ANTIMICROBIAL CONSUMPTION IN ANIMALS

4. Antimicrobial consumption in animals

Highlights: In 2023, the total consumption of antimicrobials in animals amounted to 86.69 tonnes of active compounds approved for animals.

The **pig sector** consumed 84.03% of all prescribed veterinary antimicrobials, equal to 72.85 tonnes of active compound. Calculated in treatment proportions, an estimated 3.21% (32.08 DAPD) of all pigs, on average, received antimicrobial treatment per day in 2023. In sows and piglets and in finishers, the treatment proportions increased by 3.41% and 14.12%, respectively, in 2023 compared to 2022. The highest treatment proportion was observed in the treatment of weaners: 11.92%, corresponding to 119.3 DAPD. The treatment of weaners increased by 14.86% in 2023 compared to 2022, continuing the increasing trend observed in 2022, with a 7.61% increase compared to 2021. This increase is most likely a result of the ban of prescribed zinc oxide usage in pig production implemented June 2022. In addition, the previous ceased use of colistin, and the implementation of Order 2019/6 on veterinary medicinal products applied since January 2022 could also have affected the antimicrobial use. The increase seen in 2022 and 2023 was mostly due to an increased use of neomycin and apramycin to treat post-weaning diarrhea.

Over time, the antimicrobial classes used in the treatment of pigs have changed notably. The critically important antimicrobials 3rd and 4th generation cephalosporins, glycopeptides, polymyxins, and fluoroquinolones have been phased out. However, over the last decade, there has been an increase in the consumption of macrolides from 6.07 DAPD to 8.23 DAPD, aminoglycosides from 1.42 DAPD to 6.65 DAPD, and simple penicillins from 2.82 DAPD to 3.46 DAPD. During the same period, the consumption of tetracyclines has decreased from 9.20 DAPD in 2014 to 4.47 DAPD in 2023.

In 2023, antimicrobial consumption in **cattle** amounted to 7.96 tonnes. Approximately two thirds of the consumption were used to treat older cattle (>1 year). Over the past decade, the total antimicrobial consumption has decreased for older cattle (>1 year), from 2.79 DAPD to 1.91 DAPD. During the same period, an increase in the total consumption from 5.43 DAPD to 7.04 DAPD was observed in young cattle. Also in cattle, the changes in usage of antimicrobial classes are noticeable i.e., there has been an increased consumption of aminoglycoside, amphenicols, macrolides, and simple penicillins (beta-lactamase sensitive penicillins) for treatment of younger cattle and increased consumption of simple penicillins (beta-lactamase sensitive penicillins) for intramammary treatment.

The antimicrobial consumption in **poultry** was 1305.80 kg active compound and has decreased by 40.55 kg from 2022 to 2023. In 2023 the consumption of macrolides decreased by 257.62 kg of active compound compared to 2022, while consumption of penicillins and tetracyclines increased.

In 2023, cephalosporins were prescribed mainly for **pets and horses** (58.49 kg) or as intramammary treatment for **cattle** (50.09 kg). Furthermore, fluoroquinolones (13.80kg) were prescribed almost exclusively for horses and pets.

4.1 Introduction

The DANMAP programme began monitoring the national consumption of antimicrobials in humans and animals in 1995.

Since the early 1990s, there has been increased political and public focus on the consumption of antimicrobials in the Danish animal production. This has resulted in discontinued usage of antimicrobials for growth promotion combined with several other initiatives, including voluntary bans on the use of 3rd and 4th generation cephalosporins in the pig and cattle production, as well as regulatory legislation regarding therapeutic use.

Figure 4.1 presents the total consumption of antimicrobials in animals and humans since 1990 and 1997, respectively. Increases in, and intensification of, pig production has also had a significant impact on the overall consumption during this time.

The observed decrease in antimicrobial consumption after 1994 was foremost due to the discontinued usage of antimicrobials for growth promotion and most likely also the result of 1) limitation of veterinary practitioners' profit from sales of medicine; 2) implementation of Veterinary Advisory Service contracts (VASCs) with regular visits from the veterinarian to promote preventive veterinary strategies and optimize antimicrobial consumption; and 3) enforcement of the so-called "cascade rule" [Order (DK) 142/1993], limiting the prescription of (cheaper) extemporaneously produced medicines.

Other important interventions were the restriction on the use of fluoroquinolones in production animals through legislation

implemented in 2002 and 2003, and the voluntary ban on use of cephalosporins in pig production in 2010, followed by a similar initiative in dairy cattle production in 2014.

Furthermore, the cattle production implemented a ban on use of 3rd and 4th generation cephalosporins for cattle from 2019.

The national action plan against antimicrobial resistance has had several goals throughout time. Initially, a 10% reduction of antimicrobial consumption in production animals by 2014 compared to the 2009 level was set as a national target. In 2015 the national action plan to reduce livestock-associated MRSA called for a 15% reduction in antimicrobial consumption in pigs from 2015 to 2018.

