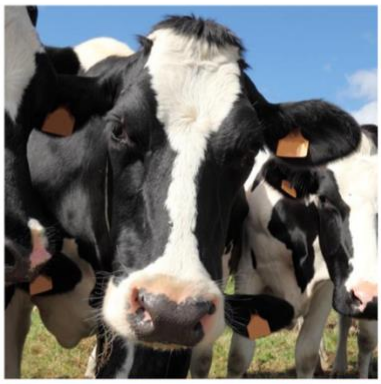
2022

Antimicrobial Use Report







Welsh Lamb and Beef Producers

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Foreword

Welcome to the second annual Welsh Lamb and Beef Producers Antimicrobial Use Report. This report provides detailed analysis of antimicrobial use (AMU) in beef, sheep and dairy sectors across Wales in 2022.

Following the interest received in the 2021 Antimicrobial Use Report, we provide a second edition of the Welsh Lamb and Beef Producers (WLBP) Antimicrobial Use Report for 2022. This report provides a detailed summary of antimicrobial use (AMU) on 5428 beef, sheep and dairy enterprises across Wales in 2022. AMU by enterprise type, European Medicines Agency (EMA) category, antimicrobial (AM) class and AM administration route are presented.

AM sales data were captured and collated via the WLBP AMU Calculator, a novel reporting tool that produces accurate, standardised reports of AMU based on industry-agreed standards (CHAWG, 2020; SHAWG, 2019; ESVAC, 2021). Veterinary surgeons complete AMU calculations for enterprises under their care, which is a requirement for farmers as part of the Farm Assured Welsh Livestock (FAWL) assurance scheme. Veterinary surgeons review the AM sales data and assign purchased products to each herd or flock under their care, reporting on disposed quantities where necessary to achieve accurate AMU data.

In future years, WLBP aims to continue to provide publicly available AMU reports as well as comment on the average trends in AMU in the Welsh beef, sheep and dairy sectors. Currently, it is not possible to provide evidence of a change in AMU year-on-year. Firstly, only 681 enterprises reported AMU for both 2021 and 2022. This is partly due to the expansion of AMU Calculator use between 2021 and 2022, and partly because of the FAWL assurance scheme (of which the AMU Calculator is a requirement) which requires reporting only every 18 months for most WLBP members. For example, a member who reported in July 2022 would have reported AMU data which would be included in the 2021 AMU Report. However, their next FAWL assurance review would fall 18 months later in January 2024, and therefore their AMU data would not be included in the 2022 report. As not every member contributes to each report, it would be erroneous to compare the data collected from 2021 and 2022 to one another, especially as members that reported AMU in 2021 might be seen to be 'early adopters' who might vary considerably in enterprise demographics and type from the 2022 reporters. Secondly, comparing single years can provide an incomplete picture of overall trends. A rolling average across multiple years is likely to give a more accurate and more easily interpretable trend within the industry. Readers are therefore cautioned to consider these caveats if comparing the 2021 and 2022 reports.

Although the WLBP Antimicrobial Use report is not currently able to comment on trends, in the UK context, trends in AMU in food-producing animals are reported to be decreasing (UK-VARSS, 2022). This highlights the UK's successful collaborative approach to AM stewardship within the livestock industry.

Contribution

This report and all supporting analyses were commissioned by WLBP and conducted independently by researchers at Bristol Veterinary School, University of Bristol, UK.

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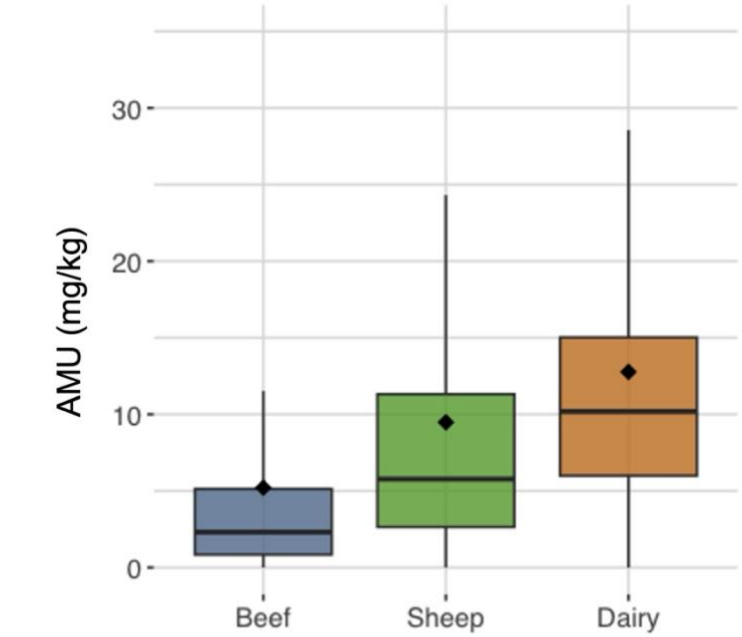
AMU by enterprise type

