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Treatment frequency and antibiotic consumption quantities 2022

Development in cattle, pigs, chickens, and turkeys kept for meat production

Summarising assessment

The present report in accordance with Section 93, para. 3 of the German Veterinary Medicinal Products Act (TAMG) describes the development of treatment frequency and consumption quantities of antibiotics in cattle, pigs, chickens, and turkeys kept for meat production for the year 2022. The basis for this are the notification obligations for the administration of medicinal products containing antibiotically active substances as well as for changes in the animal population in accordance with Sections 54–55 TAMG for farms that keep animals for the following animal categories: fattening calves, fattening cattle, fattening piglets, fattening pigs, fattening chickens (broilers), and/or fattening turkeys. In the present report, data from the two half-years of 2022 (i.e. from the 1st half-year of 2022 (1 January 2022 – 30 June 2022) and the 2nd half-year of 2022 (1 July 2022 – 31 December 2022)) transmitted to BfR by the veterinary medicinal product database of the German federal states were evaluated and related to data from the previous year or since the beginning of antibiotic use monitoring.

Overall development, farm-level treatment frequency

In 2022, the farm-level treatment frequency shows a slightly decreasing trend for the individual animal categories compared with the previous year as well as considerable fluctuations between the half-years.

At the beginning of the data collection period, between 2014 and 2016, a considerable decrease in farm-level treatment frequencies was recorded for all animal categories; since then, this development has only been observed to a lesser extent for most animal categories. For fattening calves, fattening piglets, and fattening pigs as well as fattening turkeys, a slight upward trend can be seen between 2017 and 2019 followed by a renewed decrease since 2020. In the past, there have always been considerable decreases in antibiotic use in broilers from one half-year to the next followed by a rebound over several half-years. For example, antibiotic use fell noticeably from the first half of 2021 to the

second half of the year. However, in 2022 there was once again an increase in both half-years. As a result, no clear downward trend can be observed.

Overall development, population-wide treatment frequency

For the year 2022, the highest population-wide treatment frequency was observed in broilers (45 days), followed by fattening turkeys (41 days), fattening calves (26 days), fattening piglets (21 days), and fattening pigs (6 days). Fattening cattle had the lowest value (< 1 day). Except for fattening cattle, the population-wide treatment frequency decreased for all animal categories compared with the previous year – most strongly in fattening piglets (−8%), followed by fattening turkeys (−4%), broilers (−3%), and fattening calves and fattening pigs (both −2%).

The observation of the population-wide treatment frequency for the most important antibiotic classes in 2022 shows a heterogeneous picture for the individual animal categories. Penicillins and tetracyclines are among the three most frequently used antibiotic classes in fattening calves, fattening cattle, fattening piglets, and fattening pigs; this also applies to macrolides except in fattening piglets. Polypeptide antibiotics play an important role in fattening piglets; this is also true for broilers and fattening turkeys. In addition, the most commonly used antibiotic classes in poultry include lincosamides and aminoglycosides in broilers and penicillins and fluoroquinolones in fattening turkeys.

Active ingredients of AMEG Category D (Prudence) are most frequently used in all animal categories. For fattening calves, fattening cattle, fattening pigs, and broilers, active ingredients of AMEG Category C (Caution) follow; for fattening piglets and fattening turkeys, active ingredients of AMEG category B (Restrict) are used second most frequently.

Looking specifically at the changes for active ingredients in **AMEG Category B**, there was an overall increase (+2%) in **fattening calves**, whereby the increasing use of fluoroquinolones outweighed the decrease in third- and fourth-generation cephalosporins and polypeptide antibiotics. In fattening cattle, the treatment frequency with these substances decreased by 4%. In **fattening piglets,** the use of active ingredients of Category B decreased (−5%), whereby the decrease in third- and fourth-generation cephalosporins and polypeptide antibiotics was offset by an increase in fluoroquinolones. In **fattening pigs**, active ingredients of AMEG Category B were used considerably less frequently (−8%); this is due mainly to the less frequent use of polypeptide antibiotics (−11%). In contrast, for this type of animal use, there were slight increases for third- and fourth-generation cephalosporins and fluoroquinolones (+0.4% and +1%, respectively). In **broilers**, the largest percentage decrease was for active ingredients of AMEG Category B (−25%); this included decreases for fluoroquinolones (−27%) and polypeptide antibiotics (−25%). In **fattening turkeys**, active ingredients of AMEG Category B were used somewhat less frequently (−4%), whereby the use of polypeptide antibiotics decreased (−14%) but fluoroquinolones (+9%) were used more frequently.

Overall development, consumption quantities

The largest **absolute quantities** were used for fattening pigs (91 t), followed by fattening piglets (62 t), fattening turkeys (56 t), broilers (52 t), and fattening calves (46 t). Consumption quantities for fattening cattle were below 1 t. With the exception of fattening cattle, there was a decrease in consumption quantities for all animal categories compared with the previous year. The largest percentage decrease was in fattening piglets (−18%), followed by fattening turkeys (−13%), broilers and fattening pigs (both −11%), and fattening calves (−6%). The increase in fattening cattle (+20%) can be neglected; consumption quantities remained at a low absolute level.

If the changes in the animal populations are also taken into account, there was also a decrease in the **consumption quantity per livestock day** for all animal categories with the exception of fattening cattle. This was most pronounced in the case of fattening piglets and broilers (both −12%) followed by fattening turkeys (−8%), fattening calves (−5%), and fattening pigs (−3%). A significant increase of 19% was observed in fattening cattle. However, this took place at the low level that has characterised fattening cattle for years.

The **antibiotic classes** with the highest consumption quantities in 2022 (aggregated across allanimal categories) were penicillins (133.2 t; −16.9 t compared with the previous year), tetracyclines (58.4 t; −11.5 t), and macrolides (34.1 t; −1.3 t). From almost all antibiotic classes, fewer quantities were consumed than in the previous year. In terms of percentages, the largest decreases were recorded for third- and fourth-generation cephalosporins (−32%), polypeptide antibiotics (−24%), and tetracyclines (−16%). Pleuromutilins are the only noteworthy antibiotic class in which there was an increase against the general trend (+6%).

If we look at the consumption quantities in 2022 **per antibiotic class for the individual animal categories**, a heterogeneous picture emerges. In fattening calves and fattening cattle, tetracyclines were the most frequently administered antibiotic class in terms of quantity followed by penicillins and sulfonamides. In the case of fattening piglets and fattening pigs, penicillins were by far the most frequently used antibiotic class in terms of quantity followed by tetracyclines. Whilst polypeptide antibiotics are in third place in fattening piglets, macrolides are in third place in fattening pigs.

Penicillins also play an important role in poultry and are found in first (fattening turkeys) and second place (broilers) of the absolute consumption quantities. Whilst polypeptide antibiotics were the antibiotic class with the highest consumption quantities for broilers in 2022, this antibiotic class is in third place for fattening turkeys. Aminoglycosides (broilers) and macrolides (fattening turkeys) are the other most commonly used antibiotic classes in poultry.

In terms of consumption quantities, differences are evident in 2022 in the individual animal categories with regard to the use of the active ingredients of the various **AMEG categories**. Active ingredients of AMEG Category D were used most in terms of quantity in all animal categories. For fattening calves, fattening piglets, fattening pigs, and fattening turkeys, this is followed by active ingredients of AMEG Category C; for fattening cattle and broilers, active ingredients of AMEG Category B were used second most frequently. Here, differences to the treatment frequency become apparent. In terms of population-wide treatment frequency, active ingredients of Category B were used second most frequently in fattening piglets and fattening turkeys but not in fattening cattle and broilers. This can partly be attributed to differences in the daily dose.

The development trends compared with the previous year also differ for the animal categories. In fattening calves and fattening cattle, the consumption quantities of **AMEG Category B** increased considerably; this can be attributed almost exclusively to the increased consumption quantity of polypeptide antibiotics. In the case of fattening piglets, the consumption quantities of active ingredients of AMEG Category B decreased by 15% overall as did the consumption quantities of all associated antibiotic classes (third- and fourth-generation cephalosporins, fluoroquinolones, polypeptide antibiotics). Although for fattening pigs a decrease in the consumption quantities was recorded, this is hardly significant in absolute terms (0.3 t). For broilers, active ingredients of AMEG Category B continued to account for a relevant proportion of the total consumption quantities (17.9 t). However, a strong decrease was recorded in Category B with −26% (−6.1 t) compared with the previous year. The consumption quantities of fluoroquinolones (−36%) as well as polypeptide antibiotics (−25%) decreased considerably. For fattening turkeys, there was also a considerable decrease in active ingredients of AMEG Category B (−24%), whereby this is largely due to the reduced consumption quantities of polypeptide antibiotics (−27%).

The considerable increase in the consumption of **polypeptide antibiotics** in 2022 for **fattening calves** and **fattening cattle** is striking. In fattening calves, this contrasts with a slight decrease in population-wide treatment frequency for this antibiotic class and is due to an increase in the average daily animal dose used in oral administrations of colistin. The sharp increase in the consumption quantities of polypeptide antibiotics in fattening cattle is due to two individual group treatments with an oral administration of colistin in high daily animal doses. Also for **broilers and fattening turkeys**, the high consumption quantities of polypeptide antibiotics are due, among other things, to the fact that the oral administration of colistin in these species is carried out at high daily animal doses, compared to the daily animal dose which, for this active ingredient, can be derived from standardised values for dosages and animal weights.

Overall development, antibiotic resistances

In this report, the development of antibiotic resistance was examined on the basis of the resistance of *Escherichia coli* for both the last two years and the overall period since 2014/2015. Four livestock populations were considered: Broilers, fattening turkeys, and fattening pigs as well as fattening calves and young cattle. The bacteria considered were obtained from appendix samples at slaughter.

Over the entire period, considerable decreases in the proportion of resistant isolates were found for 10 of the 48 antibiotic–livestock combinations (four livestock populations and 12 antimicrobial substances). None of the combinations showed a significant increase in resistance over the period considered. Seven decreases were found in the resistance of isolates from fattening turkeys, which also had the highest resistance rates at the beginning of the period (ampicillin, tetracycline, gentamicin, chloramphenicol, sulfamethoxazole, trimethoprim, azithromycin). In the other livestock populations, resistance to only one antibiotic class decreased in each case. Against two active ingredients, no resistance (meropenem) or only isolated resistance (tigecycline) was found during the entire period under review.

Between the respective last years of investigation (2019/2021 for fattening pigs and fattening calves/young cattle; 2020/2022 for broilers and fattening turkeys), a considerable decrease in resistance was observed for three antibiotic–livestock combinations, all of which related to active ingredients of AMEG Category B. The decreases concerned third-generation cephalosporins (cefotaxime and ceftazidime) and (fluoro)quinolones (ciprofloxacin, nalidixic acid) in fattening pigs. A further decrease was observed in the resistance rate of isolates from broilers to colistin. A significant increase in the resistance rate was observed only once (the macrolide azithromycin in broilers).

Comparison of the development of antibiotic resistance and population-wide treatment frequency

In most cases, the decrease in the resistance rate corresponded to a decrease in the population-wide treatment frequency for the respective antibiotic class in the respective animal category during the observation period. Exceptions were the resistance rate to sulfamethoxazole in turkey isolates, which decreased despite increasing treatment frequency, and the increase in the resistance rate to azithromycin in broilers, which occurred despite a decrease in treatment frequency with macrolides.

The detailed data and development trends are described in the following chapters. All numerical values shown in the figures are contained in the additional document “Tables on the development of treatment frequency and antibiotic consumption quantities 2022”. This document also contains an overview of the spreadsheets included and the assignment of these to the figures and tables of this report.

Contents

1 Introduction

The present report in accordance with Section 93, para. 3 of the Veterinary Medicinal Products Act (TAMG) describes the development of treatment frequency and consumption quantities of antibiotics in cattle, pigs, chickens and turkeys kept for meat production for the year 2022.

1.1 Animal categories

For cattle and pigs, a subdivision into two animal categories each is made in accordance with Section 54 TAMG ; thus, six animal categories are considered:

- Fattening calves from the time of weaning until they are eight months old (hereafter referred to as fattening calves to improve readability)
- Fattening cattle from the age of eight months (fattening cattle)
- Pigs from the time of weaning up to and including a body weight of 30 kg (fattening piglets)
- Pigs over 30 kg (fattening pigs)
- Chickens intended for meat production (broilers)
- Turkeys intended for meat production (fattening turkeys)

For farms keeping animals of the aforementioned animal categories, notification obligations apply in accordance with Sections 54–55 TAMG for the use of medicinal products containing antibiotically active substances as well as for communications on animal husbandry. Exemptions from the notification requirement existed for the reporting year 2022 in accordance with Section 2 TAMMitDurchfV for farms that do not exceed certain lower population limits in a half-year[1].

1.2 Measures of antibiotic use

In this report, the development of antibiotic use is evaluated using various measures.

The antibiotic minimisation concept anchored in Sections 54–59 TAMG is based on a comparison of average antibiotic use at the farm level carried out semi-annually and separately for each animal category. As a measure of the average antibiotic use of a farm, the farm-level treatment frequency according to Section 57, para. 1 TAMG is used; this measures on how many days in the half-year an antibiotically active substance was used for each average animal of a specific animal category kept on the farm.

At the level of the animal category, the development of antibiotic use can be well represented and understood on the basis of the quantiles of the farm-level treatment frequencies. In this report, the median (i.e. the 50% quantile) is considered as representative of antibiotic use in average-use farms, the 3rd quartile (75-% quantile) is considered as representative of antibiotic use in high-use farms, and the 90% quantile is considered as representative of antibiotic use in very-high-use farms. The median and the

[1] The lower population limit were 20 animals kept on average for fattening calves and fattening cattle, 250 for fattening piglets and fattening pigs, 1,000 for fattening turkeys, and 10,000 for broilers.

3rd quartile also serve as indicators 1 and 2 for the benchmarking of farms in the antibiotic minimisation concept and are published every six months by the German Federal Office of Consumer Protection and Food Safety (BVL)[2]. The TAMG does not provide for an evaluation of the farm-level treatment frequencies for each active ingredient class separately.

Farm-level treatment frequency

- Frequency-based measure of antibiotic use at the farm level (measured in days)
- Calculation per animal category and half-year
- Enables comparison between farms of different sizes
- Basis of the farm benchmarking system
- The farm-level treatment frequency indicates the number of days in the half-year on which an antibiotically active substance was applied to each average animal of a specific animal category kept on the farm.

As a further measure of antibiotic use within an animal category, the population-wide treatment frequency can be used. This takes into account the entire animal population of an animal category in Germany for a selected period of time (i.e. all farms subject to notification obligations[3] are combined to form an average total population size)[4]. The population-wide treatment frequency then indicates on how many days in the selected period an antibiotically active substance was applied to each animal in the average total population size of the animal category[5]. In previous reports, the BfR had calculated the population-wide treatment frequency on a half-yearly basis (Flor et al., 2019; Flor et al., 2022b); these half-yearly values are also given in the present report. However, because the development of antibiotic use from year to year is easier to observe using a year-based measure, this report focuses on the annual population-wide treatment frequencies in the animal categories[6].

Both the median of the farm-level treatment frequencies and the population-wide treatment frequency can be considered as a measure of the average antibiotic use in a usage category. It is helpful to keep in mind that the median is less influenced by extreme values than the arithmetic mean, that the population-wide treatment frequency constitutes.

[2] The indicators 1 and 2 for all previous half-years can be found on the BMEL website at https://www.bmel.de/DE/themen/tiere/tierarzneimittel/entwicklung-kennzahlen-therapiehaeufigkeit.html
[3] In the present report, this always includes farms that have declared themselves to be subject to notification obligations although they have not exceeded the lower population limits.
[4] The average total population size of a animal categories for a given period is defined as follows:

$$\text{Average total population size} = \frac{\text{Total livestock days in all notifiable farms during the period}}{\text{Number of days in period}}$$

[5] The population-wide treatment frequency in a specific animal category in a given period is calculated as follows:

$$\text{Population-wide treatment frequency} = \frac{\text{Total livestock days in all farms subject to notification obligations during the period}}{\text{Average total population size during the period}}$$

[6] The annual population-wide treatment frequency is not exactly identical to the sum of the half-yearly population-wide treatment frequencies because of the different lengths of the half-years; however, in practice, the deviations are small.

For example, individual farms with a high farm-level treatment frequency lead to only a small shift (if any) in the median of farm-level treatment frequencies regardless of their size. However, if these are large farms, these can noticeably increase the population-wide treatment frequency.

Population-wide treatment frequency

- Frequency-based measure of the average antibiotic use in the total population of an animal category (measured in days)
- Calculation per animal category and year
- Stratification according to antibiotic class
- The population-wide treatment frequency indicates on how many days in the year an antibiotically active substance was applied to each animal in the average total population of an animal category.

Finally, the development of antibiotic use can be shown by the consumption quantities of antibiotically active substances (measured in tonnes), which can be calculated from the individual administrations. In contrast to the recording of sales quantities according to BfArM-AMV, the data evaluated in this report makes it possible to allocate the quantities to the animal categories. However, because of the plausibility checks carried out and the exclusion criteria applied, the consumption quantities reported in this document must be considered as underestimated by several percent (see Section 1.3).

Consumption quantity

- Weight-based measure of antibiotic use (measured in tonnes of antibiotically active substance)
- Calculation per type of animal use and year
- Stratification according to antibiotic class
- The consumption quantities are to be distinguished from the sales quantitites, which are collected in accordance with BfArM-AMV and cannot be allocated to individual animal categories.

In order to take into account any changes in animal population sizes when analysing the development of the consumption quantities of antibiotically active substances, the quantities can be related to the total number of livestock days in an animal category; in this case, it is useful to convert the quantities into milligrams[7].

[7] The consumption quantity per livestock day for a type of animal use shall be calculated as follows:
$$\text{Consumption quantity per livestock day} = \frac{\text{Total consumption [mg] of all antibiotically active substances per year}}{\text{Total livestock days in all farms subject to notification obligations in the year}}$$

1.3 Data set and reporting period

In the present report, data from the two half-years of 2022 (i.e. from the 1st half-year of 2022 (1 January 2022 – 30 June 2022) and the 2nd half-year of 2022 (1 July 2022 – 31 December 2022)) transmitted to the BfR from the veterinary drug database of the German federal states[8] were evaluated[9]. The reporting period is therefore the entire year 2022. The data include farms that were subject to notification obligations or registered themselves as subject to notification obligations in the HIT database during this period[10]. The plausibility procedures used for the report on the period 2018 to 2021 (Flor et al., 2022b) were also applied in the present report (for more details, see Flor et al., 2022a). In order to depict the developments in antibiotic use, this report compares the reporting period 2022 with the previous year (2021) for the population-wide treatment frequency and the consumption quantities. For selected questions, data from previous years are also taken into account as presented in the evaluation of the 16th AMG amendment and in the assessment of the development of treatment frequency and consumption quantities in the years 2018–2021 (Flor et al., 2019; Flor et al., 2022b).

