# Measuring and comparing the use of antibiotics on beef farms Cattle Health and Welfare Group Antimicrobial Usage Subgroup (CHAWG AMU) Consultation Document

## 1. Responsible Antibiotic Use

Antibiotics are very important medicines. Every time an antibiotic is used, there is a risk that it will increase the number of bacteria resistant to that antibiotic. This means that these antibiotics will stop becoming effective for treating infections in people and animals. Responsible antibiotic use is therefore vital to help preserve these life-saving medicines.

Some antibiotics are also very important as a last resort for use in the treatment of serious infections in people. These are called the Highest Priority Critically Important Antibiotics (HP-CIAs). The HP-CIAs, as currently defined by the Antimicrobial Advice Expert Group (AMEG)[1], are fluoroquinolones, 3rd and 4th generation cephalosporins and colistin. It is very important to minimise how much of these HP-CIAs are used on farms and only use them when needed, for example when bacterial culture and sensitivity show it is the only group that is effective for maintaining health and welfare.

Beef farmers and vets should work together to monitor the amount of antibiotic used on farm every year and ensure that antibiotics are used responsibly. This is now part of the Red Tractor standards for beef farms[2].

## 2. Benchmarking Antibiotic Use

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

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.

The CHAWG AMU group would like to consult with beef industry stakeholders to develop a core set of standard metrics for benchmarking antibiotic use on UK beef farms, following a similar process that was recently completed for the dairy sector[3]. The chosen system(s) of measurement will then become the standard suggested core metric(s) for beef farms in the UK and will be incorporated, for example, in the electronic Medicines Book for Cattle and Sheep, which is currently under development. This does not, however, exclude the calculation of additional antibiotic usage metrics, according to individual requirements and needs.

While systems are in place for the national monitoring of beef herds, for example using the Population Correction Unit (PCU) method developed by the European Surveillance for Veterinary Antimicrobial Consumption (ESVAC) group[4], it is not possible to use these for benchmarking at farm level as, for the beef sector, these are focused on measuring the number of slaughter animals. In the UK, many beef farms do not produce slaughter animals, or they produce so few that this number does not fairly represent their production system.

There is always a balance between improving accuracy and having a metric that as many people as possible can work with. Given the wide variety of beef production systems, it will not be possible to create a "perfect" metric that covers all possible systems. The aim is to create one that provides a sensible balance between accuracy and pragmatism and works for the majority of farms. Many metrics rely on assumptions (such as standardised liveweights) which may not reflect the actual situation on each farm, but this is necessary because, while some farms may be able to easily provide this information, not all beef farms weigh their cattle or, if they do, record this information in a way that can be easily shared. The values created by such metrics should therefore be considered "technical units" rather than true values and should be interpreted carefully by the farm's veterinary surgeon on a case by case basis, considering specific factors on each individual farm.

Ideally, full access to movement system records (such as the Cattle Tracing System for Great Britain and APHIS for Northern Ireland) will make it possible to collect accurate animal data, including number, age and breed, and take account of time on farm without having to ask the farmer for this information. However, when creating these metrics, it has been assumed that (at least in some cases) the information will need to be obtained directly from the farmer. The aim has therefore been to minimise the amount and complexity of the information that the farmer needs to provide. If a system, such as the electronic Medicines Book for Cattle and Sheep, develops full access to movement record in the future, then it will be possible to improve the overall accuracy of the metric(s).

In all cases, it is recommended that the core metrics are calculated for both total antibiotic usage and overall usage of HP-CIAs separately. The recommendations assume that a 12-month benchmarking period is being used, based on a calendar year.

The document has incorporated some of the recommendations suggested by the University of Bristol, as part of a project with AHDB to explore options for benchmarking medicine use in the beef sector. The full provisional Bristol benchmarking report produced for this consultation is included in Appendix One.

Broadly speaking, there are two main type of metrics that can be used for measuring antibiotic use on a farm:

- Weight-based – based on the weight of antibiotic active ingredient used
- Animal-based – based on the number of animals/days an animal was treated with an antibiotic

## 3. Consultation Process

This consultation document will focus on creating a farm metric. The methodology could also be extended to calculate, for example, usage in specific animal groups (e.g. calves, weaned calves, yearlings or adults) and could be combined with further information, for example reason for treatment and treatment success.

As part of this consultation, two weight-based proposals and two animal- based proposals will be included for consideration. Upon reviewing these, your feedback to the following consultation questions would be extremely valuable:

| Please rate the metrics for calculating and monitoring antibiotic use out of 10 for each of the elements below (where 10 is the best outcome): | Proposal One mg/SBCU option one | Proposal Two mg/SBCU option two | Proposal Three % treated | Proposal Four Treatment days |
|---|---|---|---|---|
| 1. How easy do you think it would be for farmers to provide the information required relating to antibiotic use? | Refers to the information described in section 4a (combined for Proposal One and Proposal Two, as the information required is the same) | | Refers to the information described in section 8a | Refers to the information described in section 9a |
| 2. How easy do you think it would be for farmers to provide the information relating to the cattle population? | Refers to the information described in section 5a | Refers to the information described in section 6a | Refers to the information described in section 8b | Refers to the information described in section 9b |
| 3. Overall, how accurately do you think the metric will reflect antibiotic use on the farm? | Refers to the information included in section 5b | Refers to the information included in section 6b | Refers to the information described in section 8b | Refers to the information described in section 9b |
| 4. Overall rating (taking into account the balance between ease of use and accuracy) | | | | |

| | |
|---|---|
| 5. Do you have any suggestions as to how the metric(s) could be improved? | |
| 6. Are there any other metrics which you would use instead of those proposed? | |
| 7. Any other comments? | |

## 4. Weight-based Metrics

Weight-based metrics include two elements:

a) The weight of antibiotic active ingredient used:

Every antibiotic product contains a known amount of active ingredient. This is part of its registration with the Veterinary Medicines Directorate (VMD) and is centrally recorded[5]. By measuring the number of units used on a farm in a calendar year (for example in packs, grams (g) or millilitres (ml)) it is then possible to calculate the weight of active ingredient in milligrams (mg), see example below:

| Antibiotic product | Amount used (A) | Concentration mg/unit (C) | Total antibiotic used in mg (A x C) |
|---|---|---|---|
| Duphapen | 600 ml | 300 mg/ml | 180000 |
| Alamycin | 1000 ml | 100 mg/ml | 100000 |
| Trimacare Boluses | 42 boluses | 1200 mg/bolus | 50400 |
| Terramycin Powder | 1 kg | 50000 mg/kg | 50000 |
| Nuflor | 200 ml | 300 mg/ml | 60000 |
| Total amount of antibiotic used (mg) | | | 440400 |

The amount of antibiotic used can be collected from details of the antibiotics supplied/ prescribed to a farm (e.g. veterinary practice records) and/or records of actual use, for example from a farm medicine record book.

When calculating the weight of active ingredient used, the recommendation is to follow the methodology set out by ESVAC, which currently includes all antibiotics except topical antibiotics such as eye drops and sprays[6]. However, antibiotics that are being used off-license as footbaths (e.g. those that are licensed as oral products for other species) should be included.