AMU in 2022 was calculated for 2422 beef, 2576 sheep and 430 dairy enterprises across Wales using data submitted via the WLBP AMU Calculator. On average, beef enterprises had the lowest AMU and dairy enterprises had the highest AMU out of these three sectors.

AMU data was captured from 2422 beef, 2576 sheep and 430 dairy enterprises for the 2022 calendar year (1st January to 31st December). Compared to the 2021 dataset, over double the number of beef and sheep enterprises recorded data via the AMU Calculator, and dairy enterprises increased by 48%. It is important to note that only 681 enterprises (or 27% of the total enterprises) in the 2022 dataset also appeared in the 2021 AMU report. This is due to the requirements for farmers to report to FAWL only every 18 months. Therefore, the 2022 AMU Report findings cannot be directly compared to the 2021 AMU Report findings.

Median AMU in 2022 was found to be the highest in dairy (10.4 mg/kg*) and lowest in beef (2.3mg/kg*). Sheep fell between these, with a median AMU of 6.1 mg/kg† (Figure 1). See the supplementary information for the full methodology used to calculate AMU and why the median is chosen as an averaging method.

Similar to as was seen in the 2021 dataset, there is a large amount of variation in AMU between the enterprises in 2022. The highest users are responsible for a large proportion of total use. Figure 1 shows the distribution of AMU, with the two averages, median and mean, indicated to illustrate the effect of outliers (e.g. enterprises with very high AMU; see supplementary information on reporting average values). The highest 25% of AMU users in beef, sheep and dairy enterprises contributed 74%, 63% and 52% of the total AMU in each sector, respectively.



	Beef	Sheep	Dairy
◆ Mean mg/kg	5.2	9.5	12.8
– Median mg/kg	2.3	6.1	10.4

Figure 1: Farm AMU (mg/kg) by enterprise type, 2022
Distribution of total annual AMU for all 2422 beef, 2576 sheep and 430 dairy enterprises in 2022. 5th to 95th percentile shown. The methods used to create this graph are covered in the supplementary information.

* mg/kg for beef and dairy enterprises was calculated using methodology defined by CHAWG (CHAWG 2020)
† mg/kg for sheep enterprises was calculated using methodology defined by SHAWG (SHAWG 2019)

AMU by EMA category

By mass of AM ingredient, use of EMA Category B (Restrict) AMs were very low on all enterprise types. Category C (Caution), however, made up 55% of all AMs used by mass in dairy, 37% in beef and 18% in sheep enterprises.

In 2020, the EMA updated its classification of AMs to include four categories, from A to D: Avoid, Restrict, Caution and Prudence (Figure 2). AMs were ranked according to the risk that their use in animals poses to public health through the possible development of AMR and the need to use them in veterinary medicine.

