Comparison of UK and US antibiotic use by farm-animal species

Summary

Up until recently, very little data was available on farm use of medically important antibiotics in different animal species in both the UK and the US. This was due to the fact that the regulatory bodies only collect data on the sales of veterinary antibiotic products from the pharmaceutical companies, and many of these products are licensed for use in more than one animal species.

However, in the past three months, a large amount of new information on antibiotic use in different livestock species has become available, although the data is still incomplete. This information has largely been published by the regulatory bodies, the Veterinary Medicines Directorate (VMD) in the UK and the Food and Drug Administration (FDA) in the US.

In the UK, the information has been based on collections by the British Poultry Council and the National Pig Association of actual usage data, and on a large survey of cattle farms. Very recently published information by some supermarkets supplements this data.

In the US, the data has been based on pharmaceutical-industry estimates of the species breakdown of their sales, which they must now provide to the FDA.

We have compiled this information to compare these estimates of antibiotic use in different livestock species in both the UK and the US. In order to make the data comparable, we have taken into account the size of the different livestock populations, and have used the European Medicine Agency's (EMA) "Population Correction Unit" (PCU) as the livestock unit to do this.

Our findings show that in terms of mg of active ingredient of antibiotic per tonne of livestock unit (PCU):

- use in US pigs is about twice as high as use in UK pigs
- use in US chickens is about 3 times as high as use in UK chickens
- use in US turkeys is about 5 times as high as use in UK turkeys
- use in US cattle use is about 9-16 times as high as use in UK cattle
- use in all food animals in the US is about 5 times as high as use in the UK.

Table 1 Estimates of antibiotic use in different livestock species in the UK and the US, in terms of mg of active ingredient of antibiotic per kg of Population Correction Unit (mg/kg)

	United Kingdom	United States	US/UK ratio
Pigs	183	349	1.9
Chickens	17	58	3.4
Turkeys	86	479	5.5
Cattle	15-25	237	9–16
All food animals	45	221	4.9

The particularly large difference in antibiotic use in cattle between the two countries is likely to be at least in part due to the more industrial-type farming systems used in US cattle farming in comparison to the UK. https://www.soilassociation.org/media/14610/top-10-food-safety-risks-posed-by-a-us-uk-trade-deal.pdf

At present, the European Union has a ban on the importation of US beef, due to the use of growth hormones in the cattle in the US. However, post-Brexit, there exists the possibility that the UK will allow US beef to be imported as part of a trade deal with the US. The finding that antibiotic use in US

cattle is 9 to 16 times higher than it is in British cattle, raises further concerns about the ways in which US beef is produced, and the potential dangers it may pose to consumers.

Detailed calculations

FDA estimates for antibiotic use in each livestock species

In December 2017, the US FDA published farm antibiotic-sales data for 2016 [1]. The FDA gathers farm antibiotic sales annually from pharmaceutical companies, and usually it is not possible to obtain a species breakdown from such data since many farm antibiotic products are licensed for use in more than one species.

However, pharmaceutical companies are now required to provide an estimate to the FDA of the species breakdown of their sales. Using this information, the FDA was able to publish, for the first time ever, an overall estimate for the breakdown in antibiotic sales by farm-animal species.

According to Table 2, the highest overall use in terms of weight of active ingredient was in cattle, followed by pigs.

Table 2 US sales of medically important antibiotics by farm-animal species (FDA estimate) in weight of active ingredient (kg)

Cattle	3,610,943
Pigs	3,133,262
Chickens	508,800
Turkeys	756,620
Other	352,114
Total	**8,361,740**

The "Population Correction Unit"

In order to make these figures comparable to UK figures, or figures from other European countries, the size of the livestock population needs to be taken into account and a unit must be used to measure these populations.

The EMA has introduced a unit to enable such international comparisons, called the "Population Correction Unit" (PCU).

As explained by the VMD: "The Population Correction Unit (PCU) is a theoretical unit of measurement developed by the European Medicines Agency (EMA) in 2009 and adopted across Europe. It takes into account a country's animal population over a year, along with the estimated weight of each particular species at the time of treatment with antibiotics. Although it is an estimation it does enable year-on-year comparisons to be made and trends to be seen.

