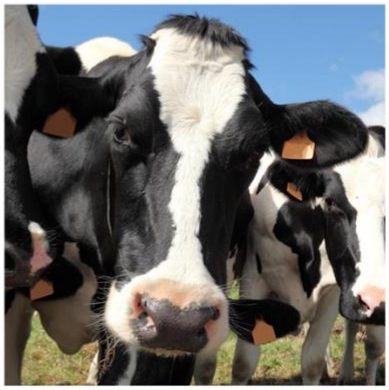
2021

Antimicrobial Use Report







Welsh Lamb and Beef Producers

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Foreword

Welcome to first 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 2021.

The Veterinary Antimicrobial Resistance and Sales Surveillance (UK-VARSS) 2021 report published in November 2022 documented the continued downward trend in sales of veterinary antibiotics in food-producing animals in the UK. This reduction has been observed over successive UK-VARSS reports, which highlights the UK's successful collaborative approach to antimicrobial (AM) stewardship within the livestock industry. Data now show that the UK is one of the countries with the lowest AM consumption in Europe, despite having one of the largest livestock industries (UK-VARSS, 2022).

In this first edition of the Welsh Lamb and Beef Producers (WLBP) Antimicrobial Use Report, we provide a detailed summary of AMU trends from 2510 beef, sheep and dairy enterprises across Wales in 2021. AMU by enterprise type, EMA category, 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. Farmers and veterinary surgeons then receive a personalised AMU report on their enterprise's AMU, aiding them in setting targets to improve productivity and welfare, and to reduce the use of AMs on beef, sheep and dairy farms in Wales.

WLBP aims to continue improving the AMU Calculator and providing annual AMU reports which can evidence changes in AMU on Welsh farms over time. In the future, WLBP also aim to report dose-based AMU metrics such as DDDvet or DCDvet (ESVAC 2016).

> "We believe that farmers are using antibiotics responsibly, but we need the evidence to prove it. This process, based on veterinary surgeons and farmers working together, will take us far down that road. Being proactive in collecting these data demonstrates to government and consumers that livestock produced on farms in Wales are done so to the highest standards."
>
> **WLBP General Manager, Iestyn Tudur-Jones**

Contribution

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

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University of BRISTOL

AMU by enterprise type

AMU in 2021 was calculated for 1037 beef, 1182 sheep and 291 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 captured from 1037 beef, 1182 sheep and 291 dairy enterprises across Wales for the 2021 calendar year (1st January to 31st December) shows an encouraging picture. The median AMU in 2021 was calculated as 3.4 mg/kg* for beef enterprises, 7.5 mg/kg† for sheep and 11.6 mg/kg* for dairy enterprises (Figure 1).

In Figure 1, mean AMU is reported alongside the median to illustrate the effect that outliers (e.g. enterprises with very high AMU), have when reporting mean AMU alone (see supplementary information on reporting average values). Here, mean AMU is always higher than the median, particularly in beef where mean AMU is twice the median.

Large variation in AMU was observed between the enterprises, with the highest users responsible for a large proportion of total usage. The highest 25% of AMU users in beef, sheep and dairy enterprises contributed 70%, 59% and 51% of the total AMU in each sector, respectively.

