Cattle Health and Welfare Group Antimicrobial Usage Subgroup (CHAWG AMU) Dairy Benchmarking Paper

The CHAWG AMU group has, following consultation with dairy industry stakeholders, developed a core set of standard metrics for benchmarking UK dairy farms. The conclusions and final recommendations are discussed in this document.

There has not been unanimous agreement from all CHAWG AMU group members/ stakeholders consulted but, on areas where there are disagreements, the arguments for and against and the consensus view are presented here.

Farm benchmarking:

Farm benchmarking refers to the comparison of a farm's antibiotic usage with other farms in the region/country. This has a number of benefits:

- It allows farms to understand their antibiotic use and how this is changing over time and relative to the industry
- It stimulates the vet-farmer conversation and should encourage persistently high using farms to look into their management practices and make changes

Monitoring antibiotic use and benchmarking is increasingly being carried out by veterinary practices, and some food retailers and milk buyers are placing emphasis on regular reporting of antibiotic usage data[1,2]. In addition, all Red Tractor dairy farms are required to collate antibiotic usage and undertake an annual review of antibiotics with their vet[3].

When interpreting benchmarking data, it is vital to focus on encouraging responsible antibiotic use. Herd health planning and strategies to prevent disease are key to reducing the need to administer antibiotics and improving health and welfare on the farm. Reducing use by, for example, withholding necessary treatment, using lower than recommended doses or switching to an inappropriate antibiotic because it has a lower amount of active ingredient per dose, is not responsible use.

There are many different ways of benchmarking dairy farms, each with their own advantages and disadvantages[1,2]. If a standard UK benchmarking system is not developed, there is a risk that many different methods will be developed, potentially meaning that farmers and/or vets will need to provide different data to different interested parties, which could prove an added burden.

The CHAWG AMU group have considered many different possible benchmarking metrics used across Europe[1,2,3,4,5,6] with the aim of choosing the core metric(s) that are most appropriate for use in the UK dairy sector. While different metrics show different things[1,2], the CHAWG AMU group believe that the number of metrics should be minimised as far as possible, as having too many metrics may be confusing for vets and farmers.

The recommendation is intended to be applicable irrespective of the source of antibiotic usage data (which can come from either veterinary practices or producers). However, caution should be exercised when comparing data from different sources as they may differ. For example:

- Veterinary practice data on antibiotics purchased by the farm has a number of limitations. For example:
    - It does not take into account possible wastage or products going out of date
    - A product purchased one year may be used in the next usage year
    - A farm may purchase antibiotics from more than one source, for example if a farm has more than one veterinary practice looking after its animals and/or purchases medicines under prescription. In the latter case, prescription data should also be collected
    - For mixed enterprises, for example with dairy, beef and/or sheep, it may be difficult to determine in which species or sector a product has been used
- Farmer derived data overcomes the issues highlighted above, but relies on accurate and diligent recording of all medicines administered and this may be variable between farms

There is always a balance between improving accuracy and having a metric that as many people as possible can carry out. The recommendations provide a core set of metrics that include standardised average weights at treatment and standardised treatment courses. The metrics should therefore be considered “technical units” rather than true values, as the standard assumptions may not reflect the actual weights at treatment or treatment courses used on each farm.

The CHAWG AMU group recognizes that there is value in extending the core benchmarking metrics with more accurate farm-specific information, but these will not be covered by this document. This could include:

- Benchmarking by age group (e.g. separating out calves and adult cattle)
- Monitoring the actual number of treated animals and treatment courses given
- Monitoring the reasons for treatment

The recommendations assume that a 12-month benchmarking period is being produced which could be based on a calendar year (e.g. 2017) or a rolling year to date figure (e.g. 1st September 2016 to 31st August 2017).

Core metrics:

The CHAWG AMU group recommends that the following core metrics are calculated, for both total usage and overall usage of Highest Priority Critically Important Antibiotics (HP-CIAs), as defined by the Antimicrobial Advice Ad Hoc Expert Group (AMEG)[6], i.e. fluoroquinolones, 3rd and 4th generation cephalosporins and colistin:

<u>Core Metric One</u> = mg/Population Correction Unit (PCU):

- mg refers to the amount of antibiotic active ingredient (note that, in line with European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) principles, topical antibiotics such as antibiotic sprays and eye drops will not be included)[6]
- PCU refers to the weight of animal at risk on the dairy farm, based on the average weight at time of treatment. This is calculated by multiplying the average number of adult dairy cows by 425 kg
- 425 kg is the weight used by ESVAC in the PCU figure used for national monitoring of antibiotic sales data[6]

