional period during which broiler farms can implement additional changes in order to reduce their usage levels, and it suggests a 4-year period. The SDa expert panel could propose interim benchmark thresholds for broiler farms with conventional breeds to be used during this transitional period. It feels such an approach would be justified, considering the broiler farming sector has already managed to reduce its antibiotic use by more than 70%. The broiler farming sector is clearly evolving, with farmers adjusting and improving their processes on an ongoing basis. The SDa expert panel considers it likely for responsible farm management practices to result in additional usage level reductions.

Turkey farming sector

Current state of affairs

The SDa has only been monitoring turkey farms for a few years. The turkey farming sector is characterized by a relatively large amount of usage level variation between individual farms. Over the past two years, the overall amount of antibiotics used within this livestock sector has declined substantially. The SDa expert panel has determined that it has to use a provisional benchmark threshold for the turkey farming sector. Based on the sector's 2017 $DDDA_F$ distribution, the expert panel has set this provisional benchmark threshold at 10 $DDDA_F$.

Figure 10. Long-term developments in the amount of antibiotics used in the turkey farming sector, as a spline with 95% CI point estimates for each year

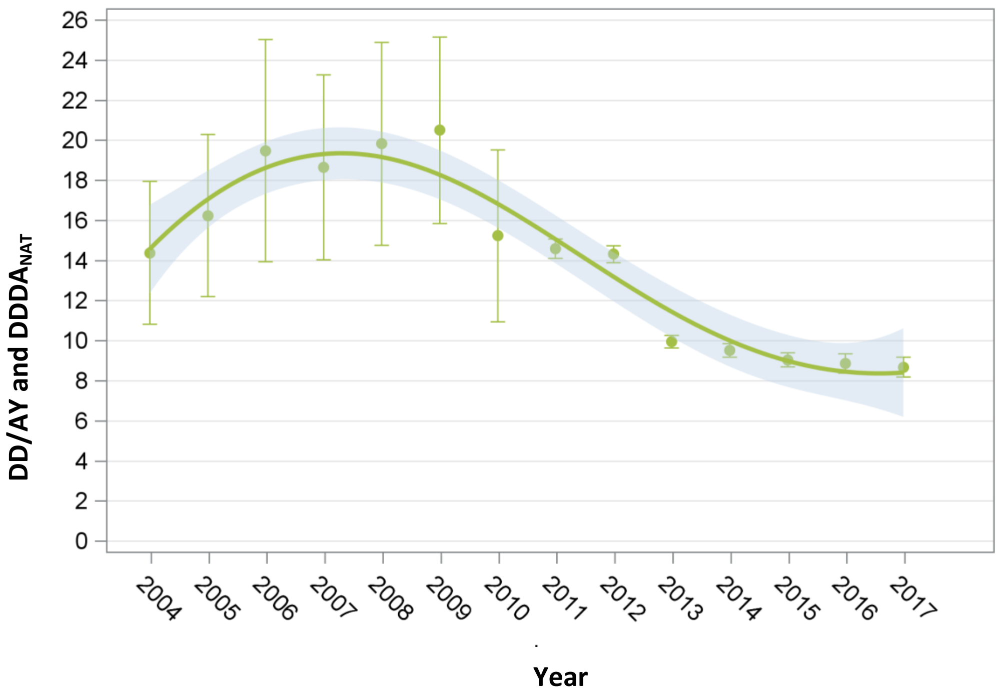


Pig farming sector

Current state of affairs

The pig farming sector has achieved an impressive 58% usage level reduction over the 2009-2017 period (corresponding to 8.1% per year). Pig farms were originally benchmarked by type of farm, but due to between-farm differences in the age groups making up individual farms' pig populations, the SDa expert panel revised its benchmarking approach for the pig farming sector two years ago. Since then, pig farms have been benchmarked by age-based production category. This change meant veterinarians active in the pig farming sector had to start specifying the production category or categories concerned when prescribing antibiotics, which initially resulted in some issues. The pig farming sector's $DDDA_F$ distributions have changed substantially over the years. Wide distributions have turned into skewed, long-tailed distributions indicative of a large proportion of pig farms with low usage levels. The number of pig farms with structurally high usage levels is relatively small. Antibiotic consumption in weaner pigs is still relatively high and characterized by a large amount of between-farm variation.

Figure 11. Long-term developments in the amount of antibiotics used in the pig farming sector, as a spline with 95% CI point estimates for each year



Considerations regarding current benchmark thresholds

In 2015, the SDa expert panel changed its categorization of the pig farming sector in the context of its benchmarking approach. It opted for categorization based on three production categories (sows/piglets, weaner pigs and fattening pigs) instead of its former distinction between two different types of farms. Even though the issues associated with this transition have subsided by now, usage level differences between specialized pig farms (pig farms with a single production category) and non-specialized pig farms still exist. Furthermore, the usage patterns recorded differ between the two quality management systems employed in the pig farming sector. The discrepancies can in part be attributed to differences in the production categories making up individual farms' pig populations and differences in farm size between both quality management systems. The usage pattern discrepancies between the two quality management system have increased slightly, and have therefore been taken into account by the SDa expert panel when determining the new benchmark thresholds.

For farms with sows and piglets and farms with fattening pigs, the current benchmark thresholds correspond to a usage level located in the long tail of their respective distributions, which means the benchmark thresholds are relatively high considering the number of farms recording low usage levels or zero-level use. The introduction of a dedicated category for recording antibiotics administered to weaner pigs may have contributed to this situation, in addition to a structural decline in the amounts of antibiotics used. The current benchmark thresholds for farms with weaner pigs are the most recently determined benchmark thresholds. The SDa set these benchmark thresholds when amending the categorization of the pig farming sector in the context of its benchmarking method. As they have been updated fairly recently, the benchmark thresholds for farms with weaner pigs reflect the current usage level distribution for this production category relatively well.

The critical success factor study

Due to the revision of the calculation method used to benchmark pig farms, the critical success factor study results are based on a relatively short period. The study identified a limited number of factors that are associated with (structurally) low usage levels, such as farm size, farm management practices, biosecurity and the pig farmer's level of knowledge, attitude and behavior. The study also identified regional differences in the amount of antibiotics used.

New benchmark thresholds

According to the SDa expert panel's findings, the percentage of pig farms with low usage levels or zero-level use was highest for farms with sows and piglets and farms with fattening pigs. Only some of these farms recorded structurally high usage levels and despite the long-tailed distributions, the degree of between-farm variation is relatively low for these production categories. This means the SDa expert panel is able to define benchmark thresholds representing acceptable use for farms with sows and piglets and farms with fattening pigs. For both production categories, this threshold reflects a relatively low usage level. The SDa expert panel considers 5 $DDDA_F$ to be an acceptable level. When determining the benchmark thresholds, the SDa expert panel found out the usage level discrepancies between the pig farming sector's two quality management systems ranged from 25% for farms with sows and piglets to 66% for farms with weaner pigs.

Currently, over 50% of farms have a 3-year usage pattern below this 5 $DDDA_F$ benchmark threshold. Their risk of exceeding this benchmark threshold will be 10% at most. For pig farms whose current average usage level is below 3 to 4 $DDDA_F$, the probability of exceeding the new benchmark threshold will be 20% at most according to the same analysis. Therefore, the SDa expert panel feels a 5 $DDDA_F$ benchmark threshold would be ambitious yet realistic and feasible.

The application of lower benchmark thresholds and the move from three to just two benchmark zones will mean that a substantial number of pig farms currently recording target zone usage levels will probably be included in the new signaling zone. The SDa expert panel is aware of this issue facing the pig farming sector, but feels it is a necessary step towards a new generation of benchmark thresholds that can remain valid for years, will drive acceptable use at all pig farms and will continue to address the emergence and spread of antibiotic resistance. The expert panel stresses that the usage level discrepancies between the sector's two quality management systems have to be resolved in the next few years.

Pig farms whose usage levels exceed the new benchmark threshold will be required to take action in order to reduce their antibiotic use. The SDa expert panel feels its proposed proportional approach to the application of corrective measures (i.e. more excessive deviations from a benchmark threshold should be met with stricter measures) will facilitate a smooth transition to the new benchmarking method for the pig farming sector.

The current benchmark thresholds for farms with weaner pigs were introduced quite recently, in conjunction with the revised benchmarking method (in 2016). The consequences of the 2016 revision have been most prominent for this production category. With regard to farms with weaner pigs, the SDa expert panel feels the only possibility for applying a single provisional benchmark threshold is having these farms' current signaling threshold (20 $DDDA_F$) become the new action threshold.

Rabbit farming sector

The SDa expert panel aims to agree on benchmark thresholds with the rabbit farming sector before the end of 2018. As the rabbit farming sector has not yet recorded usage level data for several consecutive years, the SDa expert panel is currently unable to define new benchmark thresholds that are in line with those for other livestock sectors.

Table 16. Summary of old and new benchmark thresholds. Benchmark thresholds representing acceptable use will be valid from 2019 to 2024. Provisional benchmark thresholds will be valid during the 2019-2020 period

		Current benchmark thresholds		**Proposed benchmark thresholds, with specification of the type of threshold**	
Livestock sector	Type of farm/ production category	Signaling threshold	Action threshold	Type of benchmark threshold	Action threshold
Veal farming sector*	White veal farms	23	39	Provisional	23
	Rosé veal starter farms	67	110	Provisional	67
	Rosé veal fattening farms	1	6	Representing acceptable use	4
	Rosé veal combination farms	12	22	This category will cease to exist	
Pig farming sector	Sows/piglets	10	20	Representing acceptable use	5
	Weaner pigs	20	40	Provisional	20
	Fattening pigs	10	12	Representing acceptable use	5
Poultry farming sector	Broiler farms	15	30	Representing acceptable use	8
	Turkey farms	19	31	Provisional	10[¥]
Rabbit farming sector	Rabbit farms			Provisional	**
Cattle farming sector	Dairy cattle farms	6[§]		Representing acceptable use	6
	Rearing farms	2[§]		Representing acceptable use	2
	Suckler cow farms	2[§]		Representing acceptable use	2
	Beef farms	2[§]		Representing acceptable use	2

* The benchmark thresholds are based on a 1.5-year period
** No benchmark threshold can be determined based on the currently available data
¥ Determined using the new, growth curve-based calculation method
§ Threshold for inclusion in the signaling zone; cattle farms are included in the action zone if their usage level has exceeded the signaling threshold two years in a row

Veterinarians

In several livestock sectors, the general revision of the benchmarking method will greatly affect the Veterinary Benchmark Indicator (VBI) assigned to veterinarians active in the sector concerned. The SDa expert panel will determine the extent of the consequences in the next few months. The external experts consulted by the SDa expert panel suggested several ways to avoid sudden VBI changes and offered suggestions to improve the benchmarking method for veterinarians. In light of these suggestions, the SDa expert panel will also explore several alternative approaches when analyzing the effects of its new benchmark thresholds on the VBI. It will present its proposals for a revision of the benchmarking method for veterinarians and the associated new VBIs in the second half of 2018.

DDD_{VET}: The European equivalent of the DDDA parameter used in the Dutch *Diergeneesmiddelenstandaard*

2017 was the second consecutive year for which the SDa expert panel used the European ESVAC parameter (DDD_{VET}) when determining the number of treatable kilograms of animal based on the veterinary medicinal products used in a particular sector. The denominator by which to divide the DDD_{VET} value, i.e. the number of kilograms of animal present within the livestock sector concerned, was calculated according to the SDa method: the standardized average body weights applied by the SDa were multiplied by the number of animals present within the sector concerned (these numbers are included in Table A1). This approach enables third parties to compare the usage data for a particular type of livestock farm or production category in the Netherlands with usage data collected in another country (after adjusting for body weight, if necessary). This promotes international transparency regarding the amounts of antibiotics used in agricultural livestock. The resulting values differ from the SDa's $DDDA_{NAT}$ values due to the application of antibiotic-specific conversion factors. 2016-2017 usage pattern developments might show some discrepancies as well, as the kg of antibiotics to DDDA conversion is performed differently. Such discrepancies are inherent to the application of different conversion factors.

Table 17. Amounts of antibiotics used in 2016 and 2017 based on the European DDD_{VET} parameter, by livestock sector

	Broiler farming sector DDD_{VET}/animal-year		Turkey farming sector DDD_{VET}/animal-year		Pig farming sector DDD_{VET}/animal-year		Dairy cattle farming sector DDD_{VET}/animal-year		Veal farming sector DDD_{VET}/animal-year		Non-dairy cattle farming sector DDD_{VET}/animal-year	
Pharmacotherapeutic group	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
1st-choice antibiotics	**4.02**	**3.71**	**16.12**	**11.37**	**6.91**	**6.62**	**0.95**	**0.92**	**19.51**	**18.52**	**0.95**	**0.95**
As a proportion of overall AB use	**34.80%**	**34.36%**	**57.72%**	**49.48%**	**79.13%**	**77.72%**	**90.33%**	**89.76%**	**78.93%**	**87.61%**	**81.28%**	**86.12%**
Amphenicols	0.00	*	0.00	*	0.18	0.19	0.04	0.04	1.22	1.11	0.09	0.08
Macrolides/lincosamides	0.24	*	1.28	*	0.81	0.85	0.03	0.03	3.81	3.94	0.17	0.19
Penicillins	0.68	0.58	3.64	1.61	0.57	0.54	0.15	0.15	0.26	0.26	0.05	0.05
Pleuromutilins	*	*	*	0.14	0.07	0.10	*	*	*	*	*	*
Tetracyclines	1.32	1.27	10.71	9.20	3.46	3.42	0.24	0.22	10.88	10.61	0.47	0.48
Trimethoprim/sulfonamides	1.78	1.86	0.49	0.42	1.81	1.51	0.47	0.48	3.34	2.61	0.17	0.15
2nd-choice antibiotics	**7.47**	**7.03**	**10.21**	**10.54**	**1.82**	**1.90**	**0.10**	**0.10**	**5.18**	**2.59**	**0.22**	**0.15**
As a proportion of overall AB use	**64.59%**	**65.15%**	**36.55%**	**45.89%**	**20.87%**	**22.28%**	**9.34%**	**9.97%**	**20.97%**	**12.23%**	**18.68%**	**13.81%**
Aminoglycosides	0.00	0.03	0.20	0.01	0.00	0.00	0.01	0.01	0.09	0.09	0.01	0.01
1st- and 2nd-gen. cephalosporins	0.00	*	0.00	*	0.00	*	0.00	*	0.00	*	0.00	*
Quinolones	1.08	1.23	0.01	0.19	0.02	0.02	0.00	0.00	0.85	0.74	0.04	0.03
Fixed-dose combinations	0.09	0.02	0.00	*	0.08	0.03	0.04	0.04	0.00	0.01	0.03	0.03
Macrolides/lincosamides	0.00	0.19	0.00	1.40	0.41	0.53	0.01	0.01	0.12	0.14	0.01	0.01
Penicillins	6.28	5.53	9.56	8.95	0.97	1.01	0.04	0.05	4.05	1.59	0.13	0.07
Polymyxins	0.03	0.02	0.44	0.00	0.34	0.31	0.01	0.00	0.07	0.02	0.01	0.00
3rd-choice antibiotics	**0.07**	**0.05**	**1.60**	**1.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**	**0.03**	**0.00**	**0.00**
As a proportion of overall AB use	**0.61%**	**0.49%**	**5.73%**	**4.63%**	**0.00%**	**0.00%**	**0.33%**	**0.27%**	**0.10%**	**0.16%**	**0.03%**	**0.07%**
3rd- and 4th-gen. cephalosporins	0.00	*	0.00	*	0.00	*	0.00	0.00	0.00	*	0.00	*
Fluoroquinolones	0.07	0.05	1.60	1.06	0.00	0.00	0.00	0.00	0.02	0.03	0.00	0.00
Overall antibiotic use	**11.56**	**10.78**	**27.93**	**22.98**	**8.73**	**8.52**	**1.05**	**1.03**	**24.72**	**21.15**	**1.17**	**1.10**

0.00 means use was below 0.005 $DDDA_{VET}$/animal-year; * means no use was reported

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Appendices

Computational basis for Figure 1 – long-term developments in antibiotic use

- Until 2010, defined daily doses animal were based on data reported by LEI Wageningen UR (DD/AY figures). From 2011 onwards, SDa-reported defined daily doses animal ($DDDA_F$ figures) have been used;
- The 2011 $DDDA_{NAT}$ figures were estimated as follows:
  - For the veal and pig farming sectors: by means of the 2011:2012 $DDDA_F$ ratio (with weighting based on the average number of kilograms present at individual farms);
  - For the dairy cattle farming sector: by means of the 2011:2012 DD/AY ratio;
  - For the broiler farming sector: by means of the 2011:2012 treatment days ratio (with weighting based on the number of animal-days at individual farms);
- Data on the overall number of kilograms of animal in a particular livestock sector, required for calculating the $DDDA_{NAT}$ figures, were provided by EUROSTAT (for the pig and dairy cattle farming sectors) and Statistics Netherlands (for the broiler and veal farming sectors);
- 95% confidence intervals were based on the corresponding confidence intervals for the weighted $DDDA_F$ figures.