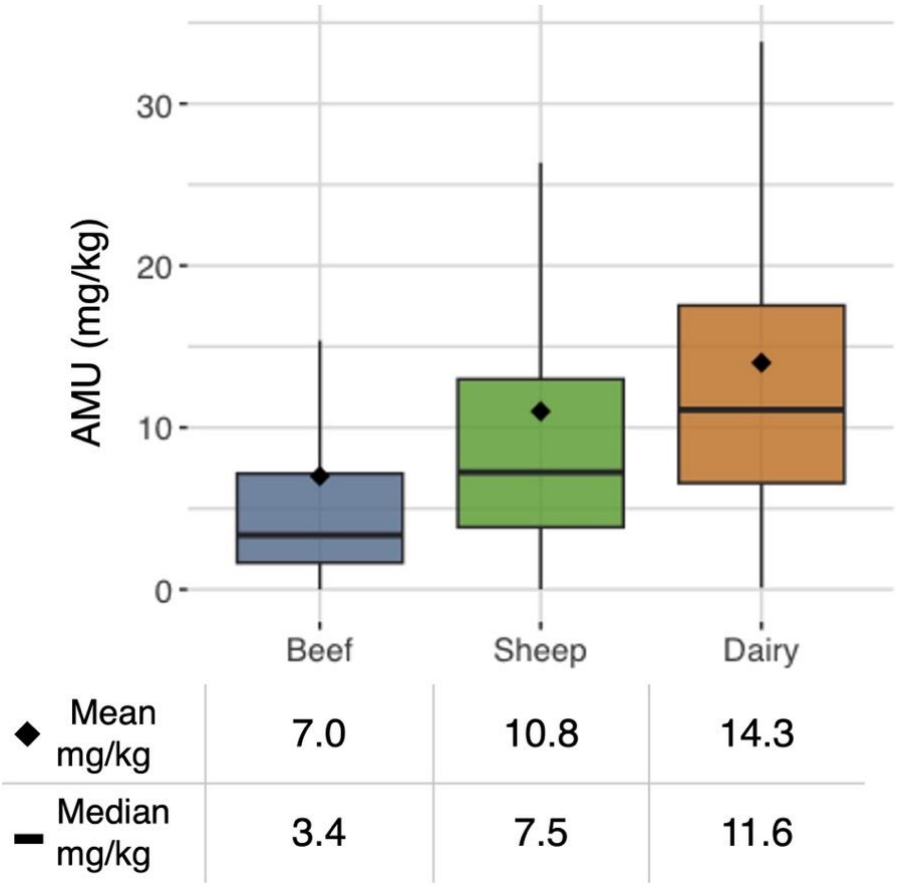


Figure 1: Farm AMU (mg/kg) by species, 2021
Distribution of total annual AMU for all 1037 beef, 1182 sheep and 291 dairy farms in 2021. 5th to 95th percentile shown. The methods used to create this graph are covered in the supplementary information.

* 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 over 50% of all AMs used by mass in dairy, 40% in beef and 22% in sheep enterprises.

In 2020, the EMA updated their 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.

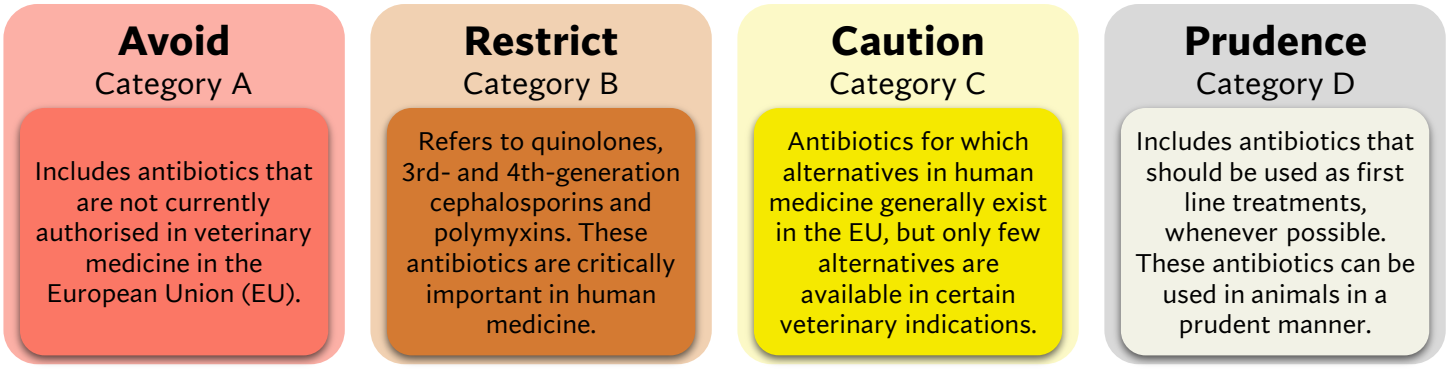


Figure 2: Definitions of EMA categories
Four categories of AMs, from A to D: Avoid, Restrict, Caution and Prudence (EMA, 2020).