The plausibility checks carried out, together with a slightly different data basis (cf footnote 10), lead to deviations of the 50% and 75% quantiles of the farm-level treatment frequencies calculated in this report from the indicators 1 and 2 published by the BVL. The plausibility checks can lead to the exclusion of individual administrations and thus change the treatment frequency of the farm concerned. However, they can also lead to the exclusion of entire farms if the animal population takes on a negative value in the course of a half-year because of a missing communication of an animal acquisition. In such a case, none of the antibiotic administrations carried out on an excluded farm are included in the calculations in this report. In this way, all calculations of quantiles of farm-level treatment frequencies, population-wide treatment frequency, and consumption quantities are based on the same data set. Assuming that missing animal acquisition notifications are randomly distributed across all farms, it can be assumed that the administration behaviour of excluded farms corresponds to that of included farms. For the quantiles of farm-level treatment frequencies as well as for the population-wide treatment frequency, it can be expected under this assumption that the values determined in the present report are slightly underestimated[11]. The 50% quantile is more strongly affected than the 75% and 90% quantiles and the population-wide treatment frequency. The size of the deviation depends on the proportion of excluded farms. For the consumption quantities, the procedure directly leads to an underestimation because of the exclusion of treatments.

Table 2 shows the number of farms and administrations in the data set for both half-years of 2022 and each animal category as well as the proportions of farms and administrations

[8] Herkunftssicherungs- und Informationssystem für Tiere (Origin assurance and information system for animals), https://www1.hi-tier.de

[9] Section 93, para. 3 TAMG provides for an evaluation of the data from the period 28 January 2022 to 31 December 2022 and assigns the data from the period 1 January 2022 to 27 January 2022 to the report in accordance with Section 93, para. 2. However, because the evaluations are generally carried out on a half-yearly basis, the partial data from January 2022 were excluded from the report in accordance with Section 93, para. 2 and are instead included in this report.

[10] Farms may withdraw their notifications concerning a half-year at a later date, even retroactively, if it has turned out in the meantime that they did not exceed the lower population limit in that half-year. Because this concerns mainly (very) small farms for which antibiotic use is generally low in terms of both treatment frequency and consumption quantities, this means that presumably fewer small farms are included in the data submitted at the time of evaluation than at the time the BVL determined the indicators 1 and 2.

[11] Simple simulations indicate that, taking into account the excluded farms, the quantiles of farm-level treatment frequencies and population-wide treatment frequency would be about 1–10% higher than the values determined in this report.

included. The lowest six-month inclusion rate occurred in broilers for which only 87% of administrations were included in the first six months. The highest rates were recorded in fattening pigs and fattening calves in the second half of the year (97.6% included administrations in each case). All consumption quantity data in this report should be considered against this background. Depending on the animal category, the actual quantities are probably between 4% (fattening pigs) and 13% (broilers) higher.

1.4 Stratifications

The developments in antibiotic use are presented in this report stratified by antibiotic class[12] as well as according to the categories developed by the Antimicrobial Advice Ad Hoc Expert Group (AMEG) of the European Medicines Agency (EMA). The AMEG categories are intended to promote the careful and responsible use of antibiotics in animals (see Table 1). Category A antibiotics are reserved for human medicine and are not authorised as veterinary medicines in the EU. In the data set transmitted to the BfR, antibiotics of this category are not included but rather only active ingredients of categories B to D. In general, the classification takes place at the level of antibiotic classes, taking into account any combinations with other active ingredients; however, some individual active ingredients are also categorised differently (EMA, 2019, 2020). AMEG Category B, the use of which should be restricted, includes third- and fourth-generation cephalosporins, fluoroquinolones, and polypeptide antibiotics.

Table 1: AMEG categories[a] for the prudent and responsible use of antibiotics.

AMEG category	Use	Explanation
A	Avoid	– Antibiotics of this category are not authorised as veterinary medicines in the EU – May not be used in animals[b]
B	Restrict	– Antibiotics in this category are critically important in human medicine and use in animals should be restricted to mitigate the risk to public health. – Should be considered only if there are no antibiotics in Categories C or D that could be clinically effective – Use should be based on antimicrobial susceptibility testing, wherever possible
C	Caution	– For antibiotics of this category, there are alternatives in human medicine – For some veterinary indications, there are no alternatives belonging to Category D – Should be considered only when there are no antibiotics in Category D that could be clinically effective
D	Prudence	– Should be used as first-line treatments, whenever possible – As always, should be used prudently, only when medically needed

[a] EMA (2019, 2020)

[12] To protect commercial and industrial secrets, the following antibiotic classes are not included: Fusidic acid, ionophores, nitrufurans, nitroimidazoles. This data may not be published because there is usually only one authorisation holder (according to Section 6 IFG and Section 9, para. 1 (3) UIG). However, these antibiotic classes play a negligible role both in terms of treatment frequencies and consumption quantities.

[b] Since 9 February 2023, active ingredients of Category A may no longer be used in animals (Commission Implementing Regulation (EU) 2022/1255). During the reporting period, it was still the case that these active ingredients *should* not be used in food-producing animals.

2 Overall development

The overall development can be described by the various measures of antibiotic use. With the help of the quantiles of the farm-level treatment frequencies, the development in the entire period since the introduction of the antibiotic minimisation concept in the second half of 2014 is presented below. For the population-wide treatment frequency and the antibiotic consumption quantities, the focus is on the values determined for the year 2022 and the changes compared with the previous year.

2.1 Farm-level treatment frequencies

Figure 1 shows the development of the 50%, 75% and 90% quantiles from 2014 to 2022 for all animal categories. Table 2 shows the corresponding values for the two half-years of 2022[13]. The development of antibiotic use is best traced by the smoothed trend lines in Figure 1; these can smooth out seasonal fluctuations (as can be seen especially in fattening calves and fattening cattle). Between 2014 and 2016, a considerable decrease in farm-level treatment frequencies was recorded for all animal categories – this trend applies to average-use farms (50% quantile; green lines), high-use farms (75% quantile; orange lines) and very-high-use farms (90% quantile; red lines). Since then, only developments of lesser magnitude have been observed in most animal categories.

For fattening calves, fattening piglets, fattening pigs, and fattening turkeys, a slight increase in the trend lines can be seen between 2017 and 2019 followed by a renewed decrease since 2020. In the past, there have always been considerable decreases in antibiotic use in broilers from one half-year to the next followed by a rebound over several half-years. Thus, for average- as well as high- and very-high-use farms, antibiotic use decreased noticeably from the first half of 2021 to the second half of the year. In 2022, however, there was an increase again in both half-years. The declining course of the trend lines since 2021 is thus subject to greater uncertainty (visible from the width of the confidence interval).

For fattening cattle, more than three quarters of the farms have not used antibiotics in individual half years since 2015. Thus, only for the 90% quantile can a development – or rather a stagnation – be observed since 2017.

With the 17th AMG amendment, livestock farms were obliged to submit a zero report (i.e. to report that they have not used any antibiotics in a half-year) (17th AMG Amendment Act). Because the amendment came into force on 21 November 2021, this mandatory zero report applied to the second half of 2021. A comparison of the two half-years 2021 (cf Flor et al., 2022b) suggests that this obligation led to an increase in the proportion of zero-use farms (among included farms) in all but one of the animal categories: For fattening piglets, fattening pigs, and broilers, the proportion of zero-use farms increased by about 4% between the 1st and 2nd half-year. For fattening calves and fattening turkeys, this was 1.5% and 0.4%, respectively. Only for fattening cattle was there a decrease of 1.7%. However, as

[13] Values for earlier half-years were published in Flor et al. (2022b).

already described, the proportion of zero-use farms for this type of animal use is by far the highest. The proportions of zero-use farms in the two half-years of 2022 (see Table 2) were about the same as in the 2nd half-year of 2021 for all animal categories with again slight increases in all animal categories with the exception of fattening cattle, which remained at the same high level.

2.2 Population-wide treatment frequency

In Table 3, the population-wide treatment frequencies for all animal categories, including changes compared with the previous year, are listed for the entire year of 2022. The highest population-wide treatment frequency was observed in broilers (45 days; −1.6 days compared with the previous year) followed by fattening turkeys (41 days; −1.8 days), fattening calves (26 days; −0.6 days), fattening piglets (21 days; −1.9 days), and fattening pigs (6 days; −0.1 days). Fattening cattle had the lowest value (< 1 day). Thus, except for one exception, the population-wide treatment frequency decreased in all animal categories compared with the previous year – most strongly in fattening piglets (−8%), followed by fattening turkeys (−4%), broilers (−3%), and fattening calves and fattening pigs (both−2%). The increase in fattening cattle (+5%) can be neglected because of the low absolute values.

2.3 Consumption quantities

In 2022, a total of 308 t of antibiotics were consumed in all the animal categories considered. Figure 2(A) shows how the consumption quantities are distributed among the animal categories, and Table 4 contains the corresponding figures as well as the changes compared with the previous year. Accordingly, the largest absolute quantities were used for fattening pigs (91 t; −10.8 t compared with the previous year) followed by fattening piglets (62 t; −14 t), fattening turkeys (56 t; −8.9 t), broilers (52 t; −6.2 t), and fattening calves (46 t; −3 t). Consumption quantities for fattening cattle were below 1 t. This means that compared with the previous year, there was a decrease in consumption quantities in all but one of the animal categories. The largest percentage decrease was in fattening piglets (−18%), followed by fattening turkeys (−13%), broilers and fattening pigs (both−11%), and fattening calves (−6%). The increase in fattening cattle (+20%) can be neglected; consumption quantities remained at a low absolute level.

In order to be able to better assess the changes in consumption quantities, the development of the animal population sizes considered in this report should also be considered. In Table 5, the average total population size in 2022 and the respective changes compared with the previous year are listed for each of the animal categories. According to this, there was a slight increase of 1% each for fattening cattle and broilers compared with the previous year. In the other animal categories, however, the average total population size decreased, most strongly for fattening piglets (−8%) and fattening pigs (−8%) followed by fattening turkeys (−6%) and fattening calves (−1%).

In Table 6, the consumption quantities per livestock day for the year 2022 are shown; these allow the consumption quantities to be considered directly in relation to the animal population sizes. With the exception of fattening cattle, all animal categories showed a decrease in consumption quantity per livestock day with the exception of fattening cattle. This was most pronounced in the case of fattening piglets and broilers (both −12%), followed by fattening turkeys (−8%), fattening calves (−5%), and fattening pigs (−3%). A significant increase of 19% was observed in fattening cattle. However, this took place at the low level that has characterised fattening cattle for years.

The strong decreases in absolute consumption quantities for fattening piglets and fattening pigs as well as fattening turkeys can therefore be explained in part by lower animal numbers but also in part by reduced consumption quantities per livestock day. In the case of fattening calves and fattening cattle as well as broilers, on the other hand, the development of the average total population size had hardly any influence on the absolute consumption quantities. In the case of fattening calves and broilers, the decrease in absolute consumption quantities is due to reduced consumption quantities per livestock day. In the case of fattening cattle, on the other hand, the increase in the absolute consumption quantity is due to an increase in the consumption quantity per livestock day.

As shown by Figure 2(B), the antibiotic classes with the highest consumption quantities in 2022 (aggregated across all animal categories) were penicillins (133.2 t; −16.9 t compared with the previous year), tetracyclines (58.4 t; −11.5 t), and macrolides (34.1 t; −1.3 t). All aggregated consumption quantities as well as the changes compared with the previous year can be found in Table 7. In almost all antibiotic classes, smaller antibiotic quantities were consumed than in the previous year. In terms of percentages, the largest decreases were recorded for third- and fourth-generation cephalosporins (−32%), polypeptide antibiotics (−24%), and tetracyclines (−16%). Pleuromutilins are the only noteworthy antibiotic class in which there was an increase against the general trend (+6%).

In accordance with BfArM-AMV , pharmaceutical companies and wholesalers have been obliged since 2011 to report the quantities of antibiotic active ingredients they supply to veterinarians each year. In 2022, these sales volumes totalled 540 t, i.e. 61 t less than in the previous year, which corresponds to a decrease of 10.1% (BVL, 2023). Even though not all products sold are used on animals in the same year, a comparison between sales and consumption quantities is made below. The consumption quantities in animals kept for fattening determined in the present report (309 t) thus accounted for about 57% of the sold quantities. However, in view of the administrations excluded by plausibility checks, the actual proportion presumably is several percentage points higher. In relation to the individual antibiotic classes, the highest proportions of consumption quantities in the sold quantities were observed for pleuromutilins (76%), macrolides (74%), and lincosamides (71%). Also, for polypeptide antibiotics and tetracyclines (65% each) as well as penicillins (58%), more than half of the sold quantities were found in the consumption quantities in fattening animals. For cephalosporins, on the other hand, the proportion was quite low (< 1% for first-generation cephalosporins and 2% for third- and fourth-generation cephalosporins).

With regard to the change in antibiotic quantities compared with the previous year, there was a good overall match between the development of consumption and sales quantities (consumption quantities −12%; sales quantities −10%). Stratified by antibiotic class, the direction of change (increase or decrease) was consistent for 10 antibiotic classes (decrease in both consumption and sales quantities). Different directions of change were observed for aminoglycosides (consumption quantity −6%; sales volume +7%) and pleuromutilins (consumption quantity +6%; sales quantity −1%). For macrolides, consumption quantities showed a decrease of 4%, whereas sales quantities did not change.

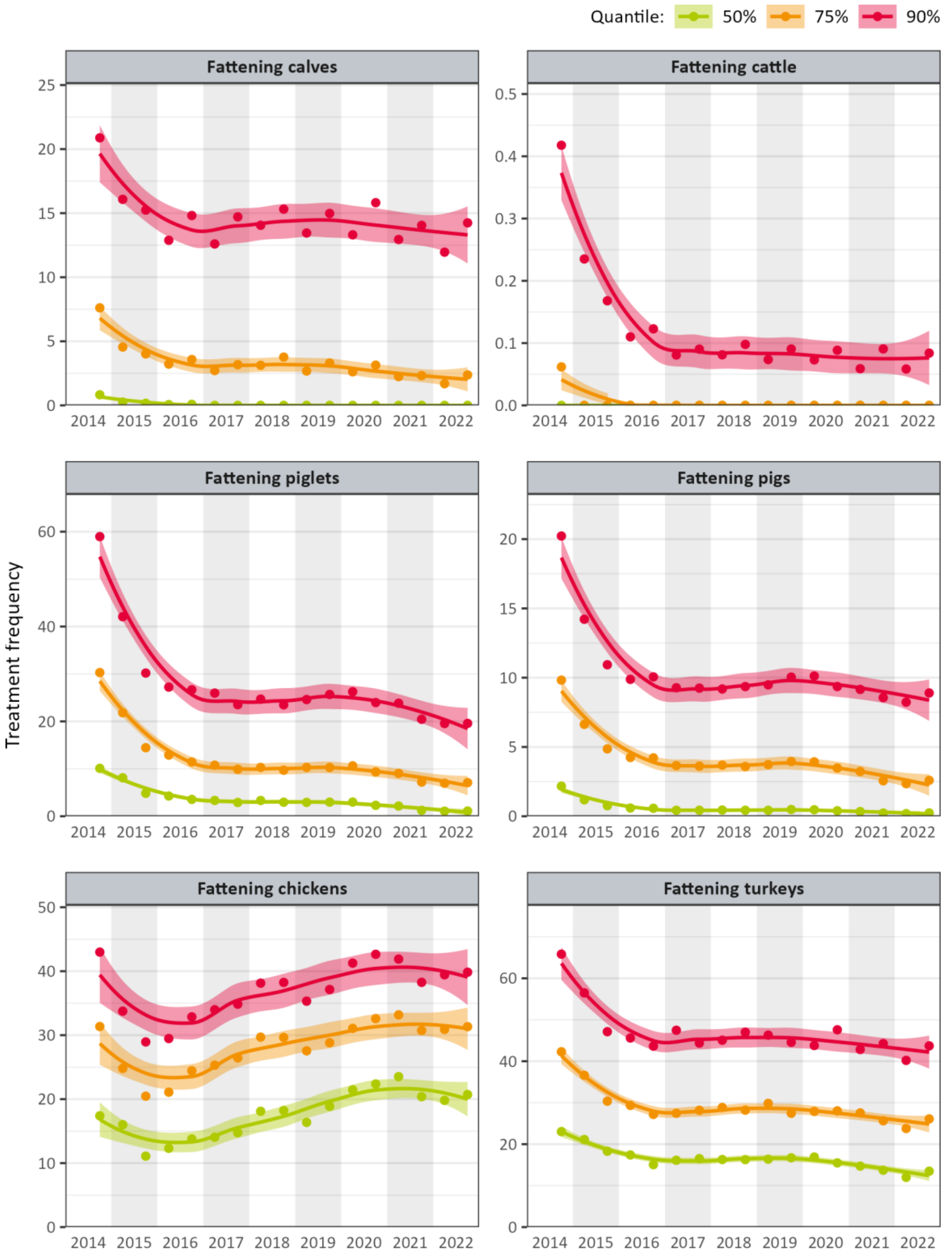


Figure 1: Quantiles (50%, 75%, 90%) of farm-level treatment frequencies in the animal categories for all half-years since 2014 with smoothed trend line and 95% confidence interval. The axis for the treatment frequency is individually scaled for each type of animal use.

Table 2: Overview statistics (numbers of farms, numbers of administrations, quantiles of farm-level treatment frequencies, population-wide treatment frequency, and consumption quantities) for all ani and both half-years of the reporting period.