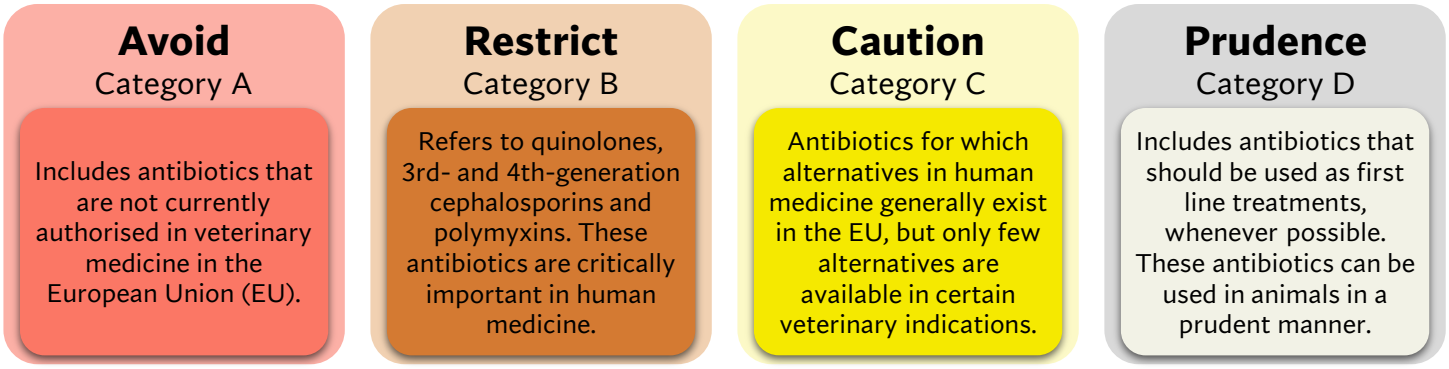


Figure 2: Definitions of EMA categories
Four categories of AMs, from A to D: Avoid, Restrict, Caution and Prudence (EMA, 2020).

Analysis of AMU in 5428 Welsh enterprises highlighted a preference towards Category C (Caution) and D (Prudence) AM products, with little usage of Category B (Restrict) AMs which are critically important in human medicine (Figure 3). Less than 1% of the AM mass used was from Category B antimicrobials in dairy and beef enterprises and less than 0.1% in sheep enterprises. No enterprises reported using Category A (Avoid) AMs. The majority of AM products used in beef and sheep were from Category D, representing 63% and 82% of AM mass used, respectively. In dairy enterprises, 55% of AM products were from Category C, compared to 45% of products from Category D.

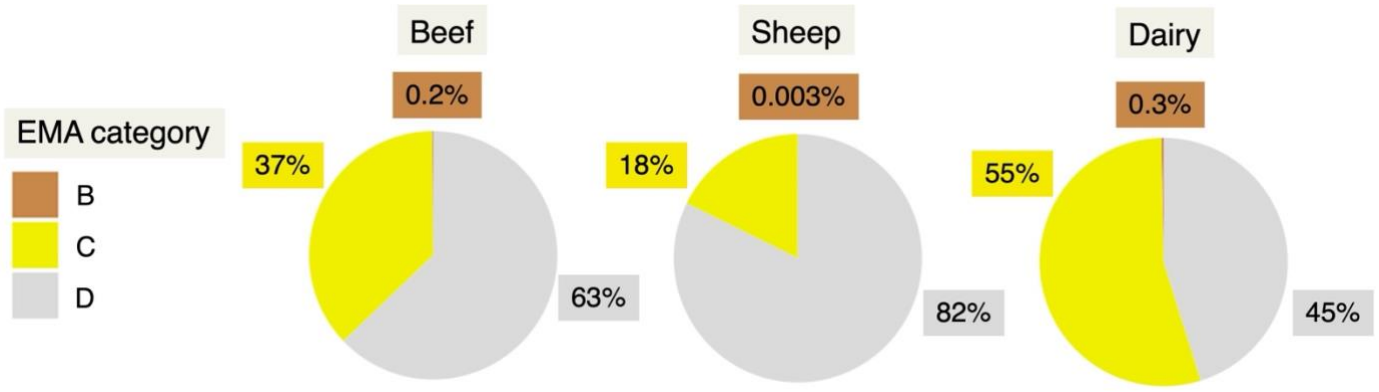


Figure 3: Proportion of AM ingredient used by species and EMA category, 2022
Proportion by mass of AM ingredient used, split by species and AM category. For products with multiple different AM ingredients, products were placed into categories based on the AM ingredient in the formulation of highest EMA importance (EMA, 2020). See supplementary information for methodology.

AMU by class

By mass of AM, the most used AM classes were tetracyclines, aminoglycosides, penicillins and aminopenicillins. Use varied between enterprise type, with sheep enterprises using predominantly tetracyclines, and cattle enterprises using more aminoglycosides and penicillins.

The percentage of each AM class used by mass was analysed for 2422 beef, 2576 sheep and 430 dairy enterprises in 2022.

In beef, tetracyclines, penicillins and aminoglycosides made up the majority of use by mass (66%) (Figure 4).

In sheep, 55% of the total use by mass was of tetracyclines, whereas aminoglycosides (excluding spectinomycin) and aminopenicillins taken together made up 30%. There was no use of 3rd or 4th generation cephalosporins recorded. Spectinomycin use was also very low, at 1.5% of total use by mass.

In dairy, aminoglycosides (excluding spectinomycin) were the most-used AM class by mass (26%). Macrolides, penicillins, tetracyclines and aminopenicillins were also commonly used (totalling 50% by mass).

Across beef, sheep and dairy enterprises, EMA Category B (Restrict) AM classes made up a very low percentage of use by mass (<1%). There was no recorded use of 3rd or 4th generation cephalosporins on the 2576 sheep enterprises.