Numbers of animals in the Dutch livestock sector

Table A1. Numbers of agricultural livestock (x1,000) from 2004 to 2017 in the Netherlands, based on data provided by CBS (poultry, veal calves and rabbits) and EUROSTAT (the other types of livestock)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Piglets (<20 kg)	4,300	4,170	4,470	4,680	4,555	4,809	4,649	4,797	4,993	4,920	5,116	5,408	4,986	5,522
Sows	1,125	1,100	1,050	1,060	1,025	1,100	1,098	1,106	1,081	1,095	1,106	1,053	1,022	1,066
Fattening pigs	3,850	3,830	4,040	4,010	4,105	4,099	4,419	4,179	4,189	4,209	4,087	4,223	4,140	3,967
Other pigs	1,865	1,900	1,660	1,960	2,050	2,100	2,040	2,021	1,841	1,789	1,765	1,769	1,733	1,741
Turkeys	1,238	1,245	1,140	1,232	1,044	1,060	1,036	990	827	841	794	863	762	671
All poultry combined	86,776	94,220	93,195	94,479	98,184	98,706	102,585	98,253	96,268	98,587	103,944	107,743	105,550	105,184
With broilers accounting for	50,127	54,660	42,289	44,262	44,496	41,914	43,352	44,358	43,285	44,748	47,020	49,107	48,378	48,237
Veal calves	765	829	844	860	899	894	928	906	908	925	921	909	956	953
All cattle combined	2,984	2,933	2,849	2,960	3,083	3,112	3,039	2,993	3,045	3,064	3,230	3,360	3,353	3,082
With dairy cattle accounting for						1,562	1,518	1,504	1,541	1,597	1,610	1,717	1,794	1,665
Goats	300	310	340	355	390	415	377	392	403	409	441	468	504	546
Sheep	1,700	1,725	1,755	1,715	1,545	1,091	1,211	1,113	1,093	1,074	1,070	1,032	1,040	1,015
Weaned meat rabbits	297	312	283	338	282	271	260	262	284	270	278	333	318	300
Breeding does	49	48	41	49	41	41	39	39	43	41	43	48	45	43

Table A2. Standardized average body weights used for determining the $DDDA_{NAT}$ figures, by livestock sector and production category

Livestock sector	Production category	Standardized body weight in kg[1]
Veal farming sector	Veal calves	172
Pig farming sector	Piglets (<20 kg)	10
	Sows	220
	Fattening pigs	70.2
	Other pigs	70
Broiler farming sector	Broilers	1
Turkey farming sector	Turkeys	6
Cattle farming sector	Dairy cattle	600
	Non-dairy cattle	500
Rabbit farming sector	Weaned meat rabbits	1.8
	Breeding does with kits	8.4

[1] Body weights as defined by LEI Wageningen UR, determined at the start of the agricultural census in the Netherlands. The standardized body weights are to be multiplied by the numbers of animals reported by CBS/EUROSTAT.

Table A3. Standardized average body weights used by the SDa for determining the $DDDA_F$ figures, by livestock sector and production category

Livestock sector	Production category	Further specification	Age group	Standardized body weight in kg[1]
Veal farming sector	Calves at white veal farms		0-222 days	160
	Calves at rosé veal starter farms		0-98 days	77.5
	Calves at rosé veal fattening farms		98-256 days	232.5
	Calves at rosé veal combination farms		0-256 days	205
Pig farming sector	Sows/piglets	Sows (all females that have been inseminated), breeding boars and heat-check boars		220
		Suckling piglets	0-25 days	4.5
		Replacement gilts	7 months - 1st insemination	135
	Weaner pigs	Weaned piglets	25-74 days	17.5
	Fattening pigs/gilts	Fattening pigs	Until ready for slaughter	70
		Gilts	74 days – 7 months	70
Broiler farming sector[2]	Conventional broilers		0-42 days	n/a
Turkey farming sector[2]	Toms			n/a
	Hens			n/a
Cattle farming sector[3]	Dairy cattle		>2 years	600
	Heifers		1-2 years	440
	Yearlings		56 days – 1 year	235
	Calves (female)		<56 days	56.5
	Beef bulls		>2 years	800
	Beef bulls		1-2 years	628
	Beef bulls		56 days – 1 year	283
	Calves (male)		<56 days	79
Rabbit farming sector	Breeding does/kits		>4 months and <4.5 weeks	8.4
	Weaned meat rabbits		4.5-12 weeks	1.8
	Replacement breeding does		12 weeks – 4 months	3.4

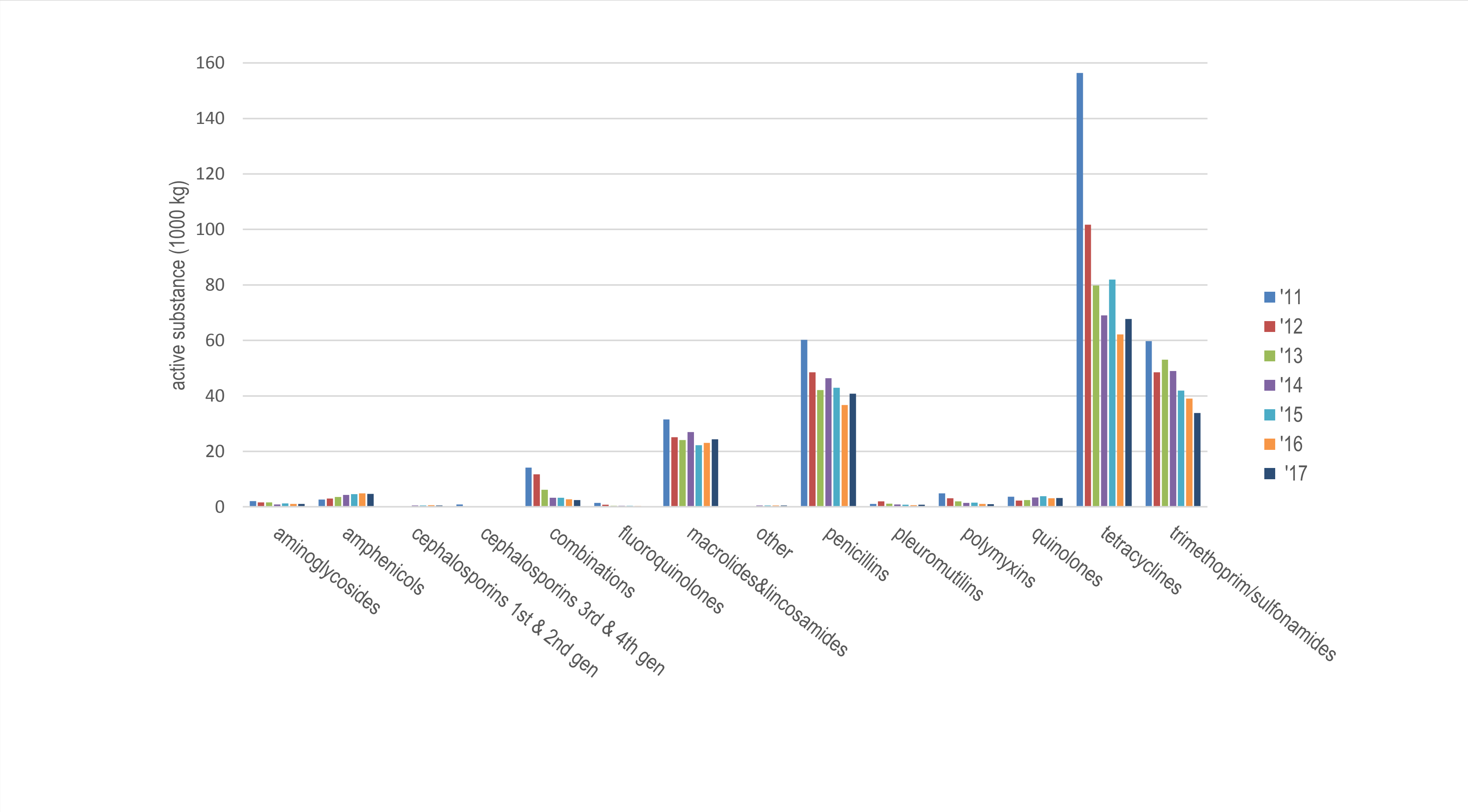
[1] Body weights (in kilograms) as determined in consultation with the livestock sectors concerned. They may be adjusted if deemed necessary (e.g. in response to refinement of the benchmarking approach).
[2] As of 2017, the body weights used for determining poultry farms' $DDDA_F$ value are based on the age of the animals at the time of treatment.
[3] Livestock farms in the cattle farming sector are categorized based on whether or not they produce milk. They are classified as either dairy cattle farms or non-dairy cattle farms. Non-dairy cattle farms include rearing farms (with <40% of cattle present being male and none of the animals being over 2 years of age), suckler cow farms (with <40% of cattle present being male and some of the animals being over 2 years of age) and beef farms (with >40% of cattle present being male).

Table A4. Standardized average body weights used for determining the PCU figures in accordance with the European Medicines Agency's approach, by animal category (source: ESVAC population correction unit template:
http://www.ema.europa.eu/ema/pages/includes/document/open_document.jsp?webContentId=WC500152312)

Animal category	Specification	Standardized body weight in kg
Broilers	Slaughtered broiler	1
Turkeys	Slaughtered turkey	6.5
Pigs	Slaughtered pig	65
	Living sow	240
Cattle	Living or slaughtered cow	425
	Slaughtered heifer	200
	Slaughtered bullock/bull	425
	Slaughtered calf/young cattle	140
Sheep and goats	Slaughtered sheep/goat	20
	Living sheep	75
Horses	Living horse	400
Rabbits	Slaughtered rabbit	1.4
Import/export		
Broilers	Slaughtered broiler	1
Turkeys	Slaughtered turkey	6.5
Pigs	Slaughtered pig	65
	Fattening pig	25
Cattle	Slaughtered bovine	425
	Fattening bovine	140
Sheep and goats	Slaughtered sheep	20
	Fattening sheep	20
	Slaughtered goat	20
	Fattening goat	20

Sales figures for antibiotics, by class of antibiotics

Figure A1. Sales of antibiotics from 2011 to 2017, by class of antibiotics



Autoriteit Diergeneesmiddelen

Antibiotic use in $DDDA_F$ at broiler farms

All broiler farms combined

Number of broiler farms: 852
Number of broiler farms with $DDDA_F$=0: 303
Number of broiler farms that used third- and fourth-generation cephalosporins: 0
Number of broiler farms that used fluoroquinolones: 24

Table A5. Antibiotic use in $DDDA_F$ at broiler farms in 2016 and 2017*

Year	N	Mean	Median	P75	P90
2016	853	10.1	5.2	14.6	27.2
2017	852	10.3	4.4	14.4	27.1

* Only years for which similar $DDDA_F$ calculation methods were used have been included.

Figure A2. 2013 and 2017 $DDDA_F$ distributions for broiler farms; 2017 $DDDA_F$ values based on standardized body weight

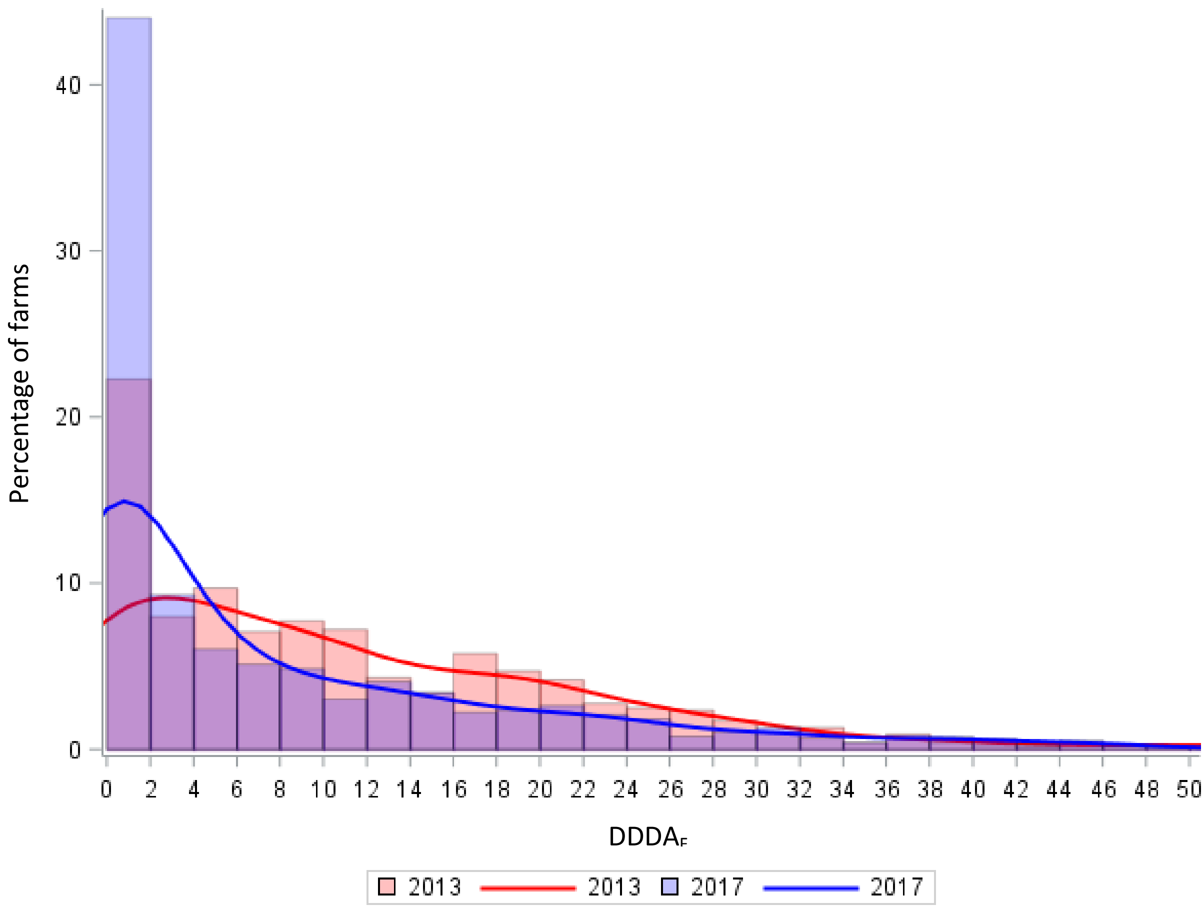


Table A6. Antibiotic use in $DDDA_F$ at broiler farms in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$ Median	P75	Mean
1st choice	Penicillins	Oral	777	0.00	0.00	0.40
1st choice	Tetracyclines	Oral	640	0.00	0.00	1.10
1st choice	Trimethoprim/sulfonamides	Oral	458	0.00	4.79	3.82
2nd choice	Aminoglycosides	Oral	847	0.00	0.00	0.01
2nd choice	Quinolones	Oral	665	0.00	0.00	1.47
2nd choice	Fixed-dose combinations	Oral	845	0.00	0.00	0.07
2nd choice	Macrolides/lincosamides	Oral	785	0.00	0.00	0.22
2nd choice	Penicillins	Oral	523	0.00	3.65	3.12
2nd choice	Polymyxins	Oral	845	0.00	0.00	0.03
3rd choice	Fluoroquinolones	Oral	828	0.00	0.00	0.07

Broiler farms with conventional breeds

Number of broiler farms with conventional breeds: 487
Number of broiler farms with conventional breeds with $DDDA_F$=0: 111
Number of broiler farms with conventional breeds that used third- and fourth-generation cephalosporins: 0
Number of broiler farms with conventional breeds that used fluoroquinolones: 20

Table A7. Antibiotic use in $DDDA_F$ at broiler farms with conventional breeds in 2016 and 2017*

Year	N	Mean	Median	P75	P90
2016	570	12.3	8.5	17.5	29.7
2017	487	13.9	9.3	19.5	33.3

* Only years for which similar $DDDA_F$ calculation methods were used have been included.