### b) The weight of animals at risk on the farm:

It is important that the weight of antibiotic used (in mg) is interpreted relative to the weight of animal population in the farm (in kg) to create a mg/kg metric.

In this consultation, two proposals, which differ only in how the weight of the animal population on the farm (in kg) is calculated, are presented. Both approaches aim to calculate a figure based on the average liveweight of animals on the farm across the 12-month benchmarking period.

This is different to the PCU methodology for beef farms used for national reporting, which is based on measuring number of animals slaughtered and uses standard weights that represent the "average weight at time of treatment". To make it clear that the results will be different from the PCU, it is therefore recommended that it is called a different name, and a suggestion for consideration is "Standard Beef Cattle Unit (SBCU)".

#### Advantages of weight-based metrics:

- They are used for national monitoring and for benchmarking in other sectors, including pigs and dairy
- They can be calculated using both supply/prescription data (e.g. from veterinary practice records) and farm-derived data
- There is often good correlation with dose-based metrics. For example, in a study looking at a convenience sample of 207 commercial sheep only farms in England, Wales and Scotland from 8 veterinary practices, an 84% correlation between a mg/kg-based metric and daily dose metric was found[7]

#### Disadvantages of weight-based metrics:

- The amount of active ingredient per course can be lower for some antibiotics than others. This is particularly the case for HP-CIAs such as fluoroquinolones, colistin and 3rd and 4th generation cephalosporins. This has led to a concern that a mg/kg-based metric may drive farmers towards using these antibiotics. However, in the beef sector the use of HP-CIAs is relatively low (1.5% active ingredient administered in a 2017 sample[8]) and, to avoid driving inappropriate behaviour, it is recommended that HP-CIA use is monitored separately alongside a total figure
- Some non-HP-CIA products (e.g. trimethroprim-sulphonamides, which have two active ingredients) can have a higher amount of active ingredient than others, but may be the responsible choice in a particular case
- Weight-based metrics don't always reflect the number of animals treated. For example, the weight of antibiotic given to a calf will usually be less than the weight given to an adult cow. However, when considering risk of selection or transmission of Antimicrobial Resistance (AMR), it is unknown if the mass of antibiotics used or the number of animals treated is more important

# 5. Proposal One – mg/SBCU[option one]

## a) Information provided by the farmer:

With this proposal, the farmers need to provide the following pieces of information, relating to a calendar year:

- Number of suckler cows put to the bull
- Number of animals and days spent on farm in each of the following categories:
    - **Pre-weaned dairy calves***
        - Calves up to 56 days of age
    - **Weaned intensively grown dairy calves*, ****
        - <450kg or <12m if liveweight is not available
    - **Weaned conventionally grown dairy calves***
        - <450kg or <18m if liveweight is not available
    - **Weaned conventionally grown beef calves*****
        - <450kg or <18m if liveweight is not available***
    - **Intensively finished dairy cattle***
        - >450kg or >12m if liveweight is not available
    - **Conventionally finished cattle******
        - >450kg or >18m if liveweight is not available

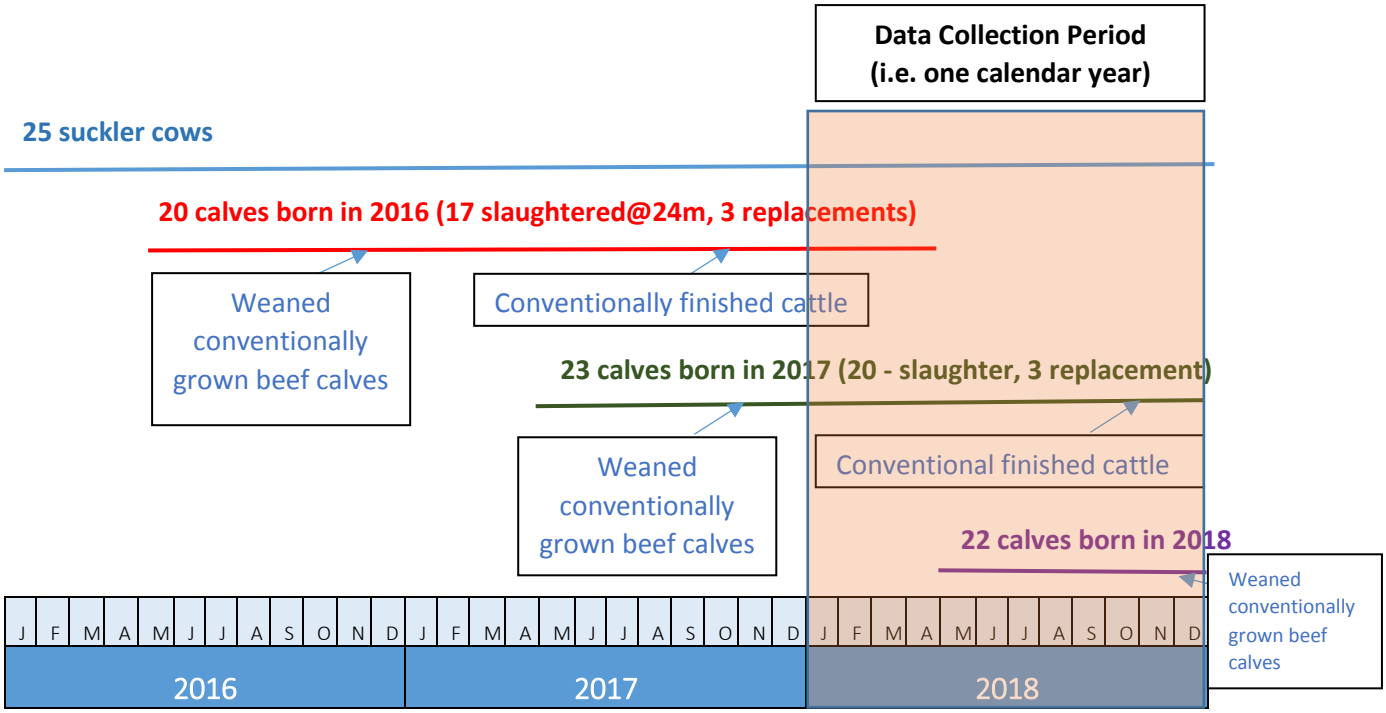
** - Refers to progeny of a dairy cow, regardless of sire breed*
*** - Often, but not always, dairy bulls*
**** - Refers to progeny of a beef cow, regardless of sire breed*
***** - May be the progeny of either dairy or beef cows, regardless of sire breed*

Ideally this categorisation should be based on liveweight (with 450kg being used as the key cut-off liveweight between the growing and finishing phase). However, age is included as an alternative if liveweight is not available on the farm.