To achieve the action plan goals, the Yellow Card initiative was established in 2010, introducing surveillance at pig herd level. In practice, antimicrobial consumption is monitored in individual herds in relation to legislation-supported thresholds, which enables legal action on individual farmers with high antimicrobial consumption per pig [DANMAP 2010]. As a result, a distinct decrease in antimicrobial consumption has been observed at national level both when the Yellow Card was implemented (from 2010 to 2011), and when it was revised (from 2016 to 2018). In 2016, the Yellow Card initiative was revised, adding multiplication factors to adjust the consumption of certain antimicrobials. Tetracyclines were multiplied by 1.2, and the factor was increased to 1.5 in 2017. Fluoroquinolones, cephalosporins and colistin (added in 2017) were given the highest multiplication factor of 10 [DANMAP 2017].



Sources: Human therapeutics: The Danish Medicines Agency. Antimicrobials for animals: Data are based on reports from the pharmaceutical industry of total annual sales (until 2001), from the Federation of Danish pig producers and slaughterhouses (1994-1995), from the Danish Medicines Agency and Danish Plant Directorate (1996–2000), and since 2001 from VetStat. For DANMAP 2023, consumption data were extracted from the VetStat on 1 July 2024 and include all antimicrobials approved for use in animals

Effects from other legislative actions are also likely to have affected prescription patterns. As an example, the rules for group medication in pig herds were tightened in 2014 [Order (DK) 534 of 27/05/2014], calling for thorough laboratory diagnoses and frequent veterinary visits before and during prescription of antimicrobials for peroral treatment of groups of pigs through water or feed rather than injection treatment of individual pigs.

In 2017, the Ministry of Environment and Food in Denmark and the Ministry of Health in Denmark presented a new One Health strategy against antimicrobial resistance, setting the framework for reducing the development and occurrence of antimicrobial resistance (AMR) in both animals and humans. At the same time, a new national action plan to reduce AMR in animals was introduced, setting specific targets to further reduce the antimicrobial consumption for animals in the coming years (from 2019 to 2023).

Also, to reduce the need for disposal of excess antimicrobials, veterinarians and pharmacies were permitted to split packages of veterinary medicine as from 2019 [Order (DK) 1655/2018]. This initiative may also enhance surveillance by reducing the difference between amounts of antimicrobials prescribed and amounts consumed.

Official treatment guidelines for pigs and cattle have been available since 1996. The guidelines provide specific recommendations for selection of the appropriate antimicrobial treatment of all common problems in the major production animal species. Since 2005, the Danish Veterinary and Food Administration (DVFA) has updated the guidelines in collaboration with stakeholders and university experts. The guidelines were updated in 2010, when new dynamic evidence-based treatment guidelines for pigs were launched [DANMAP 2010, <u>https://foedevarestyrelsen.dk/]</u>, and a revised version was published in April 2018.

In 2012, to promote prudent use of antimicrobials in dogs and cats the Danish Veterinary Association (DVA) published treatment guidelines developed by clinical specialists and experts from the Faculty of Health and Medical Sciences at the University of Copenhagen and the National Food Institute, Technical University of Denmark. Revised treatment guidelines for dogs and cats were published in 2018. Similarly, DVA published treatment guidelines for use of antimicrobials in horses in 2017.

Order 2019/6 on veterinary medicinal products (VMPs) has been applied since 28 January 2022. There is a particular focus on reducing the risk of antimicrobial resistance [Order (DK) 6/2019], and it includes relevant provisions on the prescription and use of VMPs such as limiting the quantity prescribed to the amount required for the treatment or therapy concerned, limiting the prescription of antimicrobials for metaphylaxis or prophylaxis, ensuring that VMPs are used in accordance with the marketing authorisations (SPC), restricting the routine use of antimicrobials to compensate for e.g. poor hygiene and reserving the use of antimicrobials listed in Order 2022/1255 for treatment of certain infections in humans [DANMAP 2022, Textbox 4.2].

Following the recommendations from the European Medicines Agency (EMA), and the consequent decision issued by the European Commission in 2017, Denmark and all Member States had to ban the use of VMPs containing zinc oxide for food-producing animals by June 2022. The use of prescribed zinc oxide in pig production has been banned in Denmark since then [DANMAP 2022, Textbox 4.1].

4.1.1 Data sources

In Denmark, antimicrobials are available by prescription only, and data on antimicrobial consumption have been collected since 1990.

Since 2001, data on all medicines prescribed for consumption in animals, including vaccines, antimicrobial growth promoters, and coccidiostatica have been recorded in the national database VetStat. Since 2010, the VetStat database has been hosted and maintained by DVFA. In June 2021, DVFA launched an updated platform for VetStat. The 2023 data presented in this report were extracted from this new VetStat on 1. July 2024. The data were extracted, analysed, and interpreted for DANMAP by the National Food Institute, Technical University of Denmark.