Analysis of AMU in 2510 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 enterprises, with 0.1% in beef enterprises and less than 0.1% in sheep enterprises. No enterprises used Category A (Avoid) AMs. The majority of AM products used in beef and sheep were from Category D, representing 59% and 78% of AM mass used, respectively. In dairy enterprises, 57% of AM products were from Category C, compared to 42% of products from Category D.

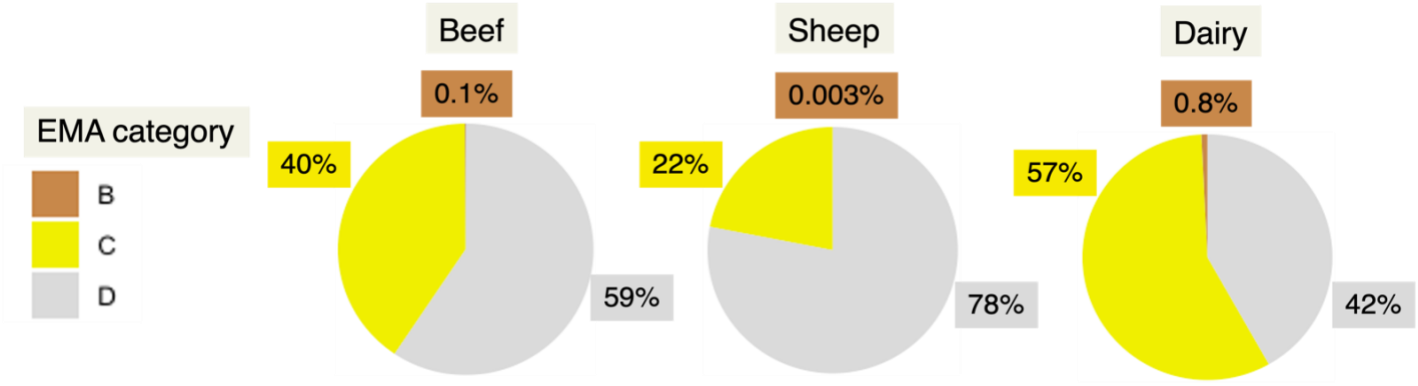


Figure 3: Proportion of AM ingredient used by species and EMA category, 2021
Proportion by mass of AM ingredient used, split by species and AM category. For products with multiple different AM ingredients, products were placed into categories based on the AM ingredient in the formulation of highest EMA importance (EMA, 2020). See supplementary information for methodology.

AMU by class

By mass of AM, the most commonly used AM classes were tetracyclines, aminoglycosides, penicillins, aminopenicillins and macrolides. EMA Category B (Restrict) AM classes such as fluoroquinolones and 3rd and 4th generation cephalosporins were more rarely used.

AMU by class was analysed for 2510 beef, sheep and dairy enterprises in 2021. In total, 16 classes of AMs were used (Figure 4).

There was variation by species in the top five AM classes, by proportion of mass used. In beef, the top five classes used were tetracyclines, aminoglycosides, penicillins, macrolides and amphenicols.

In sheep, the top five classes used were tetracyclines, aminoglycosides, aminopenicillins, penicillins and macrolides. Here, tetracycline use was considerably higher than the second most-used class, aminoglycosides.

In dairy, the top five classes used were aminoglycosides, macrolides, penicillins, aminopenicillins and sulfonamides.