		Farms					Administrations		Quantile of the farm-level treatment frequencies					
			Inclusion		Zero-use									
Half-year	Animal category	Total number	Number	Proportion[a] (%)	Number	Proportion[b] (%)	Total number	Exclusion[c] (%)	50% median	75% 3rd quartile	90%	100% Maximum	Population wide treatment frequency	Total consumption quantity [t]
1	Fattening calves	11,542	11,094	96.10%	6,617	59.6%	61,723	94.6%	0	1.689	11.956	130.416	12.012	21.129
1	Fattening cattle	18,406	18,114	98.4%	15,756	87.0%	9,435	91.8%	0	0	0.058	20.620	0.064	0.387
1	Fattening piglets	6,484	6,240	96.2%	2,270	36.4%	43,750	96.1%	1.065	6.957	19.550	304.978	10.653	31.324
1	Fattening pigs	18,507	17,822	96.3%	6,694	37.6%	82,425	95.4%	0.189	2.350	8.234	590.951	2.935	43.074
1	Broilers	2,351	2,127	90.5%	571	26.8%	15,429	87.0%	19.807	30.901	39.444	627.259	22.346	26.378
1	Fattening turkeys	1,140	1,042	91.4%	292	28.0%	5,917	87.5%	11.997	23.779	40.201	239.311	18.873	24.605
2	Fattening calves	11,419	11,043	96.7%	6,380	57.8%	64,927	97.6%	0	2.377	14.244	204.030	13.971	25.199
2	Fattening cattle	18,329	18,088	98.7%	15,412	85.2%	10,681	95.2%	0	0	0.084	13.074	0.071	0.536
2	Fattening piglets	6,215	6,039	97.2%	2,128	35.2%	42,970	96.8%	1.100	7.089	19.580	248.672	10.332	31.085
2	Fattening pigs	17,809	17,422	97.8%	6,139	35.2%	84,093	97.6%	0.238	2.591	8.897	387.110	3.179	47.876
2	Broilers	2,336	2,159	92.4%	536	24.8%	15,188	89.3%	20.722	31.331	39.845	126.554	22.933	25.398
2	Fattening turkeys	1,156	1,099	95.1%	265	24.1%	6,558	92.6%	13.490	26.097	43.708	184.000	21.829	31.310

[a] Proportion of included farms in the total number of farms
[b] Proportion of zero-use farms in the number of included farms in animal category
[c] Proportion of included applications in the total number of applications in the animal category

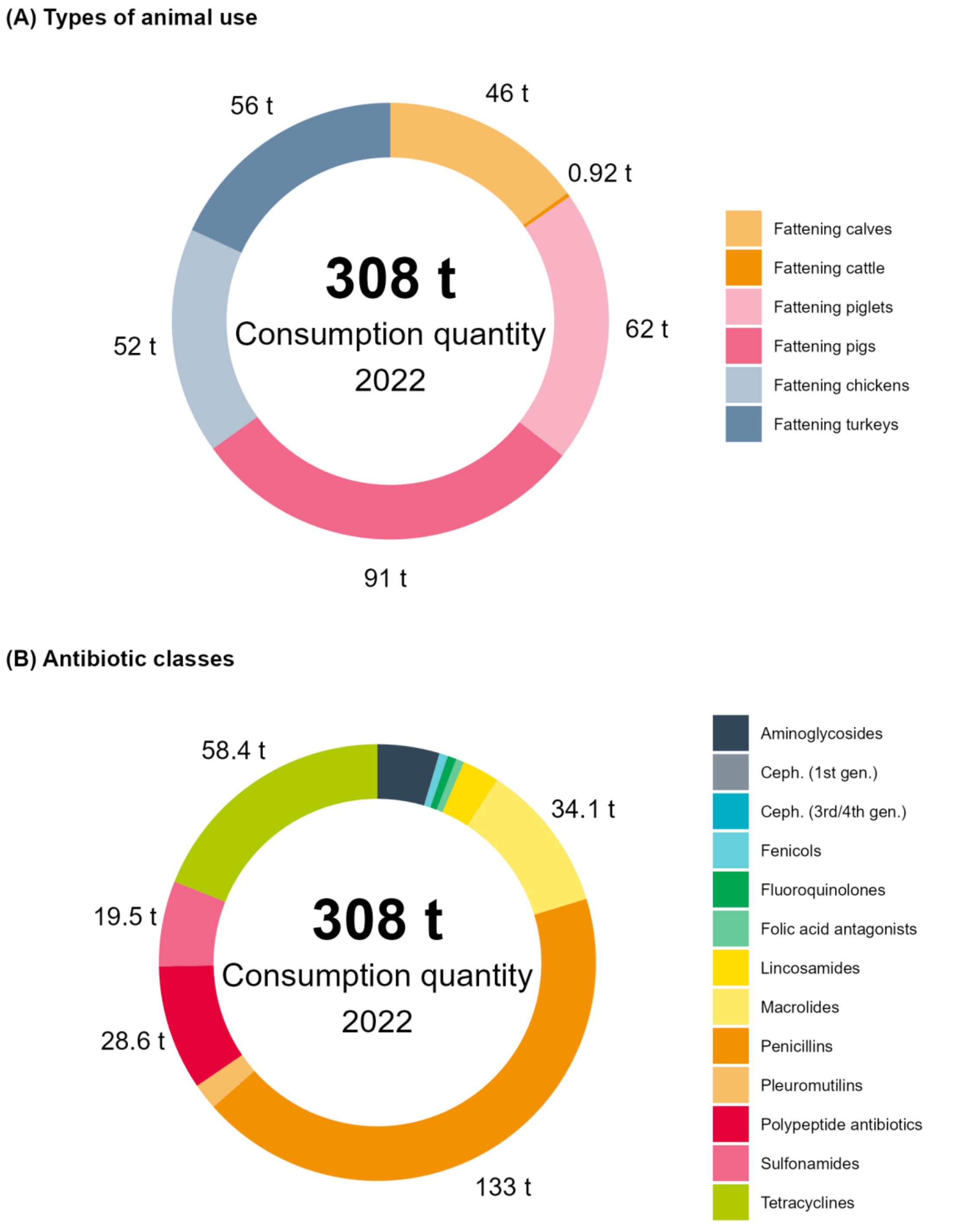


Figure 2: Allocation of the total consumption quantities in 2022 to (A) the animal category aggregated across all antibiotic classes and to (B) the antibiotic classes aggregated across all animal categories. The quantities are given for the five active ingredient classes with the highest consumption quantities.

Table 3: Population-wide treatment frequency in the animal categories in 2022 and changes compared with the previous year.

Animal category	Population-wide treatment frequency 2022[a] [days]	Change compared with the previous year[a] [days]	Change compared with the previous year[b] [%]
Fattening calves	25.965	−0.597	−2%
Fattening cattle	0.135	+0.00593	+5%
Fattening piglets	20.990	−1.878	−8%
Fattening pigs	6.112	−0.131	−2%
Broilers	45.281	−1.630	−3%
Fattening turkeys	40.797	−1.794	−4%

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place.

Table 4: Consumption quantities in the animal categories in 2022 and changes compared with the previous year.

Animal category	Consumption quantity 2022[a] [t]	Change compared with the previous year[a] [t]	Change compared with the previous year[b] [%]
Fattening calves	46.328	−2.951	−6%
Fattening cattle	0.923	+0.154	+20%
Fattening piglets	62.409	−14.063	−18%
Fattening pigs	90.951	−10.787	−11%
Broilers	51.775	−6.218	−11%
Fattening turkeys	55.915	−8.582	−13%
Total	**308.301**	**−42.446**	**−12%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place.

Table 5: Average total population size in the animal categories in 2022 and changes compared with the previous year.

Animal category	Average total population size 2022[a,b] [million animals]	Change compared with the previous year[b] [million animals]	Change compared with the previous year[c] [%]
Fattening calves	0.730	−0.010	−1%
Fattening cattle	1.721	+0.016	+0.9%
Fattening piglets	6.851	−0.562	−8%
Fattening pigs	13.796	−1.126	−8%
Broilers	86.056	+0.754	+0.9%
Fattening turkeys	10.038	−0.636	−6%

[a] The average total population size of a type of animal use is calculated as the sum of the livestock days in all farms subject to the notification obligation in the year divided by the length of the year in days.
[b] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[c] Rounded to whole percentages or, in the case of values below 1%, to one decimal place.

Table 6: Consumption quantities per livestock day in the animal categories in 2022 and changes compared with the previous year.

Animal category	Consumption quantity per livestock day 2022[a] [mg]	Change compared with the previous year[a] [mg]	Change compared with the previous year[b] [%]
Fattening calves	174.0	−8.5	−5%
Fattening cattle	1.47	+0.23	+19%
Fattening piglets	25.0	−3.3	−12%
Fattening pigs	18.1	−0.62	−3%
Broilers	1.65	−0.21	−12%
Fattening turkeys	15.3	−1.3	−8%

[a] Rounded to one decimal place or, for values below 1, to two significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place.

Table 7: Consumption quantities per antibiotic class in 2022 and changes compared with the previous year. The quantities are aggregated across all animal categories.

Antibiotic class	Consumption quantity 2022[a] [t]	Change compared with the previous year[a] [t]	Change compared with the previous year[b] [%]
Aminoglycosides	14.142	−0.925	−6%
First-generation cephalosporins	0.0000275	+0.0000264	n/a
Third- and fourth-generation cephalosporins	0.025	−0.012	−32%
Fenicols	1.946	−0.319	−14%
Fluoroquinolones	2.025	−0.198	−9%
Folic acid antagonists	1.870	−0.159	−8%
Lincosamides	8.455	−0.874	−9%
Macrolides	34.084	−1.347	−4%
Penicillins	133.248	−16.919	−11%
Pleuromutilins	6.002	+0.358	+6%
Polypeptide antibiotics	28.556	−8.897	−24%
Sulfonamides	19.537	−1.639	−8%
Tetracyclines	58.410	−11.514	−16%
Total	**308.301**	**−42.446**	**−12%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for antibiotic classes for which the consumption quantity in the reporting or previous year's period was less than one kilogram or for which the change was less than one per thousand.

3 Development in the animal categories

In the following, the stratification of population-wide treatment frequency and consumption quantities by antibiotic classes and AMEG categories is described for the individual animal categories. The development of farm-level treatment frequencies in the animal categories has already been described in Section 2.1 .

3.1 Fattening calves

In Figure 3, a comparison is made of how the population-wide treatment frequency and the consumption quantities in fattening calves in 2022 were distributed among the antibiotic classes. All corresponding figures can be found in Table 8 (population-wide treatment frequency) and Table 10 (consumption quantities). These tables also contain the changes compared with the previous year.

Table 9 contains the distribution of the population-wide treatment frequency among the AMEG categories including changes compared with the previous year; Table 11 shows the corresponding distribution of the consumption quantities.

Population-wide treatment frequency

According to the population-wide treatment frequency, tetracyclines represented the most important antibiotic class in fattening calves in 2022 (9.5 days; −0.3 days compared with the previous year) followed by macrolides (5.2 days; +0.1 days) and penicillins (4.9 days; −0.2 days). The largest percentage changes were decreases in lincosamides (compared with 2021, −19% to 0.09 days in 2022), third- and fourth-generation cephalosporins (−13% to 0.03 days), and aminoglycosides (−11% to 0.84 days), and an increase in fluoroquinolones (+11% to 0.52 days).

Broken down by AMEG category, active ingredients of Category D were used most frequently in fattening calves in 2022 with a population-wide treatment frequency of 17.6 days (−0.6 days compared with the previous year) followed by active ingredients of Category C (7.1 days; negligible change compared with the previous year). Active ingredients in the highest AMEG category B were used least frequently (1.2 days). However, there was a slight increase of 0.03 days (+2%). The increase in fluoroquinolones outweighed the decreases in third- and fourth-generation cephalosporins and polypeptide antibiotics.

Consumption quantities

In terms of consumption quantities, tetracyclines were also the most important antibiotic class in fattening calves in 2022 (15.1 t; −1.9 t or −11% compared with the previous year) followed by penicillins (13.6 t; −1 t or −7%) and sulfonamides (11.8 t; −0.1 t or −1%). The decreases in population-wide treatment frequency of lincosamides, aminoglycosides, and third- and fourth-generation cephalosporins are reflected in decreases in the corresponding consumption quantities (−23%, −14%, −36%). It is striking that the slight decrease in the population-wide treatment frequency of polypeptide antibiotics is contrasted by a considerable increase in the consumption quantities (+89%). This increase is due to an increase in the average daily animal dose used for the oral administration of colistin: The median increased from 535 mg per animal per day in 2021 to 667 mg per animal per day in 2022. The increase also means that, overall, the consumption quantities of AMEG Category B in 2022 have increased strongly by 55% compared with the previous year.

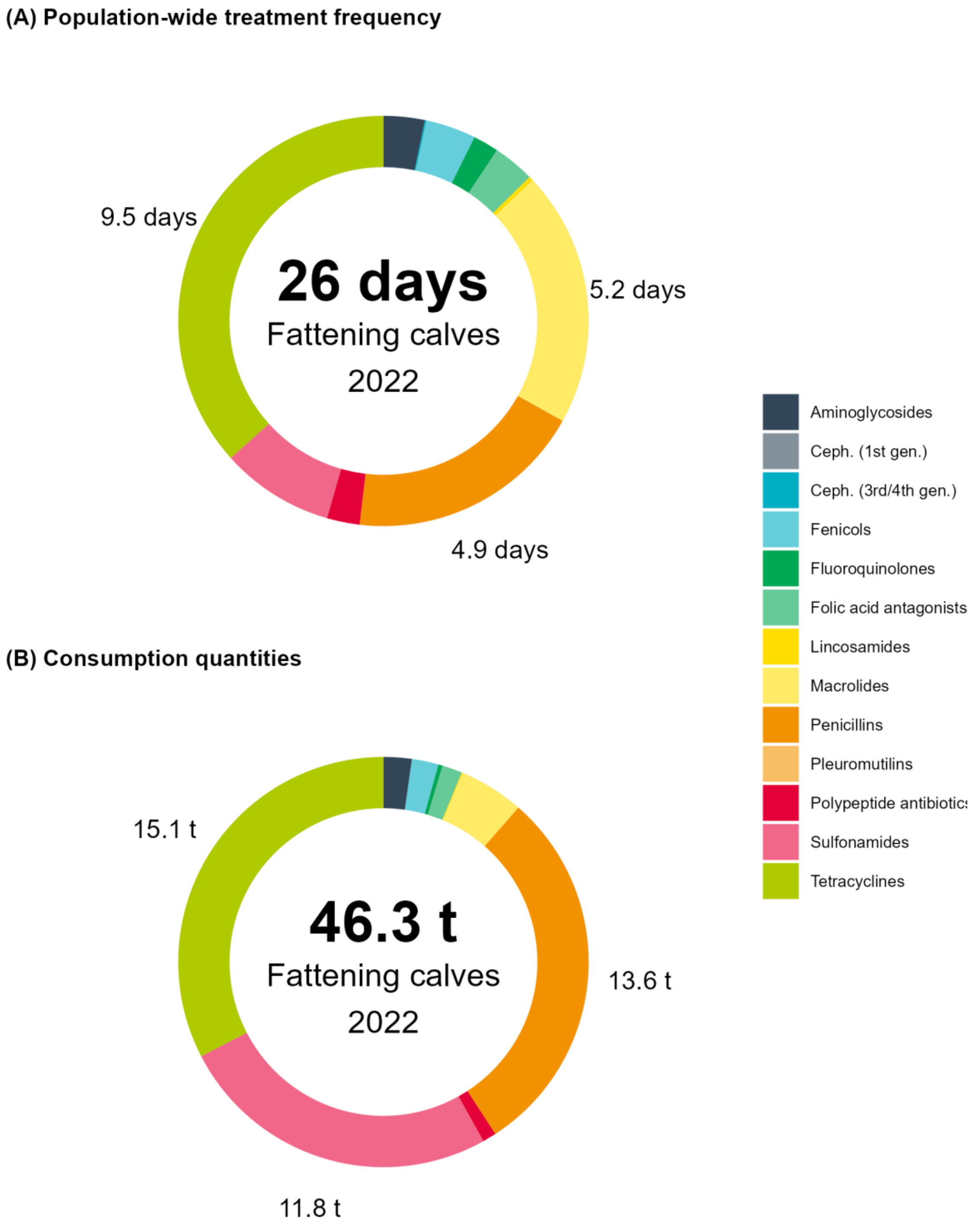


Figure 3: Distribution of (A) population-wide treatment frequency in days and (B) consumption quantities in tonnes among the antibiotic classes in fattening calves in 2022. The values are given for each of the three antibiotic classes with the highest population-wide treatment frequency or consumption quantity.

Table 8: Population-wide treatment frequency per antibiotic class in fattening calves in 2022 and changes compared with the previous year.

Antibiotic class	Population-wide treatment frequency 2022[a] [days]	Change compared with the previous year[a] [days]	Change compared with the previous year[b] [%]
Aminoglycosides	0.843	−0.106	−11%
First-generation cephalosporins	0.0000110	+0.00000285	n/a
Third- and fourth-generation cephalosporins	0.030	−0.00461	−13%
Fenicols	1.028	+0.019	+2%
Fluoroquinolones	0.524	+0.053	+11%
Folic acid antagonists	0.852	−0.050	−6%
Lincosamides	0.089	−0.021	−19%
Macrolides	5.229	+0.091	+2%
Penicillins	4.870	−0.153	−3%
Pleuromutilins	0	−0.00000406	n/a
Polypeptide antibiotics	0.670	−0.023	−3%
Sulfonamides	2.316	−0.055	−2%
Tetracyclines	9.515	−0.348	−4%
Total	**25.965**	**−0.597**	**−2%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for antibiotic classes for which the population-wide treatment frequency in the reporting or previous year's period was less than 0.001 days or for which the change was less than one per thousand.

Table 9: Population-wide treatment frequency per AMEG category in fattening calves in 2022 and changes compared with the previous year.

AMEG category	Population-wide treatment frequency 2022[a] [days]	Change compared with the previous year[a] [days]	Change compared with the previous year[b] [%]
B (Restrict)	1.224	+0.026	+2%
C (Caution)	7.099	+0.00373	n/a
D (Prudence)	17.642	−0.626	−3%
Total	**25.965**	**−0.597**	**−2%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for AMEG categories for which the population-wide treatment frequency in the reporting or previous year's period was less than 0.001 days or for which the change was less than one per thousand.

Table 10: Consumption quantities per antibiotic class in fattening calves in 2022 and changes compared with the previous year.

Antibiotic class	Consumption quantity 2022[a] [t]	Change compared with the previous year[a] [t]	Change compared with the previous year[b] [%]
Aminoglycosides	1.028	−0.170	−14%
First-generation cephalosporins	0.00000160	+0.000000456	n/a
Third- and fourth-generation cephalosporins	0.00561	−0.00313	−36%
Fenicols	0.970	−0.052	−5%
Fluoroquinolones	0.155	+0.00241	+2%
Folic acid antagonists	0.731	−0.070	−9%
Lincosamides	0.037	−0.011	−23%
Macrolides	2.367	+0.129	+6%
Penicillins	13.618	−1.023	−7%
Pleuromutilins	0	−0.00000874	n/a
Polypeptide antibiotics	0.500	+0.234	+88%
Sulfonamides	11.815	−0.109	−0.9%
Tetracyclines	15.102	−1.878	−11%
Total	**46.328**	**−2.951**	**−6%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for antibiotic classes for which the consumption quantity in the reporting or previous year's period was less than one kilogram or for which the change was less than one per thousand.

Table 11: Consumption quantities per AMEG category in fattening calves in 2022 and changes compared with the previous year.

AMEG category	Consumption quantities 2022[a] [t]	Change compared with the previous year[a] [t]	Change compared with the previous year[b] [%]
B (Restrict)	0.660	+0.234	+55%
C (Caution)	4.328	−0.083	−2%
D (Prudence)	41.339	−3.102	−7%
Total	**46.328**	**−2.951**	**−6%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for AMEG categories for which the consumption quantity in the reporting or previous year's period was less than one kilogram or for which the change was less than one per thousand.

