Veterinary Medicines Directorate

Supplementary Material

UK-VARSS 2020

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Table S1.1.1: Active ingredient in mg/kg of antibiotics sold for food-producing animals from 2014 to 2020

Please note, the figures in the total sales row are rounded to the nearest integer. This explains any discrepancy between the overall total and the classes' totals. Also, because of the heightened interest in and the low use of HP-CIA classes, the sales of fluoroquinolones, third and fourth generation cephalosporins and colistin are presented in two or more decimal places. Additionally, the class of antibiotics referred to as "other", includes amphenicols, lincomycins, pleuromutilins, polymyxins (including colistin), steroidal antibiotics and imidazole derivatives.

Antibiotic Class	2014	2015	2016	2017	2018	2019	2020	Change since 2014
Tetracyclines	**26.1**	**23.6**	**15.0**	**13.1**	**11.7**	**10.2**	**10.2**	**-61%**
Beta (ß)-lactams	**11.7**	**10.1**	**8.2**	**7.4**	**6.8**	**7.6**	**8.1**	**-31%**
Amoxicillin	9.7	8.4	6.1	5.5	5.4	6.3	7.0	-28%
3rd/4th generation cephalosporins	0.19	0.17	0.14	0.11	0.065	0.032	0.038	-80%
Trimethoprim/ sulphonamides	**10.0**	**9.7**	**7.0**	**3.3**	**3.2**	**3.5**	**3.5**	**-65%**
Aminoglycosides	**3.6**	**3.5**	**2.2**	**2.5**	**2.6**	**3.4**	**3.0**	**-17%**
Streptomycin	1.4	1.4	1.2	1.5	1.3	1.4	1.3	-5%
Neomycin	0.1	0.1	0.1	0.3	0.5	1.0	0.5	746%
Apramycin	0.6	0.6	0.4	0.3	0.3	0.3	0.4	-30%
Macrolides	**7.2**	**5.5**	**4.0**	**3.2**	**2.3**	**2.3**	**2.9**	**-60%**
Tylosin	6.5	4.7	3.3	2.7	1.7	1.7	2.3	-65%
Fluoroquinolones	**0.35**	**0.35**	**0.22**	**0.16**	**0.15**	**0.13**	**0.10**	**-71%**
Other	**3.3**	**3.8**	**2.5**	**2.4**	**2.2**	**3.3**	**2.3**	**-30%**
Tiamulin	1.8	2.2	1.4	1.4	1.2	2.1	1.0	-43%
Colistin	0.1	0.1	0.02	0.001	0.001	0.0002	0.00007	99.9%
Total sales	**62.3**	**56.5**	**39.0**	**32.1**	**29.0**	**30.5**	**30.1**	**-52%**
Total HP-CIA sales (% total)	**0.67 (1.1%)**	**0.64 (1.1%)**	**0.38 (1.0%)**	**0.26 (0.8%)**	**0.21 (0.7%)**	**0.17 (0.5%)**	**0.14 (0.5%)**	**-79%**

Table S1.1.2: Active ingredient in mg/kg of antibiotics sold for food-producing animals by route of administration from 2014 to 2020

Please note, the oral/water category includes oral powders, oral pastes, oral solutions, and bolus preparations, and the administration route classed as “other” includes intramammary dry and lactating cow, bolus and intrauterine preparations.

Administration route	2014	2015	2016	2017	2018	2019	2020	Change since 2014
In-feed	38.6	33.4	20.6	14.7	12.3	12.7	12.1	-69%
Oral/water	16.6	15.3	11.5	9.4	9.4	11.1	11.8	-29%
Injectable	6.4	7.1	6.3	7.5	6.7	6.3	5.9	-7%
Other	0.7	0.8	0.6	0.5	0.5	0.4	0.3	-56%
Total	**62.3**	**56.5**	**39.0**	**32.1**	**29.0**	**30.5**	**30.1**	**-52%**

S1.2: Sales of intramammary products (in courses per dairy cow)