<u>Core Metric Two</u> = Average number of antibiotic courses per dairy cow for dry cow therapy

- This is calculated by dividing the number of dry cow antibiotic tubes sold by 4 (the assumed number of tubes used per course) and then dividing this by the average number of adult dairy cows

<u>Core Metric Three</u> = Average number of antibiotic courses per dairy cow for lactating cow therapy

- This is calculated by dividing the number of lactating cow antibiotic tubes sold by 3 (the assumed number of tubes used per course) and then dividing this by the average number of adult dairy cows

These metrics align with how national use in the dairy sector is being reported, for example in the UK-VARSS report[9] and in the antibiotic usage targets for the dairy sector[10]. It should be noted, however, that the antibiotic usage targets are based on a total national UK figure and therefore reflect the mean usage per dairy farm. They are not intended to be a farm-level target and, when interpreting farm level antibiotic usage, the specific situation on that farm, include system type and disease challenges, need to be considered.

To help interested parties carry out these calculations, a master spreadsheet will be made publicly available for each licensed antibiotic (linked to the Veterinary Medicine number) which will contain the amount of active ingredient in mg per item, g or ml (calculated using ESVAC principles).

Questions and answers

How are adult dairy cows defined?

Adult dairy cows are defined as dairy cows which have had a calf, including those that are lactating and in the dry period. If using BCMS to determine this number, and information on calving is not available, then this can be estimated by counting the number of female dairy breed animals over 2 years of age. This is the approach used when government report on the total breeding dairy herd numbers[11].

How is the average number of adult dairy cows calculated?

This should represent the average number of adult dairy cows in the 12 month monitoring period. This number may vary over the year, especially in seasonal herds. It is therefore recommended that the number is measured at specific time-points (at least once per quarter) and an average is taken. For example:

- 1st January – 100 adult dairy cows
- 1st April – 110 adult dairy cows
- 1st July – 120 adult dairy cows
- 1st October – 90 adult dairy cows
- **Average number over the year - 105 adult dairy cows**

Why is the weight of 425 kg per dairy cow used? This isn't the weight of a dairy cow in the UK?

This area has been subject to a lot of debate. The average weight of an adult dairy cow in the UK has been estimated to be 627 kg[12]. However, 425 kg is the weight used by ESVAC as the PCU figure for adult dairy cows[8] and is intended to represent "the average weight at time of treatment". However, concerns have been raised that explaining this concept to dairy farmers can be difficult[1].

On the other hand, the national figure for monitoring antibiotic usage will be calculated using the ESVAC methodology and, if a different weight is used for benchmarking farms, this could be confusing. In addition, while increasing the weight (for example to 627 kg) will reduce the overall farm mg/PCU, it will not affect the relative position of one farm compared to another farm.

Won't the average weight vary by breed?

Yes, in the UK it has been estimated that, for example, the average weight of a Jersey cow is 466 kg while the average weight of a Holstein is 636 kg[12]. However, collecting animal numbers and applying different weights by breed would add an extra layer of complexity to the metric, especially as many farms have mixed-breed animals[1].

Why are only dairy cows used when calculating the farm animal weight? What about calves, replacement dairy heifers, etc.?

It is true that some groups are missing when calculating the kg of animals at risk. With this measure, usage in calves and replacement dairy heifers, for example, will be captured in the mg part of the mg/PCU calculation but their weight is not captured in the PCU part.

It was considered by CHAWG AMU that information on the average number of adult dairy cows is relatively easy for farmers to provide, compared with the average number of calves which, for seasonal herds in particular, can fluctuate widely throughout the year. Given that the majority of antibiotic active ingredient (in volume terms) is likely to be given to the adult dairy cows, the omission of calves/ replacement dairy heifers from the PCU is, in most cases, unlikely to significantly influence the relative position of one farm against another. However, CHAWG AMU does recognize that antibiotic usage in calves, for example for calf pneumonia, is a big issue on some farms and will continue to look into how this can be captured and benchmarked separately.

What about dairy farms that also rear beef animals?

CHAWG AMU recognize that some dairy farms do rear beef animals as well. Where possible, it is advisable that farmers and veterinary practices separate dairy and beef usage, for example by having one sub-account for dairy cattle/ replacements and another for animals being reared for beef. Otherwise the usage on these farms may appear high when compared with dairy farms that that do not rear beef animals.