4.2 Total antimicrobial consumption in animals

Together with the introduction of the new VetStat database in 2021, the criteria for allocating antimicrobial consumption to the different animal species and age groups were revised i.e., consumption is allocated to the species and age group combinations from the categories defined in VetStat [Order (DK) 2542/2021]. This affected the calculated amounts per species while the overall trends of antimicrobial consumption remained the same.

The total consumption of antimicrobials in all animals amounted to 86.69 tonnes of active compound, representing a 0.61% (523.18 kg) increase compared to 2022 (Figure 4.1). The 2023 consumption in pigs, cattle and poultry comprised approximately 84.03%, 9.18%, and 1.51%, respectively, of the total antimicrobial consumption in animals (Figure 4.2).

The pig production is the main driver of consumption of antimicrobials in animals in Denmark. Cattle comprises the largest live biomass followed by the live biomass of pigs. However, the vast proportion of cattle live biomass consists of dairy cows, which have very low consumption of antimicrobials compared with growing animals such as slaughter pigs.

Historically, the overall consumption of kg active compound of antimicrobials was 57.85% lower in 2023 compared to 1994. A major part of this reduction can be explained by the discontinued consumption of growth promoters from 1994 to 1999.

Between 2000 (start of VetStat) and 2009, the amount of kg active compound of antimicrobials used in animals increased by 61.7% (Figure 4.1). During this period, the number of finishers produced also increased, as did the proportion of exported live pigs at approximately 30 kg. Until 2021, the proportion of these pigs continued to increase, while there was an overall gradual decrease in the consumption of antimicrobials in animals. In 2022 and 2023, the number of produced finishers decreased by 4.33% and 17.93%, respectively.



The live biomass is estimated from census data (pigs, cattle, and companion animals) and production data (poultry, and aquaculture). The live biomass estimates for poultry (turkeys and broilers), aquaculture, horses and pets are based on 2012 data and may well be underestimated. The estimation procedures are described in Chapter 10, Section 10.2

Table 4.1 Antimicrobial consumption by animal species and age group, kg active compound, Denmark

DANMAP 2023

	Aminoglycosides	Amphenicols	Cephalosporins ^(a)	Fluoroquinolones	Lincosamides	Macrolides	Other antimicrobials ^(b)	Other quinolones	Penicillins, b-lactamase sensitive	Penicillins, others	Pleuromutilins	Sulfonamides and trimethoprim	Tetracyclines	2022	2023
Pigs	19236.6	608.9	-	-	1768.0	11114.8	-	-	11120.8	7255.4	6466.3	4712.9	10567.6	71356.2	72851.2
Sows, piglets, gilts and boars	2007.8	272.4	-	-	351.5	428.7	-	-	5903.8	2146.4	627.3	3658.5	1074.6	17082.9	16470.8
Weaners, =<30kg	17137.0	320.7	-	-	949.7	7469.5	-	-	1620.4	4368.9	2315.8	946.8	6936.8	39023.5	42065.6
Finishers and polts	91.8	15.8	-	-	466.8	3216.7	-	-	3596.6	740.1	3523.2	107.7	2556.1	15249.8	14314.8
Cattle	801.3	931.2	50.1	-	4.3	229.6	4.5	-	4263.0	563.4	-	363.3	750.5	8164.9	7961.2
Intramammaries	21.3	-	50.1	-	3.6	-	0.0	-	227.1	155.4	-	0.0	-	451.0	457.6
Cows, bulls, heifers and steers >24 months	184.1	10.3	-	-	0.5	73.1	0.2	-	3459.9	292.9	-	280.4	469.5	4851.5	4770.9
Calves <12 months	579.6	907.8	-	-	0.1	154.2	4.3	-	496.0	107.8	-	81.3	264.3	2589.3	2595.4
Young cattle btw 12 and 24 months	16.3	13.1	-	-	0.0	2.4	0.0	-	80.0	7.3	-	1.6	16.7	273.1	137.2
Poultry	50.2	-	-	-	15.3	176.3	-	-	315.9	203.1	16.9	31.2	496.9	1346.4	1305.8
Broilers	21.3	-	-	-	9.2	67.7	-	-	168.0	43.8	-	26.4	327.0	653.5	663.4
Layer hens	3.5	-	-	-	-	89.8	-	-	51.7	10.7	16.9	0.6	20.8	267.8	193.9
Turkeys	20.2	-	-	-	5.6	16.5	-	-	96.2	134.4	-	-	97.0	295.2	369.9
Other poultry	5.3	-	-	-	0.4	2.4	-	-	-	14.2	-	4.2	52.1	130.0	78.6
Other production animals	2.0	125.1	0.0	-	0.7	0.2	0.0	525.2	1.0	2.5	-	931.8	0.8	2460.2	1589.3
Aquaculture	-	124.9	0.0	-	-	-	-	525.2	-	-	-	931.7	-	2452.0	1581.9
Fur animals	1.3	-	-	-	0.7	-	-	-	-	1.0	-	0.0	-	0.6	3.1
Other	0.6	0.2	0.0	-	-	0.2	0.0	-	1.0	1.5	-	0.1	0.8	7.6	4.4
Companion animals	3.6	1.1	58.5	13.1	73.4	2.2	74.0	-	15.9	477.5	0.2	1595.1	39.3	2159.3	2353.5
Horses	0.3	0.0	0.0	0.0	0.0	-	0.3	-	5.9	0.6	-	166.6	7.7	150.2	181.3
Pets	2.2	0.6	21.6	4.3	17.7	2.2	24.5	-	10.0	86.5	0.2	194.4	18.8	345.8	383.0
Unspecfied	1.0	0.4	36.9	8.7	55.6	-	49.2	-	-	390.4	-	1234.1	12.8	1663.3	1789.3
Unknown ^(c)	85.6	11.0	0.5	0.7	3.5	7.6	0.4	6.0	342.9	84.2	2.8	12.7	73.4	682.3	631.3
Total	20179.3	1677.2	109.1	13.8	1865.1	11530.9	78.8	531.2	16059.4	8586.1	6486.1	7647.0	11928.4	86169.1	86692.3