Table S1.2.1: Sales of a) dry and lactating cow intramammary products in courses per dairy cow from 2014 to 2020 and b) HP-CIA sales of dry and lactating intramammary products in courses per dairy cow from 2014 to 2020

a) Dry and lactating cow intramammary products

Intramammary product DCDvet	2014	2015	2016	2017	2018	2019	2020	Change since 2014
Lactating cow tubes	0.89	0.8	0.82	0.69	0.78	0.6	0.51	-42%
Dry cow tubes	0.62	0.73	0.61	0.54	0.64	0.58	0.48	-22%

b) HP-CIA sales of dry and lactating intramammary products

Intramammary product DCDvet	2014	2015	2016	2017	2018	2019	2020	Change since 2014
Combination of lactating and dry cow HP-CIAs	0.37	0.33	0.24	0.17	0.12	0.03	0.07	-80%

S1.3: Sales of veterinary antibiotics for dogs and cats (in mg/kg)

Table S1.3.1: Active ingredient in mg/kg of antibiotics by antibiotic class sold for use in dogs and cats from 2014 to 2020

Please note, the figures listed in the total sales row were rounded to the nearest integer. This explains any minor discrepancy between the overall total and the classes' totals. Also, because of the heightened interest in HP-CIA classes and lower amounts sold, sales of fluoroquinolones and third and fourth generation cephalosporins are presented in kg. Additionally, the class of antibiotics referred to as "other", includes lincomycins and imidazole derivatives.

Antibiotic class	2014	2015	2016	2017	2018	2019	2020	Change since 2014
Beta-lactams	**61.3**	**50.5**	**53.9**	**55.8**	**50.4**	**48**	**42.7**	**-30%**
Amoxicillin with clavulanic acid (aminopenicillin/ beta lactamase inhibitor)	36.7	27.3	31.7	35.2	30.7	30	27.6	-25%
Amoxicillin alone (aminopenicillin)	1.4	1.5	0.8	1.5	1.1	1.1	0.3	-78%
Cephalexin (1st generation cephalosporin)	22.9	21.0	21.1	18.9	17.9	16.7	14.6	-36%
Cefovecin (3rd/4th generation cephalosporin)	0.21	0.13	0.21	0.19	0.19	0.20	0.17	-17%
Other	**4**	**3.8**	**8.7**	**12.1**	**13.2**	**13.2**	**13.8**	**249%**
Metronidazole (imidazole derivative)	0.4	0.4	5.0	8.8	10	10.2	11.1	2941%
Clindamycin (lincosamide)	3.6	3.4	3.6	3.2	3.2	3.0	2.7	0.24
Tetracyclines	**4.3**	**4.8**	**3.9**	**4.4**	**1.9**	**1.2**	**2.0**	**-54%**
Fluoroquinolones	**0.79**	**0.65**	**0.63**	**0.54**	**0.53**	**0.44**	**0.48**	**-39%**
Macrolides	**0.7**	**0.8**	**0.7**	**0.5**	**0.4**	**0.3**	**0.4**	**-36%**
Trimethoprim/ sulphonamides	**4.9**	**4.5**	**8.5**	**1.3**	**0.0**	**0.0**	**0.0**	**-100%**
Total sales	**76.0**	**65.1**	**76.2**	**74.6**	**66.5**	**63.2**	**59.4**	**-22%**
Total HP-CIA's (% total)	**1.00 (1.3)**	**0.78 (1.1)**	**0.84 (1.0)**	**0.73 (1.1)**	**0.72 (1.0)**	**0.63 (1.0)**	**0.66 (1.1)**	**-34%**

S1.4: Sales of veterinary antibiotics for all animal species (in tonnes)

Table S1.4.1: Active ingredient in tonnes and percentage of total sales of antibiotics sold for the animal species categories: a) food-producing animal species only, b) non-food-producing animal species only and c) combination of food- and non-food-producing animal species from 2014 to 2020

Please note that totals were rounded to the nearest integer. This explains the minor discrepancies between the sum of individual species categories and the totals presented. Also, regarding the food-producing animal species categories, the pigs and poultry only and poultry only categories, include products authorised for use in ducks and gamebirds. Additionally, the multiple food-producing animal species category does not include products indicated for pigs and poultry only, horses or products indicated for a combination of both farmed food- and non-food-producing species, to prevent double counting. It does include products licensed for sheep only. Note that unlike in previous years, this section includes products licensed for the combination of food-producing animals and rabbits for example if a product was licensed for pigs and rabbits, it was put in the pig only section. This is because these products are licensed for farmed rabbits and there are no rabbits being farmed for food in the UK.