In some cases, farmers will need to assign animals into two categories over the year. For example:

- At weaning, dairy calves will move from the "Pre-weaned dairy calves" category to either:
    - "Weaned intensively grown dairy calves" and subsequently (at >450kg or >12m) the "Intensively finished dairy cattle" category
    - "Weaned conventionally grown dairy calves" and subsequently (at >450kg or >18m) the "Conventionally finished cattle" category
- At weaning, suckler beef calves will move into the "Weaned conventionally grown beef calves" category and then subsequently (at >450kg or >18m) to the "Conventionally finished cattle" category

If we take an example of a spring calving suckler herd that put 25 cows to the bull in 2018 and had 20 calves born in 2016, 23 calves born in 2017 and 22 calves born in 2018. Every year, 3 calves were kept as replacements (put to the bull at 24 months) and the rest were sent for slaughter (at 24 months). This is mapped out below:




Calves up to 7 months of age are included in the Suckler cow metric. However, cattle up to 450kg (i.e. between 7 months and, in this case, 18 months of age) are included in the "Weaned conventionally grown beef calves" category and those over 450kg (in this case between 18 and 24 months of age) are included in the "Conventionally finished cattle" category.

For this farm, the following data would therefore need to be provided by the farmer:

| | Number in 2018 (N) | Days In category during 2018 (T) |
|---|---|---|
| Suckler cows put to the bull | 25 | |
| 2016 Batch<br>Conventionally finished cattle<br>(>450kg or >18m if liveweight not available) | 20 | 120 |
| 2017 Batch<br>Weaned conventionally grown beef calves<br>(<450kg or <18m if liveweight not available) | 23 | 304 |
| 2017 Batch<br>Conventionally finished cattle<br>(>450kg or >18m if liveweight not available) | 23 | 61 |
| 2018 Batch<br>Weaned conventionally grown beef calves<br>(<450kg or <18m if liveweight not available) | 22 | 31 |

### b) Calculation of the liveweight of animals on the farm:

Once this information is provided, standardised liveweights are then used to estimate the overall liveweight of animals on the farm:

- For Suckler cows, the number of cows put to the bull is multiplied by 779kg:
    - This weight represents the liveweight of the Suckler cows, but also takes into account the liveweight of the pre-weaned dairy calves (0-7 months of age) and mature bulls on the farm (on the assumption that 90 calves are weaned per 100 suckler cows put to the bull and 4 stock bulls are run per 100 suckler cows put to the bull). For further details on how this liveweight has been derived, please see Appendix Two

- For the other beef categories, standard liveweights have also been applied:

| | Average category liveweight in kg |
|---|---|
| Pre-weaned dairy calves **(Calves up to 56 days of age)** | 60 |
| Weaned intensively grown dairy calves **(<450kg or <12m if liveweight not available)** | 265 |
| Weaned conventionally grown dairy calves **(<450kg or <18m if liveweight not available)** | 265 |
| Intensively finished dairy cattle **(>450kg or >12m if liveweight not available)** | 504 |
| Weaned conventionally grown beef calves **(<450kg or <18m if liveweight not available)** | 388 |
| Conventionally finished cattle **(>450kg or >18m if liveweight not available)** | 528 |

    - These standard liveweights are then adjusted according to the time spent in the category. For example, the average liveweight for the group "Intensively finished dairy cattle" is 504kg. If an animal/group of animals were in this category for half the year, the average liveweight assigned per animal would be divided by two, i.e. 257kg

If you look at the example included in 5a, you would get the following SBCU (in kg). Note that the information in orange is provided by the farmer, whereas the rest relates to the underlying calculation used to create the final SBCU:

| | Number (N) | Days In category (T) | Average liveweight in kg (L) | Adjusted liveweight in kg (AL = T/365 x L) | $SBCU^{option\ one}$ in kg (N x AL) |
|---|---|---|---|---|---|
| Suckler cows put to the bull **(90% weaning; 1 bull / 25cows)** (incorporates pre-weaned calves) | 25 | 365 | 779 | 779 | 19475 |
| 2016 Batch Conventionally finished cattle **(>450kg or >18m if liveweight not available)** | 20 | 120 | 528 | 174 | 3480 |
| 2017 Batch Weaned conventionally grown beef calves **(<450kg or <18m if liveweight not available)** | 23 | 304 | 388 | 323 | 7429 |
| 2017 Batch Conventionally finished cattle **(>450kg or >18m if liveweight not available)** | 23 | 61 | 528 | 88 | 2024 |
| 2018 Batch Weaned conventionally grown beef calves **(<450kg or <18m if liveweight not available)** | 22 | 31 | 388 | 33 | 726 |
| **Total average liveweight of animals on the farm over the year in kg – $SBCU^{option\ one}$** | | | | | 33134 |

If the farm had the antibiotic usage as described in section 4a then the following can be calculated:

$$mg\ per\ SBCU\ (option\ one) = \frac{440400\text{mg}}{33134\text{kg}} = 13.3$$

For further example calculations, please see Appendix Three.

# 6. Proposal Two – mg/SBCU[option two]

## a. Information provided by the farmer:

In Proposal Two, the farmers need to provide the following information on the numbers of cattle relating to the last calendar year. Not all questions need to be answered, depending on the farm enterprise(s) included within the farm:

- Suckler Herd:
  - In the last year, how many cows and heifers did you put to the bull?
  - In the last year, how many home-bred beef cattle were sold for further feeding or breeding (not for slaughter)?
    - Average age when leaving farm: <1yr ☐ 1-1.5yrs ☐ >1.5 years ☐
  - In the last year, how many home-bred beef cattle were sold for slaughter?
    - Average age when leaving farm: <1yr ☐ 1-1.5yrs ☐ >1.5 years ☐
  - Of the calves born in the last year, how many do you expect to be retained for breeding?

- Calf Rearing:
  - In the last year, how many dairy-origin calves (born on farm or purchased to rear on milk) were sold for further feeding or breeding (not for slaughter)?
    - Average age when leaving farm: <1yr ☐ 1-1.5yrs ☐ >1.5 years ☐
  - In the last year, how many dairy-origin calves (born on farm or purchased to rear on milk) were sold for slaughter?
    - Average age when leaving farm: <1yr ☐ 1-1.5yrs ☐ >1.5 years ☐