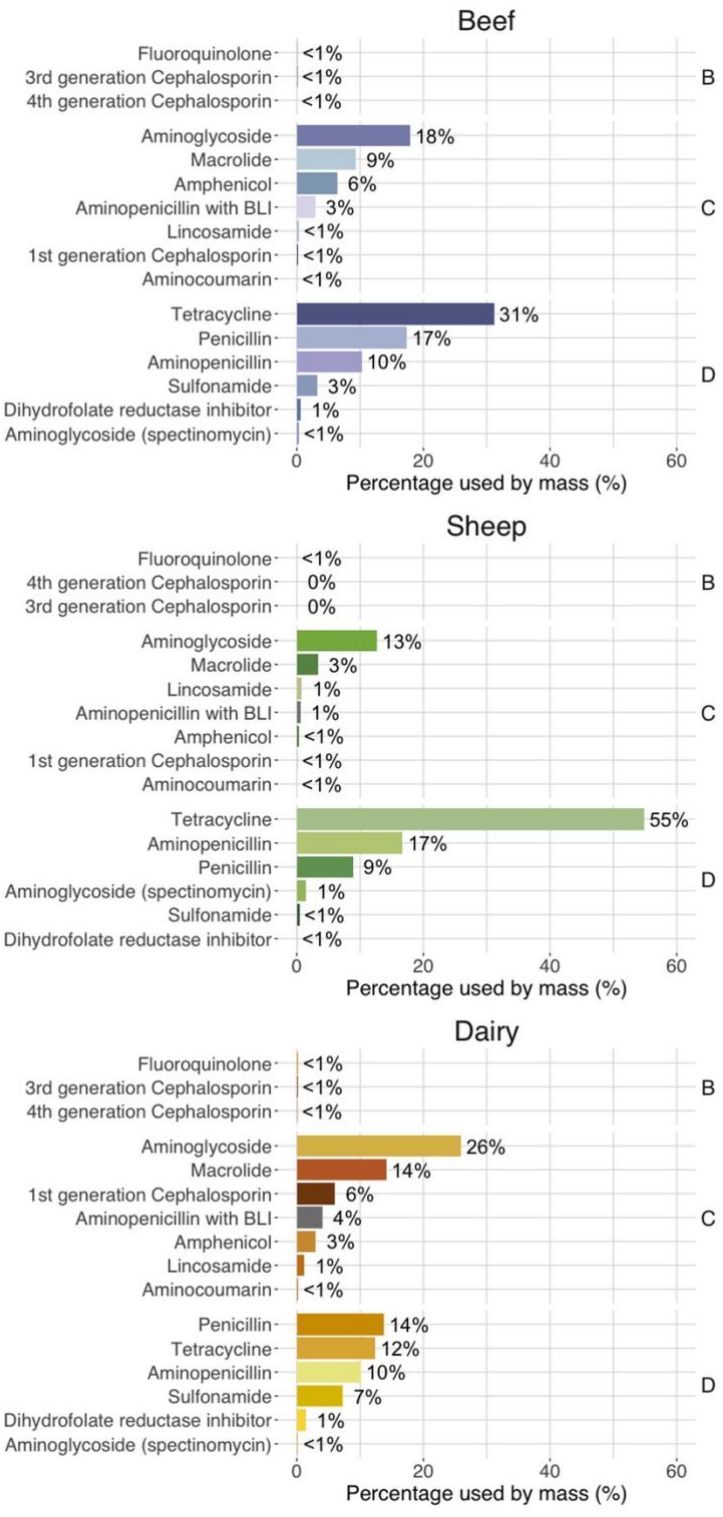


Figure 4: Proportion of AM classes used by species and EMA category, 2022

Proportion by mass of AM used, split by AM class, species and AM category. Note: topicals are included in sheep AM use only. See the supplementary information for details on the method used.

BLI = Beta-lactamase inhibitor

AMU by administration route

Injectables were the most commonly used administration route by mass of AM used across all three enterprise types. After injectables, the most-used administration route by mass was sprays on beef and sheep enterprises, and intramammaries on dairy enterprises.

The total mass of AMU by product administration route was analysed for 2422 beef, 2576 sheep and 430 dairy enterprises in 2022. Topical AMs (sprays and eye ointments) were included in all three enterprise types for this analysis.

For all three enterprise types, the majority of AM used by mass were injectable products (Figure 5). In beef, injectables represented 93% of total AM mass used, compared to 88% in sheep and 75% in dairy.