Regarding the non-food producing animal species, the companion animal only category includes dogs, cats, reptiles, rodents, ornamental birds, cage birds, pigeons, exotic animals, reptiles, bearded dragons and rabbits. Regarding the horse only category, in the UK, horses are primarily a companion or sport animal, and not raised for food. For this reason, horses have been classified as ‘non-food-producing animals’ when reporting tonnage of active ingredient. Finally, regarding the total (percentage) for combination of food and non-food producing animal species unlike last year, this excludes products that are licensed for a combination of food-producing animals and rabbits, as these are designed for farmed rabbits and no rabbits are farmed in UK for food.

a) Food-producing animal species only

Animal species	2014	2015	2016	2017	2018	2019	2020
Pigs and poultry only	240.4	220.6	132.0	100.6	101.0	100.8	106.8
Pigs only	63.7	51.5	41.1	33.8	25.8	29.6	24.6
Poultry only	42.9	38.1	26.2	15.0	12.9	15.1	14.7
Cattle only	13.0	14.1	15.2	13.7	12.9	12.0	11.2
Fish only	2.4	0.7	1.6	3.4	1.6	3.1	5.1
Multiple food-producing animal species	29.4	31.4	24.6	30.6	28.1	25.7	26.3
Total (percentage)	**391.8 (88)**	**356.3 (88)**	**240.7 (82)**	**197.2 (80)**	**182.4 (82)**	**186.4 (82)**	**188.6 (84)**

b) Non-food-producing animal species only

Animal species	2014	2015	2016	2017	2018	2019	2020
Companion animal only excluding horse only	15.8	12.7	14.7	14.4	13.4	12.5	11.8
Horse only	16.0	13.4	14.9	6.7	2.4	2.1	2.4
Total (percentage)	**31.8 (7)**	**26.1 (6)**	**29.6 (10)**	**21.1 (9)**	**15.7 (7)**	**14.6 (6)**	**14.2 (6)**

c) Combination of food- and non-food-producing animal species

Animal species	2014	2015	2016	2017	2018	2019	2020
Total (percentage) for combination of food and non-food producing animal species	**22.9 (5)**	**23.6 (6)**	**22.9 (8)**	**27.2 (11)**	**24.7 (11)**	**27.6 (12)**	**23.0 (10)**

Table S1.4.2: Active ingredient in tonnes by antibiotic class and route of administration; 2020

Please note, the totals were rounded to the nearest integer. This explains any minor discrepancy between the overall total and the classes' totals. Also, because of the heightened interest in HP-CIA classes and lower amounts sold, sales of fluoroquinolones and third and fourth generation cephalosporins are presented in kg. Additionally, the oral/water category includes oral pastes, oral solutions and bolus preparations, the administration route classed as "other" includes intramammary and intrauterine preparations and the class of antibiotics referred to as "other", includes amphenicols lincomycins, pleuromutilins, polymyxins (including colistin), steroidal antibiotics and imidazole derivatives.