Figure A3. 2017 $DDDA_F$ distribution for broiler farms with conventional breeds

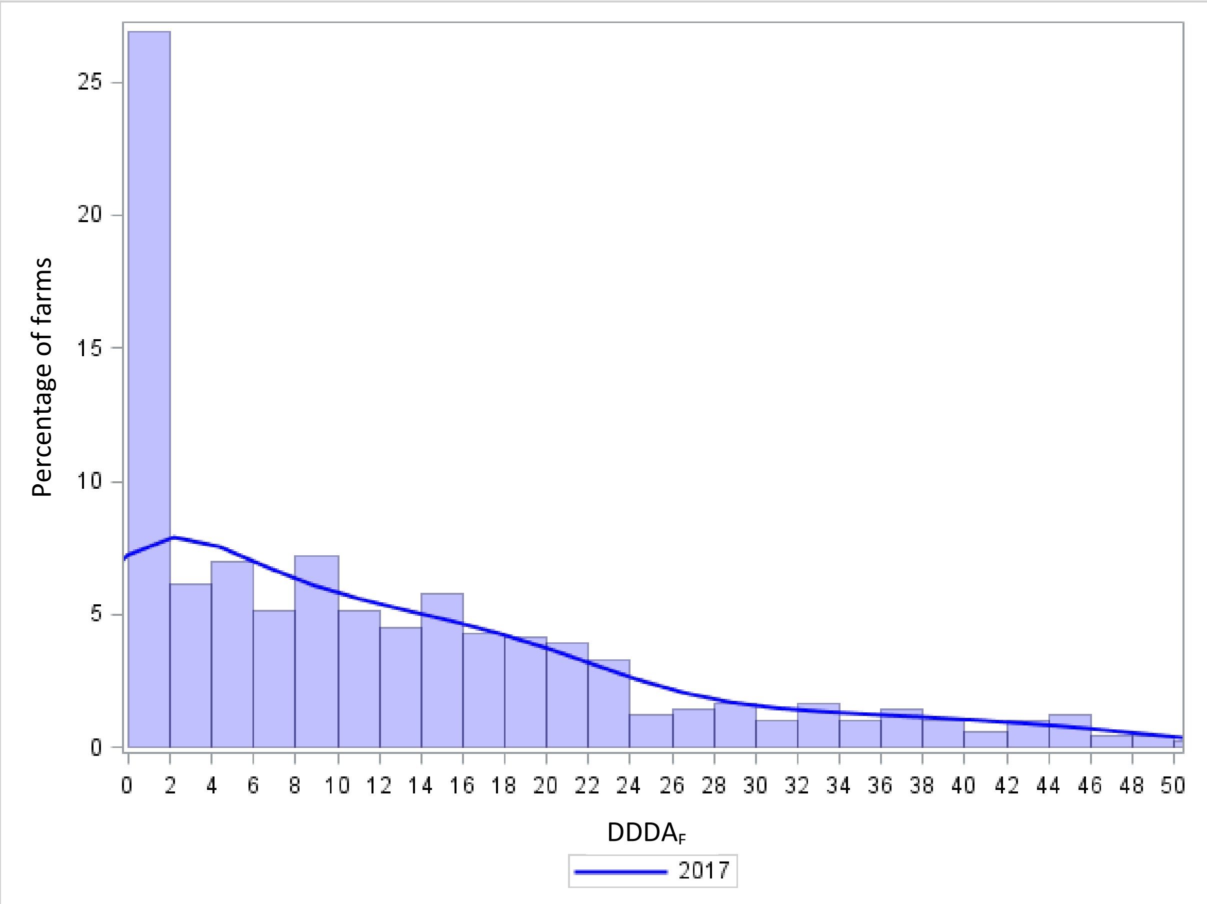


Table A8. Antibiotic use in $DDDA_F$ at broiler farms with conventional breeds in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$		
				Median	P75	Mean
1st choice	Penicillins	Oral	427	0.00	0.00	0.59
1st choice	Tetracyclines	Oral	340	0.00	1.05	1.40
1st choice	Trimethoprim/sulfonamides	Oral	207	1.59	6.00	4.70
2nd choice	Aminoglycosides	Oral	482	0.00	0.00	0.01
2nd choice	Quinolones	Oral	351	0.00	1.34	1.76
2nd choice	Fixed-dose combinations	Oral	480	0.00	0.00	0.12
2nd choice	Macrolides/lincosamides	Oral	425	0.00	0.00	0.38
2nd choice	Penicillins	Oral	210	1.58	6.52	4.78
2nd choice	Polymyxins	Oral	481	0.00	0.00	0.06
3rd choice	Fluoroquinolones	Oral	467	0.00	0.00	0.10

Broiler farms with alternative breeds

Number of broiler farms with alternative breeds: 493
Number of broiler farms with alternative breeds with $DDDA_F$=0: 281
Number of broiler farms with alternative breeds that used third- and fourth-generation cephalosporins: 0
Number of broiler farms with alternative breeds that used fluoroquinolones: 4

Table A9. Antibiotic use in $DDDA_F$ at broiler farms with alternative breeds in 2016 and 2017*

Year	N	Mean	Median	P75	P90
2016	461	3.6	0.0	3.8	11.9
2017	493	4.1	0.0	5.0	12.6

* Only years for which similar $DDDA_F$ calculation methods were used have been included.

Figure A4. 2017 $DDDA_F$ distribution for broiler farms with alternative breeds

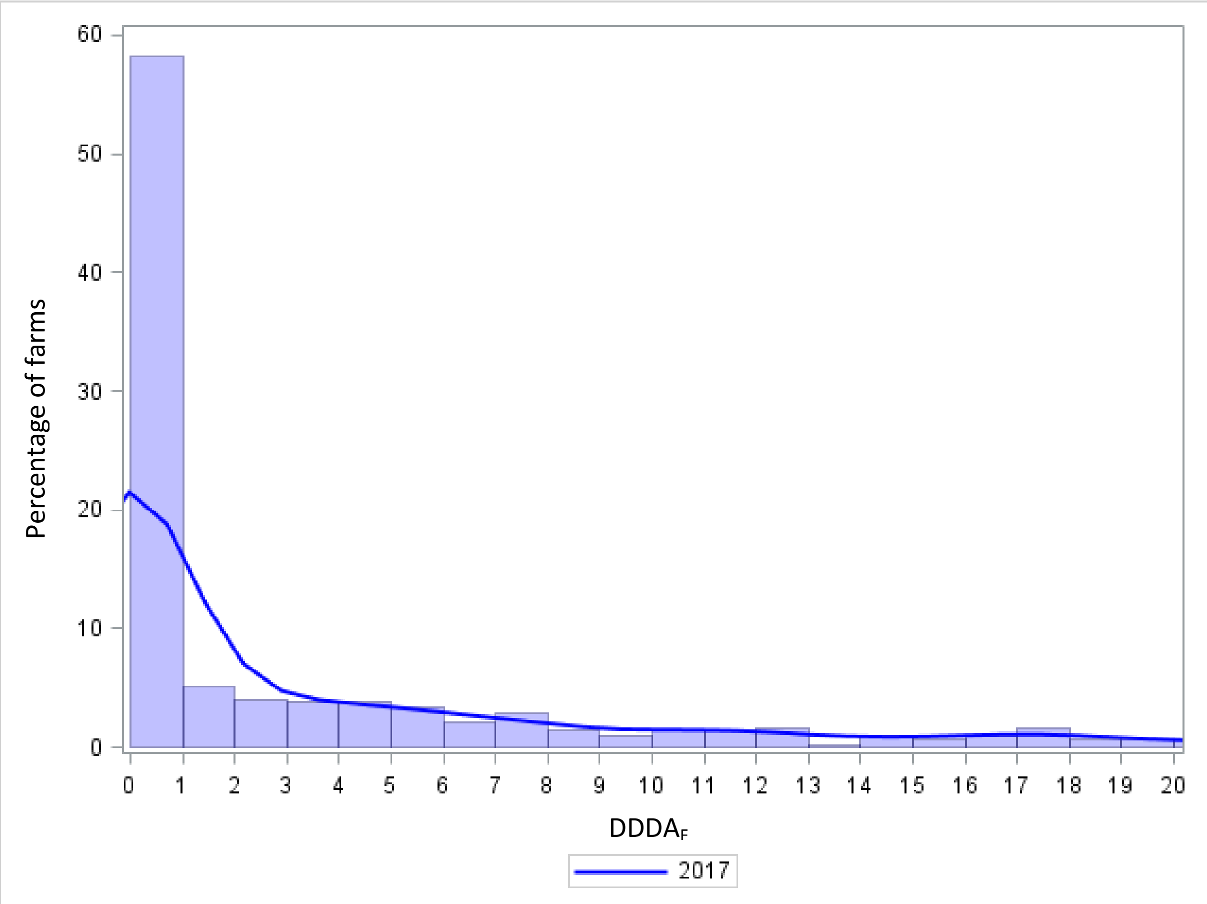


Table A10. Antibiotic use in $DDDA_F$ at broiler farms with alternative breeds in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$		
				Median	P75	Mean
1st choice	Penicillins	Oral	476	0.00	0.00	0.10
1st choice	Tetracyclines	Oral	423	0.00	0.00	0.52
1st choice	Trimethoprim/sulfonamides	Oral	359	0.00	1.60	1.96
2nd choice	Quinolones	Oral	438	0.00	0.00	0.80
2nd choice	Macrolides/lincosamides	Oral	488	0.00	0.00	0.01
2nd choice	Penicillins	Oral	434	0.00	0.00	0.67
2nd choice	Polymyxins	Oral	492	0.00	0.00	0.00
3rd choice	Fluoroquinolones	Oral	489	0.00	0.00	0.02

Turkey farms

Number of turkey farms: 45
Number of turkey farms with $DDDA_F$=0: 9
Number of turkey farms that used third- and fourth-generation cephalosporins: 0
Number of turkey farms that used fluoroquinolones: 17

Table A11. Antibiotic use in $DDDA_F$ at turkey farms in 2016 and 2017*

Year	N	Mean	Median	P75	P90
2016	46	28.0	19.3	34.2	72.8
2017	45	18.7	10.4	25.5	59.8

* Only years for which similar $DDDA_F$ calculation methods were used have been included.

Figure A5. 2013 and 2017 $DDDA_F$ distributions for turkey farms; 2017 $DDDA_F$ values based on standardized body weight

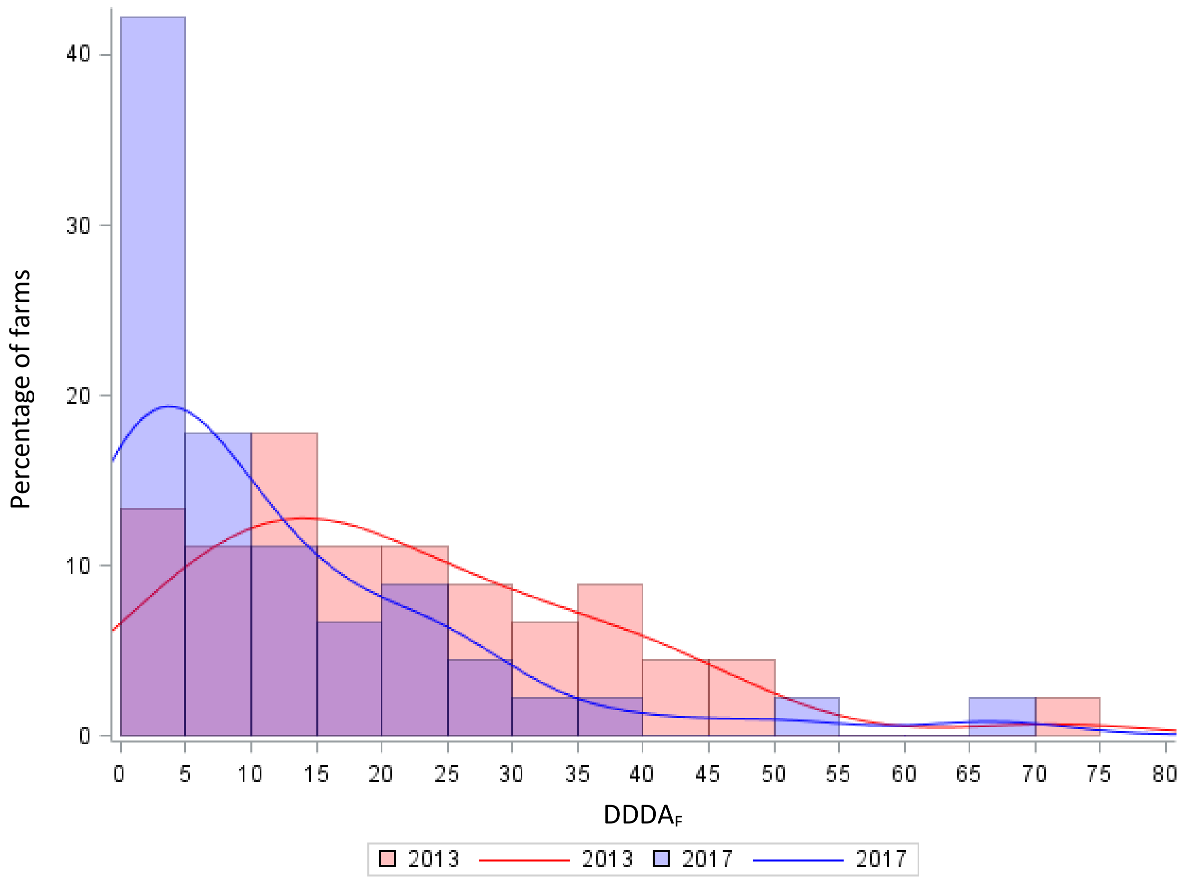


Table A12. Antibiotic use in $DDDA_F$ at turkey farms in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$		
				Median	P75	Mean
1st choice	Penicillins	Oral	33	0.00	2.25	2.20
1st choice	Pleuromutilins	Oral	43	0.00	0.00	0.03
1st choice	Tetracyclines	Oral	17	2.07	5.03	3.99
1st choice	Trimethoprim/sulfonamides	Oral	33	0.00	1.93	1.56
2nd choice	Aminoglycosides	Oral	44	0.00	0.00	0.15
2nd choice	Quinolones	Oral	43	0.00	0.00	0.34
2nd choice	Macrolides/lincosamides	Oral	26	0.00	1.21	0.79
2nd choice	Penicillins	Oral	20	1.36	11.19	7.76
3rd choice	Fluoroquinolones	Oral	28	0.00	2.74	1.91

Antibiotic use in DDDA$_F$ at pig farms

Farms with sows and suckling piglets

Number of farms with sows and suckling piglets: 1,853
Number of farms with sows and suckling piglets with DDDA$_F$=0: 110
Number of farms with sows and suckling piglets that used third- and fourth-generation cephalosporins: 0
Number of farms with sows and suckling piglets that used fluoroquinolones: 3

Table A13. Antibiotic use in DDDA$_F$ at farms with sows and suckling piglets from 2015 to 2017*

Year	N	Mean	Median	P75	P90
2015	2,109	5.4	3.1	6.8	12.8
2016	1,919	3.5	2.3	4.7	8.1
2017	1,853	3.7	2.2	4.7	8.2

* Only years for which similar DDDA$_F$ calculation methods were used have been included.