3.2 Fattening cattle

In Figure 4, a comparison is made of how the population-wide treatment frequency and the consumption quantities in fattening cattle in 2022 were distributed among the antibiotic classes. All corresponding figures can be found in Table 12 (population-wide treatment frequency) and Table 14 (consumption quantities). These tables also contain the changes compared with the previous year.

Table 13 contains the distribution of the population-wide treatment frequency among the AMEG categories, including changes compared with the previous year; Table 15 shows the corresponding distribution of the consumption quantities.

An analysis of the percentage changes seems to make little sense for fattening cattle in view of the consistently low absolute values. Therefore, only the most important antibiotic classes, measured in terms of population-wide treatment frequency or consumption quantities, are briefly listed below.

Population-wide treatment frequency

According to the population-wide treatment frequency, macrolides (0.036 days; −0.001 days compared with the previous year) and penicillins (0.035 days; +0.004 days) were practically equal as the most important antibiotic class in fattening cattle in 2022 followed by tetracyclines (0.028 days; +0.006 days). The largest percentage changes were the decrease for aminoglycosides (compared with 2021, −42% to 0.0012 days in 2022) and the increases for sulfonamides and folic acid antagonists (+26% to 0.006 days and +34% to 0.004 days, respectively).

Broken down by AMEG category, active ingredients of Category D were used most frequently in fattening cattle in 2022 with a population-wide treatment frequency of 0.073 days (+0.01 days compared with the previous year) followed by active ingredients of Category C (0.051 days; −0.004 days). Active ingredients in the highest AMEG category B were used least frequently (0.011 days).

Consumption quantities

In terms of consumption quantities, tetracyclines represented the most important antibiotic class in fattening cattle in 2022 (0.31 t; +0.045 t or +17% compared with the previous year) followed by penicillins (0.222 t; negligible change compared with the previous year) and sulfonamides (0.148 t; +0.007 t or +5%). The large increase in polypeptide antibiotic consumption quantities from 0.0002 t in 2021 to 0.12 t in 2022, which nominally also led to a 552% increase in the consumption quantities of AMEG Category B, is due to two individual group treatments with oral administration of colistin in high daily animal doses.

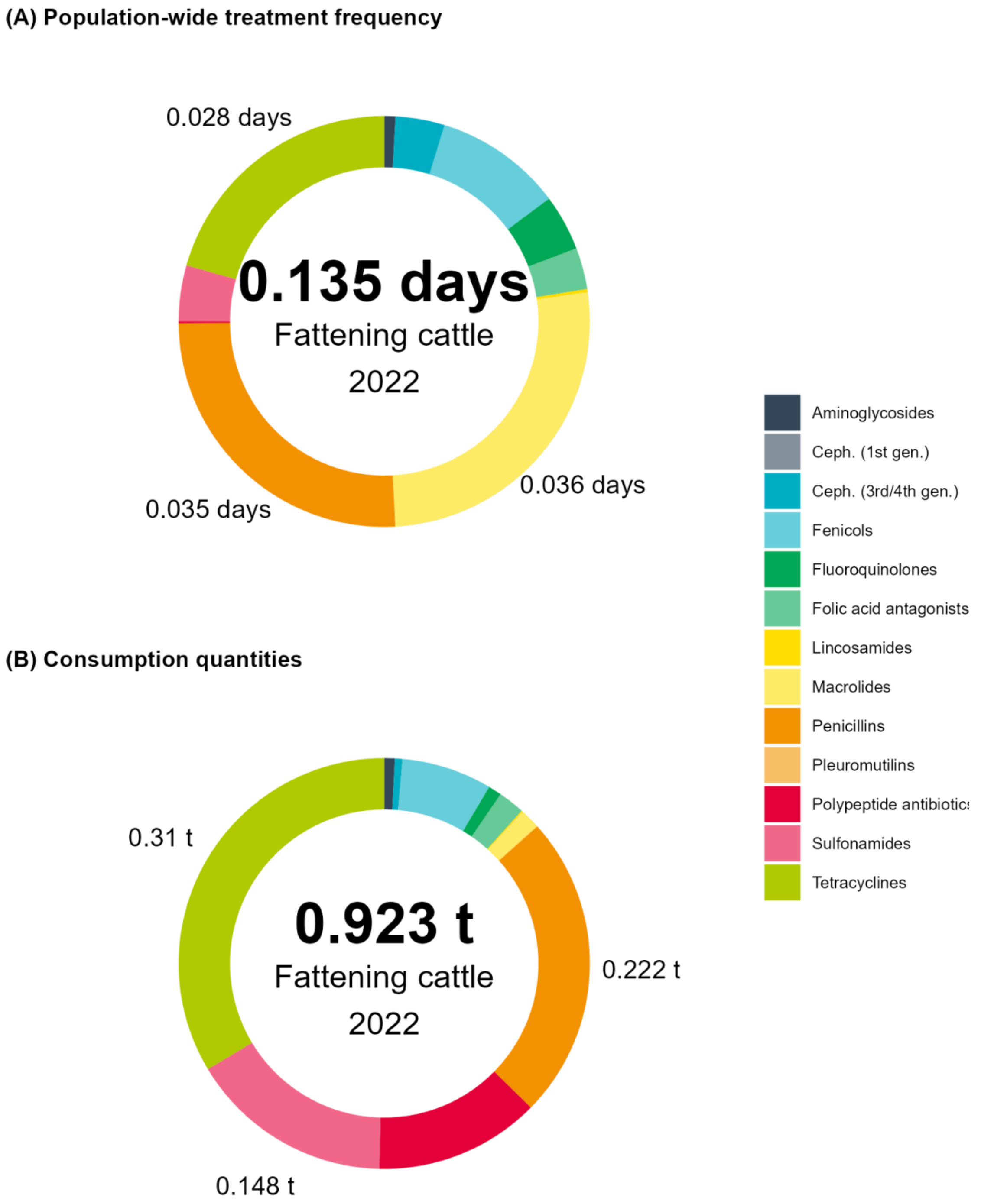


Figure 4: Distribution of (A) population-wide treatment frequency in days and (B) consumption quantities in tonnes among the antibiotic classes in fattening cattle in 2022. The values are given for each of the three antibiotic classes with the highest population-wide treatment frequency or consumption quantity.

Table 12: Population-wide treatment frequency per antibiotic class in fattening cattle in 2022 and changes compared with the previous year.

Antibiotic class	Population-wide treatment frequency 2022[a] [days]	Change compared with the previous year[a] [days]	Change compared with the previous year[b] [%]
Aminoglycosides	0.00119	−0.000855	−42%
First-generation cephalosporins	0.00000581	+0.00000581	n/a
Third- and fourth-generation cephalosporins	0.00522	−0.00118	−18%
Fenicols	0.014	−0.00165	−11%
Fluoroquinolones	0.00596	+0.000524	+10%
Folic acid antagonists	0.00441	+0.00113	+34%
Lincosamides	0.000327	−0.000310	n/a
Macrolides	0.036	−0.00130	−4%
Penicillins	0.035	+0.00402	+13%
Pleuromutilins	0	0	
Polypeptide antibiotics	0.000207	+0.000137	n/a
Sulfonamides	0.00594	+0.00124	+26%
Tetracyclines	0.028	+0.00416	+18%
Total	**0.135**	**+0.00593**	**+5%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for antibiotic classes for which the population-wide treatment frequency in the reporting or previous year's period was less than 0.001 days or for which the change was less than one per thousand.

Table 13: Population-wide treatment frequency per AMEG category in fattening cattle in 2022 and changes compared with the previous year.

AMEG category	Population-wide treatment frequency 2022[a] [days]	Change compared with the previous year[a] [days]	Change compared with the previous year[b] [%]
B (Restrict)	0.011	−0.000523	−4%
C (Caution)	0.051	−0.00387	−7%
D (Prudence)	0.073	+0.010	+16%
Total	**0.135**	**+0.00593**	**+5%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for AMEG categories for which the population-wide treatment frequency in the reporting or previous year's period was less than 0.001 days or for which the change was less than one per thousand.

Table 14: Consumption quantities per antibiotic class in fattening cattle in 2022 and changes compared with the previous year.

Antibiotic class	Consumption quantity 2022[a] [t]	Change compared with the previous year[a] [t]	Change compared with the previous year[b] [%]
Aminoglycosides	0.00765	−0.00646	−46%
First-generation cephalosporins	0.0000259	+0.0000259	n/a
Third- and fourth-generation cephalosporins	0.00548	−0.00260	−32%
Fenicols	0.066	−0.00722	−10%
Fluoroquinolones	0.00971	−0.00274	−22%
Folic acid antagonists	0.019	+0.000615	+3%
Lincosamides	0.000899	−0.000660	n/a
Macrolides	0.015	+0.000644	+5%
Penicillins	0.222	−0.0000115	n/a
Pleuromutilins	0	0	
Polypeptide antibiotics	0.120	+0.120	n/a
Sulfonamides	0.148	+0.00701	+5%
Tetracyclines	0.310	+0.045	+17%
Total	**0.923**	**+0.154**	**+20%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for antibiotic classes for which the consumption quantity in the reporting or previous year's period was less than one kilogram or for which the change was less than one per thousand.

Table 15: Consumption quantities per AMEG category in fattening cattle in 2022 and changes compared with the previous year.

AMEG category	Consumption quantities 2022[a] [t]	Change compared with the previous year[a] [t]	Change compared with the previous year[b] [%]
B (Restrict)	0.135	+0.115	+552%
C (Caution)	0.087	−0.013	−13%
D (Prudence)	0.700	+0.052	+8%
Total	**0.923**	**+0.154**	**+20%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for AMEG categories for which the consumption quantity in the reporting or previous year's period was less than one kilogram or for which the change was less than one per thousand.

3.3 Fattening piglets

In Figure 5, a comparison is made of how the population-wide treatment frequency and the consumption quantities in fattening piglets in 2022 were distributed among the antibiotic classes. All corresponding figures can be found in Table 16 (population-wide treatment frequency) and Table 18 (consumption quantities). These tables also contain the changes compared with the previous year.

Table 17 contains the distribution of the population-wide treatment frequency among the AMEG categories, including changes compared with the previous year; Table 19 shows the corresponding distribution of the consumption quantities.

Population-wide treatment frequency

According to the population-wide treatment frequency, penicillins represented the most important antibiotic class in fattening piglets in 2022 (8.6 days; −0.8 days compared with the previous year) followed by polypeptide antibiotics (3.9 days; −0.3 days) and tetracyclines (3.9 days; −0.8 days). The largest percentage changes were decreases for pleuromutilins (compared with 2021, −20% to 0.29 days in 2022), tetracyclines (−18% to 3.9 days) and fenicols (−14% to 0.19 days) as well as increases for sulfonamides (+15% to 0.26 days) and folic acid antagonists (+14% to 0.26 days).

Broken down by AMEG category, active ingredients of Category D were used most frequently in fattening piglets in 2022 with a population-wide treatment frequency of 13.2 days (−1.6 days compared with the previous year) followed by active ingredients of Category B (4.2 days; −0.2 days). In Category B, the decreases for third- and fourth-generation cephalosporins (−11%) and polypeptide antibiotics (−6%) contrast with an increase for fluoroquinolones (+11%). Active ingredients of AMEG Category C were used least frequently with negligible change compared with the previous year (3.6 days).

Consumption quantities

The antibiotic class with the highest consumption quantities in fattening piglets in 2022 was by far penicillins (41.1 t; −8.4 t compared with the previous year) followed by tetracyclines (11 t; −4.1 t) and polypeptide antibiotics (3.2 t; −0.6 t). In percentage terms, the largest decreases compared with 2021 were for third- and fourth-generation cephalosporins (compared with 2021, −31% to 0.0047 t in 2022), tetracyclines (−27% to 11 t), fenicols (−24% to 0.221 t), and aminoglycosides (−23% to 1.6 t). These decreases can be partly explained by the 7.6% decrease in the average total number of fattening piglets compared with the previous year. In contrast, there was an increase for pleuromutilins (+12% to 0.51 t) and lincosamides (+6% to 0.42 t).

The decrease in consumption quantities for fattening piglets is also reflected in all AMEG categories. In particular, the consumption quantities of active ingredients of Category B decreased by 15% overall as did the consumption quantities of all associated antibiotic classes (third- and fourth-generation cephalosporins, fluoroquinolones, polypeptide antibiotics).

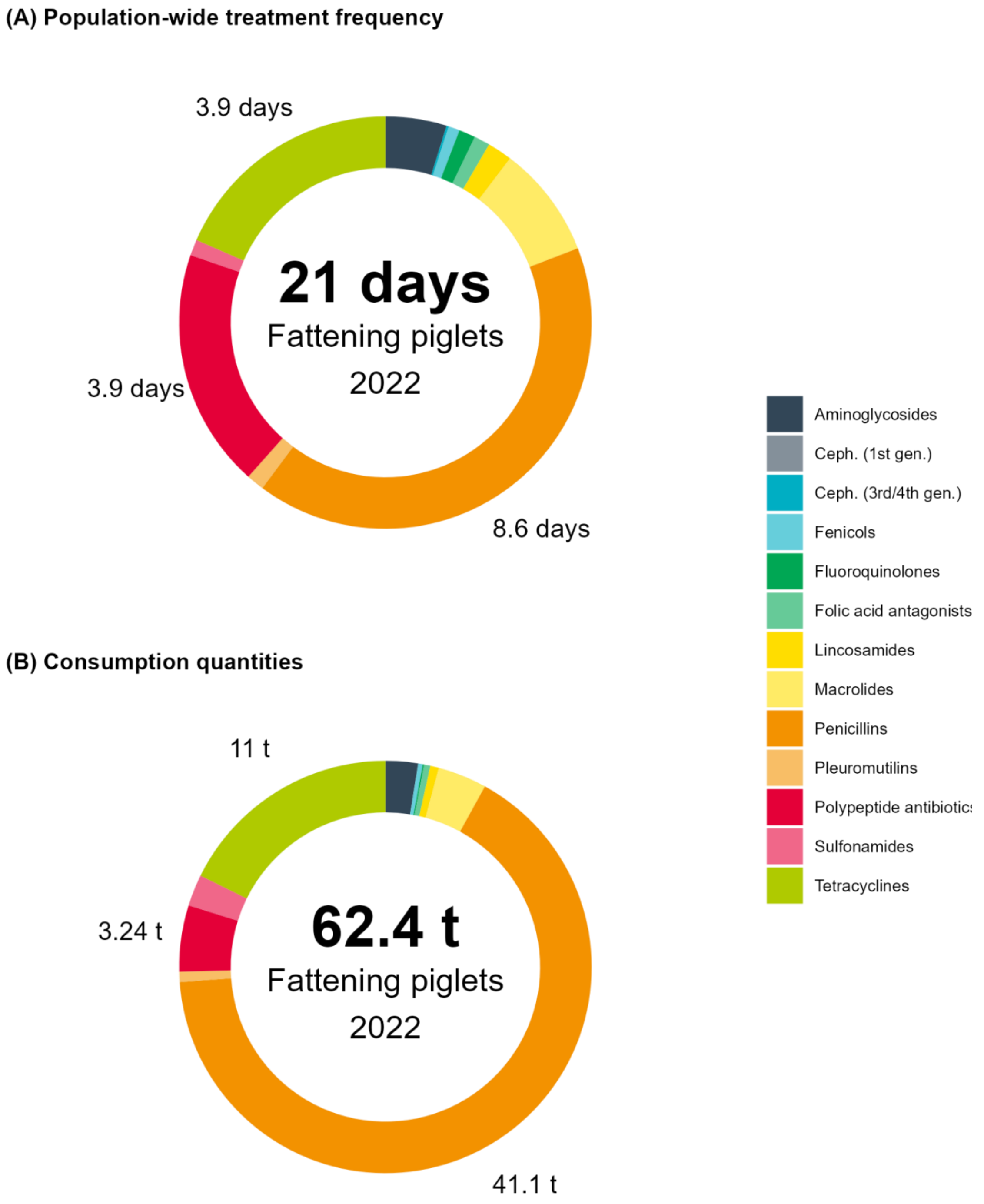


Figure 5: Distribution of (A) population-wide treatment frequency in days and (B) consumption quantities in tonnes among the antibiotic classes in fattening piglets in 2022. The values are given for each of the three antibiotic classes with the highest population-wide treatment frequency or consumption quantity.

Table 16: Population-wide treatment frequency per antibiotic class in fattening piglets in 2022 and changes compared with the previous year.

Antibiotic class	**Population-wide treatment frequency 2022[a] [days]**	**Change compared with the previous year[a] [days]**	**Change compared with the previous year[b] [%]**
Aminoglycosides	1.007	−0.047	−4%
First-generation cephalosporins	0	0	
Third- and fourth-generation cephalosporins	0.036	−0.00452	−11%
Fenicols	0.186	−0.030	−14%
Fluoroquinolones	0.271	+0.027	+11%
Folic acid antagonists	0.261	+0.033	+14%
Lincosamides	0.409	+0.041	+11%
Macrolides	1.848	+0.050	+3%
Penicillins	8.615	−0.816	−9%
Pleuromutilins	0.292	−0.071	−20%
Polypeptide antibiotics	3.934	−0.257	−6%
Sulfonamides	0.263	+0.035	+15%
Tetracyclines	3.870	−0.838	−18%
Total	**20.990**	**−1.878**	**−8%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for antibiotic classes for which the population-wide treatment frequency in the reporting or previous year's period was less than 0.001 days or for which the change was less than one per thousand.

Table 17: Population-wide treatment frequency per AMEG category in fattening piglets in 2022 and changes compared with the previous year.

AMEG category	**Population-wide treatment frequency 2022[a] [days]**	**Change compared with the previous year[a] [days]**	**Change compared with the previous year[b] [%]**
B (Restrict)	4.241	−0.235	−5%
C (Caution)	3.560	−0.014	−0.4%
D (Prudence)	13.189	−1.629	−11%
Total	**20.990**	**−1.878**	**−8%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for AMEG categories for which the population-wide treatment frequency in the reporting or previous year's period was less than 0.001 days or for which the change was less than one per thousand.

Table 18: Consumption quantities per antibiotic class in fattening piglets in 2022 and changes compared with the previous year.