Antibiotic Class	In-feed	Oral/water	Injectable	Tablets	Other	Total
Tetracyclines	42.4	19.9	10.1	0.4	0.1	**72.8**
Beta (ß)-lactams	10.5	31.9	13.7	8.3	1.9	**66.1**
3rd/4th generation cephalosporins (kg)	0.0	0.0	220.2	0.0	50.0	**270.2**
Trimethoprim/ sulphonamides	14.7	8.5	1.5	0.0	0.0	**24.7**
Aminoglycosides	1.1	10.8	9.2	0.0	0.4	**21.4**
Macrolides	12.7	4.5	3.5	0.1	0.0	**20.8**
Fluoroquinolones (kg)	0.0	343.9	374.5	93.0	0.0	**811.4**
Other	4.9	8.1	3.5	2.7	0.0	**19.2**
Colistin (kg)	0.0	0.5	0.0	0.0	0.0	**0.5**
Total sales of antibiotics	**86.3**	**83.7**	**41.9**	**11.6**	**2.5**	**226.0**

Table S1.4.3: Active ingredient in kg of antibiotics sold for all animal species by antibiotic class from 2014 to 2020

Please note, for colistin sales in 2017 and 2018, one colistin product, which accounts for 2.9kg, 17.6kg and 8.8kg active ingredient for 2017, 2018 and 2019 respectively was excluded as the MAH identified that this was exported as medicated feed and therefore not used in the UK.

Antibiotic Class	2014	2015	2016	2017	2018	2019	2020
3rd/4th generation cephalosporins	1335.1	1203.4	1001.7	779.2	466.8	226.8	270.3
Fluoroquinolones	2586.7	2526.6	1724.6	1220.9	1156.5	1037.2	811.4
Colistin	842.3	876.8	128.4	4.2	4.9	1.2	0.5
Total sales of HP-CIAs	**4764.0**	**4606.8**	**2854.7**	**2004.3**	**1628.2**	**1265.3**	**1082.2**

S1.5: Further details on the methodology

The European Commission has requested the European Medicines Agency (EMA) to take the lead in collating data collected on the use of antibiotic agents in animals in the European Union. The EMA has therefore developed a harmonised approach for the collection and reporting of data based on national sales figures. This is designed to be comparable with usage data of human antibiotics, to the extent possible.

Published European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) reports are available from: https://www.ema.europa.eu/en/veterinary-regulatory/overview/antimicrobial-resistance/european-surveillance-veterinary-antimicrobial-consumption-esvac.

The ESVAC publications use a different method to calculate mg/kg (called milligram per Population Correction Unit (mg/PCU) for ESVAC purposes) compared to the approach previously used in the UK (in reports prior to UK-VARSS 2015). Table S1.5.1 summarises these differences.

Table S1.5.1: Differences between the UK-VARSS and ESVAC methodology used in previous publications for the calculation of quantity of active ingredient of antibiotics sold

	UK-VARSS	ESVAC
Products included	All authorised veterinary antibiotic products.	Topical presentations are not included.
Calculation of active ingredient quantity	Ingredients are converted to active moiety (the active molecule not including salts).	Active ingredient weights relate directly to information held within the SPC.
Calculation of kg biomass	Horses not included as food-producing animals.	Horses included as food-producing animals.
Calculation of mg/kg	Only takes into account products which are authorised for use in food-producing animals only. Horses are excluded. Takes into account all administration routes.	All formulations (for all species) other than tablets included. It is considered that tablets are primarily used in the treatment of non-food-producing animals.
Conclusion	Likely underestimates mg/kg.	Likely overestimates mg/kg.

In order to harmonise national and European reporting, the ESVAC methodology has been adopted since the UK-VARSS 2015 report.

For further details on how mg/PCU is calculated please see: https://www.gov.uk/government/publications/understanding-the-mgpcu-calculation-used-for-antibiotic-monitoring-in-food-producing-animals.

The data reported in Chapter 1 of the main report are presented according to the Anatomical Therapeutic Chemical Classification System for veterinary medicinal products (ATCvet) as shown in Table S1.5.2[1].

Table S1.5.2: Categories and ATCvet codes of antibiotic veterinary medicinal products included in the data

Veterinary antibiotic category	ATCvet codes
Antibiotics for intestinal use	QA07AA; QA07AB
Antibiotics for intrauterine use	QG01AA; QG01AE; QG01BA; QG01BE; QG51AA; QG51AG
Antibiotics for systemic use	QJ01
Antibiotics for intramammary use	QJ51
Antibiotics for antiprotozoal use (solely sulphonamides)	QP51AG

Table S1.5.3 shows the sales for other antibiotic products, which include topical preparations and those for sensory organs, for example aerosols, creams, gels, shampoos and ear and eye medications. These are not included in the ESVAC calculation.