Figure A6. 2015 and 2017 DDDA$_F$ distributions for farms with sows and suckling piglets

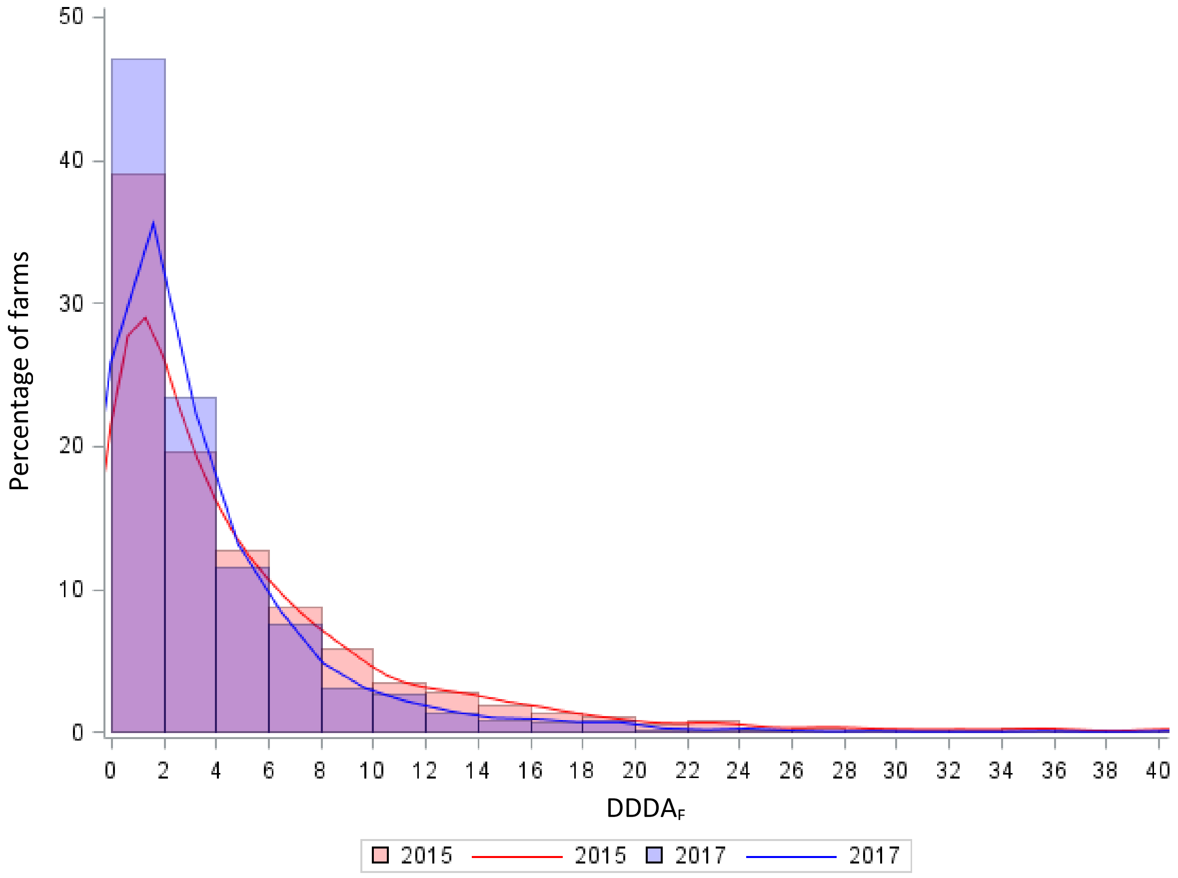


Table A14. Antibiotic use in $DDDA_F$ at farms with sows and suckling piglets in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$ Median	P75	Mean
1st choice	Amphenicols	Oral	1,852	0.00	0.00	0.00
1st choice	Amphenicols	Parenteral	1,370	0.00	0.03	0.19
1st choice	Macrolides/lincosamides	Oral	1,698	0.00	0.00	0.13
1st choice	Macrolides/lincosamides	Parenteral	1,668	0.00	0.00	0.01
1st choice	Penicillins	Parenteral	300	0.49	1.10	0.83
1st choice	Pleuromutilins	Oral	1,839	0.00	0.00	0.03
1st choice	Pleuromutilins	Parenteral	1,796	0.00	0.00	0.00
1st choice	Tetracyclines	Oral	1,353	0.00	0.32	0.92
1st choice	Tetracyclines	Parenteral	740	0.06	0.37	0.39
1st choice	Trimethoprim/sulfonamides	Oral	1,503	0.00	0.00	0.26
1st choice	Trimethoprim/sulfonamides	Parenteral	675	0.06	0.27	0.22
2nd choice	Aminoglycosides	Oral	1,844	0.00	0.00	0.00
2nd choice	Aminoglycosides	Parenteral	1,852	0.00	0.00	0.00
2nd choice	Quinolones	Oral	1,835	0.00	0.00	0.02
2nd choice	Fixed-dose combinations	Oral	1,851	0.00	0.00	0.00
2nd choice	Fixed-dose combinations	Parenteral	1,631	0.00	0.00	0.02
2nd choice	Macrolides/lincosamides	Parenteral	1,489	0.00	0.00	0.28
2nd choice	Penicillins	Oral	1,683	0.00	0.00	0.13
2nd choice	Penicillins	Parenteral	1,006	0.00	0.19	0.17
2nd choice	Polymyxins	Oral	1,666	0.00	0.00	0.09
2nd choice	Polymyxins	Parenteral	1,387	0.00	0.00	0.04
3rd choice	Fluoroquinolones	Parenteral	1,850	0.00	0.00	0.00

Farms with weaner pigs

Number of farms with weaner pigs: 2,037
Number of farms with weaner pigs with $DDDA_F$=0: 276
Number of farms with weaner pigs that used third- and fourth-generation cephalosporins: 0
Number of farms with weaner pigs that used fluoroquinolones: 2

Table A15. Antibiotic use in $DDDA_F$ at farms with weaner pigs from 2015 to 2017*

Year	N	Mean	Median	P75	P90
2015	2,276	19.6	7.6	24.4	52.2
2016	2,088	24.2	11.9	29.1	57.2
2017	2,037	21.7	10.6	25.5	52.9

* Only years for which similar $DDDA_F$ calculation methods were used have been included.

Figure A7. 2015 and 2017 $DDDA_F$ distributions for farms with weaner pigs

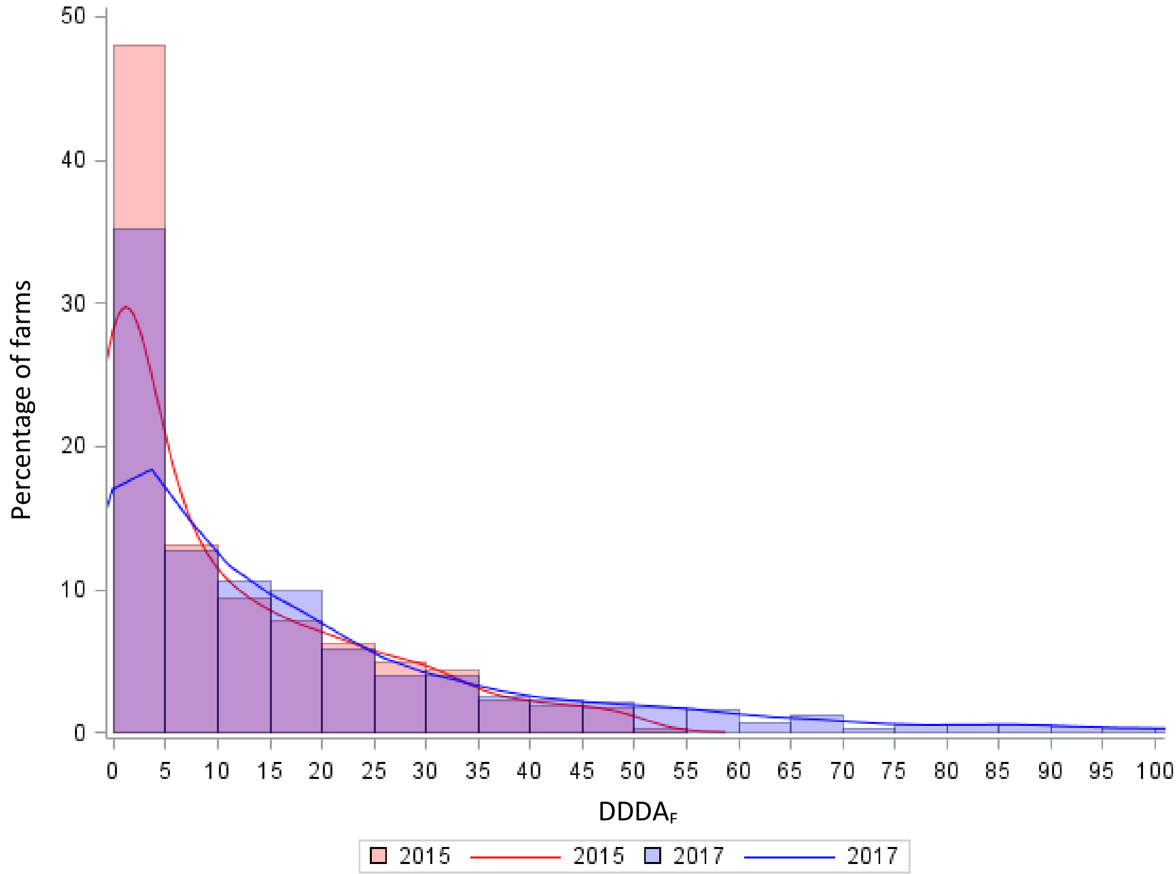


Table A16. Antibiotic use in $DDDA_F$ at farms with weaner pigs in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$ Median	P75	Mean
1st choice	Amphenicols	Oral	2,034	0.00	0.00	0.01
1st choice	Amphenicols	Parenteral	1,646	0.00	0.00	0.31
1st choice	Macrolides/lincosamides	Oral	1,791	0.00	0.00	0.63
1st choice	Macrolides/lincosamides	Parenteral	1,954	0.00	0.00	0.02
1st choice	Penicillins	Parenteral	1,076	0.00	0.71	0.67
1st choice	Pleuromutilins	Oral	2,010	0.00	0.00	0.12
1st choice	Pleuromutilins	Parenteral	2,007	0.00	0.00	0.01
1st choice	Tetracyclines	Oral	1,089	0.00	8.16	7.12
1st choice	Tetracyclines	Parenteral	1,432	0.00	0.16	0.63
1st choice	Trimethoprim/sulfonamides	Oral	1,278	0.00	2.65	3.35
1st choice	Trimethoprim/sulfonamides	Parenteral	1,709	0.00	0.00	0.06
2nd choice	Aminoglycosides	Oral	2,023	0.00	0.00	0.04
2nd choice	Quinolones	Oral	2,004	0.00	0.00	0.05
2nd choice	Fixed-dose combinations	Oral	2,033	0.00	0.00	0.00
2nd choice	Fixed-dose combinations	Parenteral	1,883	0.00	0.00	0.03
2nd choice	Macrolides/lincosamides	Parenteral	1,646	0.00	0.00	1.27
2nd choice	Penicillins	Oral	1,437	0.00	2.74	5.77
2nd choice	Penicillins	Parenteral	1,234	0.00	0.40	0.49
2nd choice	Polymyxins	Oral	1,601	0.00	0.00	1.04
2nd choice	Polymyxins	Parenteral	1,658	0.00	0.00	0.11
3rd choice	Fluoroquinolones	Parenteral	2,035	0.00	0.00	0.00

Farms with fattening pigs

Number of farms with fattening pigs: 4,580
Number of farms with fattening pigs with $DDDA_F$=0: 1,018
Number of farms with fattening pigs that used third- and fourth-generation cephalosporins: 0
Number of farms with fattening pigs that used fluoroquinolones: 3

Table A17. Usage of antibiotics in $DDDA_F$ at farms with fattening pigs from 2015 to 2017*

Year	N	Mean	Median	P75	P90
2015	5,072	4.1	1.6	5.4	10.2
2016	4,701	4.0	1.7	5.7	10.1
2017	4,580	3.8	1.7	5.4	9.8

* Only years for which similar $DDDA_F$ calculation methods were used have been included.