Data for 2023 were extracted from VetStat on 1 July 2024

Combination products are split into active compounds

a) In 2023, 3rd cephalosporins were only used in pets (0.93 kg), and registered as "unspecified"

b) Including other antiinfectives, dermatologicals, ontological, opthalmologicals, polymyxin, quinolones, and sulfonamides, plain

c) Including data with no information on animal species/age group, or mismatch between animal species and age group

4.3 Antimicrobial consumption by animal species 4.3.1 Antimicrobial consumption in pigs

Most of the antimicrobials used for animals were consumed within the pig production in 2023. The total consumption in pigs was 72.85 tonnes of active compound, which was 1494.98 kg more than in 2022 (Table 4.1). The estimated live biomass of pigs decreased by 11.31% in 2023 compared to 2022 primarily due to a decrease in finishers slaughtered in Denmark.

The national MRSA action plan aimed to reduce antimicrobial consumption in pigs by 15% in 2018 compared to 2014. This goal was reached in 2019, where the achieved reduction was 16%. A revised action plan with new targets was agreed upon in August 2021, establishing that antimicrobial consumption in the pig production should decrease by 2% each year from 2019-2022 compared to the consumption level in 2018 (74.00 tonnes). That action plan was extended until 2023, however targets were not met by the end of 2023. A new food and veterinary agreement has been established in June 2024 aiming for an 8% reduction in antimicrobial use from 2024 to 2027 compared to the consumption level in 2018.

The **treatment proportion** (DAPD) of the total population reflects the trends in selection pressure within the population. The DAPDs in the pig population overall and by age group are presented in Figures 4.3 a.-c. and 4.4. The distribution of parental and peroral administration for the overall population and by age group are shown in Figures 4.3 b.-c. Finally, The DAPDs by age group at indication level are presented i Figure 4.5.

Historically, DAPD increased from 2004 to 2009, followed by a clear decrease in 2010 and 2011 with the introduction of the Yellow Card initiative. From 2013 to 2021, an overall slightly decreasing trend in treatment proportion has been observed (Figure 4.3 a).

In 2023, the increase in antimicrobial consumption measured as kg active compound in pigs when inspecting crude consumption data was 2,10% (Table 4.1), while changes in the overall treatment proportion are more subtle and vary between age groups and antimicrobial classes. When comparing 2023 to 2022, the overall DAPD increased by 3.41% in sows and piglets, while DAPD for weaners and finishers increased by 14.86% and 14.12%, respectively (Figure 4.3 a.). On a given day in 2023, approximately 1.60% and 1.80% of sows, piglets and finishers respectively, as well as 11.92% of weaners were treated with antimicrobials. The main prescription indication of antimicrobial consumption was for diarrhea in weaners (Figure 4.5).

In contrast to the decreasing trend in DAPD observed from 2013 to 2021, a substantial increase was observed from 2021 to 2023. Thus, DAPD of all age groups increased by 5.31% and 14.86% from 2021 to 2022 and from 2022 to 2023, respectively. The overall treatment proportion increased by 9.85% and 17.46% for parenteral and peroral usage, respectively, from 2022 to 2023 (Figure 4.3 b and c). When comparing 2022 to 2023 the increased use can be observed for all antimicrobial classes; Aminoglycosides increased by 48.92%, amphenicols increased by 18.60%, lincosamides increased by 2.21%, macrolides increased by 11.63%, penicillins, beta-lactamase sensitive, increased by 9.39%, penicillins, other, increased by 3.90%, pleuromutilins increased by 2.45%, sulfonamides and trimethoprim increased by 13.58% and tetracyclines increased by 9.22%. The main cause was increased DAPD use in weaners (Figure 4.4).