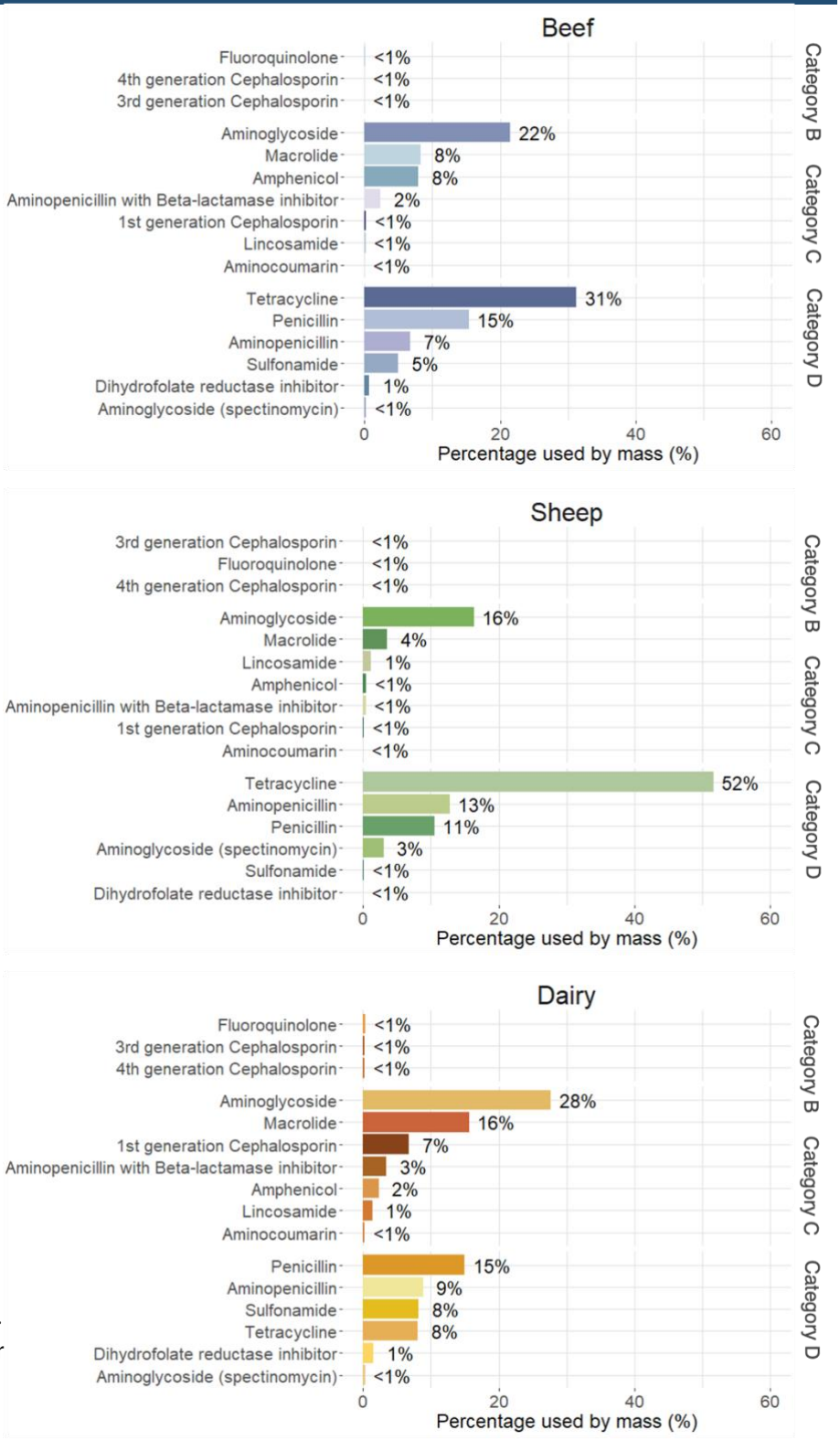


Figure 4: Proportion of AM classes used by species and EMA category, 2021

Proportion by mass of AM used, split by AM class, species and AM category. See the supplementary information for details on the method used.

AMU by administration route

By mass of AM, injectables were the most commonly used administration route across all three enterprises. Use of AM sprays was highest on sheep enterprises, whereas use of intramammary products were highest on dairy enterprises.

AMU by administration route was analysed for 2510 beef, sheep and dairy enterprises in 2021.