Figure A8. 2015 and 2017 $DDDA_F$ distributions for farms with fattening pigs

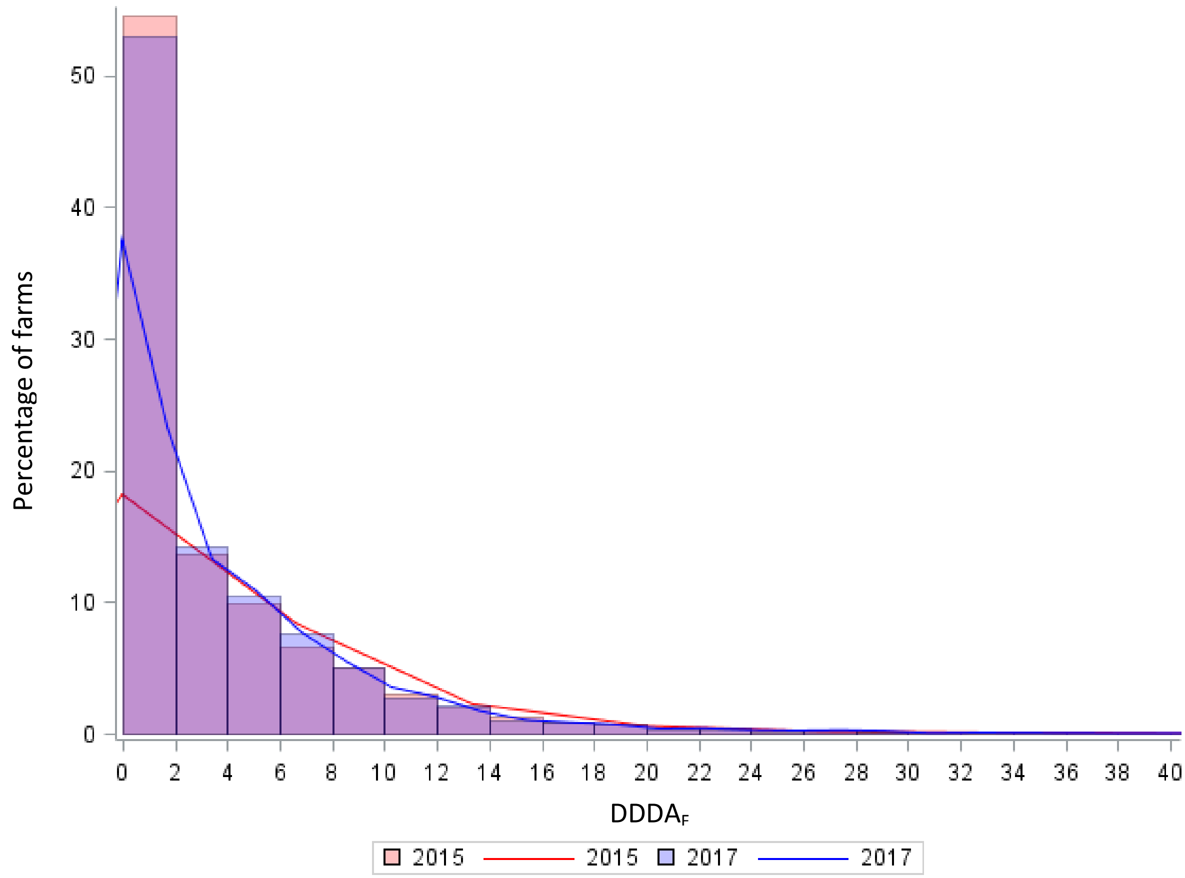


Table A18. Antibiotic use in $DDDA_F$ at farms with fattening pigs in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$		
				Median	P75	Mean
1st choice	Amphenicols	Parenteral	3,449	0.00	0.00	0.15
1st choice	Macrolides/lincosamides	Oral	3,547	0.00	0.00	0.62
1st choice	Macrolides/lincosamides	Parenteral	3,957	0.00	0.00	0.02
1st choice	Penicillins	Parenteral	1,745	0.09	0.33	0.29
1st choice	Pleuromutilins	Oral	4,479	0.00	0.00	0.05
1st choice	Pleuromutilins	Parenteral	4,369	0.00	0.00	0.00
1st choice	Tetracyclines	Oral	2,641	0.00	2.48	1.99
1st choice	Tetracyclines	Parenteral	2,426	0.00	0.18	0.21
1st choice	Trimethoprim/sulfonamides	Oral	3,686	0.00	0.00	0.35
1st choice	Trimethoprim/sulfonamides	Parenteral	4,518	0.00	0.00	0.00
2nd choice	Aminoglycosides	Oral	4,573	0.00	0.00	0.00
2nd choice	Quinolones	Oral	4,568	0.00	0.00	0.00
2nd choice	Fixed-dose combinations	Oral	4,576	0.00	0.00	0.00
2nd choice	Fixed-dose combinations	Parenteral	4,485	0.00	0.00	0.00
2nd choice	Macrolides/lincosamides	Parenteral	4,520	0.00	0.00	0.01
2nd choice	Penicillins	Oral	4,411	0.00	0.00	0.10
2nd choice	Penicillins	Parenteral	4,145	0.00	0.00	0.01
2nd choice	Polymyxins	Oral	4,486	0.00	0.00	0.01
2nd choice	Polymyxins	Parenteral	4,473	0.00	0.00	0.00
3rd choice	Fluoroquinolones	Parenteral	4,577	0.00	0.00	0.00

Antibiotic use in $DDDA_F$ at veal farms

White veal farms

Number of white veal farms: 838
Number of white veal farms with $DDDA_F$=0: 3
Number of white veal farms that used third- and fourth-generation cephalosporins: 0
Number of white veal farms that used fluoroquinolones: 98

Table A19. Antibiotic use in $DDDA_F$ at white veal farms from 2011 to 2017*

Year	N	Mean	Median	P75	P90
2011	934	41.1	33.2	44.9	57.8
2012	904	33.6	30.7	40.1	50.9
2013	862	31.4	26.2	35.1	45.2
2014	864	24.5	23.4	31.0	37.8
2015	855	25.1	24.3	31.7	38.3
2016	857	23.7	23.0	29.0	35.6
2017	838	23.0	22.2	27.0	33.1

* Only years for which similar $DDDA_F$ calculation methods were used have been included.

Figure A9. 2012 and 2017 $DDDA_F$ distributions for white veal farms

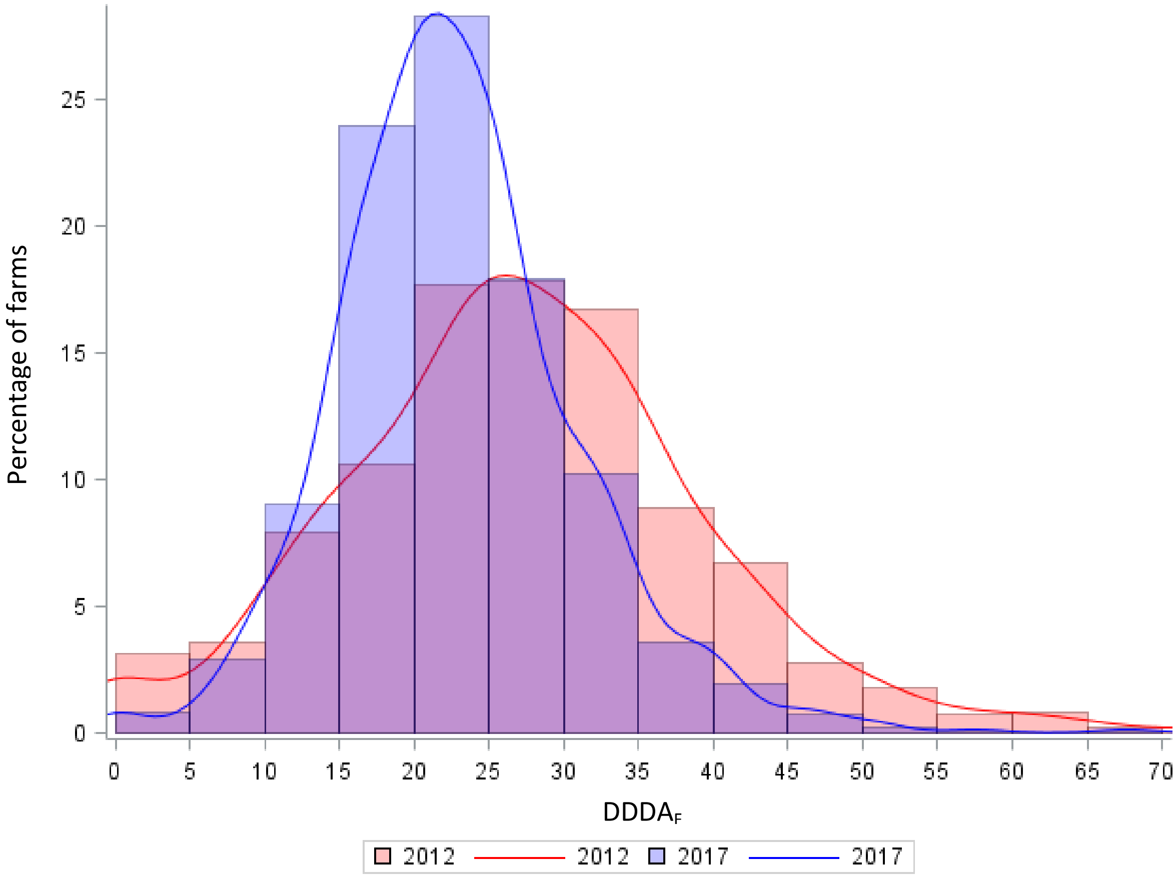


Table A20. Antibiotic use in $DDDA_F$ at white veal farms in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$ Median	P75	Mean
1st choice	Amphenicols	Parenteral	5	1.12	1.57	1.25
1st choice	Macrolides/lincosamides	Oral	24	3.74	4.58	3.74
1st choice	Macrolides/lincosamides	Parenteral	164	0.04	0.15	0.15
1st choice	Penicillins	Intramammary for dry cow therapy	837	0.00	0.00	0.00
1st choice	Penicillins	Parenteral	25	0.38	0.68	0.53
1st choice	Tetracyclines	Oral	8	11.56	14.67	12.17
1st choice	Tetracyclines	Parenteral	611	0.00	0.01	0.02
1st choice	Trimethoprim/sulfonamides	Oral	356	0.22	2.24	1.48
1st choice	Trimethoprim/sulfonamides	Parenteral	128	0.05	0.11	0.09
2nd choice	Aminoglycosides	Oral	333	0.02	0.06	0.18
2nd choice	Aminoglycosides	Parenteral	457	0.00	0.07	0.07
2nd choice	Quinolones	Oral	576	0.00	0.91	0.83
2nd choice	Fixed-dose combinations	Intramammary	837	0.00	0.00	0.00
2nd choice	Fixed-dose combinations	Parenteral	750	0.00	0.00	0.00
2nd choice	Macrolides/lincosamides	Parenteral	280	0.10	0.29	0.19
2nd choice	Penicillins	Intramammary	836	0.00	0.00	0.00
2nd choice	Penicillins	Oral	250	1.23	3.28	2.03
2nd choice	Penicillins	Parenteral	120	0.07	0.14	0.10
2nd choice	Polymyxins	Oral	807	0.00	0.00	0.04
2nd choice	Polymyxins	Parenteral	722	0.00	0.00	0.00
3rd choice	Fluoroquinolones	Oral	826	0.00	0.00	0.06
3rd choice	Fluoroquinolones	Parenteral	745	0.00	0.00	0.00

Rosé veal starter farms

Number of rosé veal starter farms: 238
Number of rosé veal starter farms with $DDDA_F$=0: 7
Number of rosé veal starter farms that used third- and fourth-generation cephalosporins: 0
Number of rosé veal starter farms that used fluoroquinolones: 26

Table A21. Antibiotic use in $DDDA_F$ at rosé veal starter farms from 2011 to 2017*

Year	N	Mean	Median	P75	P90
2011	207	120.0	94.4	127.8	171.5
2012	189	97.5	84.2	107.1	143.1
2013	264	115.6	80.9	102.2	131.0
2014	260	79.6	77.7	97.2	113.9
2015	247	82.7	83.0	101.5	115.1
2016	240	83.9	83.2	100	111.6
2017	238	83.0	83.1	102.0	113.3

* Only years for which similar $DDDA_F$ calculation methods were used have been included.

Figure A10. 2012 and 2017 $DDDA_F$ distributions for rosé veal starter farms

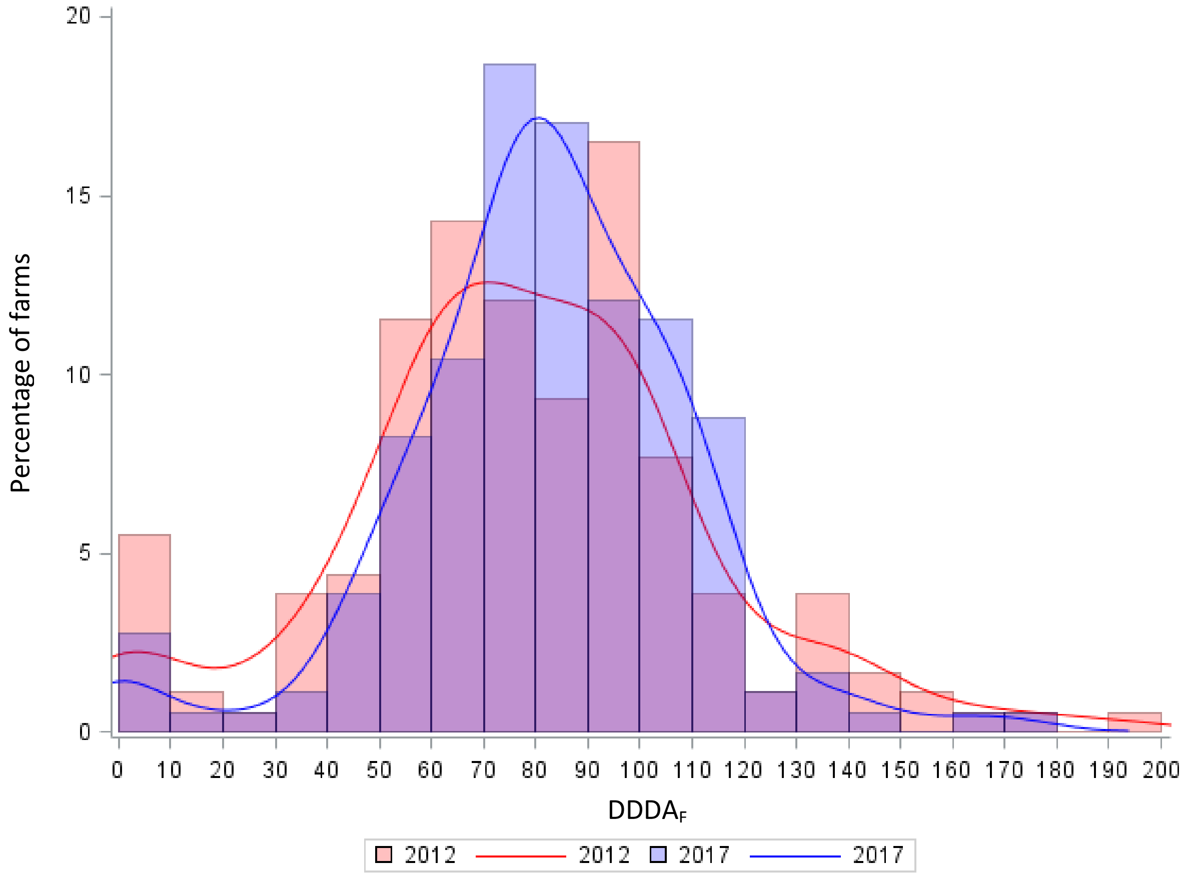


Table A22. Antibiotic use in $DDDA_F$ at rosé veal starter farms in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$ Median	P75	Mean
1st choice	Amphenicols	Parenteral	7	5.71	8.34	6.77
1st choice	Macrolides/lincosamides	Oral	14	17.38	21.09	16.27
1st choice	Macrolides/lincosamides	Parenteral	49	0.20	0.66	0.60
1st choice	Penicillins	Parenteral	16	1.22	2.18	1.79
1st choice	Tetracyclines	Oral	9	43.66	53.22	42.20
1st choice	Tetracyclines	Parenteral	167	0.00	0.07	0.19
1st choice	Trimethoprim/sulfonamides	Oral	58	4.95	11.52	7.83
1st choice	Trimethoprim/sulfonamides	Parenteral	46	0.22	0.50	0.49
2nd choice	Aminoglycosides	Oral	117	0.01	0.29	0.80
2nd choice	Aminoglycosides	Parenteral	113	0.04	0.49	0.35
2nd choice	Quinolones	Oral	176	0.00	0.80	1.07
2nd choice	Fixed-dose combinations	Parenteral	208	0.00	0.00	0.02
2nd choice	Macrolides/lincosamides	Parenteral	86	0.47	1.42	1.05
2nd choice	Penicillins	Oral	129	0.00	4.24	2.94
2nd choice	Penicillins	Parenteral	41	0.21	0.48	0.36
2nd choice	Polymyxins	Oral	229	0.00	0.00	0.19
2nd choice	Polymyxins	Parenteral	207	0.00	0.00	0.01
3rd choice	Fluoroquinolones	Oral	234	0.00	0.00	0.02
3rd choice	Fluoroquinolones	Parenteral	216	0.00	0.00	0.01

Rosé veal fattening farms

Number of rosé veal fattening farms: 580
Number of rosé veal fattening farms with $DDDA_F$=0: 57
Number of rosé veal fattening farms that used third- and fourth-generation cephalosporins: 0
Number of rosé veal fattening farms that used fluoroquinolones: 5

Table A23. Antibiotic use in $DDDA_F$ at rosé veal fattening farms from 2011 to 2017*

Year	N	Mean	Median	P75	P90
2011	671	7.8	1.5	6.6	14.5
2012	717	5.8	2.3	7.3	15.5
2013	723	5.2	1.4	5.4	10.8
2014	663	3.4	1.2	4.5	9.5
2015	638	2.7	1.0	4.0	7.3
2016	602	2.8	0.9	3.9	8.1
2017	580	3.0	1.6	4.1	7.8

* Only years for which similar $DDDA_F$ calculation methods were used have been included.

