Supplementary Materials for Cattle Health and Welfare Group Antimicrobial Usage Subgroup (CHAWG AMU) recommendations for measuring and comparing the use of antibiotics in dairy and beef

1. Dairy Breeds

When using a national traceability database for calculating the dairy and beef metrics, the following breeds should be considered dairy. Other breeds should be considered beef:

Breed Name	CTS Breed Code
Abondance	AB
Abondance Cross	ABX
Angler Rotvieh	AR
Angler Rotvieh Cross	ARX
Australian Lowline	ALL
Australian Lowline Cross	ALLX
Ayrshire	AY
Ayrshire Cross	AYX
Blue Albion	BAL
Blue Albion Cross	BALX
British Friesian	BF
British Friesian Cross	BFX
Brown Swiss	BS
Brown Swiss Cross	BSX

Cross Breed Dairy	CD
Dairy Shorthorn	DS
Dairy Shorthorn Cross	DSX
Danish Red	DR
Danish Red Cross	DRX
East Finnish Brown	EFB
East Finnish Brown Cross	EFBX
Estonian Red	ER
Estonian Red Cross	ERX
Frisona Espagnola	FE
Frisona Espagnola Cross	FEX
Fleckvieh	FKV
Fleckvieh Cross	FRX
Guernsey	GU
Guernsey Cross	GUX
Holstein	HO
Holstein Cross	HOX

Holstein Friesian	HF
Holstein Friesian Cross	HFX
Jersey	JE
Jersey Cross	JEX
Kerry	KE
Kerry Cross	KEX
Montbeliarde	MO
Montbeliarde Cross	MOX
Lakenvelder	LV
Lakenvelder Cross	LVX
Northern Dairy Shorthorn	NDS
Northern Dairy Shorthorn Cross	NDSX
Normande	NO
Normande Cross	NOX
Norwegian Red	NR
Norwegian Red Cross	NRX
Other Dairy	OD
Pie Rouge	PR
Pie Rouge Cross	PRX
Rotebunde	ROT
Rotebunde Cross	ROTX
Rouge Flamande	RF

Rouge Flamande Cross	RFX
Swedish Black and White	SBW
Swedish Black and White Cross	SBWX
Swedish Red	SR
Swedish Red Cross	SRX
Swedish Red Polled	SRP
Swedish Red and White	SRW
Swedish Red and White Cross	SRWX
Swiss Braunvieh	SB
Swiss Braunvieh Cross	SBX
Swiss Grey	SG
Swiss Grey Cross	SGX
Swiss Orig Braunvieh	SOB
Swiss Orig Braunvieh Cross	SOBX
Water Buffalo	BU

2. Assumptions used for standard live-weights in the simplified mg/kg$^{beef\ farm}$ metric (where there is not access to a national traceability database)

The kg$^{beef\ farm}$ represents the average liveweight of animals on the farm during the recording period, not just those that leave the farm. For this reason, the standard liveweights assigned to each cattle leaving the farm are adjusted to help take into consideration the liveweight of the animals that remain on the farm.

For example, if we look we look at "home-bred suckler beef cattle leaving the farm for slaughter >18months" from the example in section 3. b) of the main document:

- Based on national averages and liveweights, it is assumed that calves are weaned at 7 months of age (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 650kg). The average liveweight during the animal's lifetime is therefore 462kg
- The cattle that left the farm for slaughter in 2018 (which were born and weaned in 2016) were on the farm for 4 months during the recording period 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 spent on the farm (not just how long they were on the farm during the recording period). 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 462kg
    - However, in this case, the average liveweight (462kg) is adjusted by multiplying this weight with the number of years on farm (i.e. 17/12) to get 655kg
    - The number of cattle in this category that left for slaughter is then multiplied by 655kg to get the kg$^{beef\ farm}$ 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

The following assumptions are use when calculating the average total category live-weight in kg:

- *Suckler cows:*

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

  - 88 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 live-weight (kg)	Number in herd per cow	Pro-rated live-weight (kg)
Cows put to the bull	365	650		650
Pre-weaned calves (0-7 months of age)	210	157	0.88	79
Mature bulls	365	813	0.04	33
Average total live-weight				762

The average total live-weight assigned per suckler cow is therefore 762 kg. It is assumed that suckler cows are present throughout the year on the farm.