For all three species enterprises, the majority of AM product used by mass was administered via the injectable route (Figure 5). In beef, injectables represented 91% of total AM mass used, compared to 86% in sheep and 76% in dairy.

Use of AM sprays was highest in sheep, amounting to 9% of total AM mass, compared to 3% in beef and 3% in dairy. This was as expected considering topical tetracycline sprays are a first-line treatment (in conjunction with an injectable) for lameness in sheep (AHDB, 2020).

Intramammary (IMM) products represented 14% of total AM mass used in dairy enterprises, which was considerably higher than in beef (0.4%) or sheep (<0.1%).

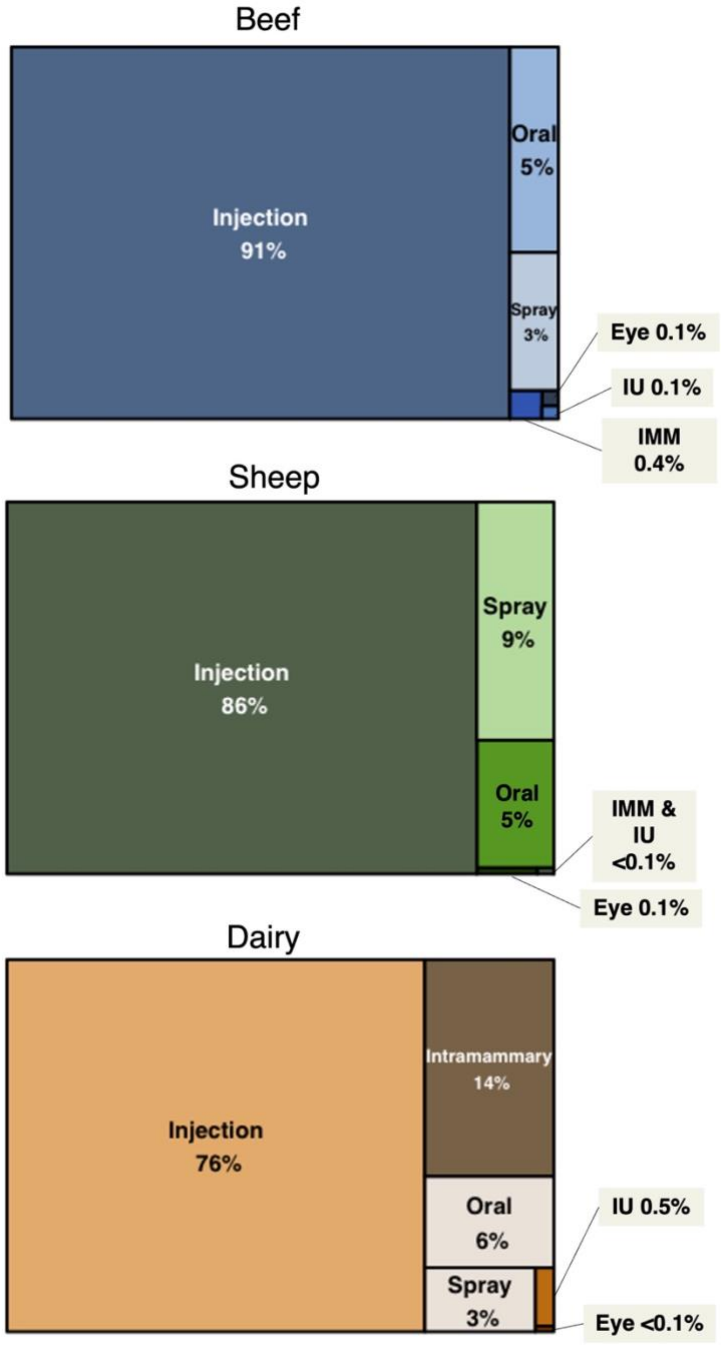


Figure 5: Proportion of AM products used by species and administration route, 2021

Proportion of AM by mass used by species and administration route, as listed in the VMD SPC for each AM product. See supplementary information for further explanation.

IU = intrauterine; IMM= intramammary

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 25% of cows were treated with lactating cow intramammaries, and 33% were treated with dry cow intramammaries.