Figure A11. 2012 and 2017 $DDDA_F$ distributions for rosé veal fattening farms

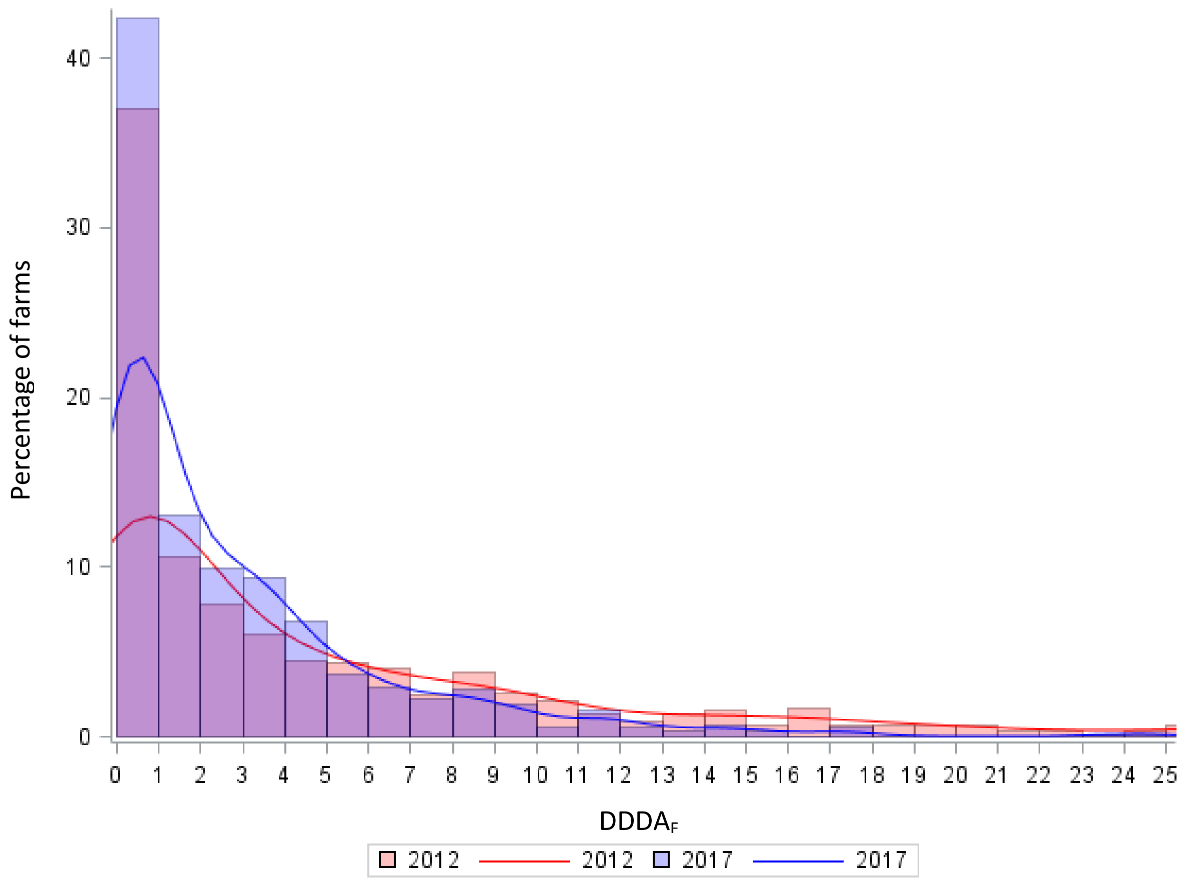


Table A24. Antibiotic use in $DDDA_F$ at rosé veal fattening farms in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$ Median	P75	Mean
1st choice	Amphenicols	Parenteral	91	0.36	0.65	0.50
1st choice	Macrolides/lincosamides	Oral	539	0.00	0.00	0.06
1st choice	Macrolides/lincosamides	Parenteral	420	0.00	0.01	0.03
1st choice	Penicillins	Parenteral	247	0.05	0.18	0.14
1st choice	Tetracyclines	Oral	333	0.00	2.27	1.55
1st choice	Tetracyclines	Parenteral	510	0.00	0.00	0.01
1st choice	Trimethoprim/sulfonamides	Oral	421	0.00	0.17	0.50
1st choice	Trimethoprim/sulfonamides	Parenteral	462	0.00	0.00	0.01
2nd choice	Aminoglycosides	Oral	575	0.00	0.00	0.00
2nd choice	Aminoglycosides	Parenteral	570	0.00	0.00	0.00
2nd choice	Quinolones	Oral	576	0.00	0.00	0.01
2nd choice	Fixed-dose combinations	Parenteral	549	0.00	0.00	0.00
2nd choice	Macrolides/lincosamides	Parenteral	395	0.00	0.05	0.10
2nd choice	Penicillins	Oral	572	0.00	0.00	0.01
2nd choice	Penicillins	Parenteral	390	0.00	0.01	0.03
2nd choice	Polymyxins	Parenteral	577	0.00	0.00	0.00
3rd choice	Fluoroquinolones	Parenteral	575	0.00	0.00	0.00

Rosé veal combination farms

Number of rosé veal combination farms: 212
Number of rosé veal combination farms with $DDDA_F$=0: 9
Number of rosé veal combination farms that used third- and fourth-generation cephalosporins: 0
Number of rosé veal combination farms that used fluoroquinolones: 13

Table A25. Antibiotic use in $DDDA_F$ at rosé veal combination farms from 2011 to 2017*

Year	N	Mean	Median	P75	P90
2011	313	34.6	17.3	29.7	45.7
2012	365	21.5	13.2	23.7	37.4
2013	276	11.7	10.1	16.2	23.8
2014	215	13.0	12.0	17.1	21.9
2015	238	11.8	11.2	16.2	21.4
2016	229	11.1	11.3	16.6	20.6
2017	212	12.8	12.6	17.3	22.6

* Only years for which similar $DDDA_F$ calculation methods were used have been included.

Figure A12. 2012 and 2017 $DDDA_F$ distributions for rosé veal combination farms

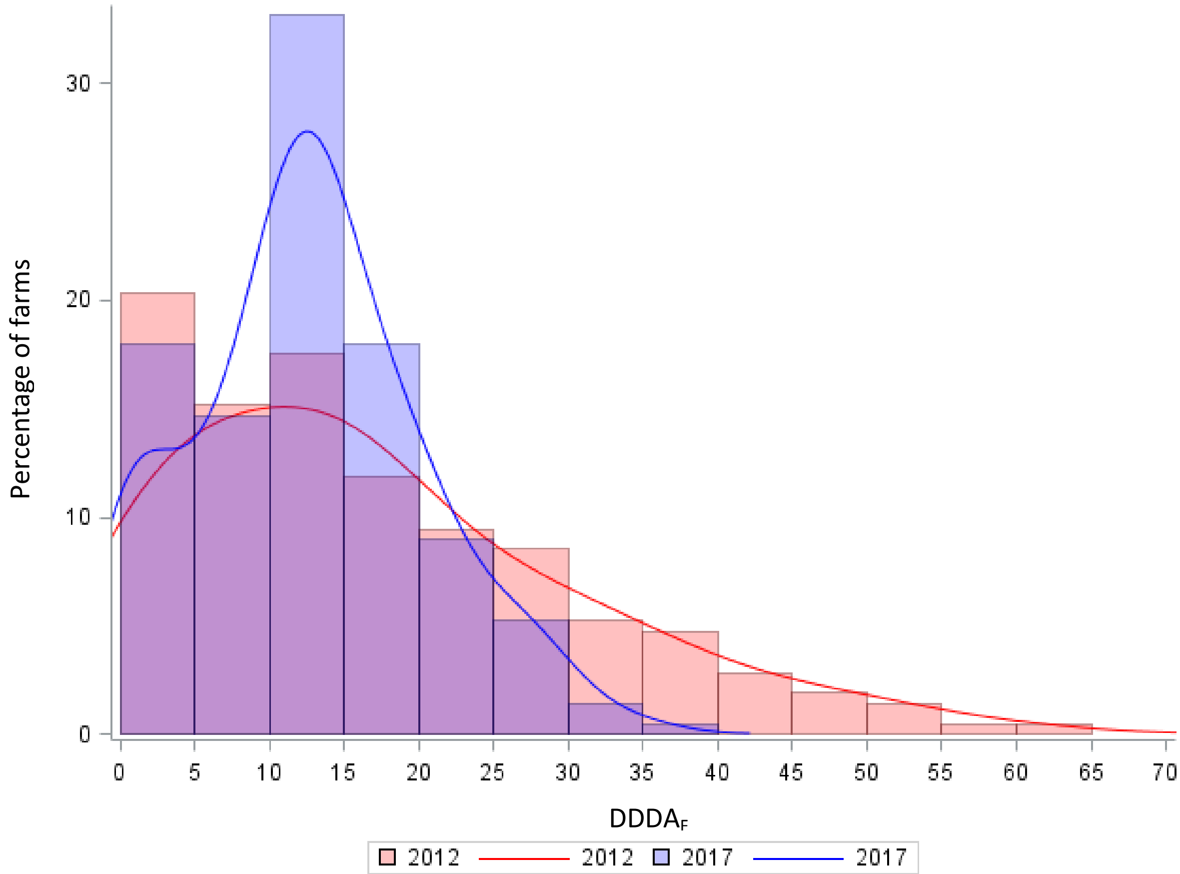


Table A26. Antibiotic use in $DDDA_F$ at rosé veal combination farms in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$		
				Median	P75	Mean
1st choice	Amphenicols	Parenteral	14	1.14	1.93	1.39
1st choice	Macrolides/lincosamides	Oral	52	1.87	2.83	1.82
1st choice	Macrolides/lincosamides	Parenteral	72	0.03	0.10	0.11
1st choice	Penicillins	Intramammary for dry cow therapy	210	0.00	0.00	0.00
1st choice	Penicillins	Parenteral	36	0.21	0.49	0.42
1st choice	Tetracyclines	Oral	29	7.12	9.60	6.75
1st choice	Tetracyclines	Parenteral	158	0.00	0.00	0.02
1st choice	Trimethoprim/sulfonamides	Oral	72	0.55	1.61	1.15
1st choice	Trimethoprim/sulfonamides	Parenteral	72	0.02	0.06	0.06
2nd choice	Aminoglycosides	Oral	133	0.00	0.03	0.12
2nd choice	Aminoglycosides	Parenteral	136	0.00	0.03	0.05
2nd choice	Quinolones	Oral	181	0.00	0.00	0.12
2nd choice	Fixed-dose combinations	Parenteral	177	0.00	0.00	0.01
2nd choice	Macrolides/lincosamides	Parenteral	68	0.13	0.38	0.28
2nd choice	Penicillins	Oral	136	0.00	0.20	0.33
2nd choice	Penicillins	Parenteral	62	0.04	0.10	0.09
2nd choice	Polymyxins	Oral	209	0.00	0.00	0.01
2nd choice	Polymyxins	Parenteral	183	0.00	0.00	0.00
3rd choice	Fluoroquinolones	Oral	210	0.00	0.00	0.00
3rd choice	Fluoroquinolones	Parenteral	200	0.00	0.00	0.00

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Antibiotic use in $DDDA_F$ at cattle farms

Dairy cattle farms

Number of dairy cattle farms: 17,121
Number of dairy cattle farms with $DDDA_F$=0: 369
Number of dairy cattle farms that used third- and fourth-generation cephalosporins: 201
Number of dairy cattle farms that used fluoroquinolones: 899

Table A27. Antibiotic use at dairy cattle farms from 2012 to 2017, presented as overall antibiotic use (A), use of dry cow (intramammary) antibiotics (B), use of mastitis injectors (C), and use of oral antibiotics in calves (D)

A **Overall antibiotic use, in $DDDA_F$**

Year	N	Mean	Median	P75	P90
2012	18,053	2.9	2.7	3.8	4.9
2013	18,005	2.8	2.8	3.7	4.7
2014	17,747	2.3	2.2	3.0	3.9
2015	17,737	2.2	2.1	2.9	3.7
2016	17,529	2.1	2.1	2.9	3.7
2017	17,121	2.1	2.1	2.9	3.8

* Only years for which similar $DDDA_F$ calculation methods were used have been included.