Since the ban of prescribed zinc oxide usage in pig production by June 2022, the ceased use of colistin and the Order 2019/6 on veterinary medicinal products applied since 28 January 2022, the use of aminoglycosides, primarily neomycin and apramycin, for weaners has increased by 145% from 16.87 DAPD in 2021 to 41.39 DAPD in 2023 (Figure 4.4).

In 2023, no consumption of the critical important antimicrobials 3rd and 4th generation cephalosporins was registered in pigs (Table 4.1). Figure 4.3 a Total antimicrobial consumption in the pig production, DAPD, Denmark. b. and c. Total antimicrobial consumption in the pig production at administration level, DAPD, Denmark DANMAP 2023





"Sows and piglets" include treatment in boars, where boars constitute 4-5% of the estimated live biomass for the age group. DAPDs are calculated as the number of standard doses for one kg animal divided by the estimated live biomass in the age group of the total population (in tonnes)



Figure 4.4 Antimicrobial consumption in the total pig production and in each age group at antimicrobial class level, DAPD, Denmark DANMAP 2023

DAPDs are calculated as the number of standard doses for one kg animal divided by the estimated live biomass in the age group or the total population (in tonnes)

The age group "sows and piglets" includes treatment in boars, where boars constitute 4-5% of the estimated live biomass for the age group

Figure 4.5 Antimicrobial use in each age group at indication level

DANMAP 2023





Note: Intramammaries, gynecologicals and topical drugs not included

4.3.2 Antimicrobial consumption in cattle

Legislation-supported thresholds for antimicrobial consumption in cattle have been in place since 2011. In 2023, approximately 7.96 tonnes were recorded for use in cattle, of which approximately 457.63 kg of active compound were used for intramammary therapeutic or dry-cow treatment. Treatments with penicillins, beta-lactamase sensitive accounts for 52.21% of the total usage for cattle (Table 4.1).

About 32.60% of the antimicrobial consumption for systemic treatment was used for young cattle (<12 months), and the rest was used to treat adult cattle (>12 months) (Table 4.1). The production of veal, beef and milk has remained relatively stable over the past 5 years (Chapter 2, Table 2.3).

Measured in kg active compound, in adult cattle, the consumption was 2.49% lower in 2023 than in 2022. Moreover, there has been a gradual decrease in the overall use of antimicrobials for systemic treatment in adult cattle over the past decade. Consumption was 20.74% lower in 2023 compared to 2019 and 21.78% lower than in 2014.

Measured as treatment proportions, the use in adult cattle was 2.79 and 1.95 DAPD in 2014 and 2022 respectively. In 2023, the treatment proportion was 1.91 DAPD.

The main indication for systemic treatment in adult cattle was mastitis (Reproduction, Udder). Systemic treatment of adult cattle was carried out using parenteral antimicrobial products only. The main indication for systemic treatment in young cattle was respiratory diseases. Overall, parenteral products accounts for 92.4% of systemic treatment of cattle (Figure 4.6 and 4.7).

Historically, the antimicrobial systemic consumption in young cattle increased until 2019, followed by a slight decrease in the following years. DAPDs at antimicrobial class level of cattle <1 year and cattle >1 year are presented in Figure 4.6.





DAPDs are calculated as the number of standard doses for one kg animal divided by the estimated live biomass in the age group or the total population (in tonnes)

Intramammary applications are not included (doses needed for calculating DAPD not available)

The DAPDs of amphenicols in cattle <1 year differ from previous reports, due to missing data in the old VetStat



Figure 4.7. Antimicrobial use in each age group at indication level, DAPD, Denmark

DANMAP 2023

Note: Intramammaries, gynecologicals and topical drugs not included

In young cattle, treatment (DAPD) with amphenicols (florfenicol) has increased steadily since 2014 and are still the most frequently prescribed antimicrobial (34.33%), followed by macrolides and tetracyclines, 28.04% and 12.20%, respectively in 2023.

The use of fluoroquinolones in cattle has been close to zero for the last decade. Fluoroquinolones are only prescribed in food-producing animals as a last-line drug, based on microbiological analysis and susceptibility testing in an accredited laboratory. The use of fluoroquinolones in food-producing animals is also notifiable to the DVFA. No fluoroquinolones were registered in VetStat for consumption in cattle in 2023. In 2014, the cattle production began to phase out the use of 3rd and 4th generation cephalosporins used for systemic treatment, resulting in a significant drop in 2015. In 2019, cattle production implemented a ban on use of 3rd and 4th generation cephalosporins in all cattle, and no use has been registered since 2020.