The PCU is a technical unit which estimates the average animal weights at time of treatment. The EMA takes into account that the majority of antibiotics are used in young animals. Therefore, the weight used is likely to be below final weight at slaughter" [2].

Unfortunately, the FDA has not provided a PCU calculation for its livestock species, although it did consider doing this [3]. We therefore need to calculate the PCU for each US livestock species, using population data and the PCU weights the EMA has established.

The PCU weights are given below (this image is taken from a VMD document [2]:

Slaughter cows	425 kg
Slaughter heifers	200 kg
Slaughter bullocks and bulls	425 kg
Slaughter calves & young cattle	140 kg
Imported/exported cattle for slaughter	425 kg
Imported/exported for fattening	140 kg
Livestock dairy cows	425 kg

Slaughter pigs	65 kg
Imported/exported pigs for slaughter	65 kg
Imported/exported pigs for fattening	25 kg
Livestock sows	240 kg

Slaughter broilers	1 kg
Slaughter turkeys	6.5 kg
Imported/exported poultry for slaughter	1 kg

Slaughter sheep & goats	20 kg
Imported/exported sheep & goats for slaughter	20 kg
Livestock sheep	75 kg

Living horses	400 kg

Slaughtered fish based on liveweight	- - kg

Slaughter rabbits	1.4 kg

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Adjustments need to be made to the PCU to take into account animals exported to, and imported from the country during the year in question. The PCU weight of imported animals get subtracted from the PCU total, and PCU weights of exported animals get added.

Information on US livestock numbers can be obtained from a US Department of Agriculture (USDA) document [4].

Calculations for antibiotic use in US pigs

According to the USDA [4], in 2016 there were 118.303 million pigs slaughtered in the US and there were 6,090.4 thousand breeding animals. A large majority of the breeding animals will be sows, but a small minority will be boars, which do not have a PCU. If we assume that all of the breeding animals are sows, we will slightly overestimate PCU, since boars have a zero PCU. By slightly overestimating PCU, we will be slightly underestimating usage per PCU. This equates to an initial calculation of US pig PCU of:

65*118,303+240*6,090.4 = 7,689,695+1,461,696 = 9,151,391 thousand kg = 9,151 thousand tonnes.

During 2016, the US imported more live pigs (5,169,881) than it exported (48,018) [5], so our initial PCU calculation is an overestimate.

Adjusting the PCU to take into account imports and exports, and taking into account the ages of the traded animals, we estimate US pig PCU to be 8,978 thousand tonnes.

From this we derive an estimate of antibiotic use in US pigs of:

3,133,262/8,978 = 349 kg of antibiotic per thousand tonnes of PCU = 349 mg per kg of PCU.

Calculations for antibiotic use in US chickens

The PCU for a slaughtered broiler is 1 kg. So the PCU for broilers is equal to the number of broilers slaughtered, plus the number of broilers exported for slaughter minus the number of broilers imported for slaughter. This is equal to the number of home-produced broilers slaughtered plus the number of broilers exported for slaughter. This is by definition equal to the number of broilers produced by the US broiler industry.

According to the USDA [4], the number of broilers produce in 2016 was 8,776,700 thousand chickens, which equates to a of US chicken PCU of 8,777 thousand tonnes.

From this we derive an estimate of antibiotic use in US chickens of:

508,800/8,777 = 58 mg/kg.

Calculations for antibiotic use in US cattle

We use USDA cattle population data for both beef and dairy cattle [4]. This data shows that in 2016 there were 9,349,000 dairy cows. This equates to an initial estimate for dairy-cow PCU of 3,973.325 thousand tonnes. We also calculate a beef-cattle PCU of 11,384 thousand tonnes. This results in an an initial cattle PCU estimate of 15,358 thousand tonnes.

Adjusting for the number of imported cattle (1,708,049) and the lower number of exported cattle (69,485) [7] we estimate US cattle PCU to be 15,225 thousand tonnes.

From this we derive an estimate of antibiotic use in US cattle of:

3,610,943/15,225 = 237 mg/kg.

Calculations for antibiotic use in US turkeys

In 2016, the total number of turkeys slaughtered in the US was 243,255 thousand. This equates to a PCU estimate of 1,581 thousand tonnes.

From this we derive an estimate of antibiotic use in US turkeys of:

756,620/1,581 = 479 mg/kg.