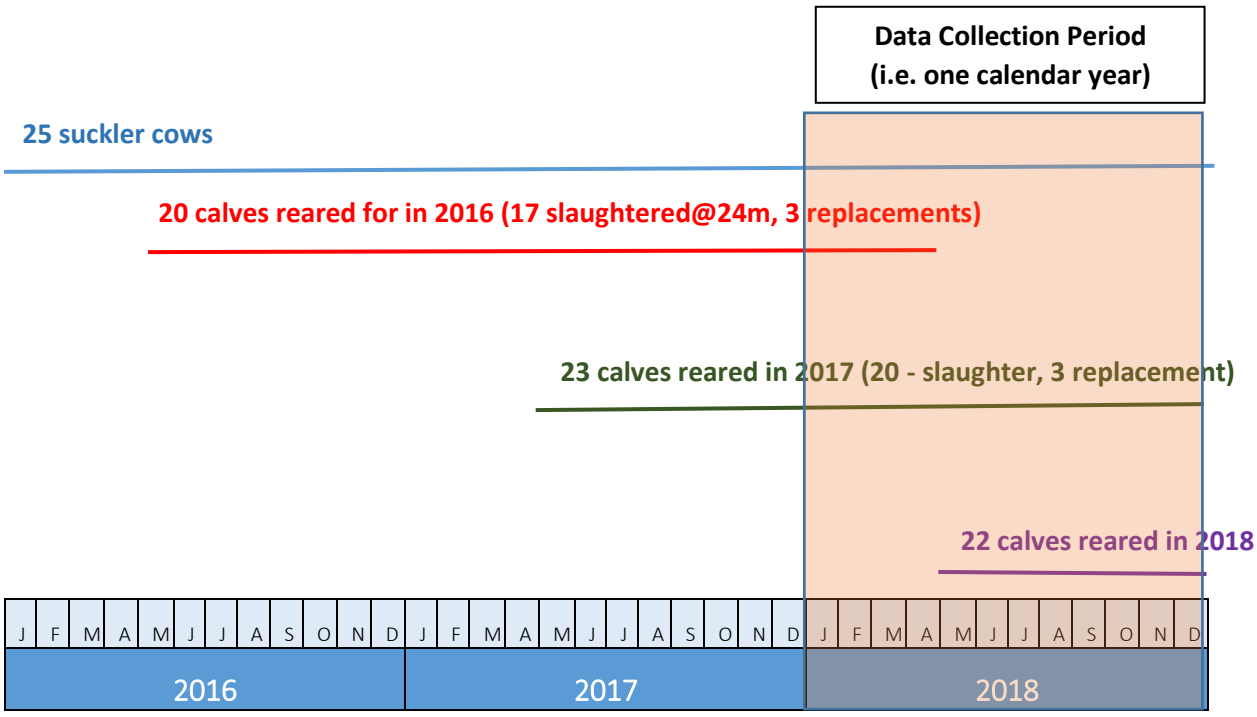
- Growing and finishing (of purchased weaned cattle):
  - In the last year, how many bought-in growing/ finishing cattle were sold for further feeding or breeding (not for slaughter)?
    - Average age when arriving on farm: <1yr ☐ 1-1.5yrs ☐ >1.5 years ☐
    - Average age when leaving farm: <1yr ☐ 1-1.5yrs ☐ >1.5 years ☐
  - In the last year, how many bought-in growing/ finishing cattle were sold for slaughter?
    - Average age when arriving on farm: <1yr ☐ 1-1.5yrs ☐ >1.5 years ☐
    - Average age when leaving farm: <1yr ☐ 1-1.5yrs ☐ >1.5 years ☐

### b. Calculation of the liveweight of the animals on the farm:

Based on the information provided, an estimate of the liveweight of animals on the farm can be calculated, again based on standardised liveweights.

- For cows put to the bull, the same methodology as suggested in Proposal One will be applied, i.e. using a liveweight of 779kg
- For other cattle, the numbers provided are multiplied by a standard liveweight, which takes into account the assumed average liveweight within the category and time on the farm (using national averages, as described below)

If we use the same example that we used in 5a, i.e. spring calving suckler herd that put 25 cows to the bull in 2018 and had 20 calves born in 2016, 23 calves born in 2017 and 22 calves born in 2018. Every year, 3 calves were kept as replacements (put to the bull at 24 months) and the rest were sent for slaughter (at 24 months). This is mapped out below:




In this case the farmer records would answer the following:

- Suckler Herd:
  - In the last year, how many cows and heifers did you put to the bull? 25
  - In the last year, how many home-bred beef cattle were sold for slaughter? 17
    - Average age when leaving farm: <1yr ☐ 1-1.5yrs ☐ >1.5 years ✓
  - Of the calves born in the last year, how many do you expect to be retained for breeding? 3

The SBCU is then calculated by multiplying these figures with the standardised liveweights as below (note orange refers to the information that the farmer provides, whereas the rest relates to the underlying calculation):

| | Number (N) | Adjusted liveweight in kg | $SBCU^{option\ two}$ in kg (N x AL) |
|---|---|---|---|
| Cows and heifers put to the bull | 25 | 779 | 19475 |
| Home-bred cattle sold for slaughter >1.5 years | 17 | 647 | 10999 |
| Home-bred cattle retained for breeding | 3 | 551 | 1653 |
| Total average liveweight of animals on the farm over the year in kg – $SBCU^{option\ two}$ | | | 32127 |

If we assume the antibiotic usage data is as described in section 4a then we get the following:

$$mg\ per\ SBCU\ (option\ two) = \frac{440400\text{mg}}{32127\text{kg}} = 13.7$$

### How do you account for animals the liveweight of animals that do not leave the farm?

This is an important question, as SBCU represents the average liveweight of animals on the farm, not just those that leave the farm. For this metric, this is accounted for as below:

- As with Proposal One, and explained in section 5b, the number of cows and heifers put to the bull is used as an estimate of the number that are on the farm over the whole year (and correspondingly the number of bulls and pre-weaned calves up to 7 months of age)
- For other cattle, Proposal Two differs as it asks the farmer to provide details relating to those cattle which leave the farm, rather than "days in category" for all cattle on the farm, as required with Proposal One. However, adjustments are made to the standard liveweight assigned to each cattle leaving the farm which help to take into consideration the liveweight of the animals that remain on the farm. When looking at "home-bred cattle leaving the farm for slaughter >18months" as in the case example above:
    - Based on national averages and liveweights, it is assumed that calves are weaned at 7 months (at a liveweight of 274kg), reared conventionally (as otherwise they would not be slaughtered at >18months) and slaughtered at 24 months of age (at a liveweight of 640kg). The average liveweight during the animal's lifetime is therefore 457kg

- The cattle that left the farm for slaughter in 2018 (which were born and weaned in 2016) were on the farm for 4 months before leaving. However, other similar weaned beef cattle remained on the farm and didn't leave, i.e.
  - The batch born in 2017 were on the farm as weaned beef cattle in 2018 for 12 months of the year
  - The batch born in 2018 were on the farm as weaned beef cattle in 2018 for 1 month of the year
- Therefore, in total for 2018, there were weaned beef cattle on this farm for 17 months of the year (4+12+1).
- To help take this into consideration, the liveweight assigned per animal leaving is adjusted according to the overall time that they spend on the farm. For example:
  - The cattle that left the farm for slaughter in 2018 (which were born in 2016) were on the farm as weaned cattle for a total of 17 months
  - As described earlier, the average liveweight during these animals' lifetime is assumed to be 457kg
  - However, in this case, the average liveweight (457kg) is multiplied by the number of years on farm (i.e. 17months/12months) to get 647kg
- The number of cattle that left for slaughter is then multiplied by 647kg to get the SBCU for this group of animals
  - This "additional weight" assigned per animal slaughtered helps to take into account the weight of animals within this category that remain on the farm, although this is under the assumption that the farm follows a similar pattern (in terms of farming systems and numbers) year on year

For a full explanation of how the adjusted liveweights are calculated for this metric, please see Appendix Two.

## 7. Animal-based metrics

Animal based metrics differ as they consider the number of animals that are treated or receive a dose of antibiotics and can provide useful additional information alongside weight-based metrics.