By the year of 2020, the board of Danish dairy and beef producers' strategy for good udder health aimed at a 20% reduction in the use of antimicrobials for treatment of mastitis and other cattle diseases compared to 2012, as well as lowering the geometric mean bulk tank cell counts to 150,000. The dairy industry also aims to promote the use of simple penicillins (beta-lactamase sensitive penicillins) when dry-cow therapy or mastitis treatment is required. The board of Danish dairy and beef producers renewed its strategy for disease prevention in calves and cows, including good udder health objectives for the period 2021-2023. The goals are, for the given period, a 10% annual reduction in use of antimicrobials for treatment of cattle <1 year old and a 3% annual reduction in use of antimicrobials for treatment of cattle >1 year old. Moreover, the new strategy aims to reduce the proportion of milk producers with a cell count >200,000 from 60% to 30%.

In 2023, the overall antimicrobial consumption in cattle was 24.40% (2569.88 kg) lower than in 2012 and the bulk tank milk counts were at 185.400 in February 2022. However, in this period systemic treatments of young cattle increased by 35.60% (680.28 kg), while the systemic treatment of adult cattle decreased by 36.83% (2857.74 kg). The use of intramammary applications decreased by 16.25% in the given period.

The consumption of intramammary treatment, measured as doses per cow per year, is shown in Figure 4.8. The consumption

of simple penicillins (beta-lactamase sensitive penicillins) has increased, whereas the consumption of 1st generation cephalosporins has decreased.

In 2019, there was a remarkable shift in the dry-cow treatments and the use of the beta-lactamase sensitive penicillins for this purpose almost ceased, while the use of the other penicillins, especially cloxacillin, increased. This shift was caused by a product shortage, where the only beta-lactamase sensitive penicillin for dry-cow treatment was unavailable for longer periods during 2019, and other penicillins especially products containing cloxacillin, had to be used instead [Personal communication; Michael Farre, Danish Agriculture and Food Council]. In 2020 and onwards, it again shifted to the use of only beta-lactamase sensitive penicillins (Figure 4.8).

For therapeutic treatments, beta-lactamase sensitive penicillins remained the most used antimicrobial class in 2023.



Figure 4.8 Consumption of antimicrobials for intramammary application in cattle, treatments per cow per year, Denmark DANMAP 2023

For intramammary treatment, the consumption has been estimated as the number of doses, Combination products are split into active compounds

a) 1st generation cephalosporins only

b) Includes lincomycin for dry-cow treatments. For therapeutic treatment, mainly sulfonamides-trimethoprim, but also lincomycin and bacitracin

4.3.3 Antimicrobial consumption in poultry

The poultry production comprises broiler production, egg layers, and turkey production. In addition, there is a small production of ducks, geese, and game birds. Conventional broiler farms have a very high level of biosecurity, and the antimicrobial consumption in broiler production is generally low compared with other species. Accordingly, disease outbreaks in just a few farms can markedly affect the national statistics on antimicrobial usage in the poultry sector (Table 4.2).

Both a substantial increase and decrease in consumption of antimicrobials is very likely caused by disease in several flocks in a single farm [personal communication, Susanne Kabel, Danish Agriculture and Food Council].

Previously, VetStat did not allow easy differentiation of antimicrobial use in different types of poultry production.

However, this has been amended in the new VetStat. From June 2021 antimicrobial use has been reported in more detail, subsequently within some years it will be possible to follow trends in antimicrobial usage in the different types of poultry production.

In 2023, the total antimicrobial usage has decreased by 40.55 kg of active compound compared to 2022. While the consumption of penicillins and tetracyclines has increased by 146.38 and 54.49 kg active compound, respectively, the macrolide consumption has decreased by 257.62 kg active compound (Table 4.2).

For the past decade, cephalosporins have not been used in poultry production, and the use of fluoroquinolones stopped in 2021. Colistin has not been used since 2016.

Table 4.2 Consumption of antimicrobials in poultry, kg active compound, Denmark

DANMAP 2023

	Aminoglycosides	Amphenicols	Fluoroquinolones	Lincosamides	Macrolides	Other antimicrobials $^{\scriptscriptstyle{(a)}}$	Penicillins, beta- lactamase sensitive	Penicillins, others	Pleuromutilins	Sulfonamides and trimethoprim	Tetracyclines	Total
2014	21.42	8.51	0.11	10.49	402.83	2.60	133.27	373.78	0.38	82.26	604.11	1639.75
2015	258.47	4.37	1.00	129.12	133.31	9.96	204.43	565.96	0.63	445.46	818.09	2570.78
2016	60.19	4.83	-	23.77	175.58	8.00	264.55	257.65	0.38	111.00	764.56	1670.51
2017	64.87	5.06	-	31.75	244.87	1.00	355.55	334.77	0.45	84.60	487.45	1610.37
2018	50.56	-	-	25.28	194.95	-	357.83	242.58	0.83	36.60	521.12	1429.73
2019	54.80	0.23	0.01	27.36	274.83	-	368.37	234.30	0.64	64.25	694.27	1719.07
2020	58.19	-	-	29.01	156.91	-	334.10	237.34	0.23	54.60	1590.93	2461.31
2021	58.87	-	-	27.69	168.86	-	115.38	204.10	0.38	34.80	656.61	1266.68
2022	50.42	-	-	14.98	433.96	-	232.70	139.88	19.38	12.60	442.43	1346.35
2023	50.23	-	-	15.28	176.34	-	315.90	203.06	16.88	31.20	496.92	1305.80