Note that in 2016 the US imported three times more turkey than it exported [6]. We have not taken this into account in our calculation of the PCU as the data is not in a form which enables this to be done easily. However, since imports were larger than exports, this means that our PCU estimate is an overestimate, and therefore that our usage estimate is an underestimate. In other words, in 2016 US use of antibiotics in turkeys was at least 479 mg/kg.

Estimates of UK antibiotic use in different animal species

In the UK, the species with by far the highest level of antibiotic use is pigs, although use was cut by an estimated 34% in 2016 compared with 2015. According to the latest Veterinary Medicines Directorate (VMD) antibiotic sales data report [8], antibiotic usage data collected directly from most

pig producers indicates that use in the UK pig industry in 2016 was 183 mg/kg. So use in US pigs is about twice as high as in the UK per livestock unit.

According to usage data collected and published by the British Poultry Council (which covers 90% of the poultry-meat industry in the UK), and also published by the VMD [8], use in chickens raised for meat (broilers) in 2016 was 17 mg/kg. This compares with our estimate of 52 mg/kg in US chickens. So use in US chickens is about three times higher than in the UK per livestock unit.

British Poultry Council data published by the VMD shows that use in turkeys in 2016 was 86 mg/kg, compared with our estimate of 479 mg/kg in the US. So use in US turkeys is over 5 times higher than in the UK per livestock unit.

The estimate of antibiotic use in the UK dairy industry published by the VMD is 26 mg/kg following a large survey by VetImpress of one third of the UK dairy industry [8]. No estimate was published of antibiotic use in UK beef cattle by the VMD. The VetImpress survey had originally published data suggesting antibiotic use in beef cattle was less than one third of antibiotic use in dairy cattle, but this result was withdrawn as further checks needed to be made to validate the result.

However, it is generally well known that antibiotic use in UK beef cattle is significantly lower than in UK dairy cattle. Furthermore, antibiotic-usage data recently published by two UK supermarkets, Waitrose and ASDA, confirm that this is the case. Waitrose reported usage in dairy farms supplying it to be 20 mg/kg whereas they reported less than 10 mg/kg for beef farms. Similarly, ASDA reported 20 mg/kg in dairy farms and 7.3 mg/kg for beef farms where the cattle were raised on pasture and 9 mg/kg for cattle housed all year round. From all of these information, we may conclude that it is reasonable to assume that antibiotic use in UK beef farms is not higher than 10-25 mg/kg.

In the UK, approximately 40-45% of cattle PCU is made of dairy cows, whereas beef cattle account for about 55-60% of PCU. From this, assuming that antibiotic use in UK beef cattle is around 10-25 mg/kg, we deduce that total antibiotic use in UK cattle is about 15-25 mg/kg. Since we have calculated that antibiotic use in US cattle is about 237 mg/kg, it follows that use in US cattle is about 9 to 15 times higher than in the UK per livestock unit.

Comparison of overall farm antibiotic use between UK and US

In its sales data report, the VMD provides an overall estimate of antibiotic use in UK farm animals of 45 mg/kg. The VMD's calculation takes into account total PCU of all species considered by the EMA to be food animals (sheep/goats, cattle, pigs, poultry, horses and farmed fish).

In order to calculate total US PCU, we first need to estimate US PCU for sheep/goats, horses and farmed fish. Based on USDA population data for sheep and goats [4], we calculate total US sheep/goat PCU to be 337 thousand tonnes. For horses, we calculate 1,448 thousand tonnes (based on 2012 population data [4]). For farmed fish, 2015 data from the National Marines Fisheries Service **Error! Reference source not found.** allows us to calculate a fish PCU of 285 thousand tonnes.

Total US PCU = 37,049 thousand tonnes.

From this we deduce a total antibiotic use level for the US in farm animals of:

8,361,740/37818 = 221 mg/kg.

So overall US farm antibiotic use is nearly five times UK use per unit of livestock.

We should note that one reason for the fivefold difference in overall farm antibiotic use between the two countries is that the UK has many more sheep than the US, and sheep are low users of antibiotics. In the UK, sheep/goats make up 40% of total PCU, whereas in the US they only make up 1% of total PCU.

Nevertheless, as we have seen in this document, large differences also exist in each animal species, particularly cattle.

References

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