The number of doses of intramammary (IMM) AM products used in dairy cows was investigated. 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 0.25 doses of IMM AM lactating cow therapy and 0.33 doses of AM dry cow therapy (Figure 6). Assuming every cow treated received one full dose, on an average (median) enterprise, 25% of cows would have been treated with a course of IMM lactating cow therapy and 33% of cows would have received a course of IMM dry cow therapy. In reality, this percentage could be lower as the same cow might have been treated (at least with lactating cow IMM tubes) multiple times throughout 2021.

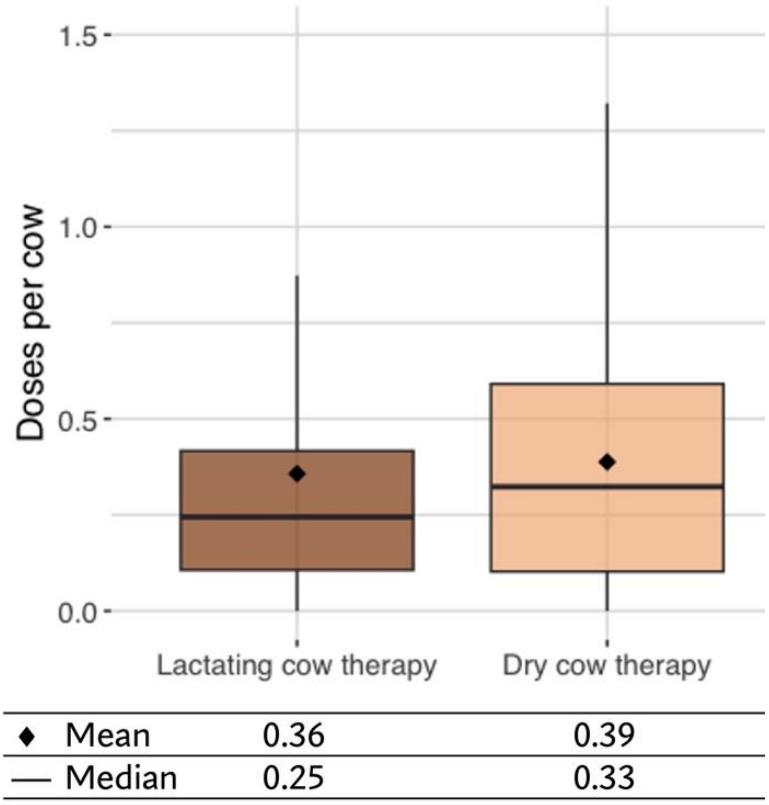


Figure 6: Doses of intramammary treatments used in 2021.

♦ 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.

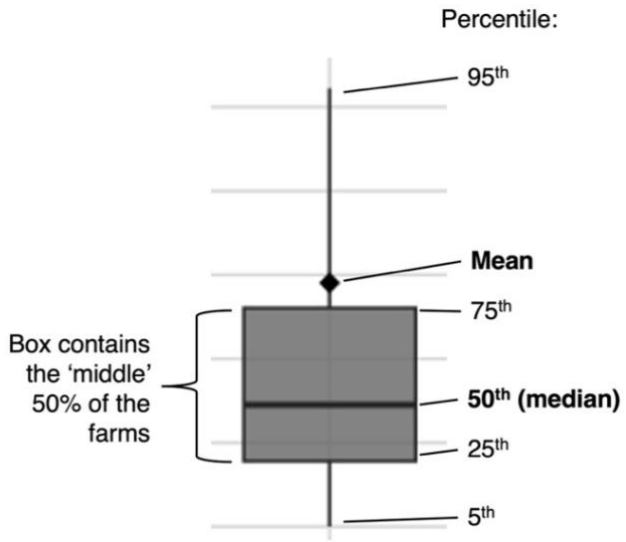


Figure S.1: Interpreting boxplots

Figure 3: EMA category of the AM ingredient used by mass, 2021

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, 2021

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, 2021

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 in 2021.

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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