Use of AM sprays was highest in sheep, accounting for 8% of total AM mass used, compared to 4% in both beef and dairy.

Intramammary (IMM) products, a first-line AM treatment for mastitis/udder infections, represented 14% of total AM mass used in dairy enterprises in 2022. As expected, IMM products accounted for a smaller proportion of use on beef and sheep enterprises (<1% on both).

Oral powders and solutions represented a higher proportion of AM mass used on dairy (7%) compared to beef and sheep enterprises (3% on both).

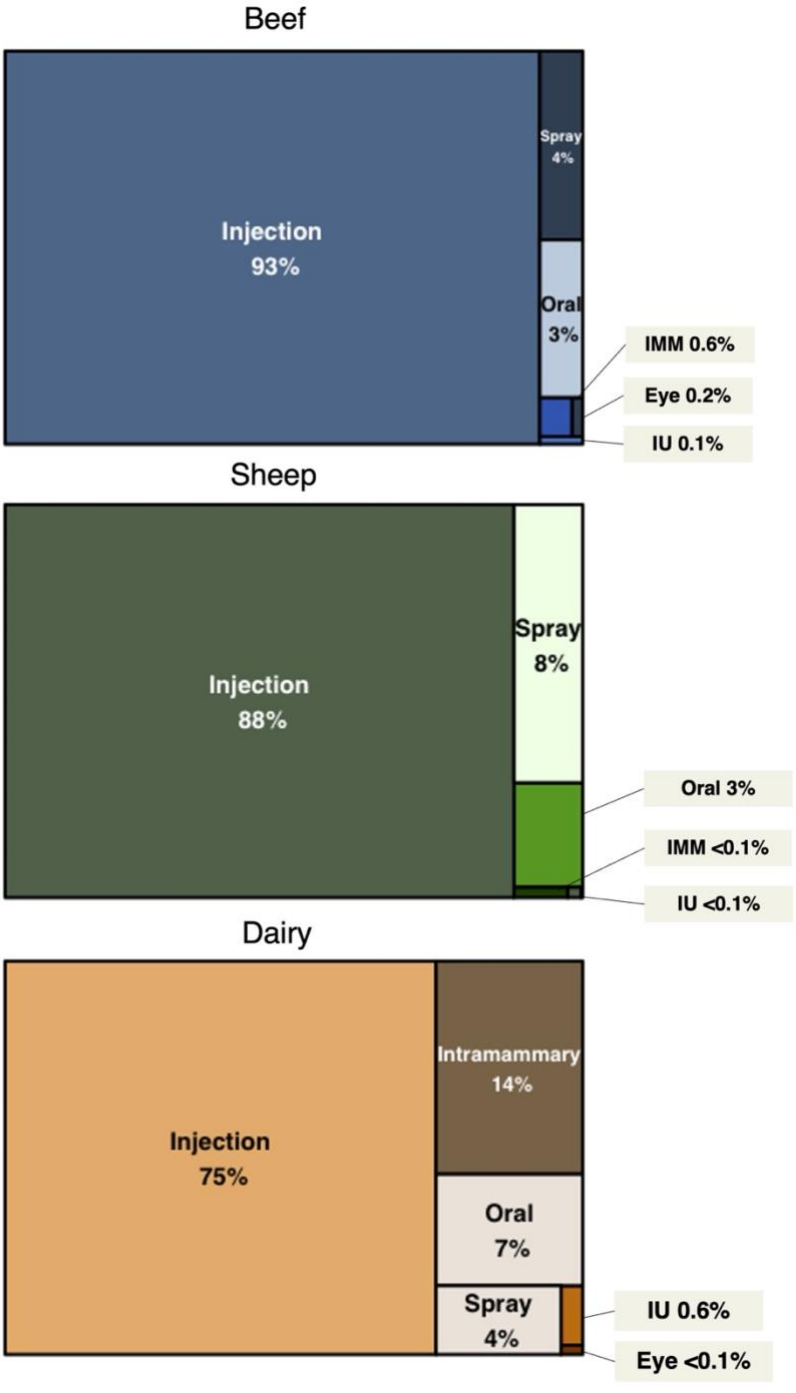


Figure 5: Proportion of AM products used by species and administration route, 2022
Proportion of AM by mass used by species and administration route, as listed in the Veterinary Medicines Directorate's Summary of Product Characteristics for each AM product. This analysis includes the use of topicals in all enterprises. See supplementary information for methodology.