Data for 2023 were extracted from VetStat on 1 July 2024

VetStat does not differentiate between consumption in the different sectors of poultry production

Combination drugs are divided into active compounds

a) Other antibacterials also include other quinolones and polymyxins

4.3.4 Antimicrobial consumption in aquaculture, and companion animals

Aquaculture

Antimicrobial consumption in aquaculture is mainly driven by the summer air temperatures and hours of summer sunlight because bacterial diseases are more likely to occur when water temperatures are high [Villumsen and Bojesen, 2022. Microbiol Spectr. 10(5):e0175222]. Although the aquaculture production continues to focus on developing improved vaccination strategies to reduce the risk of bacterial diseases that may require treatment with antimicrobials, the antimicrobial consumption varies significantly from year to year. In 2023 the antimicrobial consumption decreased by 35.62% compared to the average consumption in the previous five years. The decrease was solely due to decreased usage of combination products of sulfonamides and trimethoprim (Table 4.3).

In 2023, mainly three antimicrobial classes were used to treat bacterial infections in aquaculture: 58.90% of sulfonamides and trimethoprim, 33.20% of other quinolones (oxolinic acid), and 7.89% of amphenicols (florfenicol) (Table 4.3).

Table 4.3 Consumption of antimicrobials in aquaculture, kgactive compound, DenmarkDANMAP 2023

	Amphenicols	Other antibacterials ^(a)	Other quinolones	Penicillins, others	Sulfonamides and trimethoprim	Tetracyclines	Total
2014	297.1	-	1678.3	9.8	3131.9	-	5117.0
2015	311.1	-	1004.5	5.1	1655.0	0.7	2976.4
2016	315.3	0.0	893.1	13.6	1085.9	0.4	2308.2
2017	350.3	0.0	636.8	35.0	679.3	0.1	1701.6
2018	323.5	-	899.3	51.6	2292.6	0.5	3567.4
2019	292.6	-	446.9	43.9	1720.9	22.0	2526.3
2020	341.2	-	565.3	27.1	1030.2	1.0	1964.7
2021	295.4	1.8	366.3	19.5	1091.3	1.4	1775.8
2022	144.1	0.0	366.5	-	1940.8	0.6	2452.0
2023	124.9	0.0	525.2	-	931.7	-	1581.9

Data for 2023 were extracted from VetStat on 1 July 2024 Combination products are split into active compounds a) Other antibacterials also includes lincosamides

Companion animals - horses and pets

The information available on antimicrobial consumption in companion animals is not as accurate as for production animals, since VetStat allows registration of antimicrobials for companion animals without defining animal species. Table 4.4 shows the antimicrobial consumption registered for companion animals in three categories: horses, pets, and "unspecified".

The total amount of antimicrobials estimated for consumption in companion animals in 2023 was 2353.54 kg (Table 4.1). As in previous years, a substantial amount of sulfonamide/trimethoprim registered as used for pets or unspecified is oral paste, a product normally used for horses. Thus, a substantial amount of sulfonamide/trimethoprim included in Table 4.4 is likely to have been used for horses (1400.7 kg in 2023).

A large proportion of antimicrobials for dogs and cats are prescribed for the treatment of chronic or recurrent disease, mainly dermatitis. Due to the close contact between owners and their pets, repeated use of critically important antimicrobials may pose a risk to the owners, and the use of these antimicrobials is therefore monitored carefully. Since the treatment guidelines by DVA were published in 2012 (revised in 2018), the use of cephalosporins has been reduced from 272.70 kg in 2012 to 58.49 kg of active compound in 2023 (Table 4.1 and 4.4).

In 2023, the consumption of fluoroquinolones in companion animals, mainly dogs and cats, was 13.07 kg active compound and represented the majority (94.71%) of fluoroquinolones used in all animals (Table 4.1 and 4.4). Similarly, the companion animals accounted for 53.63% (58.49 kg) of all the cephalosporins consumed in animals (Table 4.1 and 4.4). In 2023, 3rd generation cephalosporins were only used in pets (0.93 kg) and registered as "unspecified" (Table 4.1).