### Advantages of animal-based metrics:

- Each animal is treated the same (e.g. calves and adults) so animal-based metrics more accurately reflect the number of animals exposed. However, from an AMR transmission risk it is not yet known whether the number of animals treated is more important than the amount of antibiotic used
- There is no need for standardised animal weights
- They can be more easily be applied to non-antibiotics e.g. Non-Steroidal Anti-Inflammatory Drugs
- The figure may be more tangible and easier for the vet and farmer to understand and monitor progress

### Disadvantages of animal-based metrics:

- The animal-based metrics described in this document require information (e.g. number of animals treated with an antibiotic or number of antibiotic doses administered) to be extracted from farmer records (e.g. from medicine record books). They cannot be calculated using supply or prescription data (e.g. from veterinary practices)
- By treating adult animals in the same way as calves, the amount of antibiotic given is not considered. However, as noted above, from an AMR transmission risk it is not known what is most important: the number of animals treated, or the mass of antibiotics given

## 8. Proposal Three - Percentage of animals treated

### a) Information provided by the farmer

For this metric, the farmer needs to record the number of animals treated with an antibiotic over a one-year period. Treated animals refer to any animal that has received one or more doses of antibiotic at any point in the calendar year. There is no distinction made between an animal that has received one treatment dose and one that has received multiple treatment doses.

### b) Calculation

The number of treated animals is then compared with the number of animals on the farm at any point during the year. This includes all animals which died or were sold off the farm, and doesn't take into account how long each animal spent on the farm:

$$\%\ of\ animals\ treated: \frac{\text{number of animals treated with antibiotics}}{\text{total number of animals which have been on the farm}}$$

## Example farm:

If we consider the same example included in 5a the following would be completed:

| | Number on the farm (N) | Number treated in the last year (T) | % of animals treated<br>T/N x 100 |
|---|---|---|---|
| Suckler cows | 25 | 2 | 8% |
| Suckler calves registered 2016 | 20 | 3 | 15% |
| Suckler calves registered 2017 | 23 | 2 | 9% |
| Suckler calves registered 2018 | 22 | 4 | 18% |
| Bull | 1 | 0 | 0% |
| TOTALS | 91 | 11 | 12% |

Therefore, in this case:

$$\%\ Animals\ Treated = 100 * \frac{11}{91} = 12$$

12% of the animals on the farm have therefore been treated with an antibiotic in 2018.

# 9. Proposal Four - Treatment days per animal

## a) Information provided by the farmer

For this calculation, the farmer needs to provide the total number of days that animals have received an antibiotic over a one-year period. If an animal is treated with a long-acting antibiotic, then it will be assumed that this counts as 3 treatment days.

## b) Calculation

The total number of days treated with antibiotics is then, as with Proposal Four, compared with the total number of animals at the farm, to create a figure that represents the average number of days that each animal has received an antibiotic treatment:

$$treatment\ days\ per\ animal: \frac{\text{number of days animals were treated with antibiotics}}{\text{total number of animals which have been on the farm}}$$

## Example farm:

If we consider the example farm highlighted in 5a, the farmer would complete the following details:

| | Number on the farm (N) | No. of treatment days (T) | Treatment days per animal T/N |
|---|---|---|---|
| Suckler cows | 25 | 6 | 0.2 |
| Suckler calves registered 2016 | 20 | 6 | 0.3 |
| Suckler calves registered 2017 | 23 | 4 | 0.2 |
| Suckler calves registered 2018 | 22 | 12 | 0.5 |
| Bull | 1 | 0 | 0.0 |
| TOTALS | 91 | 28 | 0.3 |

Therefore, in this case:

$$Treatment\ days\ per\ animal = \frac{28}{91} = 0.3$$

This means that, on average, each animal received 0.3 days' worth of antibiotic treatment.

## Questions and answers

### What about beef farms that also rear other livestock, particularly sheep?

CHAWG AMU recognizes that many beef farms also rear other livestock, particularly sheep. Where possible, it is advisable that farmers and veterinary practices separate beef and sheep usage, for example by having different sub-accounts. If this is not done, the usage on these farms may appear high when compared with beef farms that do not rear sheep. The Sheep Health & Welfare Antibiotics Working Group are currently working on metrics for measuring antibiotic use on sheep farms.

### 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 beef farms and removing them is in line with ESVAC methodology.

### 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 all calculations.

### Why do we need to measure 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 to minimise the risk of the development of AMR.

However, there is particular scrutiny on reducing antibiotics that are considered highest priority for human medicine (as defined by the European Medicines Agency[1]), 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).

## References

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8 – UK-VARSS Report 2017 - https://www.gov.uk/government/publications/veterinary-antimicrobial-resistance-and-sales-surveillance-2017

## Appendix One – Provisional Bristol Beef Benchmarking Paper

We would like to acknowledge Bristol University for their contribution towards this consultation document. You can read their full provisional beef benchmarking proposal here:

Beef Medicines Benchmarking UofB

# Appendix Two – Assumptions used for standard liveweights in Proposal One and Proposal Two

## Proposal One

For Proposal One, the following assumptions are use when calculating the average category liveweight in kg:

- Suckler cows:

The average liveweight of suckler cows has been adjusted to include the liveweight of the calves at foot and stock bulls running with the herd. It is assumed that:

- 90 calves are weaned per 100 suckler cows put to the bull
- 4 stock bulls are run per 100 suckler cows put to the bull

| Cattle group | Days in category | Average liveweight (kg.) | Number in herd per cow | Pro-rated liveweight (kg.) |
|---|---|---|---|---|
| Cows put to the bull | 365 | 650 | | 650 |
| Pre-weaned calves (0-7 months of age) | 210 | 183 | 0.90 | 96 |
| Mature bulls | 365 | 813 | 0.04 | 33 |
| SBCU (cows) | | | | **779** |

The average estimated liveweight for suckler cows (or SBCU for suckler cows) is 779 kg. It is assumed that suckler cows are present throughout the year on the farm.

- Other cattle:

| | Liveweight on entry to category in kg | Liveweight on leaving category in kg | Average category liveweight in kg |
|---|---|---|---|
| Pre-weaned dairy calves **(Calves up to 56 days of age)** | 40 | 79 | 60 |
| Weaned intensively grown dairy calves **(<450kg or <12m if liveweight not available)** | 79 | 450 | 265 |
| Weaned conventionally grown dairy calves **(<450kg or <18m if liveweight not available)** | 79 | 450 | 265 |
| Intensively finished dairy cattle **(>450kg or >12m if liveweight not available)** | 450 | 559 | 504 |
| Weaned conventionally grown beef calves **(<450kg or <18m if liveweight not available)** | 325 | 450 | 388 |
| Conventionally finished cattle **(>450kg or >18m if liveweight not available)** | 450 | 605 | 528 |

## Proposal Two

- Suckler cows:

  The same assumptions are used for suckler cows as with Proposal One.