Intramammary use in dairy

On average, dairy herds used more doses of intramammary AM products for dry cows than for lactating cows. On average, around 20% of cows were treated with lactating cow intramammaries, and 26% were treated with dry cow intramammaries.

The number of doses of intramammary (IMM) AM products used on the 430 dairy enterprises was analysed. A dose was defined as a course of treatment, which for a lactating cow therapy is defined as 3 IMM tubes and a dry cow therapy is 4 IMM tubes (CHAWG 2020).

On average (median), each cow received 0.20 doses of IMM AM lactating cow therapy and 0.26 doses of AM dry cow therapy (Figure 6). This means that, assuming every cow treated received one full dose, on an average (median) enterprise, 20% of cows would have been treated with a course of IMM lactating cow therapy and 26% of cows would have received a course of IMM dry cow therapy. In reality, this percentage could be lower for lactating cow therapies, as the same cow might have been treated multiple times throughout 2022.

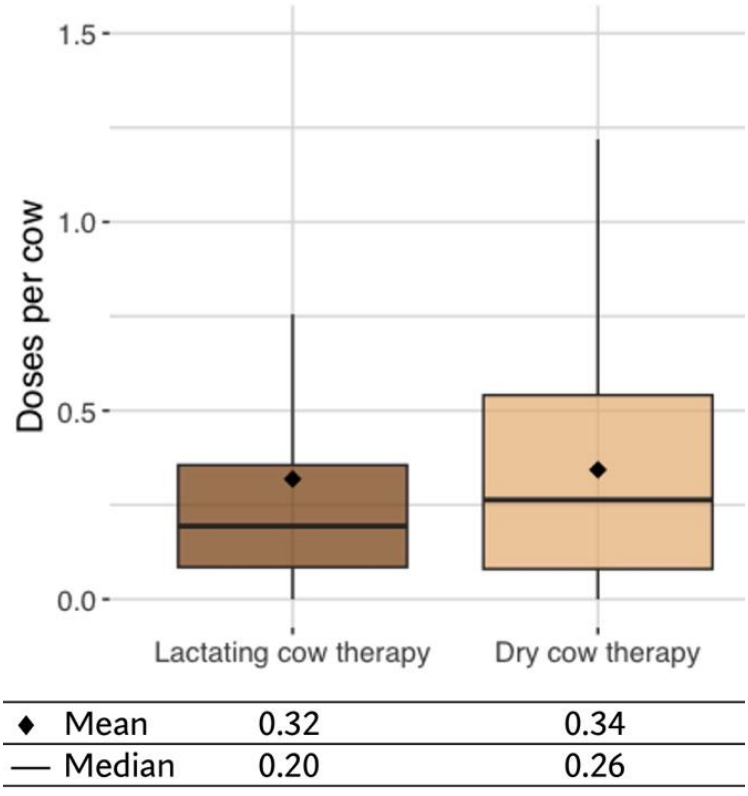


Figure 6: Doses of intramammary treatments used in 2022.

♦ mean doses

— median doses

1 lactating cow dose = 3 tubes. 1 dry cow dose = 4 tubes.

See supplementary information for methodology.

Supplementary information

Calculating AMU

Throughout this report, the metric milligrams per kilogram (mg/kg) is used to describe AMU.

Milligrams The total milligrams of active AM ingredient in the product. This is calculated using information from each product's Veterinary Medicine Directorate's (VMD) Summary of Product Characteristics[1] (SPC) Sales records for AM products sold to each farm are reviewed by the veterinary surgeon, who is able to assign products to a herd/flock (for mixed- or multi-enterprise farms) and detail if any product was disposed of (e.g. when a single dose from a multi-dose bottle was used). If product was disposed of, the corresponding milligrams of AM ingredient was then removed from the totals in this analysis. In some cases, exclusions or conversions were made:

- Clavulanic acid was removed from all analyses based on the AMU reporting recommendations (CHAWG 2020, SHAWG 2019, ESVAC, 2021).
- Where products are listed as pro-drugs, ESVAC conversion factors have been applied to calculate the milligrams of active moiety (ESVAC, 2021).
- Where products are listed using international units (IU), the ESVAC recommended conversion factor has been applied (ESVAC, 2021).
- Topical AM products (sprays and eye ointments) are excluded when quoting mean or median total use in a population (Figures 1-4 and 11-12) for dairy and beef herds, but are included for sheep flocks. This methodology follows the AMU reporting recommendations (CHAWG 2020, SHAWG 2019).