	Aminoglycosides	Amphenicols	Cephalosporins	Fluoroquinolones	Lincosamides	Macrolides	Other antimicrobials $^{\scriptscriptstyle (a)}$	Other quinolones	Penicillin's, b-lactamase sensitive	Penicillin's, others	Pleuromutilins	Sulfonamides and trimethoprim	Tetracyclines	Total
Horses														
2014	1.4	-	0.4	0.0	-	0.1	0.0	-	9.5	0.3	-	98.2	6.7	116.7
2015	2.8	-	0.4	0.0	0.0	0.1	0.0	-	6.9	0.1	-	114.6	4.8	129.6
2016	0.8	-	0.1	0.0	-	-	0.0	-	5.2	0.0	-	108.0	5.3	119.5
2017	0.9	0.1	0.1	0.0	-	-	0.0	-	5.4	0.1	-	106.4	3.0	116.0
2018	0.7	0.0	0.2		-	0.1	0.0	-	6.0	0.0	-	100.6	3.8	111.3
2019	0.9	-	0.1	0.0	-	0.0	0.0	-	4.9	0.1	-	94.2	3.8	104.1
2020	1.7	-	0.0	0.0	0.0	-	0.0	-	5.3	0.0	-	111.5	3.5	122.1
2021	0.2	-	0.0	0.0	0.0	0.0	0.1	-	5.2	0.1	-	105.8	2.0	113.4
2022	0.3	0.0	0.0	0.0	0.0	1.0	0.2	-	4.5	0.2	-	136.6	7.3	150.2
2023	0.3	0.0	0.0	0.0	0.0	-	0.3	-	5.9	0.6	-	166.6	7.7	181.3
Pets														
2014	5.6	0.2	81.3	5.0	19.0	5.0	6.8	1.0	12.1	122.3	0.4	260.9	13.3	532.9
2015	4.8	0.1	61.8	5.6	21.8	3.3	6.8	-	13.2	123.4	1.8	226.2	20.5	489.2
2016	3.4	0.4	55.3	5.4	21.8	2.3	7.4	0.1	9.8	131.2	0.3	269.1	21.5	527.8
2017	3.8	0.7	41.7	5.2	18.4	1.7	8.3	-	9.2	125.8	0.1	272.4	19.3	506.6
2018	3.9	0.3	35.9	4.9	17.5	1.7	14.3	1.0	10.0	113.7	0.5	253.2	21.1	478.1
2019	3.7	0.3	32.3	4.5	17.2	7.4	15.0	0.0	10.3	108.4	0.6	236.8	14.8	451.4
2020	4.3	0.6	30.7	5.1	19.1	3.8	17.6	-	12.9	103.4	0.5	262.3	17.7	478.0
2021	3.2	0.7	28.0	4.7	19.2	2.2	20.8	-	11.5	100.1	0.1	270.8	23.7	485.0
2022	1.7	0.0	22.3	3.9	16.5	0.2	24.4	-	9.4	79.5	0.1	165.5	22.3	345.8
2023	2.2	0.6	21.6	4.3	17.7	2.2	24.5	-	10.0	86.5	0.2	194.4	18.8	383.0
Unspecfied														
2014	48.3	0.0	132.0	8.2	50.2	0.0	26.7	-	2.6	435.5	-	968.9	20.4	1692.8
2015	41.3	0.3	95.9	8.7	46.8	0.0	25.1	1.0	1.5	429.2	-	946.8	17.0	1613.7
2016	37.4	0.4	81.6	9.7	48.9	0.3	26.3	-	2.2	468.7	-	1015.3	17.0	1707.9
2017	33.2	0.2	69.1	9.3	50.1	0.0	28.3	-	1.9	469.8	-	1071.7	14.7	1748.3
2018	31.8	1.3	61.4	9.8	45.8	-	34.8	-	1.8	453.0	-	1136.6	13.0	1789.3
2019	29.2	0.2	60.6	9.9	48.8	0.1	36.8	-	1.9	442.6	0.1	1140.7	16.0	1787.1
2020	22.6	0.4	56.9	10.7	52.2	0.1	40.2	-	2.9	446.9	-	1221.7	15.6	1870.3
2021	17.3	0.4	49.4	10.1	57.5	-	47.3	-	0.8	457.5	-	1284.6	14.5	1939.4
2022	1.3	0.4	38.8	8.8	54.3	-	51.9	-		395.3	-	1100.6	11.9	1663.3
2023	1.0	0.4	36.9	8.7	55.6	-	49.2	-		390.4	-	1234.1	12.8	1789.3

 Table 4.4 Estimated consumption of antimicrobials for horses, pets and unspecified animals, kg active compound, Denmark

 DANMAP 2023

Data for 2023 were extracted from VetStat 1 July 2024.

Combination products are split into active compounds

The estimates include all veterinary approved antimicrobials, for use in horses, pets, as well as products without a specified animal species (unknown)

a) Other antibacterials also include other otologicals, pleuromutilins, polymyxins and sulfonamides, plain

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