- *Other cattle:*

  When calculating the average live-weight (in kg) assigned to each animal category leaving the farm, assumptions are made in line with the following slaughter ages and live-weights at slaughter (based on national averages):

	Slaughter age category (assigned name)	Assumed slaughter age (months)	Assumed live-weight at slaughter (kg)
Home bred suckler beef cattle	Under 1 year (rare but may occur) (a)	12	560
	1 – 1.5 years (b)	16	640
	Over 1.5 years (c)	24	650
Dairy origin calves born on farm or purchased on milk	Under 1 year (veal production) (d)	7.5	250
	1 – 1.5 years (e)	16	580
	Over 1.5 years (f)	24	640
Grower and finisher	Under 1 year (same as d)	7.5	250
	1-1.5 years (average of b and e)	16	610
	Over 1.5 years (average of c and f)	24	645

For grower and finishers, the standard liveweights used represents an average between the assumed slaughter ages and live-weights 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 likely cattle type in this slaughter age category)

The following tables show the full list of adjusted liveweights assigned per animal category, which used to calculate the average total live-weight of animal population on the farm ($kg^{beef\ farm}$):

- Suckler Herd:

	Assumed age and live-weight at beginning of category	Assumed age and live-weight at sale	Estimated months in category (T)	Average category live-weight in kg (L)	Adjusted live-weight in kg (AL = T/12 x L)
Cows and heifers put to the bull	N/A	N/A	12	762	762
Category	**Home-bred beef cattle 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 525kg	8	400	266
Sold at >1.5 years	7 months 274kg	20 months 562kg	13	418	453
Category	**Home-bred beef cattle sold for slaughter**				
Sold at <1 year	7 months 274kg	12 months 560kg	5	417	174
Sold at 1-1.5 years	7 months 274kg	16 months 640kg	9	457	343
Sold at >1.5 years	7 months 274kg	24 months 650kg	17	462	655
Home bred beef cattle (<1yr at end of reporting period) retained for breeding	7 months 274kg	19 months 460kg	12	367	367

- Calf Rearing:

	Assumed age and live-weight at beginning of category	Assumed age and live-weight at sale	Estimated months in category (T)	Average category live-weight in kg (L)	Adjusted live-weight 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	5 months 156kg	5	98	41
Sold at 1-1.5years	0 months 40kg	15 months 477kg	15	258	323
Sold at >1.5 years	0 months 40kg	20 months 538kg	20	289	482
Category	**Dairy origin calves (born on farm or purchased to rear on milk) sold for slaughter**				
Sold at <1 year	0 months 40 kg	7.5 months 250kg	7.5	145	91
Sold at 1-1.5 years	0 months 40kg	16 months 580kg	16	310	413
Sold at > 1.5 years	0 months 40kg	24 months 640kg	24	340	680

- Growing and Finishing (1- Sold for further feeding or breeding):

		Assumed age and live-weight at beginning of category	Assumed age and live-weight at sale	Estimated months in category (T)	Average category live-weight in kg (L)	Adjusted live-weight 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 249kg	11 months 375kg	4	312	104
	Sold at 1-1.5 years	7 months 249kg	15 months 501kg	8	375	250
	Sold at >1.5 years	7 months 240kg	20 months 550kg	13	395	428
Entered at 1-1.5 years	Sold at 1-1.5 years	13 months 383kg	17 months 478kg	4	431	144

	Sold at >1.5 years	15 months 431kg	20 months 550kg	5	490	204
Entered at >1.5 years	Sold at >1.5 years	20 months 550kg	23 months 621kg	3	585	146

- Growing and Finishing (2- Sold for slaughter):

		Assumed age and live-weight at beginning of category	Assumed age and live-weight at sale	Estimated months in category (T)	Average category live-weight in kg (L)	Adjusted live-weight 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 130kg	7.5 months 250kg	3.5	190	48
	Sold at 1-1.5 years	7 months 258kg	16 months 610kg	9	434	326
	Sold at >1.5 years	7 months 240kg	24 months 645kg	17	443	627
Entered at 1-1.5 years	Sold at 1-1.5 years	12 months 454kg	16 months 610kg	4	532	177
	Sold at >1.5 years	15 431kg	24 645kg	9	538	403
Entered at >1.5 years	Sold at >1.5 years	20 months 550kg	24 months 645kg	4	597	199

3. Template for completing animal number data with the simplified mg/kg$^{beef\ farm}$ metric (where there is not access to a national traceability database)

To calculate the kg$^{beef\ farm}$, the following information needs to be provided by the farmer, relating to a 12 month recording period. Not all questions need to be answered, depending on the farm enterprise(s) included within the farm:

Beef:

Beef suckler herd	
Cows and heifers put to the bull (including purchased in-calf heifers):	
Home-bred beef cattle sold for further feeding or breeding (not slaughter)	
Younger than 12 months old when **leaving** farm:	
Between 12 and 18 months old when **leaving** farm:	
Older than 18 months of age when **leaving** farm:	
Home-bred beef cattle sold for slaughter	
Younger than 12 months when **leaving** farm:	
Between 12 and 18 months of age when **leaving** farm:	
Older than 18 months of age when **leaving** farm:	
Calves born in recording period and retained for breeding:	