Kilograms The total kilograms of animals at risk of treatment in the herd/flock. These are calculated by WLBP from animal numbers either provided automatically or manually by farmers and veterinary surgeons when using the AMU Calculator. Tables S.1 - 3 below show the animal weights and reference the methodology used.

- In the case of beef:
    - 54% of herds were linked to the British Cattle Movement Service Cattle Tracing System and animal numbers were pulled automatically as opposed to using veterinary surgeon- or farmer-reported animal counts. These herds have a different method of calculating weights which aligns with ESVAC (ESVAC, 2021). Median AMU of these farms was 3.4 mg/kg.
    - 46% of beef herds relied on the veterinary surgeon/farmer entering animal counts and used the CHAWG simplified $mg/kg^{beef\ farm}$ metric (CHAWG 2020). Median AMU of these farms was 4.3 mg/kg.

Limitations:

- For total kilograms of animal at risk of treatment, the 2 different methodologies explained above were used for beef herds. If one of these methodologies over- or under-estimates animal weight, the comparisons between these farms could be invalid.
- The mg/kg metric does not attempt to assign medicines to youngstock or adult cattle and therefore assumes that all animals on the farm were at risk of treatment. This may not accurately reflect how AMs are used (for example, intramammary tubes would not be used in non-lactating animals).

[1] VMD SPCs were accessed online via the VMD Product Information Database (www.vmd.defra.gov.uk/ProductInformationDatabase)

Count type	Herd type	Age group (years)	Sold for slaughter?	Sex	Time since arrival on farm (years)	WLBP AMU Calculator assigned weight (kg)	Method reference
Beef numbers manually entered by the veterinary surgeon	**Beef fattening**	<1	N	Mixed	<1	104	CHAWG simplified mg/kg$^{beef\ farm}$ metric[2]
		1 to 1.5	N	Mixed	<1	250	
		>1.5	N	Mixed	<1	144	
		1 to 1.5	N	Mixed	1 to 1.5	428	
		>1.5	N	Mixed	1 to 1.5	204	
		>1.5	N	Mixed	>1.5	146	
		<1	Y	Mixed	<1	28	
		1 to 1.5	Y	Mixed	<1	325	
		>1.5	Y	Mixed	<1	177	
		1 to 1.5	Y	Mixed	1 to 1.5	627	
		>1.5	Y	Mixed	1 to 1.5	403	
		>1.5	Y	Mixed	>1.5	199	
	Calf rearing	<1	N	Mixed	N/A	41	
		1 to 1.5	N	Mixed	N/A	323	
		>1.5	N	Mixed	N/A	482	
		<1	Y	Mixed	N/A	91	
		1 to 1.5	Y	Mixed	N/A	413	
		>1.5	Y	Mixed	N/A	680	
	Suckler	>1	N	Female	N/A	762	
		<1	N	Mixed	N/A	0	
		1 to 1.5	N	Mixed	N/A	266	
		>1.5	N	Mixed	N/A	453	
		<1	Y	Mixed	N/A	174	
		1 to 1.5	Y	Mixed	N/A	343	
		>1.5	Y	Mixed	N/A	655	
		<1	N	Female	N/A	367	
Beef numbers automatically sourced [1]	**All**	<1	N/A	Mixed	N/A	140	ESVAC PCU[3]
		1 - 2	N/A	Female	N/A	200	
		>1	N/A	Male	N/A	425	
		>2	N/A	Female	N/A	425	

Table S.1: Beef weights

1] Sourced from the British Cattle Movement Service.

2] CHAWG 2020

3] ESVAC 2021

Count type	Description	WLBP AMU calculator assigned weight (kg)	Method reference
Flock numbers manually entered by the veterinary surgeon	Adult ewes put to the ram	75	SHAWG mg/kg$^{sheep\ farm}$ metric[1]
	Lambs sold as stores	20	
	Lambs sold for slaughter	20	
	Lambs sold for breeding or kept for breeding	20	

Table S.2: Sheep weights

1] SHAWG 2019

Count type	Description	WLBP AMU calculator assigned weight (kg)	Method reference
Dairy numbers manually entered by the veterinary surgeon	Number of milking cows	425	ESVAC PCU2 – analogous to CHAWG mg/kg[3]
Dairy numbers automatically sourced [1]	Number of milking cows	425	

Table S.3: Dairy weights

1] Sourced from the British Cattle Movement Service

2] ESVAC 2021

3] CHAWG 2020

Reporting average values

This report calculates the AMU in mg/kg for each farm in the WLBP AMU Calculator dataset and then describes these using averages to reflect the AMU of a typical farm in Wales. Averages are a way of summarising data by describing centrality. Two types of average, which have slightly different meanings, are used within this report:

Median: The median describes the middle value when data are ordered from least to greatest. It is equal to the 50th percentile of the dataset. 50% of the data lie below the median, and 50% above.