Table S1.5.3: Active ingredient in tonnes of antibiotics sold for all animal species by 'other' routes of administration from 2015 to 2019

Administration Route	2015	2016	2017	2018	2019	2020
Other routes	2.0	2.4	2.4	2.5	2.6	2.1

S1.6: Population Correction Unit (PCU)

When assessing antibiotic sales, it is important that the demographics of the animal population potentially exposed to treatment are also considered, (see Annex D of the main report for data limitations). This is achieved through use of the PCU, a technical unit of measurement (where 1 PCU = 1 kg of animal treated), which is calculated by multiplying a standardised average weight at time of treatment (which can be found in Table S1.6.3) with the associated annual animal/slaughter numbers. The calculation also considers animals exported from the UK for slaughter or imported to the UK for fattening. Full details on the methodology of calculation of the PCU can be found in the 2011 ESVAC report (which includes data from 2005 to 2009): https://www.ema.europa.eu/en/veterinary-regulatory/overview/antimicrobial-resistance/european-surveillance-veterinary-antimicrobial-consumption-esvac.

[1] World Health Organization, 2018

Table S1.6.1 shows the UK PCU value for food-producing animal species and horses. The standard formula used for calculation of the PCU for poultry does not include population figures for egg producers (laying hens) so the poultry PCU is an underestimate[2].

Table S1.6.1: PCU in 1,000 tonnes by food-producing animal species from 2014 to 2020

Please note that for horses, horse population data are obtained from the British Equestrian Trade Association survey which is run every 5 years.

Animal species	2014	2015	2016	2017	2018	2019	2020
Sheep and goats	2824.9	2795.6	2845.3	2910.4	2832.7	2817.6	2743.9
Cattle	1731.3	1743.0	1792.3	1785.2	1787.7	1774.7	1768.5
Poultry	1041.7	1082.4	1150.9	1185.3	1233.0	1204.5	1250.9
Pigs	744.6	769.7	788.9	766.4	781.0	795.5	795.5
Horses	395.2	377.6	377.6	377.6	377.6	338.8	338.8
Fish	177.0	193.1	187.3	117.3	203.6	168.8	217.5
Total PCU	**6914.7**	**6961.4**	**7142.4**	**7202.1**	**7215.7**	**7099.9**	**7115.2**

Table S1.6.2 shows the combined UK denominator value for cats and dogs (in kg) used for the dog and cat mg/kg calculations. Population data was sourced from the Pet Food Manufacturers Association[3] and mean adult cat and dog weights provided by the Small Animal Veterinary Surveillance Network (SAVSNET)[4]. Routinely recorded tabulated weight data were extracted from electronic health records provided by veterinary practices voluntarily participating in the SAVSNET project. Animals aged under 2 years, over 22.5 years and 27.5 years for dogs and cats respectively and/or with unrealistic weight measurements were excluded from the analysis. The mean weights were then calculated from the remaining data.

Table S1.6.2 Weights, in 1,000 tonnes, of a) dogs and b) cats from 2014 to 2020
a)

Dogs	2014	2015	2016	2017	2018	2019	2020
Population (in 1,000s) heads	8,900	8,500	8,500	8,500	9,000	9,000	9000
Mean weight (in kg)	19.4	19.1	18.8	18.5	18.3	18.2	18.5
Total weight of dogs (in 1,000 tonnes)	172.8	162.3	159.8	157.1	164.9	163.5	166.2

[2] https://www.ema.europa.eu/veterinary-regulatory/overview/antimicrobial-resistance/european-surveillance-veterinary-antimicrobial-consumption-esvac
[3] https://www.pfma.org.uk/statistics
[4] University of Liverpool, Small Animal Veterinary Surveillance Network (SAVSNET) project, personal communication, 2020

b)