B **Use of dry cow (intramammary) antibiotics, in $DDDA_F$ (animals >2 years of age)**

N	Mean	Median	P75	P90
17,121	1.2	1.1	1.8	2.4

C **Use of mastitis injectors, in $DDDA_F$ (animals >2 years of age)**

N	Mean	Median	P75	P90
17,121	0.7	0.5	0.9	1.4

D **Use of oral antibiotics in calves, in $DDDA_F$ (animals <56 days of age)**

N	Mean	Median	P75	P90
17,121	2.6	0.0	0.0	5.4

Figure A13. 2012 and 2017 $DDDA_F$ distributions for dairy cattle farms

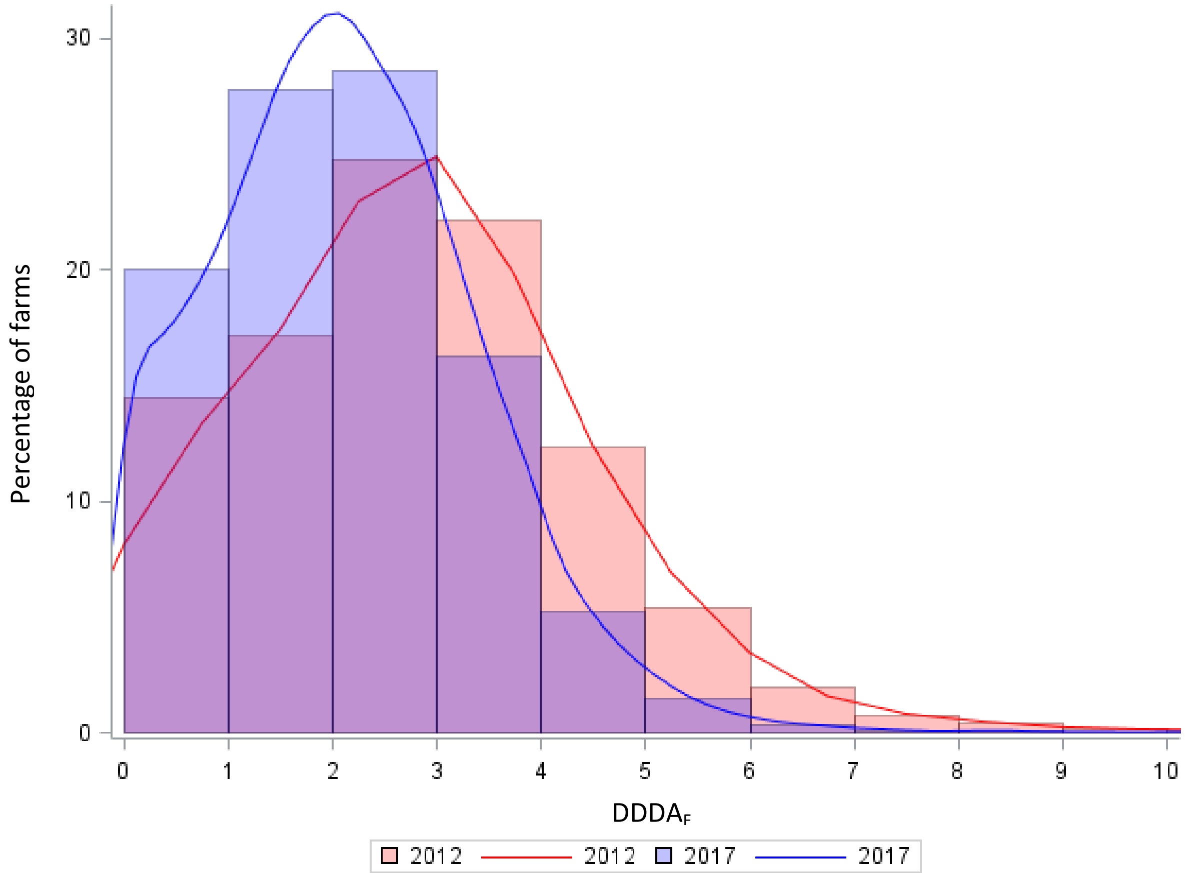

Table A28. Antibiotic use in $DDDA_F$ at dairy cattle farms in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$		
				Median	P75	Mean
1st choice	Amphenicols	Parenteral	9,811	0.00	0.04	0.03
1st choice	Macrolides/lincosamides	Intramammary	17,088	0.00	0.00	0.00
1st choice	Macrolides/lincosamides	Oral	17,110	0.00	0.00	0.00
1st choice	Macrolides/lincosamides	Parenteral	13,048	0.00	0.00	0.03
1st choice	Penicillins	Intramammary	12,495	0.00	0.09	0.12
1st choice	Penicillins	Intramammary for dry cow therapy	3,489	0.84	1.39	0.89
1st choice	Penicillins	Parenteral	4,069	0.09	0.24	0.18
1st choice	Tetracyclines	Oral	16,697	0.00	0.00	0.00
1st choice	Tetracyclines	Parenteral	3,751	0.09	0.21	0.15
1st choice	Tetracyclines	Intrauterine	7,885	0.01	0.09	0.06
1st choice	Trimethoprim/sulfonamides	Oral	15,532	0.00	0.00	0.01
1st choice	Trimethoprim/sulfonamides	Parenteral	3,218	0.10	0.23	0.17
2nd choice	Aminoglycosides	Oral	15,791	0.00	0.00	0.00
2nd choice	Aminoglycosides	Parenteral	16,822	0.00	0.00	0.00
2nd choice	1st- and 2nd-gen. cephalosporins	Intramammary	16,149	0.00	0.00	0.01
2nd choice	1st- and 2nd-gen. cephalosporins	Intrauterine	12,757	0.00	0.00	0.01
2nd choice	Quinolones	Oral	17,110	0.00	0.00	0.00
2nd choice	Fixed-dose combinations	Intramammary	8,427	0.01	0.26	0.18
2nd choice	Fixed-dose combinations	Intramammary for dry cow therapy	16,677	0.00	0.00	0.02
2nd choice	Fixed-dose combinations	Parenteral	11,183	0.00	0.03	0.03
2nd choice	Macrolides/lincosamides	Parenteral	15,493	0.00	0.00	0.01
2nd choice	Penicillins	Intramammary	5,823	0.12	0.31	0.20
2nd choice	Penicillins	Oral	17,111	0.00	0.00	0.00
2nd choice	Penicillins	Parenteral	11,352	0.00	0.02	0.03
2nd choice	Polymyxins	Oral	16,968	0.00	0.00	0.00
2nd choice	Polymyxins	Parenteral	16,916	0.00	0.00	0.00
3rd choice	3rd- and 4th-gen. cephalosporins	Intramammary	16,927	0.00	0.00	0.00
3rd choice	3rd- and 4th-gen. cephalosporins	Intramammary for dry cow therapy	17,120	0.00	0.00	0.00
3rd choice	3rd- and 4th-gen. cephalosporins	Parenteral	17,105	0.00	0.00	0.00
3rd choice	Fluoroquinolones	Oral	17,120	0.00	0.00	0.00
3rd choice	Fluoroquinolones	Parenteral	16,222	0.00	0.00	0.00

Suckler cow farms

Number of suckler cow farms: 9,351
Number of suckler cow farms with $DDDA_F$=0: 4,743
Number of suckler cow farms that used third- and fourth-generation cephalosporins: 2
Number of suckler cow farms that used fluoroquinolones: 59

Table A29. Antibiotic use in $DDDA_F$ at suckler cow farms from 2012 to 2017*

Year	N	Mean	Median	P75	P90
2012	11,927	0.9	0.0	0.6	2.0
2013	9,857	0.7	0.1	0.8	2.2
2014	9,588	0.7	0.1	0.7	2.0
2015	9,305	0.6	0.1	0.7	2.0
2016	9,067	0.6	0.1	0.7	1.9
2017	9,351	0.5	0.0	0.6	1.7

* Only years for which similar $DDDA_F$ calculation methods were used have been included.

Figure A14. 2012 and 2017 $DDDA_F$ distributions for suckler cow farms (no probability density functions can be shown due to too little variation)

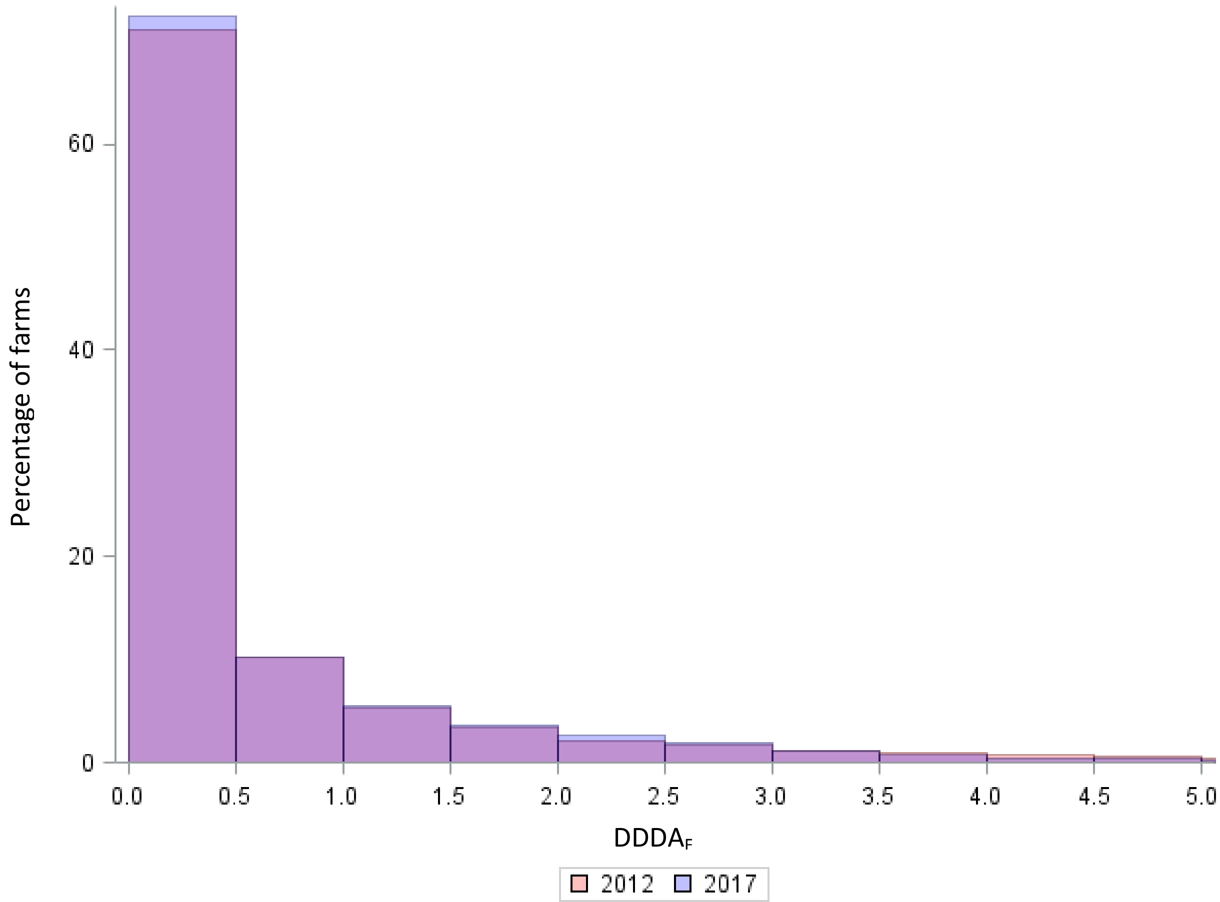

Table A30. Antibiotic use in $DDDA_F$ at suckler cow farms in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$		
				Median	P75	Mean
1st choice	Amphenicols	Parenteral	8,005	0.00	0.00	0.04
1st choice	Macrolides/lincosamides	Intramammary	9,350	0.00	0.00	0.00
1st choice	Macrolides/lincosamides	Oral	9,347	0.00	0.00	0.00
1st choice	Macrolides/lincosamides	Parenteral	9,026	0.00	0.00	0.00
1st choice	Penicillins	Intramammary	9,297	0.00	0.00	0.00
1st choice	Penicillins	Intramammary for dry cow therapy	9,040	0.00	0.00	0.04
1st choice	Penicillins	Parenteral	7,001	0.00	0.01	0.16
1st choice	Tetracyclines	Oral	9,279	0.00	0.00	0.01
1st choice	Tetracyclines	Parenteral	7,821	0.00	0.00	0.06
1st choice	Tetracyclines	Intrauterine	7,855	0.00	0.00	0.03
1st choice	Trimethoprim/sulfonamides	Oral	9,194	0.00	0.00	0.00
1st choice	Trimethoprim/sulfonamides	Parenteral	8,191	0.00	0.00	0.02
2nd choice	Aminoglycosides	Oral	9,282	0.00	0.00	0.00
2nd choice	Aminoglycosides	Parenteral	9,300	0.00	0.00	0.00
2nd choice	1st- and 2nd-gen. cephalosporins	Intramammary	9,306	0.00	0.00	0.00
2nd choice	1st- and 2nd-gen. cephalosporins	Intrauterine	9,230	0.00	0.00	0.00
2nd choice	Quinolones	Oral	9,350	0.00	0.00	0.00
2nd choice	Fixed-dose combinations	Intramammary	9,132	0.00	0.00	0.01
2nd choice	Fixed-dose combinations	Intramammary for dry cow therapy	9,336	0.00	0.00	0.00
2nd choice	Fixed-dose combinations	Parenteral	7,888	0.00	0.00	0.11
2nd choice	Macrolides/lincosamides	Parenteral	8,911	0.00	0.00	0.01
2nd choice	Penicillins	Intramammary	9,001	0.00	0.00	0.01
2nd choice	Penicillins	Oral	9,349	0.00	0.00	0.00
2nd choice	Penicillins	Parenteral	8,453	0.00	0.00	0.03
2nd choice	Polymyxins	Oral	9,344	0.00	0.00	0.00
2nd choice	Polymyxins	Parenteral	9,316	0.00	0.00	0.00
3rd choice	3rd- and 4th-gen. cephalosporins	Intramammary	9,350	0.00	0.00	0.00
3rd choice	3rd- and 4th-gen. cephalosporins	Parenteral	9,350	0.00	0.00	0.00
3rd choice	Fluoroquinolones	Parenteral	9,292	0.00	0.00	0.00

Rearing farms

Number of rearing farms: 520
Number of rearing farms with $DDDA_F$=0: 405
Number of rearing farms that used third- and fourth-generation cephalosporins: 0
Number of rearing farms that used fluoroquinolones: 2

Table A31. Antibiotic use in $DDDA_F$ at rearing farms from 2013 to 2017*

Year	N	Mean	Median	P75	P90
2012**	-	-	-	-	-
2013	472	1.1	0.0	0.2	2.3
2014	474	1.4	0.0	0.2	1.8
2015	470	0.8	0.0	0.2	1.7
2016	435	0.8	0.0	0.1	1.3
2017	520	1.0	0.0	0.0	1.6

* Only years for which similar $DDDA_F$ calculation methods were used have been included.
** Rearing and beef farms were grouped together for 2012, as the available data did not allow for categorization based on sex.