Mean: The arithmetic mean is calculated by totalling all values and dividing by the number of datapoints:

$$\text{Mean AMU} = \frac{Sum\ of\ all\ farms'\ AMU}{Number\ of\ farms}$$

The median is a more useful average to report when data are non-normally distributed. Enterprise AMU is often non-normally distributed due to the presence of outliers, especially enterprises with very high AMU. Where there are outliers with high AMU, the mean is expected to be larger than the median. An enterprise with lower than median AMU can consider themselves in the lower 50% of AMU users. The authors therefore recommend using median to report average AMU but provide mean AMU alongside this for comparison with other calculations.

Data displayed as boxplots (Figure 1 and 6)

The parts of the boxplot used in the report are explained in the diagram (Figure S.1). Farms whose use was less than the 5th or greater than 95th percentile are not shown on the plot, but their data were used to calculate the mean and median. If the mean is greater than the median, it indicates a 'long tail': a few enterprises which have very high use.

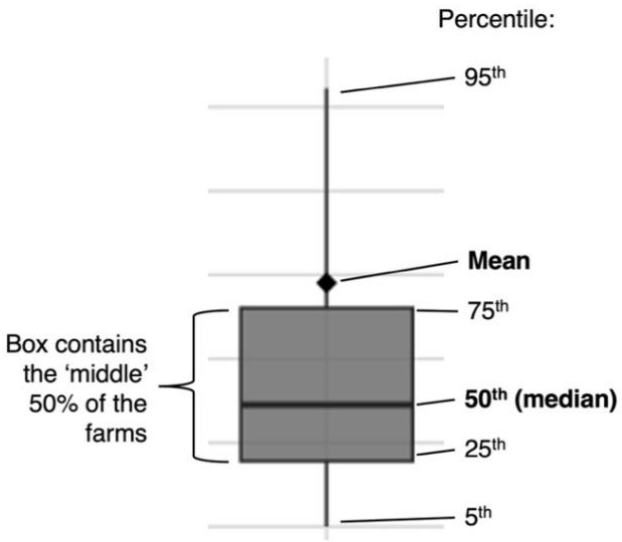


Figure S.1: Interpreting boxplots

Figure 3: EMA category of the AM ingredient used by mass, 2022

Method: Products were grouped into EMA categories (EMA 2020) based on the class of AM ingredients they contained. Products with multiple different AM ingredients were categorised according to the AM ingredient in the formulation with the highest EMA category.

Limitations: As this analysis is based on mass of AM ingredient, low-potency AMs such as tetracyclines contribute more to the total mass than high-potency AMs such as 3rd generation cephalosporins. Future reports aim to also report dose-based AMU metrics, such as DDDvet (ESVAC 2016).

Figure 4: Proportion of AM classes used by species, 2022

Method: AM ingredient was taken from the VMD SPC for each AM product. Proportion by mass (mg) of each class used was calculated.

Limitations: Same as limitations for Figure 3.

Figure 5: Proportion of AM product used by administration route, 2022

Method: Administration route was taken from the VMD SPC for each product, and the proportion by mass (mg) of each AM product used was calculated.

Limitations: The administration route listed on the SPC may not reflect the administration route used by the veterinary surgeon and farmer. For example, oral powders are sometimes used off-label in footbaths. Therefore, this analysis may not be indicative of the administration route used for each product.

Figure 6: Doses of intramammary treatments used/purchased in 2022.

Method: Doses for dry cow and lactating cow AM-containing intramammary (IMM) products were calculated using methodology defined by CHAWG (CHAWG 2020).

For dry cow therapy: 1 dose = 4 tubes.
For lactating cow therapy: 1 dose = 3 tubes (over the course of treatment, an average of 3 tubes are applied to one quarter).

The following equation was used to calculate doses per cow for each dairy enterprise:

$$\text{Doses per cow} = \frac{Number\ of\ IMM\ doses}{Number\ of\ adult\ cows}$$

Limitations: These calculations assume the number of tubes used per course to be 4 (for dry cow therapy) and 3 (for lactating cow therapy), whereas a farmer or veterinary surgeon, in reality, may have used a different number of tubes.

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