Why are topical products excluded?

Topical products (such as antibiotic sprays and eye drops) account for a small proportion of antibiotic active ingredient used in dairy farms (1.9% for the 2016 FarmVet Systems dairy survey[9]) and removing them is in line with ESVAC methodology.

Why has mg/PCU been chosen rather than daily doses or course doses? Might this not drive people towards using critically important antibiotics?

Mg/PCU is now becoming widely recognized for national monitoring and is relatively easy to calculate and understand. It is largely a measure of injectable and oral use. For example, from the 2016 VetImpress dairy sample, 68% of use was made up of injectable preparations and 17% oral preparations[9]. This is because the amount of active ingredient per course for intra-mammary preparations is relatively lower.

A disadvantage of the mg/PCU measure is that different antibiotic active ingredients have different dose rates, and so products with higher amounts of active ingredient per course will push mg/PCU up more than products with a lower amount of active ingredient per course. In addition, mg/PCU tends to over-represent oral products relative to injectable products as, on average, these have a higher amount of active ingredient per course.

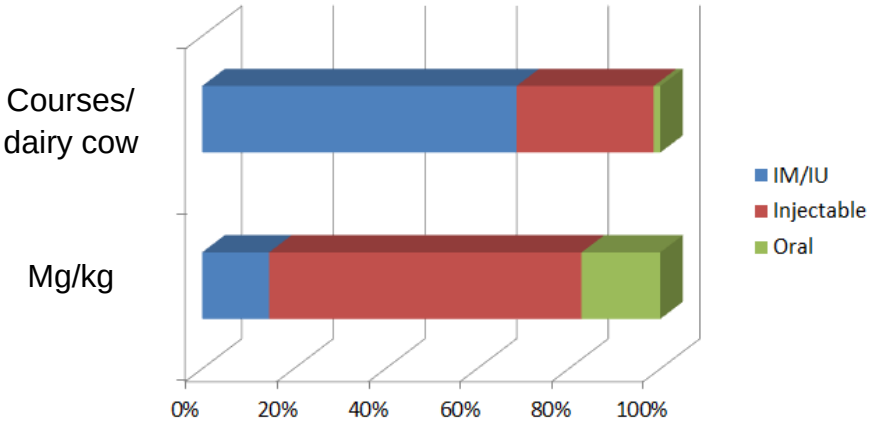
These issues can be overcome by measuring the average number of antibiotic courses per dairy cow for injectable/oral products, for example by assuming standardised doses/course lengths related to how these products are licensed for use in the UK. CHAWG AMU has received some feedback that this is easier to communicate to farmers than mg/kg. However, average number of antibiotic courses per dairy cow was not included as a core metric for injectable/ oral products as:

- The calculation is more complicated calculations to carry out than mg/PCU
- The products with the lowest amount of active ingredient per course are the HP-CIAs and, as long as a separate mg/PCU metric for HP-CIAs is monitored, this will reduce the risk that farmers will switch to these products
- The CHAWG AMU group considered that vets choose products based on what is most appropriate for that particular case, and so are unlikely to move towards using an inappropriate product just to reduce the mg/PCU figure

Why do we need a figure based on courses for intra-mammary products?

Because of the use of intra-mammary products in dairy cattle, the mg/PCU and course metrics can differ greatly. This is because, although intra-mammary products account for around 65% of all courses given, as the amount of active ingredient per dose is lower they only account for 15% of the mg/PCU metric[9].

The relative make up of mg/PCU and average number of course doses/dairy cow from the 2015 VetImpress dairy sample:[9]



IM = IM =intra-mammary, IU = intra-uterine

Why have 4 tubes per course been chosen for dry cow therapy and 3 tubes per course chosen for lactating cow therapy?

It was considered that, although some farms practice quarter level dry off, in most cases, cattle are treated every quarter for dry cow therapy.

For lactating cow therapy, while licensed treatment courses can vary from 1-4 treatments, 3 is the average number of tubes per course for the UK-licensed products and so CHAWG AMU considers this to be a reasonable assumption. This also aligns with the assumptions used by ESVAC as well as the figures which are included in the dairy sector targets.

CHAWG AMU has received feedback that off-label use of adult cow products does occur on some farms, and so the figure may not represent the actual number of courses used on that farm. However, as described earlier, the metric should be considered a “technical unit” rather than a true value, and will still allow for trend monitoring and farm benchmarking.

Can we just create one metric for intra-mammary products?