- Other cattle:

When calculating the adjusted liveweight (in kg), assumptions are made in line with the following slaughter ages and liveweights at slaughter (based on national averages):

| | Slaughter age category (assigned name) | Assumed slaughter age (months) | Assumed liveweight at slaughter (kg) |
|---|---|---|---|
| Home bred suckler beef cattle | Under 1 year (rare but may occur) (a) | 11.5 | 563 |
| | 1 – 1.5 years (b) | 16 | 630 |
| | Over 1.5 years (c) | 24 | 640 |
| Dairy origin calves born on farm or purchased on milk | Under 1year (veal production) (d) | 7.5 | 250 |
| | 1 – 1.5 years (e) | 16 | 620 |
| | Over 1.5 years (f) | 24 | 615 |
| Grower and finisher* | Under 1 year (same as d) | 7.5 | 250 |
| | 1-1.5 years (average of b and e) | 16 | 625 |
| | Over 1.5 years (average of c and f) | 24 | 627.5 |

* For this category, and unlike Proposal One, the farmer is not asked whether these cattle are dairy or beef origin. The standard weights used therefore represents an average between the assumed slaughter ages and liveweights for suckler bred beef cattle and dairy origin calves, except for those slaughtered under 1 year - when it is assumed this relates to dairy origin cattle (which are the most cattle type in this slaughter age category)

The following tables show the full list of adjusted liveweights, as well as the assumed liveweights and time in each category, used to calculate the SBCU for Proposal Two:

- Suckler Herd:

| | Assumed age and liveweight at beginning of category | Assumed age and liveweight at sale | Estimated months in category (T) | Average category live liveweight in kg (L) | Adjusted live liveweight in kg (AL = T/12 x L) |
|---|---|---|---|---|---|
| Cows and heifers put to the bull | N/A | N/A | 12 | 779 | 779 |
| **Category** | **Home-bred beef cattle were sold for further feeding or breeding (not for slaughter)** | | | | |
| Sold at <1 year | 7 months 274kg | 7 months 274kg | 0 | 274 | 0 |
| Sold between 1-1.5 years | 7 months 274kg | 15 months 518g | 8 | 396 | 264 |
| Sold at >1.5 years | 7 months 274kg | 20 months 554kg | 14 | 448 | 523 |
| **Category** | **Home-bred beef cattle were sold for further feeding or breeding (for slaughter)** | | | | |
| Sold at <1 year | 7 months 274kg | 11.5 months 563kg | 4.5 | 419 | 157 |
| Sold at 1-1.5 years | 7 months 274kg | 16 months 630kg | 9 | 452 | 339 |
| Sold at >1.5 years | 7 months 274kg | 24 months 640kg | 17 | 457 | 647 |
| Home bred beef cattle (<1yr at end of calendar year) retained for breeding | 7 months 274kg | 23 months 552kg | 16 | 413 | 551 |

- Calf Rearing:

| | Assumed age and liveweight at beginning of category | Assumed age and liveweight at sale | Estimated months in category (T) | Average category live liveweight in kg (L) | Adjusted live liveweight in kg (AL = T/12 x L) |
|---|---|---|---|---|---|
| **Category** | **Dairy origin calves (born on farm or purchased to rear on milk) sold for further feeding or breeding (not for slaughter)** | | | | |
| Sold at <1 year | 0 months 40kg | 4 months 157kg | 4 | 98 | 33 |
| Sold at 1-1.5years | 0 months 40kg | 15 492kg | 15 | 266 | 332.5 |
| Sold at >1.5 years | 0 months 40kg | 20 519kg | 20 | 280 | 466 |
| **Category** | **Dairy origin calves (born on farm or purchased to rear on milk) sold for further feeding or breeding (for slaughter)** | | | | |
| Sold at <1 year | 0 months 40 kg | 7.5 months 250kg | 7.5 | 145 | 90 |
| Sold at 1-1.5 years | 0 months 40kg | 16 months 620kg | 16 | 330 | 440 |
| Sold at > 1.5 years | 0 months 40kg | 24 months 615kg | 24 | 328 | 655 |

- Growing and Finishing (1):

| | | Assumed age and liveweight at beginning of category | Assumed age and liveweight at sale | Estimated months in category (T) | Average category live liveweight in kg (L) | Adjusted live liveweight in kg (AL = T/12 x L) |
|---|---|---|---|---|---|---|
| **Category** | | **Bought-in growing/ finishing cattle sold for further feeding or breeding (not for slaughter)** | | | | |
| Entered at <1 year | Sold at <1 year | 7 months 262kg | 11 months 384kg | 4 | 323 | 108 |
| | Sold at 1-1.5 years | 7 months 262kg | 15 months 505kg | 8 | 256 | 241 |
| | Sold at >1.5 years | 7 months 241kg | 20 months 537kg | 13 | 389 | 421 |
| Entered at 1-1.5 years | Sold at 1-1.5 years | 13 months 377kg | 17 months 468kg | 4 | 423 | 141 |
| | Sold at >1.5 years | 15 months 423kg | 20 months 537kg | 5 | 480 | 200 |
| Entered at >1.5 years | Sold at >1.5 years | 20 months 537kg | 23 months 605kg | 3 | 571 | 143 |

- Growing and Finishing (2):

| | | Assumed age and liveweight at beginning of category | Assumed age and liveweight at sale | Estimated months in category (T) | Average category live liveweight in kg (L) | Adjusted live liveweight in kg (AL = T/12 x L) |
|---|---|---|---|---|---|---|
| **Category** | | **Bought-in growing/ finishing cattle sold for slaughter** | | | | |
| Entered at <1 year | Sold at <1 year | 4 months 150kg | 7.5 months 250kg | 3.5 | 200 | 48 |
| | Sold at 1-1.5 years | 7 months 284kg | 16 months 625kg | 9 | 454 | 341 |
| | Sold at >1.5 years | 7 months 241kg | 24 months 628kg | 17 | 434 | 615 |
| Entered at 1-1.5 years | Sold at 1-1.5 years | 12 months 473kg | 16 months 625kg | 4 | 549 | 183 |
| | Sold at >1.5 years | 15 423kg | 24 628kg | 9 | 525 | 394 |
| Entered at >1.5 years | Sold at >1.5 years | 20 months 537kg | 24 months 628kg | 4 | 582 | 194 |

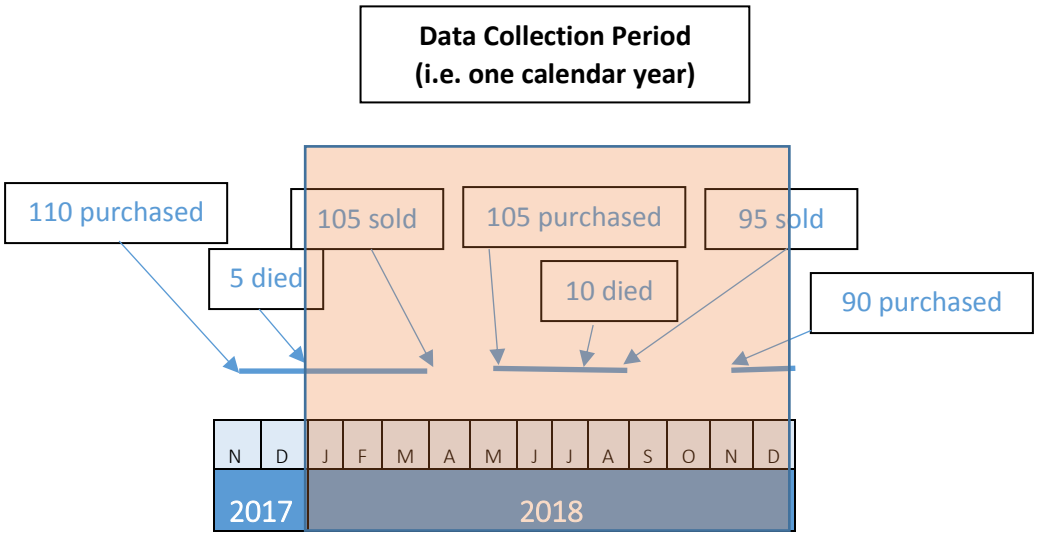
# Appendix Three – Further case examples for the weight-based metric proposals