Antibiotic class	Consumption quantity 2022[a] [t]	Change compared with the previous year[a] [t]	Change compared with the previous year[b] [%]
Aminoglycosides	1.585	−0.486	−23%
First-generation cephalosporins	0	0	
Third- and fourth-generation cephalosporins	0.00465	−0.00208	−31%
Fenicols	0.221	−0.069	−24%
Fluoroquinolones	0.068	−0.00907	−12%
Folic acid antagonists	0.307	−0.017	−5%
Lincosamides	0.418	+0.025	+6%
Macrolides	2.397	−0.401	−14%
Penicillins	41.076	−8.399	−17%
Pleuromutilins	0.506	+0.054	+12%
Polypeptide antibiotics	3.241	−0.593	−15%
Sulfonamides	1.542	−0.081	−5%
Tetracyclines	11.042	−4.084	−27%
Total	**62.409**	**−14.063**	**−18%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for antibiotic classes for which the consumption quantity in the reporting or previous year's period was less than one kilogram or for which the change was less than one per thousand.

Table 19: Consumption quantities per AMEG category in fattening piglets in 2022 and changes compared with the previous year.

AMEG category	Consumption quantities 2022[a] [t]	Change compared with the previous year[a] [t]	Change compared with the previous year[b] [%]
B (Restrict)	3.314	−0.604	−15%
C (Caution)	4.904	−0.763	−13%
D (Prudence)	54.191	−12.695	−19%
Total	**62.409**	**−14.063**	**−18%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for AMEG categories for which the consumption quantity in the reporting or previous year's period was less than one kilogram or for which the change was less than one per thousand.

3.4 Fattening pigs

In Figure 6, a comparison is made of how the population-wide treatment frequency and the consumption quantities in fattening pigs in 2022 were distributed among the antibiotic classes. All corresponding figures can be found in Table 20 (population-wide treatment frequency) and Table 22 (consumption quantities). These tables also contain the changes compared with the previous year.

Table 21 contains the distribution of the population-wide treatment frequency among the AMEG categories, including changes compared with the previous year; Table 23 shows the corresponding distribution of the consumption quantities.

Population-wide treatment frequency

In terms of population-wide treatment frequency, penicillins (1.7 days; −0.07 days compared with the previous year) and tetracyclines (1.7 days; −0.12 days) were tied as the most important antibiotic classes in fattening pigs in 2022 followed by macrolides (1.4 days; +0.1 days). The largest percentage changes were decreases for sulfonamides (compared with 2021, −16% to 0.02 days in 2022), folic acid antagonists (−13% to 0.02 days) and polypeptide antibiotics (−11% to 0.16 days), and increases for aminoglycosides (+47% to 0.12 days) and macrolides (+9% to 1.37 days).

Broken down by AMEG category, active ingredients of Category D were used most frequently in fattening pigs in 2022 with a population-wide treatment frequency of 3.4 days (−0.19 days compared with the previous year) followed by active substances of Category C (2.4 days; +0.08 days). Active ingredients in the highest AMEG category B were used much less frequently (0.23 days). This category also saw the greatest decrease (−8%), which is due to the less frequent use of polypeptide antibiotics (−11%). In contrast, there were slight increases for third- and fourth-generation cephalosporins and fluoroquinolones (+0.4% and +1%, respectively).

Consumption quantities

The antibiotic class with the highest consumption quantities in fattening pigs in 2022 was, similar to fattening piglets, by far the class of penicillins (42.1 t; −4.3 t compared with the previous year) followed by tetracyclines (25.2 t; −4.7 t) and macrolides (14.8 t; +0.14 t). The consumption of sulfonamides (compared with 2021, −34% to 0.77 t in 2022), folic acid antagonists (−28% to 0.14 t), tetracyclines (−16% to 25.2 t), and polypeptide antibiotics (−29% to 0.72 t) fell disproportionately compared with the decreases in the average total number of fattening pigs (−7.5%). The decrease for third- and fourth-generation cephalosporins occurred at a low absolute level (−29% to 0.001 t). Only for aminoglycosides (+1% to 0.85 t) and macrolides (+1% to 14.8 t) was there a slight increase.

For active substances of AMEG Category B, a decrease in consumption quantities was recorded for fattening pigs (−0.32 t or −27% compared with the previous year); however this is hardly significant in absolute terms (with consumption quantities of Category B totalling 0.9 t compared with 69 t in Category D and 21 t in Category C).

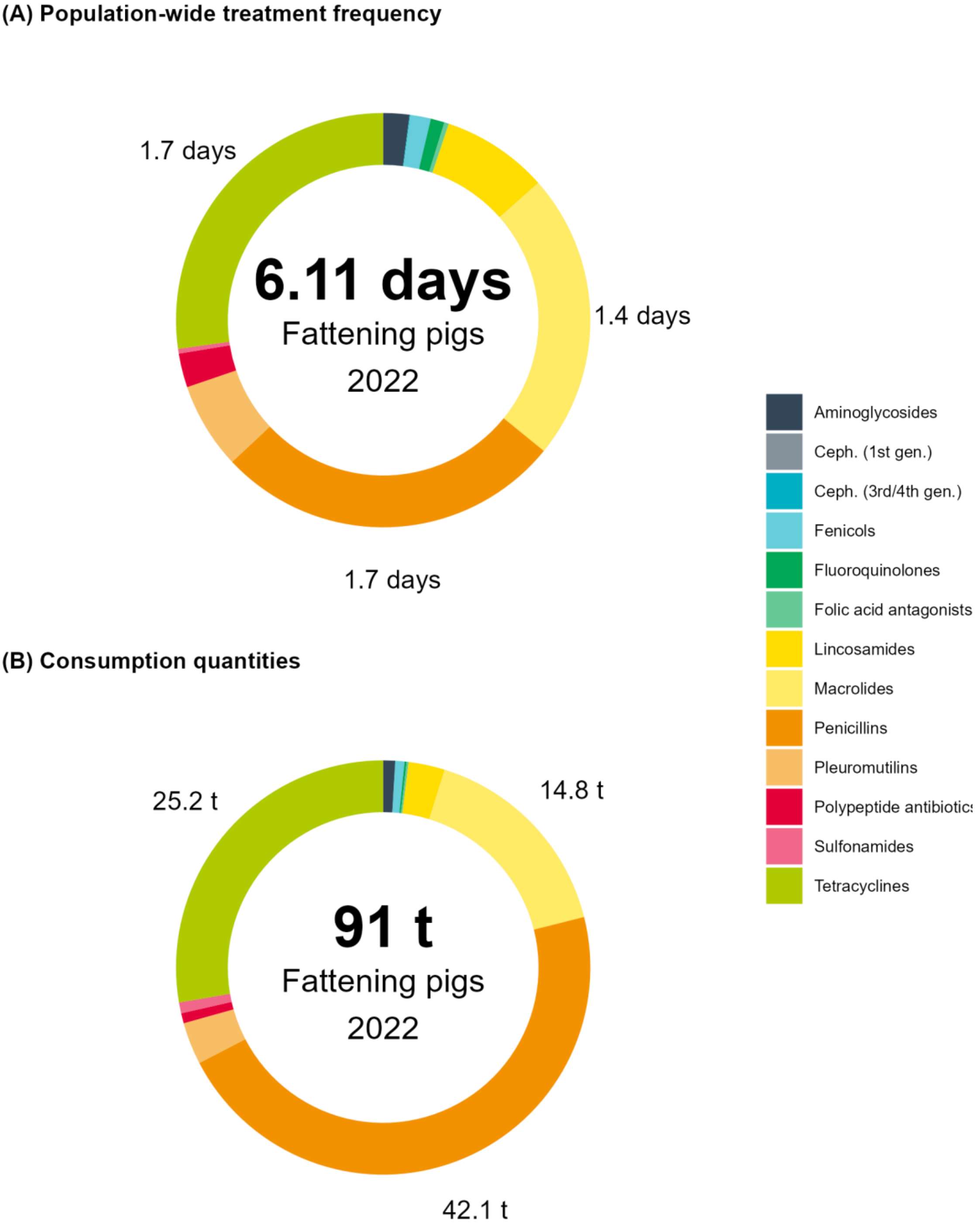


Figure 6: Distribution of (A) population-wide treatment frequency in days and (B) consumption quantities in tonnes among the antibiotic classes in fattening pigs in 2022. The values are given for each of the three antibiotic classes with the highest population-wide treatment frequency or consumption quantity.

Table 20: Population-wide treatment frequency per antibiotic class in fattening pigs in 2022 and changes compared with the previous year.

Antibiotic class	**Population-wide treatment frequency 2022[a] [days]**	**Change compared with the previous year[a] [days]**	**Change compared with the previous year[b] [%]**
Aminoglycosides	0.124	+0.040	+47%
First-generation cephalosporins	0	0	
Third- and fourth-generation cephalosporins	0.00333	+0.0000139	+0.4%
Fenicols	0.098	−0.00645	−6%
Fluoroquinolones	0.066	+0.000952	+1%
Folic acid antagonists	0.022	−0.00337	−13%
Lincosamides	0.509	−0.019	−4%
Macrolides	1.369	+0.108	+9%
Penicillins	1.658	−0.073	−4%
Pleuromutilins	0.413	−0.012	−3%
Polypeptide antibiotics	0.162	−0.020	−11%
Sulfonamides	0.023	−0.00429	−16%
Tetracyclines	1.663	−0.141	−8%
Total	**6.112**	**−0.131**	**−2%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for antibiotic classes for which the population-wide treatment frequency in the reporting or previous year's period was less than 0.001 days or for which the change was less than one per thousand.

Table 21: Population-wide treatment frequency per AMEG category in fattening pigs in 2022 and changes compared with the previous year.

AMEG category	**Population-wide treatment frequency 2022[a] [days]**	**Change compared with the previous year[a] [days]**	**Change compared with the previous year[b] [%]**
B (Restrict)	0.231	−0.019	−8%
C (Caution)	2.435	+0.075	+3%
D (Prudence)	3.445	−0.187	−5%
Total	**6.112**	**−0.131**	**−2%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for AMEG categories for which the population-wide treatment frequency in the reporting or previous year's period was less than 0.001 days or for which the change was less than one per thousand.

Table 22: Consumption quantities per antibiotic class in fattening pigs in 2022 and changes compared with the previous year.

Antibiotic class	Consumption quantity 2022[a] [t]	Change compared with the previous year[a] [t]	Change compared with the previous year[b] [%]
Aminoglycosides	0.850	+0.00938	+1%
First-generation cephalosporins	0	0	
Third- and fourth-generation cephalosporins	0.00973	−0.00403	−29%
Fenicols	0.646	−0.106	−14%
Fluoroquinolones	0.141	−0.026	−15%
Folic acid antagonists	0.142	−0.055	−28%
Lincosamides	2.571	−0.755	−23%
Macrolides	14.814	+0.139	+0.9%
Penicillins	42.103	−4.327	−9%
Pleuromutilins	2.991	−0.262	−8%
Polypeptide antibiotics	0.717	−0.288	−29%
Sulfonamides	0.771	−0.393	−34%
Tetracyclines	25.196	−4.720	−16%
Total	**90.951**	**−10.787**	**−11%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for antibiotic classes for which the consumption quantity in the reporting or previous year's period was less than one kilogram or for which the change was less than one per thousand.

Table 23: Consumption quantities per AMEG category in fattening pigs in 2022 and changes compared with the previous year.

AMEG category	Consumption quantities 2022[a] [t]	Change compared with the previous year[a] [t]	Change compared with the previous year[b] [%]
B (Restrict)	0.867	−0.318	−27%
C (Caution)	21.416	−1.076	−5%
D (Prudence)	68.667	−9.393	−12%
Total	**90.951**	**−10.787**	**−11%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for AMEG categories for which the consumption quantity in the reporting or previous year's period was less than one kilogram or for which the change was less than one per thousand.

3.5 Broilers

In Figure 7, a comparison is made of how the population-wide treatment frequency and the consumption quantities in broilers in 2022 were distributed among the antibiotic classes. All corresponding figures can be found in Table 24 (population-wide treatment frequency) and Table 26 (consumption quantities). These tables also contain the changes compared with the previous year.

Table 25 contains the distribution of the population-wide treatment frequency among the AMEG categories, including changes compared with the previous year; Table 27 shows the corresponding distribution of the consumption quantities.

Population-wide treatment frequency

In terms of population-wide treatment frequency, lincosamides (17 days; −0.6 days compared with the previous year) and aminoglycosides (16 days; no significant change compared with the previous year) were the most important antibiotic classes in broilers in 2022 followed by polypeptide antibiotics with (3.5 days; −1.1 days). The largest percentage changes compared with the previous year were for fenicols (compared with 2021 −93% to 0.003 days in 2022) and pleuromutilins (+67% to 0.021 days). However, both active ingredients classes play only a minor role in absolute terms. More relevant are the increases in the use of sulfonamides (+22% to 1.8 days) and folic acid antagonists (+23% to 1.7 days) as well as the decreases for fluoroquinolones (−27% to 1.2 days) and polypeptide antibiotics (−25% to 3.5 days).

Broken down by AMEG category, active ingredients of Category D were used most frequently in broilers in 2022 with a population-wide treatment frequency of 22.3 days (+0.7 days compared with the previous year) followed by active substances of Category C (18.3 days; −0.8 days). Active ingredients in the highest AMEG category (B) were used least frequently (4.6 days). This category also saw the sharpest percentage decrease (−25%).

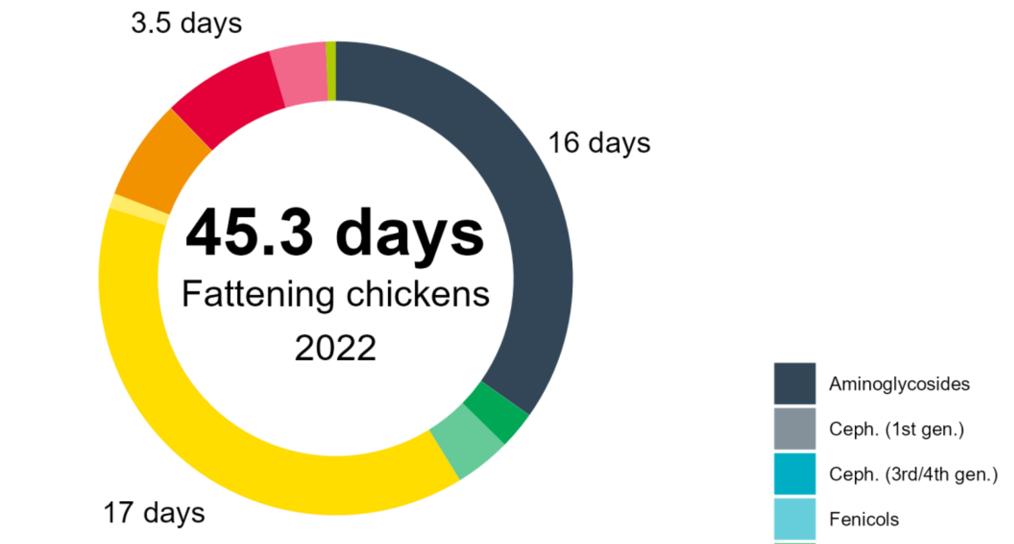
Consumption quantities

The antibiotic class with the highest consumption quantities in broilers in 2022 was polypeptide antibiotics (17.6 t; (−6 t compared with the previous year) followed by penicillins (12.2 t; +0.5 t) and aminoglycosides (9.3 t; −0.05 t). In line with the decreases in the respective population-wide treatment frequencies, the consumption quantities of fluoroquinolones (compared with 2021, −36% to 1.16 t in 2022), tetracyclines (−36% to 0.53t), and polypeptide antibiotics (−25% to 17.6 t) decreased considerably. The large percentage changes in the consumption quantities of pleuromutilins (+37% to 0.02 t) and fenicols (−93% to 0.003 t) took place at low absolute levels.

For broilers, active ingredients of Category D had the highest consumption quantities of all AMEG categories (24.6 t). However, active ingredients of the highest AMEG category B also accounted for a relevant proportion of the total consumption quantities (17.9 t). They were thus clearly ahead of active ingredients in Category C (9.2 t). However, a strong decrease was recorded in Category B (−26%; −6.1 t) compared with the previous year.

As stated in previous reports, the high consumption quantities of polypeptide antibiotics are due, among other things, to the fact that the oral administration of colistin in broilers is carried out at high daily animal doses. For most administrations, these are seven to thirteen times the daily animal dose that results from standardised values for dosages and animal weights for this active ingredient (vgl. Flor et al., 2022b; Flor et al., 2022c).

(A) Population-wide treatment frequency



(B) Consumption quantities

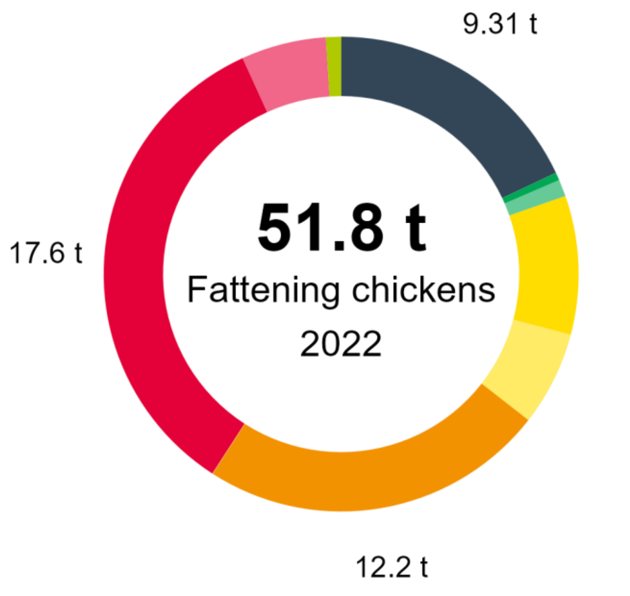


Figure 7: Distribution of (A) population-wide treatment frequency in days and (B) consumption quantities in tonnes among the antibiotic classes in broilers in 2022. The values are given for each of the three antibiotic classes with the highest population-wide treatment frequency or consumption quantity.

Table 24: Population-wide treatment frequency per **antibiotic** class in broilers in 2022 and changes compared with the previous year.

Antibiotic class	Population-wide treatment frequency 2022[a] [days]	Change compared with the previous year[a] [days]	Change compared with the previous year[b] [%]
Aminoglycosides	15.754	−0.024	−0.2%
First-generation cephalosporins	0	0	
Third- and fourth-generation cephalosporins	0	0	
Fenicols	0.00675	−0.089	−93%
Fluoroquinolones	1.162	−0.430	−27%
Folic acid antagonists	1.744	+0.328	+23%
Lincosamides	17.472	−0.643	−4%
Macrolides	0.465	+0.016	+4%
Penicillins	3.123	+0.175	+6%
Pleuromutilins	0.016	+0.00659	+67%
Polypeptide antibiotics	3.482	−1.144	−25%
Sulfonamides	1.752	+0.321	+22%
Tetracyclines	0.304	−0.147	−33%
Total	**45.281**	**−1.630**	**−3%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for antibiotic classes for which the population-wide treatment frequency in the reporting or previous year's period was less than 0.001 days or for which the change was less than one per thousand.

Table 25: Population-wide treatment frequency per AMEG category in broilers in 2022 and changes compared with the previous year.