Calf rearing (dairy or beef sired calves from the dairy herd born on farm or purchased to rear on milk for beef production)	
Dairy-origin calves sold for further feeding or breeding (not slaughter)	
Younger than 12 months of age when **leaving** farm:	
Between 12 and 18 months old when **leaving** farm:	
Older than 18 months of age when **leaving** farm:	
Dairy-origin calves sold for slaughter	
Younger than 12 months when **leaving** farm:	
Between 12 and 18 months when **leaving** farm:	
Older than 18 months when **leaving** farm:	

Growing and finishing cattle (purchased weaned dairy or suckler bred cattle)

Of the bought-in growing/finishing cattle sold for further feeding or breeding (not slaughter)

How many were:

A. Younger than 12 months old when **leaving** the farm:	
B. Between 12 and 18 months old when **leaving** the farm:	
C. Older than 18 months old when **leaving** the farm:	

Of the cattle that were between 12 and 18 months of age when leaving the farm (B):

How many were:

...Younger than 12 months when they **arrived** on farm:	
...Between 12 and 18 months old when they **arrived** on farm:	

Of the cattle that were older than 18 months of age when leaving the farm (C):

How many were:

...Younger than 12 months old when they **arrived** on farm:	
...Between 12 and 18 months old when they **arrived** on farm:	
...Older than 18 months when they **arrived** on farm:	

Of the bought-in growing/finishing cattle sold for slaughter

How many were:

D. Younger than 12 months when **leaving** farm:	
E. Between 12 and 18 months old when **leaving** farm:	
F Older than 18 months old when **leaving** farm:	

Of the cattle that were between 12 and 18 months of age when leaving the farm (E):

How many were:

...Younger than 12 months when they **arrived** on farm:	
...Between 12 and 18 months old when they **arrived** on farm:	

Of the cattle that were older than 18 months when leaving the farm (F):

How many were:

...Younger than 12 months when they **arrived** on farm:	
...Between 12 and 18 months old when they **arrived** on farm:	
...Older than 18 months when they **arrived** on farm:	

4. Activity length per administration for long acting products for the Treatment Days additional (non-core) beef metric

In order to work out treatment days for long acting products, it is necessary to understand the number of days treatment that each administration represents. This can vary by long acting product, even those with the same active ingredient. In some cases, the length of activity is presented on the SPC as a range, which may depend on the dose administered. In these cases, the mean length was chosen based on the lowest dose rate. Active ingredients which are only long acting when administered at a higher dose (e.g. some fluoroquinolones) were therefore not included. For each active ingredient, a mean was taken based on the activity length for each product within that category. For the long acting macrolides, length of activity is not included in the SPC so other references were used to provide an estimate:

Long Acting Product Active Ingredient	Product Examples	Mean Activity Length
Amoxicillin	Amoxycare LA, Amoxypen LA, Betamox LA, Bimoxyl LA, Duphamox LA, Trymox LA, , Vetrimoxin LA	2
Ampicillin	Amfipen LA	2
Ceftiofur	Naxcel	7
Danofloxacin	Advocin 180	2
Florfenicol	Cadorex, Fenflor, Flordofen, Florfenikel, Florgane, Florinject, Florkem, Kefloril, Mycoflor, Nifencol, Nuflor, Resflor, Selectan, Shotaflor, Zeleris	2
Gamithromycin	Zactran	10*
Oxytetracycline	Alamycin LA, Cyclosol LA, Duphacycline LA, Engemycin LA, Hexasol LA, Tetroxy LA, Vetroxyl LA, Terramycin LA	4
Procaine Benzylpenicillin	Ultrapen LA	3
Tilidipirosin	Zuprevo	10**
Tilimicosin	Apotil, Hymatil, Micotil, Milbotyl, Tilmodil	3
Tulathromycin	Draxxin	9***