## Calf Rearer Case Study

A calf rearing enterprise uses 250,000mg antibiotics in 2018

The calf rearer buys in pre-weaned dairy cattle at 2 weeks of age as follows:

- **Batch One** – 110 pre-weaned dairy calves purchased mid-November 2017, 5 animals died at 2 months of age and 105 were sold at the end of March at 5 months of age
- **Batch Two** – 105 pre-weaned dairy calves purchased mid-May, 10 died at 3 months of age and 95 were sold at the end of August at 4 months of age
- **Batch Three** – 90 pre-weaned dairy calves purchased in mid-November, due to be sold in 2019




## Proposal One

For Proposal One, cattle within each batch need to be split into two groups, "Pre-weaned dairy calves" (calves up to 56 days) and "Weaned intensively grown dairy calves" as below:

| | Number (N) | Days In category (T) | Average live liveweight in kg (L = SBCU) | Adjusted live liveweight in kg (AL = T/365 x L) | Calculated average liveweight in kg (N x AL) |
|---|---|---|---|---|---|
| Batch One<br>Weaned intensively grown dairy calves **(<450kg or <12m if liveweight not available)** | 105 | 90 | 265 | 65 | 6861 |
| Batch Two<br>Pre-weaned dairy calves<br>**(Calves up to 56 days of age)** | 105 | 42 | 60 | 7 | 725 |

| | Number (N) | Days In category (T) | Average live liveweight in kg (L = SBCU) | Adjusted live liveweight in kg (AL = T/365 x L) | Calculated average liveweight in kg (N x AL) |
|---|---|---|---|---|---|
| Batch Two<br>Weaned intensively grown dairy calves **(<450kg or <12m if liveweight not available)** NB this relates to the animals that died | 10 | 30 | 265 | 22 | 218 |
| Batch Two<br>Weaned intensively grown dairy calves **(<450kg or <12m if liveweight not available)** | 95 | 61 | 265 | 44 | 4180 |
| Batch Three<br>Pre-weaned dairy calves **(Calves up to 56 days of age)** | 90 | 42 | 60 | 7 | 621 |
| **Total average liveweight of animals on the farm over the year – kg SBCU$^{option\ one}$** | | | | | 12605 |

Therefore, in this example:

$$mg\ per\ SBCU\ (days\ on\ farm) = \frac{250000\text{mg}}{12605\text{kg}} = 20$$

## Proposal Two

For this proposal, the farmer records the numbers sold in the "Calf Rearing" section i.e. 105 in batch one and 95 in batch two – therefore 200 in total:

- In the last year, how many dairy-origin calves (born on farm or purchased to rear on milk) were sold for further feeding or breeding (not for slaughter)? 200
    - Average age when leaving farm: <1yr ✓ 1-1.5yrs ☐ >1.5 years ☐

These animals are then assigned a standard adjusted liveweight in kg:

| | Number (N) | Adjusted liveweight in kg | SBCU$^{option\ two}$ in kg (N x AL) |
|---|---|---|---|
| Dairy origin calves (born on farm or purchased to rear on milk) sold for further breeding or feeding (not for slaughter) | 200 | 33 | 6600 |
| Total average liveweight of animals on the farm over the year in kg – SBCU$^{option\ two}$ | | | 6600 |

Therefore, in this example:

$$mg\ per\ SBCU\ (sales\ of\ animals) = \frac{250000\text{mg}}{6600\text{kg}} = 38$$

In this example, Proposal Two gives a significantly lower liveweight of animal at risk (and therefore higher mg/SBCU figure). The main reason for this is that, before adjusting for time on farm, the average liveweight assigned per animal is lower for Proposal Two:

- *Proposal One* – the standard liveweight used is 265kg (based on the average liveweight between birth and 12 months of age). In this case, this significantly overestimates the liveweight of animals on the farm as they are being sold at 4-5 months of age
- *Proposal Two* – the standard liveweight used is 98kg (based on the average liveweight between birth and 4 months of age) which, in this example case, is closer to the true average liveweight of the calves on the farm.

However, for Proposal Two:

- The time on farm is slightly under-estimated as (based on national averages for calf rearer enterprises) it assumes that calves are sold at 4 months of age, whereas in this case some are sold at 5 months of age
- Unlike Proposal One, animals that die and not sold are not counted in the metric, although in this example these animals made a minor contribution to the overall figure

## Mixed Enterprise Case Study

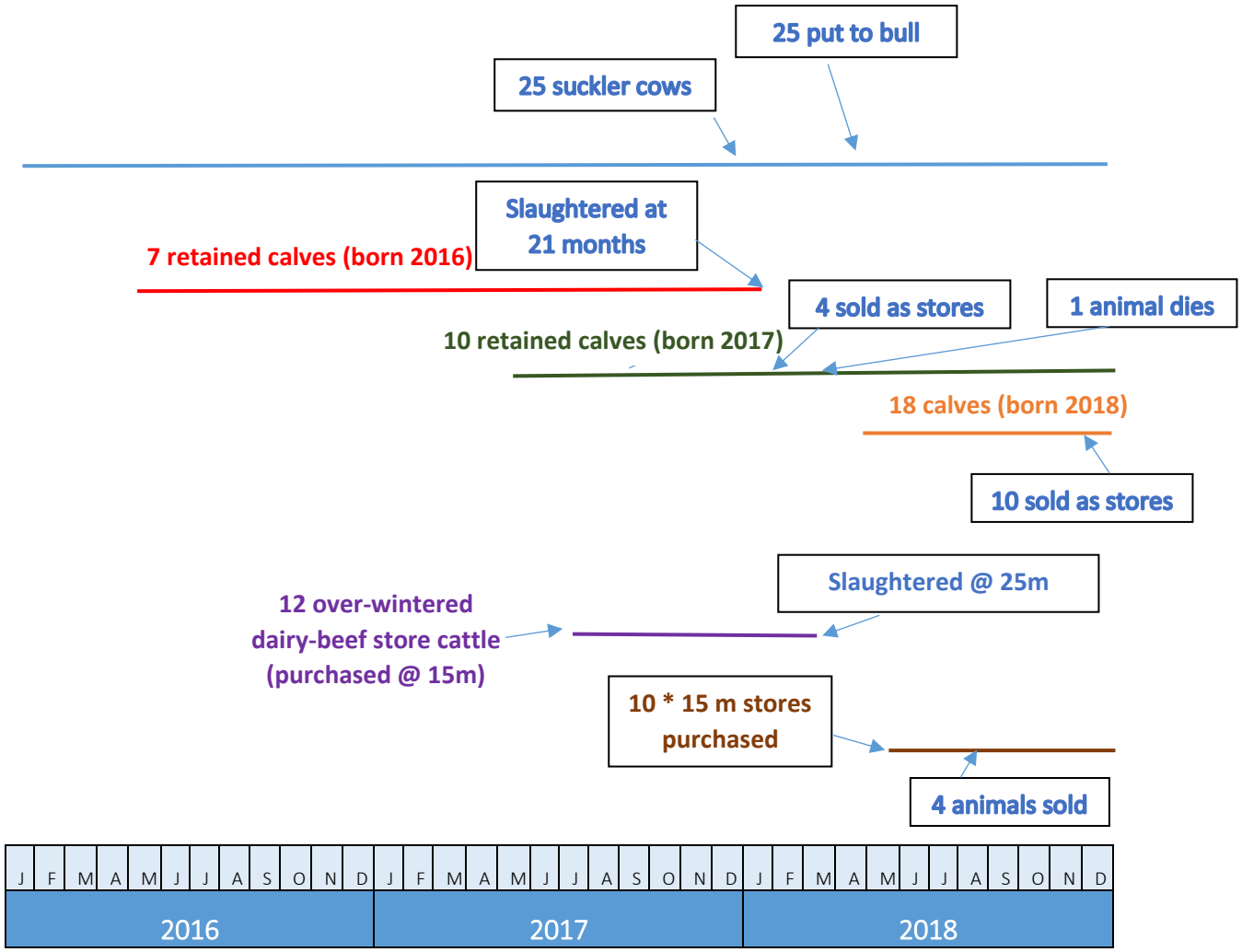
This case study has been included to illustrate an enterprise that has Suckler cows and is also a grower-finisher, with animals being purchased and sold at different times and ages. This is in order to demonstrate the complexity involved in applying these metrics to such an enterprise:

In the past year, a mixed enterprise farm used 140125mg of antibiotic active ingredient.

- The farm started the year with 25 spring calving suckler cows and put 25 suckler cows to the bull in 2018
- In 2018:
    - 7 calves (which had been retained since they were born on the farm in 2016) were sent to slaughter in January at 21 months of age
    - Of the 10 calves (which have been retained since they were born on the farm in 2017), 4 are sold as stores in January (at 9 months of age) and the remaining 6 are kept (and reared in a conventional manner). Unfortunately one dies from pneumonia in March
    - 18 calves were weaned in November. 10 of these were sold immediately after weaning and the remaining 8 kept for finishing

- The farm had 12 overwintered dairy–beef stores (purchased at around 15 months of age in May last year). These went for slaughter in March at 25 months of age
- The farm had great grass in May and purchased 10 stores in May but not sure if they were suckler derived or dairy-beef cross or what age they were – probably 15 months. Then the drought came and 4 of them were sold in August at 18 months of age as stores, but the rest were kept

This can be mapped this out in the following way:



## Proposal One

Putting this complex situation into the categories for Proposal One you get the following:

| | Number (N) | Days In category (T) | Average live liveweight in kg (L) | Adjusted live liveweight in kg (AL = T/365 x L) | Calculated average liveweight in kg (N x AL) |
|---|---|---|---|---|---|
| Suckler cows put to the bull **(90% weaning; 1 bull / 25cows)** (incorporates pre-weaned calves) | 25 | 365 | 779 | 779 | 19475 |
| Calves born in 2016 (slaughtered) Conventionally finished cattle (**>450kg or >18m if liveweight not available)** | 7 | 31 | 528 | 45 | 314 |
| Calves born in 2017 (sold as stores) Weaned conventionally grown beef calves **(<450kg or <18m if liveweight not available)** NB this relates to those sold as stores | 4 | 28 | 388 | 30 | 119 |
| Calves born in 2017 (died) Weaned conventionally grown beef calves **(<450kg or <18m if liveweight not available)** NB this relates to the animal that died | 1 | 90 | 388 | 96 | 96 |
| Calves born in 2017 (retained) Weaned conventionally grown beef calves **(<450kg or <18m if liveweight not available)** | 5 | 304 | 388 | 323 | 1616 |
| Calves born in 2017 (retained – same animals as above) Conventionally finished cattle (**>450kg or >18m if liveweight not available)** | 5 | 61 | 528 | 88 | 441 |
| Calves born in 2018 (retained after weaning) Weaned conventionally grown beef calves **(<450kg or <18m if liveweight not available)** | 8 | 31 | 388 | 33 | 264 |
| Over-wintered store cattle (slaughtered) Conventionally finished cattle (**>450kg or >18m if liveweight not available)** | 12 | 75 | 528 | 108 | 1302 |
| Store purchases (sold) Weaned conventionally grown beef calves **(<450kg or <18m if liveweight not available)** | 4 | 61 | 388 | 65 | 259 |
| Store purchases (retained) Weaned beef calves **(<450kg or <18m if liveweight not available)** | 6 | 90 | 388 | 96 | 574 |
| Store purchases (retained, same animals as above) Conventionally finished cattle (**>450kg or >18m if liveweight not available)** | 6 | 122 | 528 | 176 | 1059 |
| **Total average liveweight of animals on the farm over the year – kg SBCU$^{option\ one}$** | | | | | 25519 |

Therefore, in this example:

$$mg\ per\ SBCU\ (days\ on\ farm) = \frac{140125\text{mg}}{25519\text{kg}} = 5$$

## Proposal Two

When considering Proposal Two, it is necessary to complete both the Suckler and the Grower/ Finisher sections as follows:

### Suckler Part

| | Number (N) | Adjusted SBCU liveweight in kg | Calculated average liveweight in kg (N x AL) |
|---|---|---|---|
| In the last year, how many cows and heifers did you put to the bull? | 25 | 779 | 19475 |
| In the last year, how many home-bred beef cattle were sold for further feeding or breeding (not for slaughter)? | | | |
| Average age at sale: | | | |
| < 1 year | 14* | 0** | 0 |
| In the last year, how many home-bred beef cattle were sold for slaughter? | | | |
| Average age at sale: | | | |
| > 1.5 years | 7*** | 647 | 4529 |
| Total average liveweight of animals on the farm over the year – kg SBCU$^{\text{option two}}$ | | | 24004 |

* Relates to the 10 calves born in 2018 and sold immediately post-weaning and the 4 calves born in 2017 that were sold at 9 months of age

** As with Proposal One, no weight is applied as the weight of calves up to weaning is included in the "cows put to the bull" part of the metric

*** Relates to retained calves born in 2016 and sold for slaughter

### Grower and finisher part:

| Average age when entering the farm | Average age when leaving the farm | Number (N) | Adjusted SBCU liveweight in kg (AL) | Calculated average liveweight in kg (N x AL) |
|---|---|---|---|---|
| **In the last year, how many brought-in growing/ finishing cattle were sold for further feeding or breeding (not for slaughter)?** | | | | |
| Average age when entering the farm | Average age when leaving the farm | | | |
| 1 – 1.5 years | 1-1.5 years | 4 | 141 | 564 |
| **In the last year, how many brought-in growing/ finishing cattle were sold for slaughter?** | | | | |
| Average age when entering the farm | Average age when leaving the farm | | | |
| 1-1.5 years | >1.5 years | 12 | 394 | 4728 |
| Total average liveweight of animals on the farm over the year – kg SBCU$^{\text{option two}}$ | | | | 5292 |

Therefore, in this example:

$$mg\ per\ SBCU\ (sales\ of\ animals) = \frac{140125\text{mg}}{29296\text{kg}} = 5$$