AMEG category	Population-wide treatment frequency 2022[a] [days]	Change compared with the previous year[a] [days]	Change compared with the previous year[b] [%]
B (Restrict)	4.643	−1.575	−25%
C (Caution)	18.319	−0.753	−4%
D (Prudence)	22.319	+0.697	+3%
Total	**45.281**	**−1.630**	**−3%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for AMEG categories for which the population-wide treatment frequency in the reporting or previous year's period was less than 0.001 days or for which the change was less than one per thousand.

Table 26: Consumption quantities per antibiotic class in broilers in 2022 and changes compared with the previous year.

Antibiotic class	Consumption quantity 2022[a] [t]	Change compared with the previous year[a] [t]	Change compared with the previous year[b] [%]
Aminoglycosides	9.308	−0.051	−0.5%
First-generation cephalosporins	0	0	
Third- and fourth-generation cephalosporins	0	0	
Fenicols	0.0028	−0.034	−92%
Fluoroquinolones	0.275	−0.157	−36%
Folic acid antagonists	0.595	+0.00905	+2%
Lincosamides	4.891	−0.382	−7%
Macrolides	3.331	+0.140	+4%
Penicillins	12.190	+0.538	+5%
Pleuromutilins	0.021	+0.00583	+37%
Polypeptide antibiotics	17.633	−5.984	−25%
Sulfonamides	2.993	−0.00323	−0.1%
Tetracyclines	0.534	−0.301	−36%
Total	**51.775**	**−6.218**	**−11%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for antibiotic classes for which the consumption quantity in the reporting or previous year's period was less than one kilogram or for which the change was less than one per thousand.

Table 27: Consumption quantities per AMEG category in broilers in 2022 and changes compared with the previous year.

AMEG category	Consumption quantities 2022[a] [t]	Change compared with the previous year[a] [t]	Change compared with the previous year[b] [%]
B (Restrict)	17.908	−6.141	−26%
C (Caution)	9.227	−0.196	−2%
D (Prudence)	24.641	+0.119	+0.5%
Total	**51.775**	**−6.218**	**−11%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for AMEG categories for which the consumption quantity in the reporting or previous year's period was less than one kilogram or for which the change was less than one per thousand.

3.6 Fattening turkeys

In Figure 8, a comparison is made of how the population-wide treatment frequency and the consumption quantities in fattening turkeys in 2022 were distributed among the antibiotic classes. All corresponding figures can be found in Table 28 (population-wide treatment frequency) and Table 30 (consumption quantities). These tables also contain the changes compared with the previous year.

Table 29 contains the distribution of the population-wide treatment frequency among the AMEG categories, including changes compared with the previous year; Table 31 shows the corresponding distribution of the consumption quantities.

Population-wide treatment frequency

In terms of population-wide treatment frequency, penicillins were by far the most important antibiotic class for fattening turkeys in 2022 (21.5 days; −0.6 days compared with the previous year) followed by polypeptide antibiotics (4.3 days; −0.7 days) and fluoroquinolones (3.9 days; +0.3 days). The largest percentage changes compared with the previous year were increases for lincosamides (+32% to 0.83 days in 2022 compared with 2021) and fluoroquinolones (+9% to 3,9 days) as well as decreases for sulfonamides (−29% to 2.1 days), polypeptide antibiotics (−14% to 4.3 days), and, at a low absolute level, folic acid antagonists (−16% to 0.11 days) and fenicols (−11% to 0.09 days).

Broken down by AMEG category, active ingredients of Category D were used most frequently in fattening turkeys in 2022 with a population-wide treatment frequency of 26.6 days (−1.4 days compared with the previous year) followed by active substances of the highest Category B (8.2 days; −0.4 days) and active ingredients of Category C (5.9 days; hardly any change compared with the previous year).

Consumption quantities

The antibiotic class with the highest consumption quantities in fattening turkeys in 2022 was penicillins with (24 t; −3.7 t compared with the previous year) followed by macrolides (11.2 t; −1.4 t) and polypeptide antibiotics (6.3 t; −2.4 t). Contrary to the decrease in the average total population of fattening turkeys (−6% from 2021 to 2022), increases in consumption quantities were identified for lincosamides (+86% to 0.54 t in 2022 compared with 2021) and pleuromutilins (+29% to 2.5 t). The strongest percentage decreases were recorded in the consumption quantities of sulfonamides (−32% to 2.3 t) and polypeptide antibiotics (−27% to 6.3 t) as well as (at a low absolute level) in fenicols (−55% to 0.042 t) and folic acid antagonists (−26% to 0.075 t).

In the case of fattening turkeys, active ingredients of AMEG Category D accounted for the largest proportion of consumption quantities (32.8 t; −5.4 t compared with the previous year) followed by Category C (15.4 t; −0.8 t). In total, 7.7 t (−2.4 t) of active ingredients of Category B were consumed. Category B experienced the strongest decrease among the AMEG categories (−24%), whereby this is largely due to the reduced consumption quantities of polypeptide antibiotics.

In fattening turkeys, similar to broilers, the oral administration of colistin was usually at high daily doses (for most applications, this was five to nine times the animal daily dose that results from standardised values for dosages and animal weights for this active ingredient).

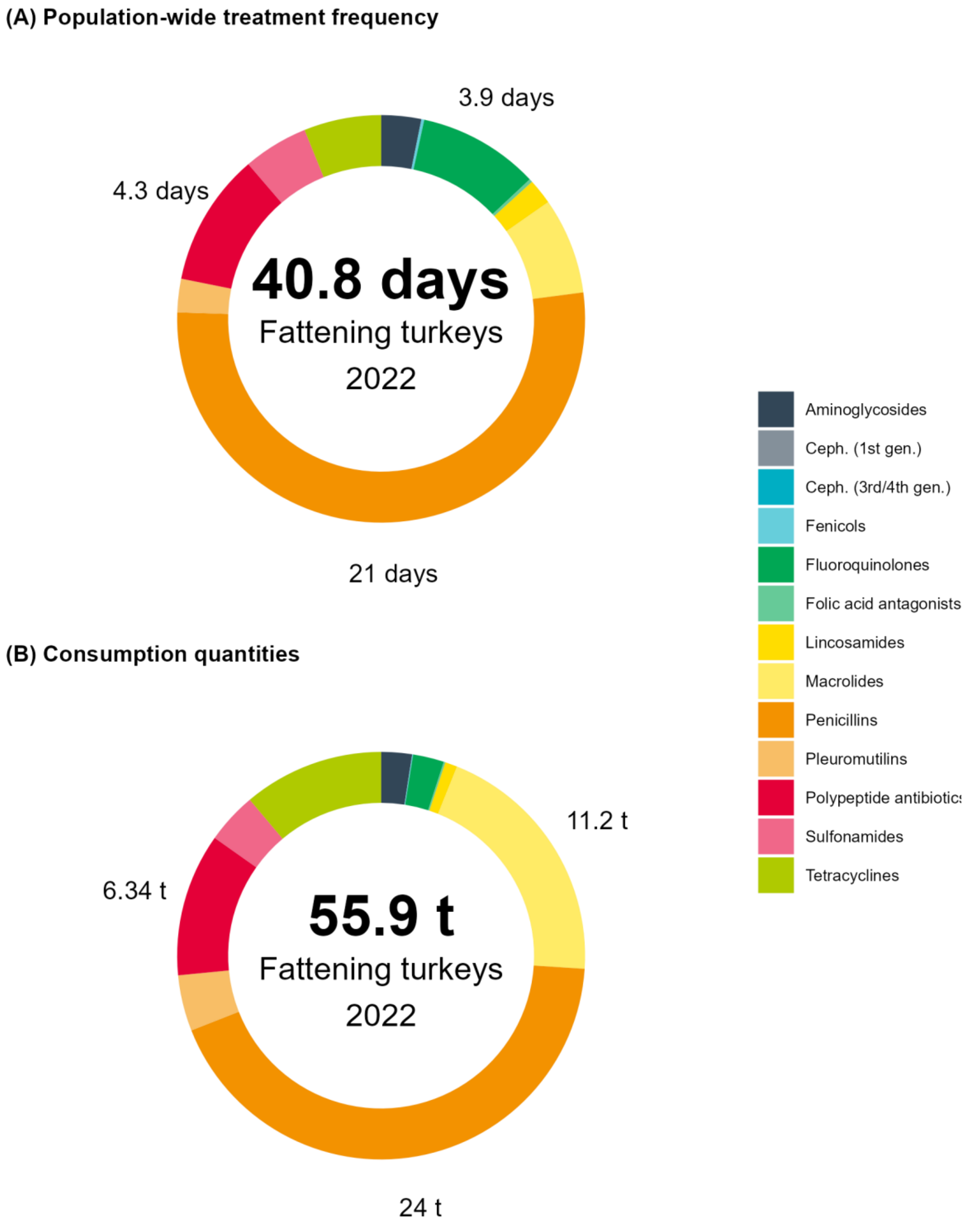


Figure 8: Distribution of (A) population-wide treatment frequency in days and (B) consumption quantities in tonnes among the antibiotic classes in fattening turkeys in 2022. The values are given for each of the three antibiotic classes with the highest population-wide treatment frequency or consumption quantity.

Table 28: Population-wide treatment frequency per antibiotic class in fattening turkeys in 2022 and changes compared with the previous year.

Antibiotic class	**Population-wide treatment frequency 2022[a] [days]**	**Change compared with the previous year[a] [days]**	**Change compared with the previous year[b] [%]**
Aminoglycosides	1.293	+0.064	+5%
First-generation cephalosporins	0	0	
Third- and fourth-generation cephalosporins	0	0	
Fenicols	0.093	−0.012	−11%
Fluoroquinolones	3.916	+0.313	+9%
Folic acid antagonists	0.109	−0.021	−16%
Lincosamides	0.826	+0.202	+32%
Macrolides	3.116	−0.270	−8%
Penicillins	21.451	−0.556	−3%
Pleuromutilins	1.084	+0.094	+9%
Polypeptide antibiotics	4.305	−0.697	−14%
Sulfonamides	2.105	−0.853	−29%
Tetracyclines	2.498	−0.056	−2%
Total	**40.797**	**−1.794**	**−4%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for antibiotic classes for which the population-wide treatment frequency in the reporting or previous year's period was less than 0.001 days or for which the change was less than one per thousand.

Table 29: Population-wide treatment frequency per AMEG category in fattening turkeys in 2022 and changes compared with the previous year.

AMEG category	**Population-wide treatment frequency 2022[a] [days]**	**Change compared with the previous year[a] [days]**	**Change compared with the previous year[b] [%]**
B (Restrict)	8.221	−0.384	−4%
C (Caution)	5.930	−0.00434	n/a
D (Prudence)	26.646	−1.405	−5%
Total	**40.797**	**−1.794**	**−4%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for AMEG categories for which the population-wide treatment frequency in the reporting or previous year's period was less than 0.001 days or for which the change was less than one per thousand.

Table 30: Consumption quantities per **antibiotic** class in fattening turkeys in 2022 and changes compared with the previous year.

Antibiotic class	Consumption quantity 2022[a] [t]	Change compared with the previous year[a] [t]	Change compared with the previous year[b] [%]
Aminoglycosides	1.363	−0.221	−14%
First-generation cephalosporins	0	0	
Third- and fourth-generation cephalosporins	0	0	
Fenicols	0.042	−0.050	−55%
Fluoroquinolones	1.377	−0.00587	−0.4%
Folic acid antagonists	0.075	−0.027	−26%
Lincosamides	0.537	+0.249	+86%
Macrolides	11.161	−1.355	−11%
Penicillins	24.040	−3.709	−13%
Pleuromutilins	2.483	+0.561	+29%
Polypeptide antibiotics	6.345	−2.387	−27%
Sulfonamides	2.268	−1.060	−32%
Tetracyclines	6.226	−0.576	−8%
Total	**55.915**	**−8.582**	**−13%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for antibiotic classes for which the consumption quantity in the reporting or previous year's period was less than one kilogram or for which the change was less than one per thousand.

Table 31: Consumption quantities per AMEG category in fattening turkeys in 2022 and changes compared with the previous year.

AMEG category	Consumption quantities 2022[a] [t]	Change compared with the previous year[a] [t]	Change compared with the previous year[b] [%]
B (Restrict)	7.722	−2.393	−24%
C (Caution)	15.392	−0.837	−5%
D (Prudence)	32.802	−5.351	−14%
Total	**55.915**	**−8.582**	**−13%**

[a] Rounded to three decimal places or, for values below 0.01, to three significant digits.
[b] Rounded to whole percentages or, in the case of values below 1%, to one decimal place. In order to avoid misleadingly large or small percentage values, no percentage changes are given for AMEG categories for which the consumption quantity in the reporting or previous year's period was less than one kilogram or for which the change was less than one per thousand.

4 Comparative development of antibiotic use and antibiotic resistance

4.1 Antibiotic use 2014–2022

For all animal categories, the annual development of antibiotic use since the start of recording in 2014, broken down by antibiotic class, is shown in Figure 9 on the basis of population-wide treatment frequency and in Figure 10 on the basis of consumption quantities[14]. In each year, the active ingredient classes are sorted from top to bottom in descending order of population-wide treatment frequency or consumption quantity. On one hand, this makes it possible to identify the most important antibiotic classes at a glance; on the other hand, it makes it clear when there are shifts in the selection of active ingredients over time.

In all animal categories, there was a considerable decrease in population-wide treatment frequencies between 2014 and 2016; this is generally also reflected in lower treatment frequencies of the individual antibiotic classes. Measured by the treatment frequency within an animal category, in some cases certain antibiotic classes gained or lost importance compared with other antibiotic classes. For example, in fattening calves, macrolides replaced penicillins as the second most frequently used antibiotic class in 2015; in fattening pigs, penicillins were also replaced by tetracyclines as the most important antibiotic class in 2015. In fattening cattle, third- and fourth-generation cephalosporins gained importance over the other antibiotic classes in 2015; however, this importance has since decreased again continuously. In fattening piglets, polypeptide antibiotics were displaced by tetracyclines as the second most important antibiotic class after penicillins in 2020. However, this development was reversed in 2022.

The development in broilers described in the previous report (Flor et al., 2022b) regarding the decreasing frequency of use of polypeptide antibiotics (i.e. colistin) since 2017 and the increased use of aminoglycosides and lincosamides (often in combination preparations) can be clearly seen in Figure 9. The resulting shift in the use from mono-preparations to combination preparations leads to an increase in the treatment frequency with a simultaneous reduction in the total consumption quantities because colistin is usually used in high doses in broilers. This development only partially continued in 2022 in the sense that the treatment frequencies and consumption quantities of polypeptide antibiotics have continued to decrease, whereas there have been hardly any changes for lincosamides and aminoglycosides.

In fattening turkeys, penicillins, polypeptide antibiotics, and fluoroquinolones have been the most frequently used antibiotic classes since the beginning of the recording.

[14] Because data for 2014 are available only from the second half of the year, the respective half-year values were doubled to an annual value for both the population-wide treatment frequencies and the consumption quantities.

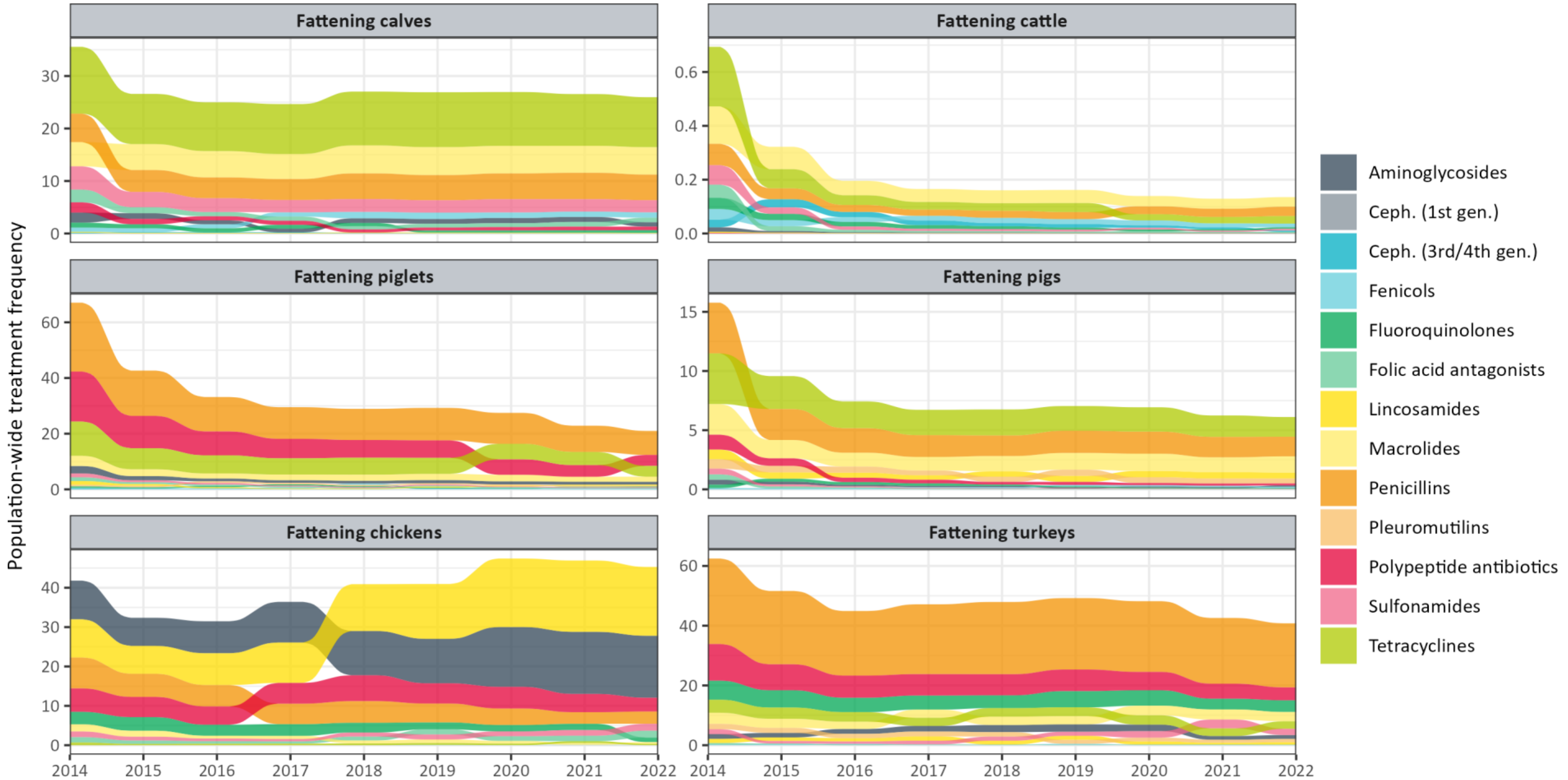


Figure 9: Development of population-wide treatment frequency per antibiotic class for the animal categories since 2014. Because only data from the second half of the year is available for 2014, this half-year value was doubled to an annual value. For each year, the antibiotic classes are sorted from top to bottom in descending order of population-wide treatment frequency. The axis for the treatment frequency is individually scaled for each animal category.