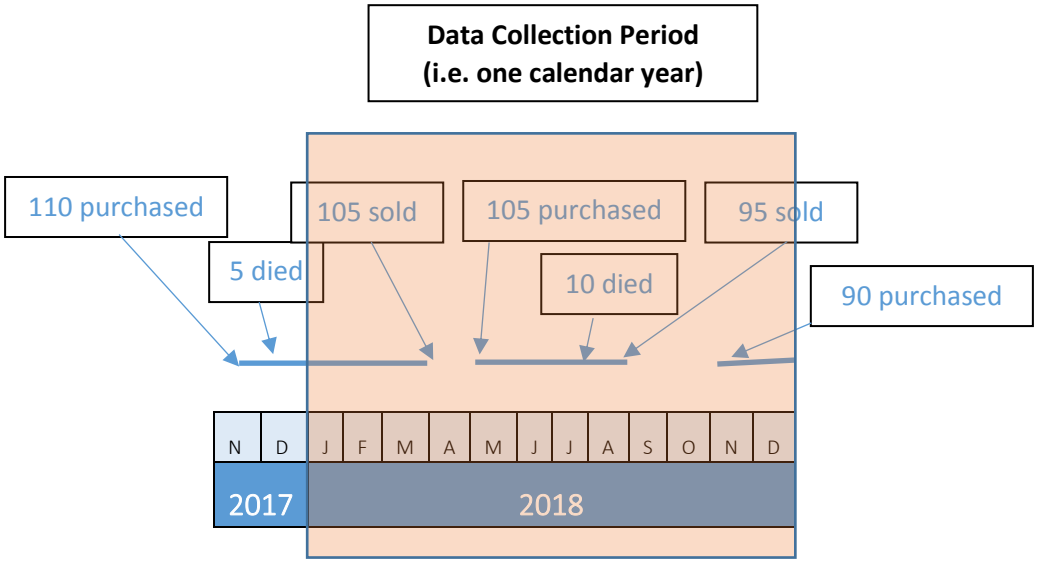
* - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3028799/
** - https://pubmed.ncbi.nlm.nih.gov/24243906/
*** - https://www.researchgate.net/publication/242724227_Duration_of_effectiveness_of_tulathromycin_injectable_solution_in_an_Actinobacillus_pleuropneumoniae_respiratory-_disease_challenge_model_in_swine, https://www.zoetisus.com/draxxin-25/Continuous_Protection.aspx

5. Calf rearer case example for the mg/kg$^{beef\ farm}$ core metric

A calf rearing enterprise uses 250,000mg antibiotics in 2019

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 2018, 5 animals died at 1 month of age and 105 were sold at the end of March at 5 months of age
- **Batch Two** – 105 pre-weaned dairy calves purchased at the beginning of 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 at the beginning of November, due to be sold in 2019



Preferred Option – using a national traceability database:

In this case, the following will be recorded by a national traceability database (assuming the information is extracted once monthly):

	Number of dairy sired males	Number of dairy sired females
Mid-January	60	45
Mid-February	60	45
Mid-March	60	45
Mid-April	0	0
Mid May	60	45
Mid-June	60	45
Mid-July	55	40
Mid-August	55	40

September	0	0
Mid-October	0	0
Mid-November	50	40
Mid-December	50	40
Average Number	43	32

For this category of animals: dairy sired males<6 months of age are assigned a weight of 118kg whereas dairy sired females<6 months of age are assigned a weight of 108kg. This gives a total liveweight of animal population on the farm ($kg^{beef\ farm}$) of (43*118) + (32*108) = 8530kg. Therefore:

$$mg/kg^{beef\ farm} = \frac{250000mg}{8530kg} = 29.3$$

Option 2 – without access to a national traceability database:

In this case, 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:

Calf rearing (dairy or beef sired calves from the dairy herd born on farm or purchased to rear on milk for beef production)

Dairy-origin calves sold for further feeding or breeding (not slaughter)	
Younger than 12 months of age when **leaving** farm:	200
Between 12 and 18 months old when **leaving** farm:	
Older than 18 months of age when **leaving** farm:	

Each animal is then assigned a standard weight of 41kg. Therefore, the average total live-weight of animal population on the farm ($kg^{beef\ farm}$) is (200*41) = 8200kg. Therefore:

$$mg/kg^{beef\ farm} = \frac{250000mg}{8200kg} = 30.5$$

6. Highest Priority Critically Important Antibiotics

The AMEG group have categorised antibiotics in terms of risk, taking into account of the need to use antibiotics in animals versus the risk of antimicrobial resistance to public health and a link can be found here - https://www.ema.europa.eu/en/documents/report/infographic-categorisation-antibiotics-use-animals-prudent-responsible-use_en.pdf.

In the benchmarking documents, the terms "Highest Priority Critically Important Antibiotic" refers to those antimicrobials included in category B i.e. quinolones (including fluoroquinolones), third and fourth generation cephalosporins and polymyxins:

- Antibiotics in this category are critically important in human medicine and use in animals should be restricted to mitigate the risk to public health
- They should be considered only when there are no antibiotics in Categories C or D that could be clinically effective
- Their use should be based on antimicrobial susceptibility testing, wherever possible