Figure A15. 2013 and 2017 $DDDA_F$ distributions for rearing farms (no probability density functions can be shown due to too little variation)

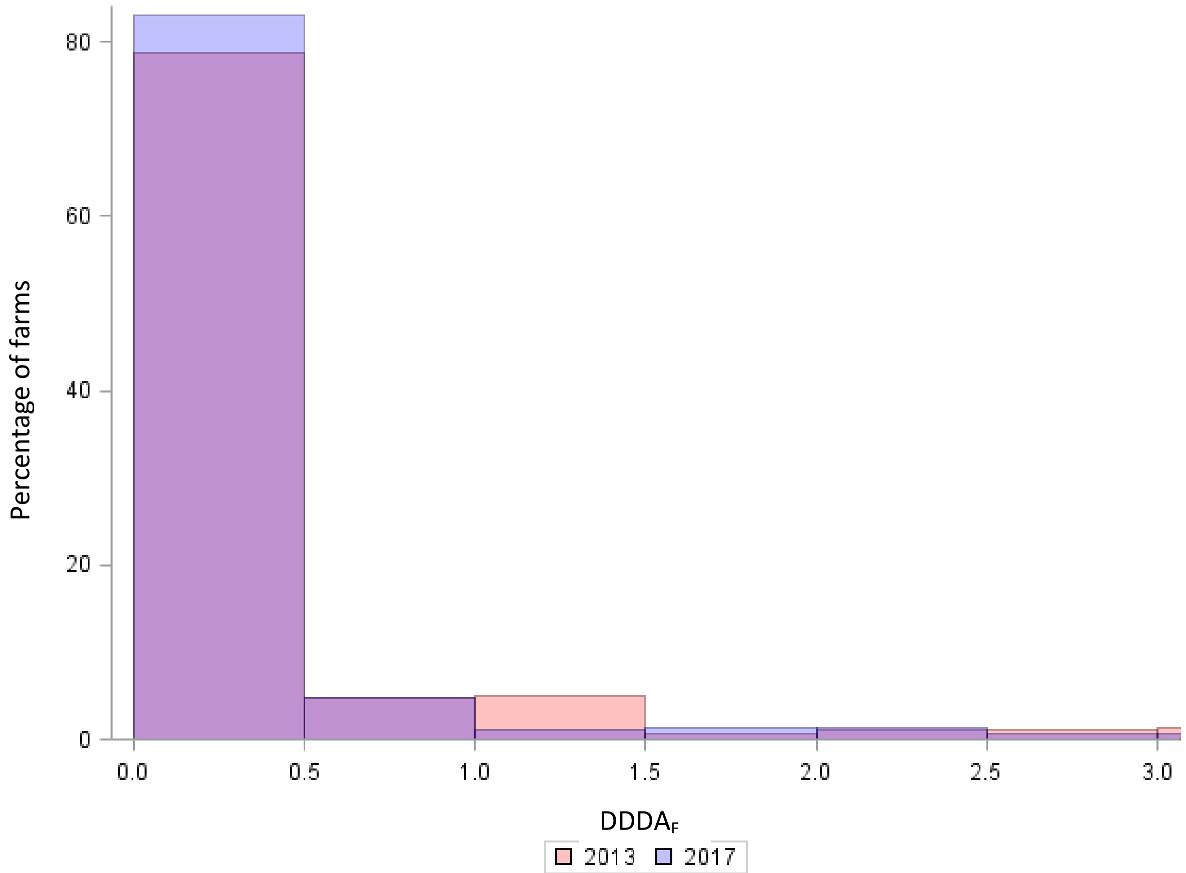

Table A32. Antibiotic use in $DDDA_F$ at rearing farms in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$		
				Median	P75	Mean
1st choice	Amphenicols	Parenteral	440	0.00	0.00	0.17
1st choice	Macrolides/lincosamides	Oral	502	0.00	0.00	0.15
1st choice	Macrolides/lincosamides	Parenteral	495	0.00	0.00	0.01
1st choice	Penicillins	Intramammary for dry cow therapy	517	0.00	0.00	0.02
1st choice	Penicillins	Parenteral	464	0.00	0.00	0.07
1st choice	Tetracyclines	Oral	494	0.00	0.00	0.41
1st choice	Tetracyclines	Parenteral	493	0.00	0.00	0.03
1st choice	Trimethoprim/sulfonamides	Oral	508	0.00	0.00	0.05
1st choice	Trimethoprim/sulfonamides	Parenteral	482	0.00	0.00	0.03
2nd choice	Aminoglycosides	Oral	513	0.00	0.00	0.01
2nd choice	Aminoglycosides	Parenteral	519	0.00	0.00	0.00
2nd choice	1st- and 2nd-gen. cephalosporins	Intrauterine	519	0.00	0.00	0.00
2nd choice	Quinolones	Oral	518	0.00	0.00	0.01
2nd choice	Fixed-dose combinations	Intramammary	517	0.00	0.00	0.01
2nd choice	Fixed-dose combinations	Parenteral	513	0.00	0.00	0.00
2nd choice	Macrolides/lincosamides	Parenteral	499	0.00	0.00	0.02
2nd choice	Penicillins	Intramammary	514	0.00	0.00	0.04
2nd choice	Penicillins	Parenteral	502	0.00	0.00	0.00
2nd choice	Polymyxins	Oral	519	0.00	0.00	0.00
2nd choice	Polymyxins	Parenteral	518	0.00	0.00	0.00
3rd choice	Fluoroquinolones	Parenteral	518	0.00	0.00	0.00

Beef farms

Number of beef farms: 2,919
Number of beef farms with $DDDA_F$=0: 1,889
Number of beef farms that used third- and fourth-generation cephalosporins: 1
Number of beef farms that used fluoroquinolones: 15

Table A33. Antibiotic use in $DDDA_F$ at beef farms from 2013 to 2017*

Year	N	Mean	Median	P75	P90
2012**	-	-	-	-	-
2013	3,316	1.8	0.0	0.6	4.2
2014	3,297	1.7	0.0	0.5	4.4
2015	3,196	1.5	0.0	0.4	2.9
2016	3,046	1.6	0.0	0.4	2.9
2017	2,919	1.3	0.0	0.3	2.3

* Only years for which similar $DDDA_F$ calculation methods were used have been included.
** Rearing and beef farms were grouped together for 2012, as the available data did not allow for categorization based on sex.

Figure A16. 2013 and 2017 $DDDA_F$ distributions for beef farms (no probability density functions can be shown due to too little variation)

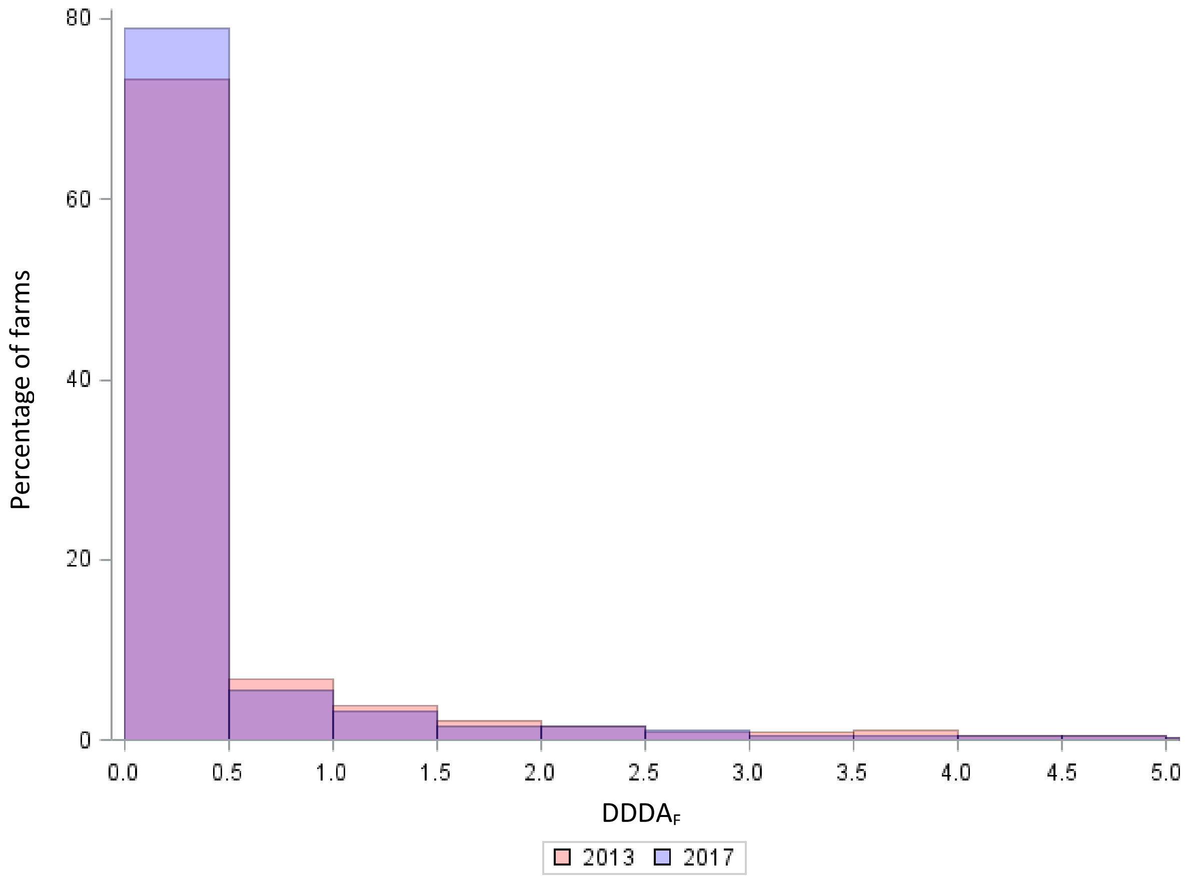

Table A34. Antibiotic use in $DDDA_F$ at beef farms in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$ Median	P75	Mean
1st choice	Amphenicols	Parenteral	2,266	0.00	0.00	0.15
1st choice	Macrolides/lincosamides	Oral	2,741	0.00	0.00	0.21
1st choice	Macrolides/lincosamides	Parenteral	2,693	0.00	0.00	0.01
1st choice	Penicillins	Intramammary	2,914	0.00	0.00	0.00
1st choice	Penicillins	Intramammary for dry cow therapy	2,911	0.00	0.00	0.00
1st choice	Penicillins	Parenteral	2,347	0.00	0.00	0.09
1st choice	Tetracyclines	Oral	2,669	0.00	0.00	0.51
1st choice	Tetracyclines	Parenteral	2,617	0.00	0.00	0.03
1st choice	Tetracyclines	Intrauterine	2,803	0.00	0.00	0.01
1st choice	Trimethoprim/sulfonamides	Oral	2,771	0.00	0.00	0.12
1st choice	Trimethoprim/sulfonamides	Parenteral	2,606	0.00	0.00	0.02
2nd choice	Aminoglycosides	Oral	2,823	0.00	0.00	0.01
2nd choice	Aminoglycosides	Parenteral	2,882	0.00	0.00	0.00
2nd choice	1st- and 2nd-gen. cephalosporins	Intramammary	2,918	0.00	0.00	0.00
2nd choice	1st- and 2nd-gen. cephalosporins	Intrauterine	2,915	0.00	0.00	0.00
2nd choice	Quinolones	Oral	2,896	0.00	0.00	0.02
2nd choice	Fixed-dose combinations	Intramammary	2,914	0.00	0.00	0.00
2nd choice	Fixed-dose combinations	Intramammary for dry cow therapy	2,918	0.00	0.00	0.00
2nd choice	Fixed-dose combinations	Parenteral	2,724	0.00	0.00	0.03
2nd choice	Macrolides/lincosamides	Parenteral	2,658	0.00	0.00	0.04
2nd choice	Penicillins	Intramammary	2,905	0.00	0.00	0.00
2nd choice	Penicillins	Oral	2,858	0.00	0.00	0.06
2nd choice	Penicillins	Parenteral	2,636	0.00	0.00	0.01
2nd choice	Polymyxins	Oral	2,915	0.00	0.00	0.00
2nd choice	Polymyxins	Parenteral	2,898	0.00	0.00	0.00
3rd choice	3rd- and 4th-gen. cephalosporins	Parenteral	2,918	0.00	0.00	0.00
3rd choice	Fluoroquinolones	Oral	2,918	0.00	0.00	0.00
3rd choice	Fluoroquinolones	Parenteral	2,904	0.00	0.00	0.00

Antibiotic use in $DDDA_F$ at rabbit farms

Rabbit farms

Number of rabbit farms: 49
Number of rabbit farms with $DDDA_F$=0: 5
Number of rabbit farms that used third- and fourth-generation cephalosporins: 0
Number of rabbit farms that used fluoroquinolones: 6

Table A35. Antibiotic use in $DDDA_F$ at rabbit farms in 2016 and 2017*

Year	N	Mean	Median	P75	P90
2016	41	40.9	31.8	60.3	84.4
2017	49	25.4	21.7	37.9	49.4

* Only years for which similar $DDDA_F$ calculation methods were used have been included.

Figure A17. 2016 and 2017 $DDDA_F$ distributions for rabbit farms

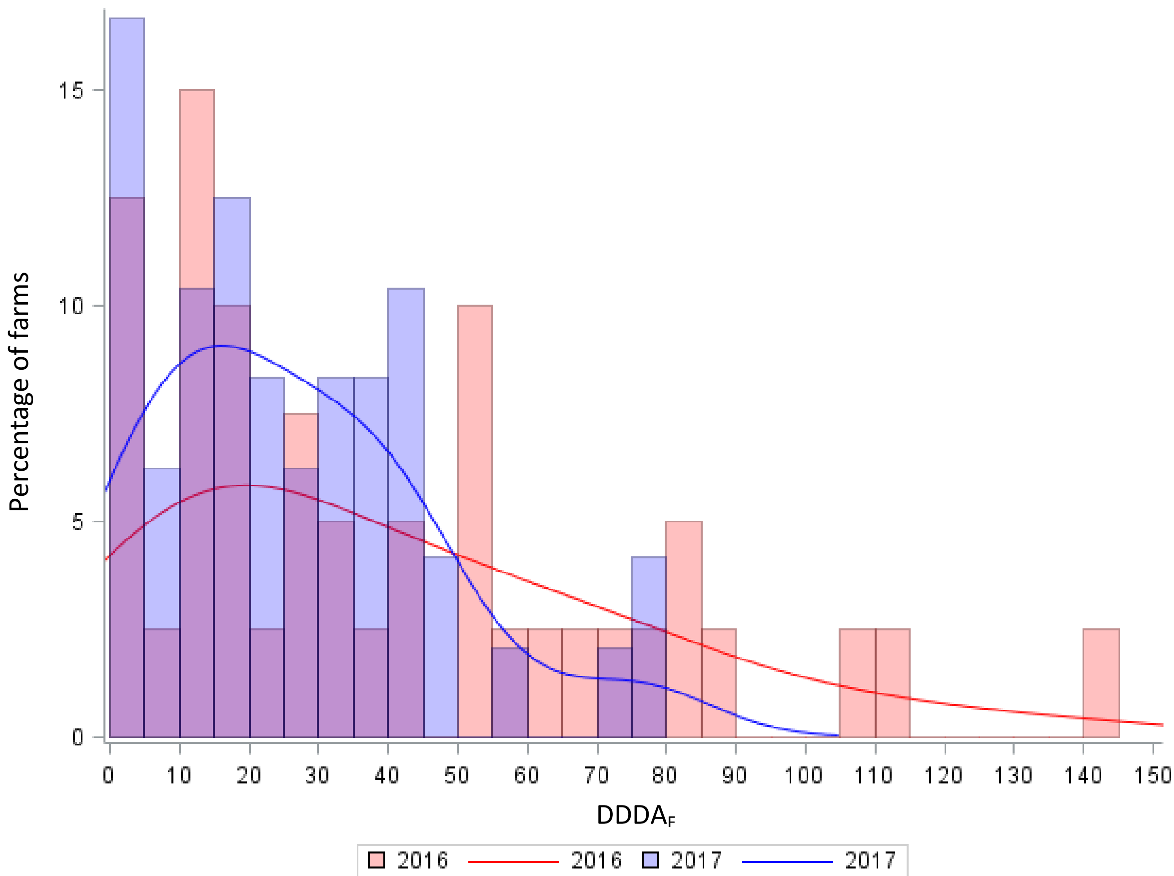

Table A36. Antibiotic use in $DDDA_F$ at rabbit farms in 2017, by pharmacotherapeutic group and route of administration

Category of antibiotics	Pharmacotherapeutic group	Route of administration	# of farms with $DDDA_F$=0	$DDDA_F$		
				Median	P75	Mean
1st choice	Macrolides/lincosamides	Oral	38	0.00	0.00	0.98
1st choice	Macrolides/lincosamides	Parenteral	48	0.00	0.00	0.01
1st choice	Other	Oral	13	7.57	16.34	10.16
1st choice	Pleuromutilins	Oral	35	0.00	1.91	1.38
1st choice	Tetracyclines	Oral	27	0.00	9.72	5.42
1st choice	Tetracyclines	Parenteral	27	0.00	0.40	0.57
1st choice	Trimethoprim/sulfonamides	Oral	37	0.00	0.00	0.85
1st choice	Trimethoprim/sulfonamides	Parenteral	48	0.00	0.00	0.02
2nd choice	Aminoglycosides	Oral	25	0.00	6.87	5.89
2nd choice	Polymyxins	Oral	47	0.00	0.00	0.08
3rd choice	Fluoroquinolones	Oral	44	0.00	0.00	0.08

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SDa/1152/2018