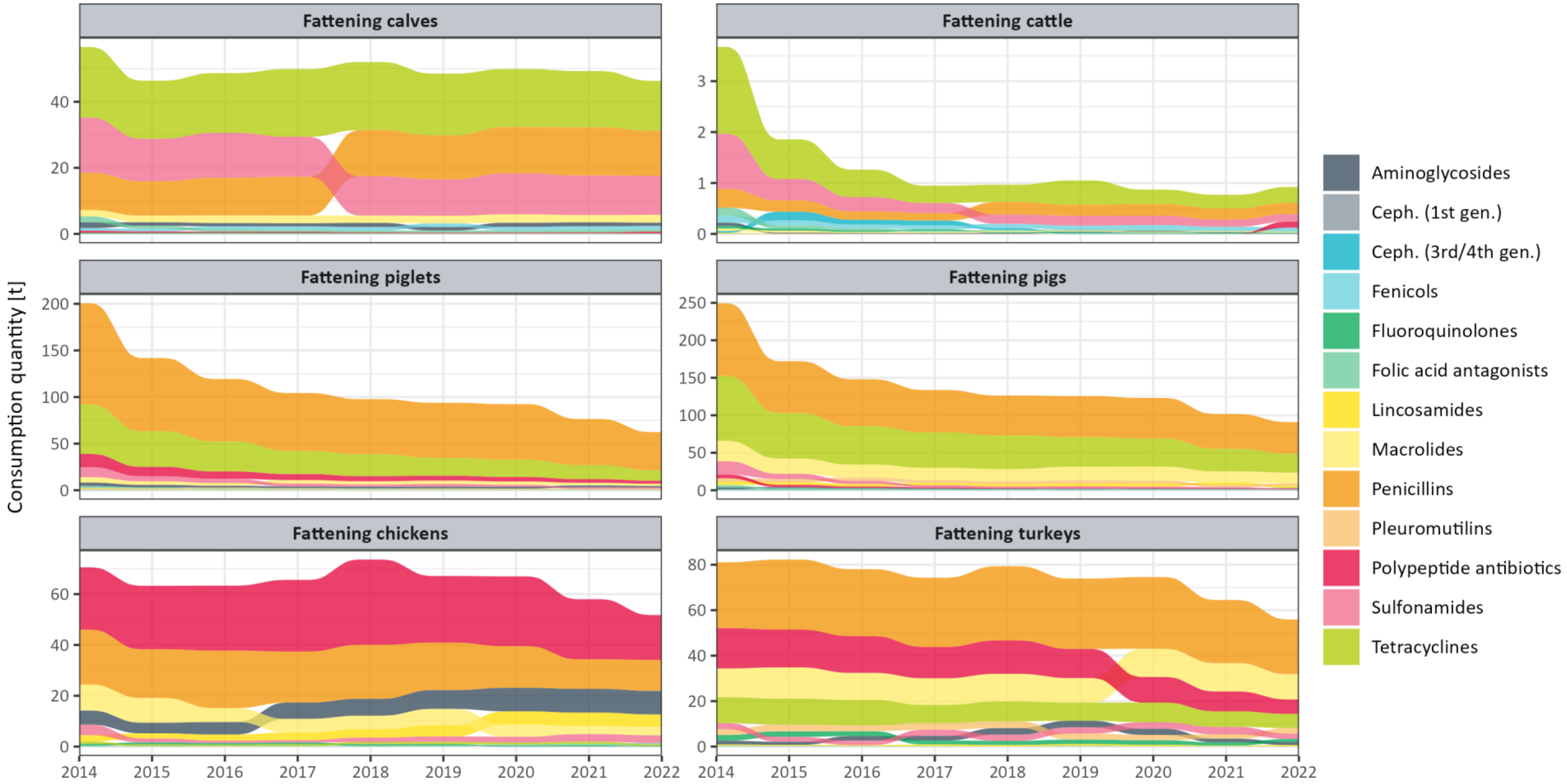


Figure 10: Development of consumption quantities per antibiotic class for the animal categories since 2014. Because only data from the second half of the year is available for 2014, this half-year value was doubled to an annual value. For each year, the antibiotic classes are sorted from top to bottom in descending order of consumption. The axis for the consumption quantity is individually scaled for each animal category.

4.2 Trend in antimicrobial resistance for 2014–2022 and 2015–2021, respectively

Based on Commission Implementing Decisions (EU) 2013/652 and 2020/1729 respectively, *E. coli* from caecal samples of slaughtered animals are tested for antimicrobial resistance across the EU. In Germany, corresponding samples from four animal populations were examined at slaughter: Fattening turkeys, broilers, fattening pigs and "fattening calves and young cattle". Fattening calves and young cattle are cattle slaughtered at less than 12 months of age. In even years, broilers and fattening turkeys are examined; in odd years fattening pigs as well as fattening calves and young cattle are examined.

The results of these investigations over time for 14 test substances that were tested in all years are shown in Figure 11 for fattening calves, young cattle, and fattening pigs and in Figure 12 for broilers and fattening turkeys. The left column shows the results for the active substances classified by the AMEG as Category A and B and thus as particularly important for consumer health protection. The right column shows the results for the other antibiotics. No isolate was classified as resistant to the carbapenem meropenem over the entire observation period.

The minimum inhibitory concentrations identified were assessed against the current cut-off values proposed in the Commission Implementing Decision (EU) 2020/1729 or by EFSA and EURL.

The figures show that *E. coli* from fattening turkeys and broilers had higher resistance rates than those from fattening calves/young cattle and pigs. They also show that the development of resistance rates differed between species as well as within species between substances.

Long-term resistance development was tested using logistic regressions in which resistance outcome was the binary dependent variable and year was the numerical independent variable. The regressions were calculated separately for the four animal populations and the test substances. A p-value < 0.05 was considered significant. With a p-value between 0.05 and 0.1, the difference was mentioned in the text, but it was pointed out that it was not significant.

At the same time, the development of resistance was also assessed in comparison to the previous examination. The results of the years 2019 and 2021 (fattening calves/young cattle and fattening pigs) and 2020 and 2022 (broilers and fattening turkeys) were compared separately for all test substances and animal categories, and the significance was assessed with the chi-square test.

Fattening calves and young cattle

Resistance of *E. coli* from fattening calves and young cattle showed little change between 2015 and 2021. Only the frequency of resistance to the macrolide azithromycin decreased significantly ($p = 0.032$). The decrease in the frequency of resistance to sulfamethoxazole was not significant ($p = 0.086$). No significant increase was found for any substance. When looking at the changes between 2019 and 2021, there were no differences in resistance rates.

Fattening pigs

E. coli from slaughter pigs showed significantly decreasing resistance rates to tetracycline between 2015 and 2021 (p = 0.008). The frequency of resistance to third-generation cephalosporins also decreased slightly; however, this decrease was not significant (p = 0.080 for cefotaxime and p = 0.073 for ceftazidime). No significant increase was found for any substance.

Looking at the changes between 2019 and 2021, there were decreases in resistance rates to the (fluoro)quinolones ciprofloxacin (p = 0.002) and nalidixic acid (p = 0.003) and the third-generation cephalosporins, cefotaxime (p = 0.012) and ceftazidime (p = 0.019).

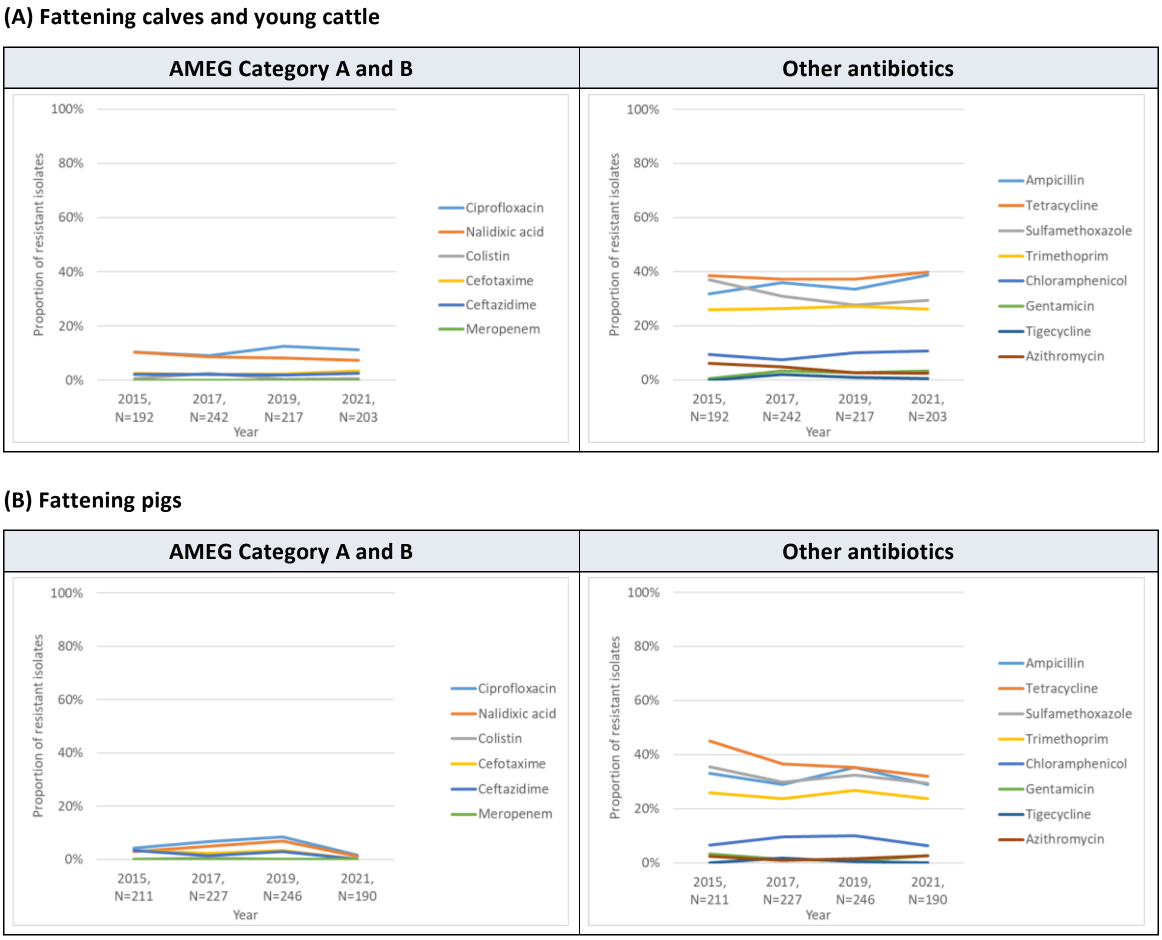


Figure 11: Resistance of *E. coli* from appendix contents of (A) fattening calves and young cattle and (B) fattening pigs. Left column: Proportions of isolates resistant against antibiotics of AMEG categories A and B; right column: proportions of isolates resistant against other antibiotics.

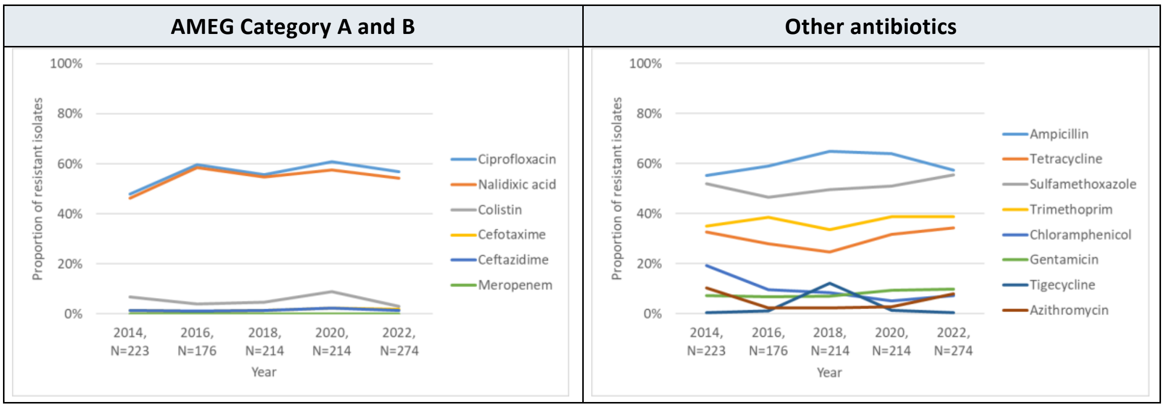
Broilers

In broilers at the slaughterhouse, there was a significant decrease in the frequency of *E. coli* resistance to chloramphenicol between 2014 and 2022. The increase in resistance to ciprofloxacin was not significant (p = 0.065). Between 2020 and 2022, the frequency of resistance to the macrolide azithromycin increased significantly (p = 0.014). At the same time, the resistance of the isolates to colistin decreased (p = 0.004).

Fattening turkeys

E. coli from fattening turkeys showed a significant decrease in resistance rates between 2014 and 2022 for seven of the 14 substances tested (ampicillin, p = 0.017, gentamicin, p = 0.005, chloramphenicol, p = 0.001, trimethoprim, sulfamethoxazole, azithromycin and tetracycline, each p < 0.001). No significant increase was found for any substance. Between 2020 and 2022, resistance to colistin decreased; however, this was not significant (p = 0.061).

(A) Broilers



(B) Fattening turkeys

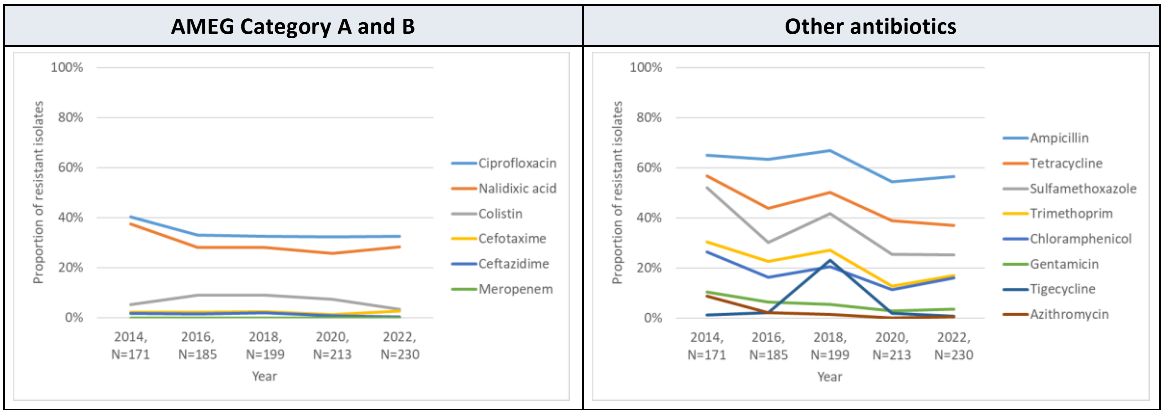


Figure 12: Resistance of *E. coli* from the appendix of (A) broilers and (B) fattening turkeys. Left column: Proportions of isolates resistant against antibiotics of AMEG categories A and B; right column: proportions of resistant isolates resistant against other antibiotics.

4.3 Comparison of the developments

The comparison between the development of population-wide treatment frequency and antibiotic resistance showed a mixed picture. Overall, a decrease in resistance rates to at least one antibiotic class was observed in slaughter animals (fattening calves and young pigs, broilers, fattening turkeys) from 2014 to 2022 (10 significant decreases with p < 0.05; three decreases with $p < 0.1$). A significant increase in the resistance rate was not observed; however, resistance to ciprofloxacin did increase in broilers but not significantly ($p = 0.065$).

Most decreases were observed in fattening turkeys. At the beginning of the observation period, isolates from turkeys had the highest resistance rates; turkeys also had the highest treatment frequencies. The long-term decrease in resistance rates affected mainly substances in AMEG Categories C and D, whereas there was no decrease in resistance rates for either fluoroquinolones, cephalosporins or colistin. For most substances, the decrease in the resistance rate also corresponded to a decrease in treatment frequency when comparing the first two half-years documented (2014/2 and 2015/1) with 2022. This was not the case for chloramphenicol because this substance has been banned for use in farm animals for decades. An opposite effect was seen for the sulfonamides. Here, the treatment frequency increased, whereas the resistance rates in fattening turkeys decreased significantly.

For the other animal categories, too, the long-term decrease in resistance rates did not apply to substances in AMEG Category B but rather only to substances from AMEG Categories C and D. Only in isolates from pigs did the proportion of isolates resistant to third-generation cephalosporins decrease slightly ($p = 0.080$ for cefotaxime and 0.073 for ceftazidime, respectively).

Between the last two years of examination, however, resistance rates to Category B antibiotics in particular decreased significantly (namely to colistin in broilers and to fluoroquinolones and third-generation cephalosporins in fattening pigs). The decrease in the frequency of colistin resistance in poultry corresponds to the considerable decrease in the population-wide treatment frequency with these substances. However, such a decrease in treatment frequency was also observed for other substances without this having a short-term influence on resistance rates. The decrease in resistance to cephalosporins and fluoroquinolones in pigs from 2019 to 2021 also corresponded to a decrease in population-wide treatment frequency. However, the increase in resistance to azithromycin in isolates from broilers cannot be explained by an increase in population-wide treatment frequency with macrolides because the treatment frequency effectively decreased from 2020 to 2022.

5 Date-based short evaluation

With the Seventeenth Act Amending the Medicinal Products Act (17. AMGÄndG), which came into force on 1 November 2021, the notification obligations regarding the use of medicinal products by livestock farms were extended to include the “date of first administration or the date of dispensing of the medicinal product”. It is now possible for the first time to map the course of antibiotic use over the course of a year. In Figure 13, the course of the population-wide treatment frequency calculated to the day is shown for each of the animal categories[15] (grey) in 2022, including smoothed trend lines (blue). Weekly

[15] The following procedure was used for the daily calculation of the population-wide treatment frequency:

1. For each notified administration of a medicinal product, the treatment animal days (product of number of treated animals and number of treatment days) were divided between the day of administration (or the day of dispensing) and the days following this according to the number of treatment days indicated.
2. For each day of the year, the sum of the treatment animal days on that day was calculated separated by animal category.

fluctuations in population-wide treatment frequency are observed in all animal categories. However, the trend lines show different developments over the course of the year for the different animal categories.

In fattening calves and especially in fattening cattle, the population-wide treatment frequency decreased in the first half of the year and increased again in the second half. The population-wide treatment frequency was thus lowest in the summer months.