It is possible to combine the intra-mammary metrics, but the CHAWG AMU group feel it is more useful to separate them out as they represent different things. For example, dry cow therapy tube use may give you an indication of the uptake/ success of any selective dry cow measures whereas lactating cow therapy tube use can give you an indication of the number of cases of clinical mastitis on the farm

Are off-label products (e.g. antibiotic footbaths) included in any of the analyses?

Yes, the amount of active ingredient in off-label oral and injectable products will be captured in the mg/PCU calculation.

Why do we need to measures total use and HP-CIA use?

Because of the risks of cross-resistance and co-resistance (i.e. the use of one antibiotic class can induce resistance to another antibiotic class), reducing overall use of antibiotics is important in minimising the risk of the development of antimicrobial resistance.

However, there is particular scrutiny on reducing antibiotics that are considered highest priority for human medicine (as defined by the European Medicines Agency[7]), so categorised if they are used as a last resort antibiotic for serious infections in people and the risk of resistance transfer is considered high.

Why is it recommended to have a 12-month (rather than a 3- or 6-month) benchmarking period?

A 12-month period (either based on calendar year or rolling year to date figure) is recommended as it takes into account seasonal fluctuations, for example due to climate as well as management systems (e.g. Spring- and Autumn-calving herds). The systems described in this paper could be adapted for a 3- or 6-month period. However, to produce a comparable figure, it would be necessary to divide the denominator (i.e. average number of dairy cows during the benchmarking period) by 4 or 2, respectively.

References

1 - Mills, HL., Turner, A., Morgans, L., Massey, J., Schubert, H., Rees, G., Barrett, D., Dowsey, A., Reyher, KK. (2018) Evaluation of metrics for benchmarking antimicrobial use in the UK dairy industry, Veterinary Record 182, 379., https://veterinaryrecord.bmj.com/content/182/13/379

2 - Hyde, RM., Remnant, JG., Bradley, AJ., Breen, JE., Hudson, CD., Davies, PL., Clarke, T., Critchell, Y., Hylands, M., Linton, E., Wood, E., Green, MJ. (2017) Quantitative analysis of antimicrobial use on British dairy farms, Veterinary Record 181, 683.

3 - https://assurance.redtractor.org.uk/contentfiles/Farmers-6912.pdf?_=636585117784901746

4 – GUIDELINES FOR COLLECTION, ANALYSIS AND REPORTING OF FARM-LEVEL ANTIMICROBIAL USE, IN THE SCOPE OF ANTIMICROBIAL STEWARDSHIP http://www.aacting.org/guidelines/

5 - Werner N, McEwen S, Kreienbrock L. 2018. Monitoring Antimicrobial Drug Usage in Animals: Methods and Applications. Microbiol Spectrum 6(4):ARBA-0015-2017. doi:10.1128/microbiolspec.ARBA-0015-2017.

6 - Guidance on collection and provision of national data on antimicrobial use by animal species/categories, http://www.ema.europa.eu/ema/pages/includes/document/open_document.jsp?webContentId=WC500224492

7 - Advice on impacts of using antimicrobials in animals, http://www.ema.europa.eu/ema/index.jsp?curl=pages/regulation/general/general_content_000639.jsp&mid=WC0b01ac058080a585

8 - Understanding the mg/PCU calculation used for antibiotic monitoring in food producing animals, https://www.gov.uk/government/publications/understanding-the-mgpcu-calculation-used-for-antibiotic-monitoring-in-food-producing-animals

9 – Veterinary Antimicrobial Resistance and Sales Surveillance 2016, https://www.gov.uk/government/publications/veterinary-antimicrobial-resistance-and-sales-surveillance-2016

10 – Targets Task Force Report 2017, https://www.ruma.org.uk/wp-content/uploads/2017/10/RUMA-Targets-Task-Force-Report-2017-FINAL.pdf

11 - https://www.gov.uk/government/statistical-data-sets/structure-of-the-livestock-industry-in-england-at-december

12 - Hannah E Schubert, Sarah Wood, Kristen Reyher, Harriet Mills. 2018 First data-driven approach to using individual cattle weights to estimate mean adult dairy cattle weight in the UK, https://www.biorxiv.org/content/early/2018/02/23/270702.article-info

13 - Defined daily doses for animals (DDDvet) and defined course doses for animals (DCDvet) (2016) - http://www.ema.europa.eu/docs/en_GB/document_library/Other/2016/04/WC500205410.pdf