In fattening piglets and fattening pigs, the population-wide treatment frequency also increased in the second half of the year and showed the lowest values in the summer months. However, there was an initial increase in population-wide treatment frequency in both pig populations at the beginning of the year.

In broilers, the trend line of the population-wide treatment frequency showed little variation over the course of the year. For fattening turkeys, after slight fluctuations in the first half of the year, the population-wide treatment frequency showed a considerable increase in the second half of the year.

The weekly fluctuations in population-wide treatment frequency for all animal categories are illustrated by Figure 14, which summarises the corresponding daily values for each day of the week. For all animal categories, it can be seen that the treatment frequency over the course of the week was generally highest on Fridays and lowest on Sundays or Mondays.

This pattern can be explained with the help of Figure 15, which shows for each day of the week the number of administrations for which the first administration or the dispensing of the medicinal product took place on the respective day of the week; the number of treatment days can also be seen from the colours used. Accordingly, it was true for all animal categories that the first day of administration or dispensing fell considerably less frequently on a Saturday or Sunday. Because the vast majority of administrations took place with more than one treatment day, the distribution of the effective days described in footnote 15 over the days following the day of the first administration or the day of dispensing led to the observed increase in the population-wide treatment frequency from Monday to Friday and the subsequent decrease over the weekend.

3. For each day of the year, the daily average total population sizes of the animal categories were calculated.
4. The daily population-wide treatment frequency of an animal category is then calculated as the quotient of these two values:

$$\text{Population-wide treatment frequency} = \frac{\text{Total treatment animal days per day}}{\text{Average total population size per day}}$$

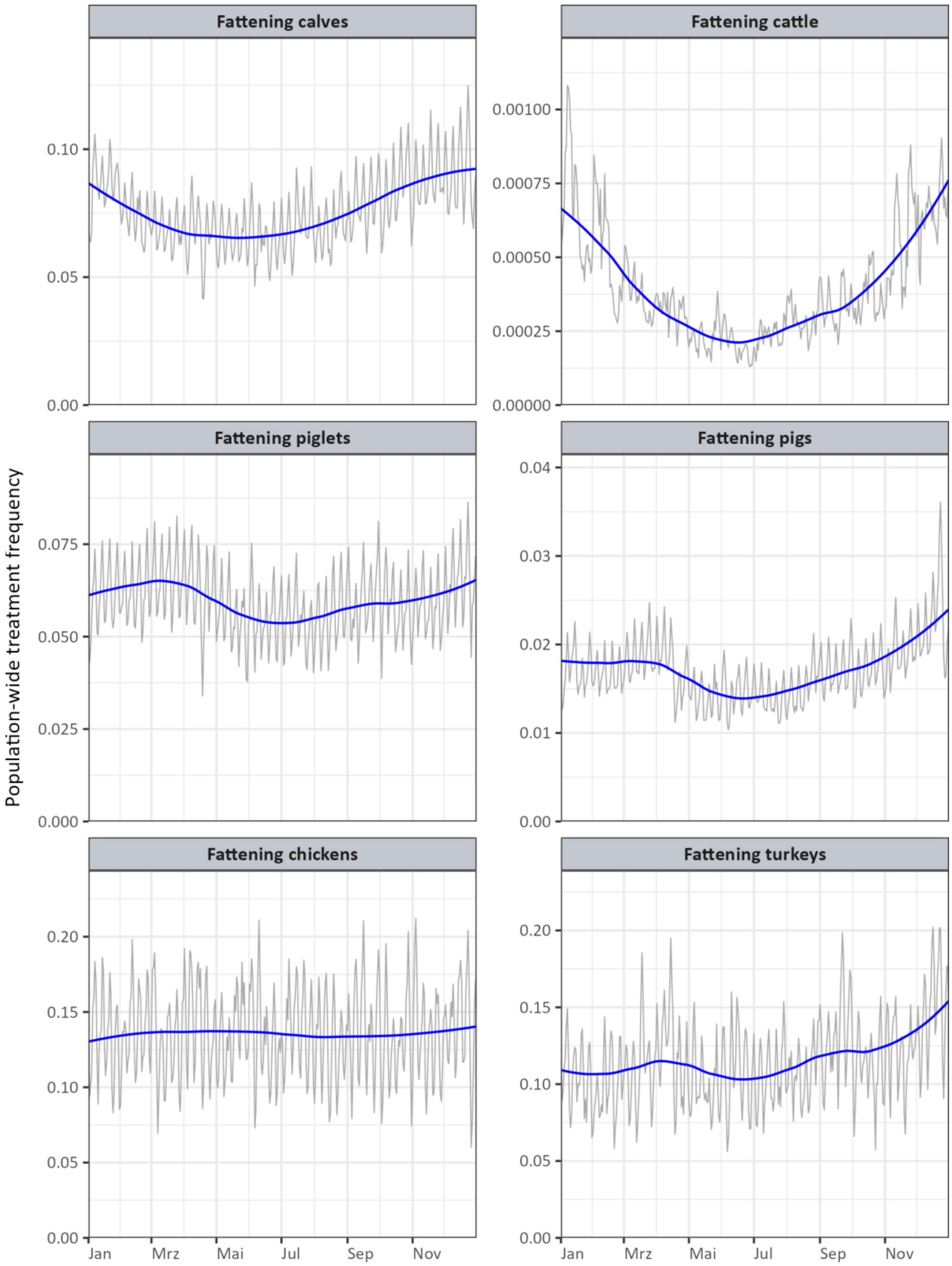


Figure 13: Course of the population-wide treatment frequency for the animal categories during 2022. The grey lines represent the values calculated to the day; the blue lines are smoothed trend lines. The axis for the treatment frequency is individually scaled for each animal category.

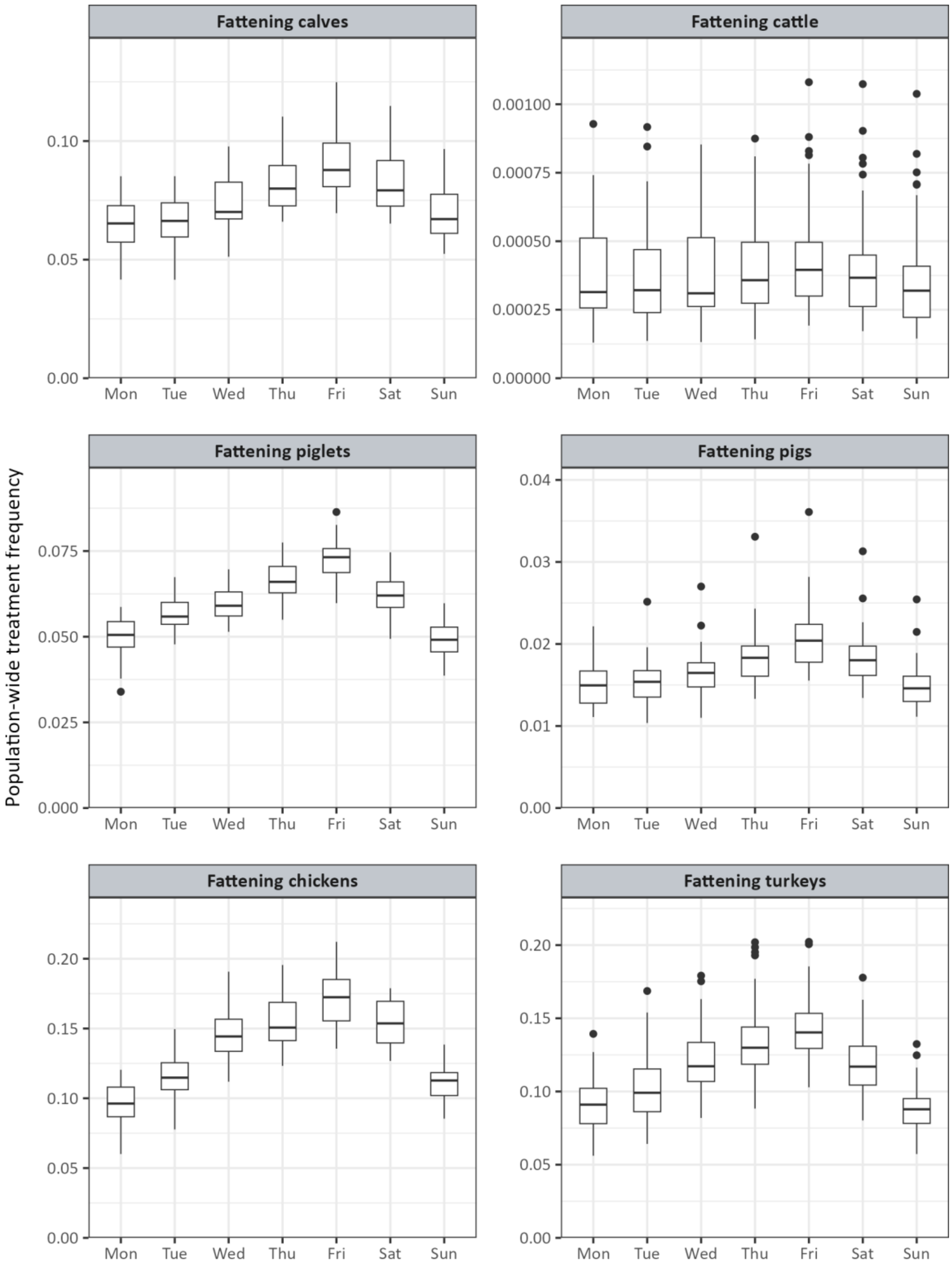


Figure 14: Distribution of the population-wide treatment frequency calculated to the day over the weekdays for all animal categories for the year 2022. The axis for the treatment frequency is individually scaled for each animal category.

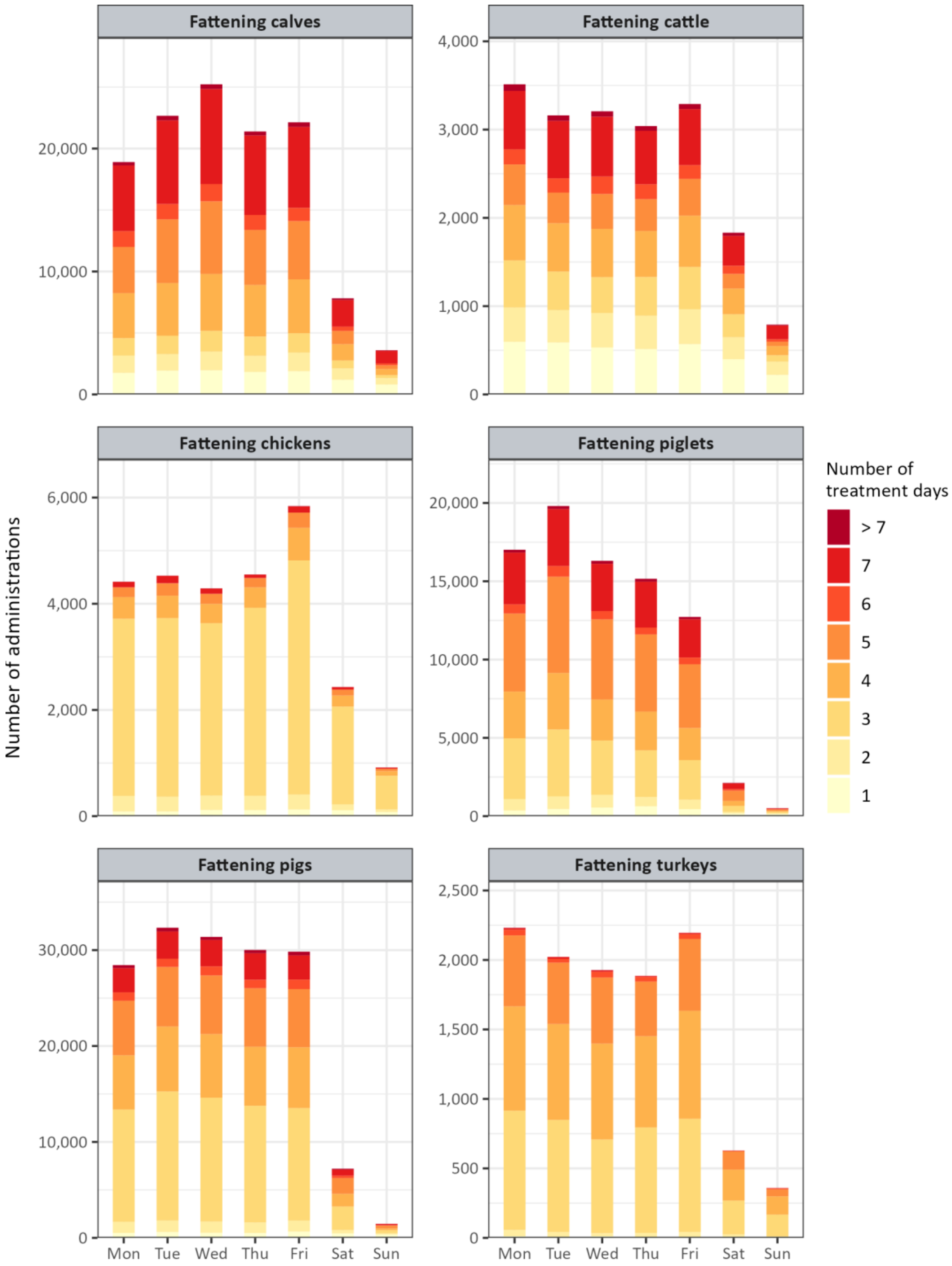


Figure 15: Number of administrations for each day of the week on which the first administration or dispensing of the medicinal product took place in 2022 for the six animal categories broken down by number of treatment days indicated. The axis for the number of administrations is individually scaled for each animal category.

6 References

17. AMGÄndG. Siebzehntes Gesetzes zur Änderung des Arzneimittelgesetzes; Gesetz vom 10.08.2021 (BGBl. I S. 3519, Nr. 53). https://www.buzer.de/gesetz/14907/index.htm

BfArM-AMV. Verordnung über das datenbankgestützte Informationssystem über Arzneimittel des Bundesinstituts für Arzneimittel und Medizinprodukte (BfArM-Arzneimitteldatenverordnung); Verordnung vom 24. Februar 2010 (BGBl. I S. 140), zuletzt geändert durch Artikel 9 des Gesetzes vom 27. September 2021 (BGBl. I S. 4530). https://www.buzer.de/gesetz/9205/index.htm

BVL (2023). Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (BVL). *Abgabemengen von Antibiotika in Tiermedizin gehen weiter zurück*. Abgerufen am 09.08.2023 von https://www.bvl.bund.de/SharedDocs/Pressemitteilungen/05_tierarzneimittel/2023/2023_PM_Abgabemengen_Antibiotika_Tiermedizin.html

Durchführungsverordnung (EU) 2022/1255. Durchführungsverordnung (EU) 2022/1255 der Kommission vom 19. Juli 2022 zur Bestimmung von antimikrobiellen Wirkstoffen oder von Gruppen antimikrobieller Wirkstoffe, die gemäß der Verordnung (EU) 2019/6 des Europäischen Parlaments und des Rates der Behandlung bestimmter Infektionen beim Menschen vorbehalten bleiben müssen. *Amtsblatt der Europäischen Union L 191*: 58-60 (2022). http://data.europa.eu/eli/reg_impl/2022/1255/oj

EMA (2019). European Food Safety Authority (EMA). Categorisation of antibiotics in the European Union. *EMA/CVMP/CHMP/682198/2017*. https://www.ema.europa.eu/en/documents/report/categorisation-antibiotics-european-union-answer-request-european-commission-updating-scientific_en.pdf

EMA (2020). European Medicines Agency (EMA). Infografik: Kategorisierung von Antibiotika zur Anwendung bei Tieren für den sorgfältigen und verantwortungsvollen Einsatz. https://www.ema.europa.eu/en/documents/report/infographic-categorisation-antibiotics-use-animals-prudent-responsible-use_de.pdf

Flor, M., Käsbohrer, A., Kaspar, H., Tenhagen, B.-A., & Wallmann, J. (2019). Bundesministerium für Ernährung und Landwirtschaft (BMEL). *Beiträge der Arbeitsgruppe Antibiotikaresistenz des Bundesinstituts für Risikobewertung (BfR) und des Bundesamtes für Verbraucherschutz und Lebensmittelsicherheit (BVL) zur Evaluierung der 16. AMG-Novelle. Themenkomplex 1: Entwicklung der Antibiotikaabgabe- und -verbrauchsmengen sowie der Therapiehäufigkeit* (Bericht des Bundesministeriums für Ernährung und Landwirtschaft über die Evaluierung des Antibiotikaminimierungskonzepts der 16. AMG-Novelle. (Anhang 2). https://www.bmel.de/DE/themen/tiere/tierarzneimittel/kurzfassung16-amg-novelle.html

Flor, M., Käsbohrer, A., & Tenhagen, B.-A. (2022a). Bundesinstitut für Riskikobewertung. *Ergänzende Informationen zum Bericht „Therapiehäufigkeit und Antibiotikaverbrauchsmengen 2018–2021: Entwicklung in zur Fleischerzeugung gehaltenen Rindern, Schweinen, Hühnern und Puten“*. https://www.bfr.bund.de/de/antibiotikaeinsatz_bei_masttieren-309250.html

Flor, M., Käsbohrer, A., & Tenhagen, B.-A. (2022b). Bundesinstitut für Risikobewertung. *Therapiehäufigkeit und Antibiotikaverbrauchsmengen 2018–2021: Entwicklung in zur Fleischerzeugung gehaltenen Rindern, Schweinen, Hühnern und Puten*. https://www.bfr.bund.de/de/antibiotikaeinsatz_bei_masttieren-309250.html

Flor, M., Tenhagen, B.-A., & Käsbohrer, A. (2022c). Contrasting Treatment- and Farm-Level Metrics of Antimicrobial Use Based on Used Daily Dose vs. Defined Daily Dose for the German Antibiotics Minimization Concept [Original Research]. *Frontiers in Veterinary Science*, *9*. https://doi.org/10.3389/fvets.2022.913197

TAMG. Gesetz über den Verkehr mit Tierarzneimitteln und zur Durchführung unionsrechtlicher Vorschriften betreffend Tierarzneimittel (Tierarzneimittelgesetz - TAMG); Gesetz vom 27.09.2021 (BGBl. I S. 4530, Nr. 70); zuletzt geändert durch Artikel 1 der Verordnung vom 21.12.2022 (BGBl. I S. 2852). https://www.buzer.de/TAMG.htm

TAMMitDurchfV. Verordnung über die Durchführung von Mitteilungen nach §§ 58a und 58b des Arzneimittelgesetzes (Tierarzneimittel-Mitteilungendurchführungsverordnung - TAMMitDurchfV); Verordnung vom 18.06.2014 (BGBl. I S. 797, Nr. 27); aufgehoben durch Artikel 3 der Verordnung vom 02.01.2023 (BGBl. I Nr. 3). https://www.buzer.de/gesetz/11198/index.htm

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