Cats	2014	2015	2016	2017	2018	2019	2020
Population (in 1,000s) heads	7,900	7,400	7,500	8,000	8,000	7,500	7500
Mean weight in kg	4.4	4.4	4.4	4.5	4.5	4.5	4.4
Total weight of cats (in 1,000 tonnes)	34.8	32.8	32.6	35.7	35.7	33.7	33
Total combined weight of dogs and cats (1,000 tonnes)	**207.7**	**195.0**	**192.4**	**192.8**	**200.6**	**197.2**	**199.2**

Table S1.6.3: Average weight at time of treatment in kg used to calculate the PCU for food-producing animals

Please note that for the category imported/exported poultry for slaughter, it's assumed this is broilers. Also, for the category slaughter sheep and goats, it's assumed this is lambs.

a) Cattle

Animal category	Average weight at treatment (kg)	Source
Slaughter cows	425	Montforts (1999)[5]
Slaughter heifers	200	EMA[4]
Slaughter bullocks and bulls	425	Montforts (1999)[3]
Slaughter calves and young cattle	140	Montforts (1999)[3]; EMA[6]
Imported/exported cattle for slaughter	425	Montforts (1999)[3]
Imported/exported cattle for fattening	140	Montforts (1999)[3]
Livestock dairy cows	425	Montforts (1999)[3]; EMA[4]

b) Pigs

Animal category	Average weight at treatment (kg)	Source
Slaughter pigs	65	Montforts (1999)[3]
Imported/exported pigs for slaughter	65	Montforts (1999)[3]
Imported/exported pigs for fattening	25	M. Goll (Eurostat, personal comm.)
Livestock sows	240	Montforts (1999)[3]

[5] Montforts, M. H. M. M. (1999). Environmental risk assessment for veterinary medicinal products. Part 1. Other than GMO-containing and immunological products. First update.
[6] European Medicines Agency (2016). Revised guideline on environmental impact assessment for veterinary medicinal products in support of the VICH guidelines GL6 and GL 38 (EMEA/CVMP/ERA/418282/2005-Rev.1- Corr.).

c) Poultry

Animal category	Average weight at treatment (kg)	Source
Slaughter broilers	1	Montforts (1999)[3]; EMA[4]
Slaughter turkeys	6.5	Montforts (1999)[3]; EMA[4]
Imported/exported poultry for slaughter	1	Montforts (1999)[3]; EMA[4]

d) Sheep and goats

Animal category	Average weight at treatment (kg)	Source
Slaughter sheep and goats	20	Montforts (1999)[3]
Imported/exported sheep and goats for slaughter[4]	20	Montforts (1999)[3]
Livestock sheep	75	Montforts (1999)[3]

e) Horses

Animal category	Average weight at treatment (kg)	Source
Living horses	400	Montforts (1999)[3]; EMA[2]

Please note that for fish, data from Eurostat is given in 1,000 tonnes slaughtered fish as live weight.

S1.7: Antibiotic active ingredients authorised for use in animals

Table S1.7.1. Antibiotic active ingredient organised by class, authorised species and administration route

a) Tetracyclines

Active ingredient	Authorised species	Administration route
Chlortetracycline	Cattle, pigs, sheep, chickens, turkeys, ducks	Cutaneous spray, oral/water, premix
Doxycycline	Pigs, chickens, turkeys, cats, dogs, pigeons	Tablet, oral/water, premix
Oxytetracycline	Cattle, pigs, sheep, chickens, salmon, trout, dogs, cats, horses	Tablet, injectable, premix, oral/water, cutaneous spray
Tetracycline	Cattle, pigs, chickens	Tablet, oral

b) Trimethoprim/sulphonamides

Active ingredient	Authorised species	Administration route
Sulfadiazine	Cattle, pigs, chickens, turkeys, cats, dogs, horses	Tablet, oral/water, injectable, premix, intramammary suspension
Sulfadimethoxine	Pigeons	Oral/water
Sulfadimidine	Cattle, pigs, sheep	Injectable
Sulfadoxine	Cattle, horses	Injectable
Sulfamethoxazole	Pigs, chickens	Oral/water
Trimethoprim	Cattle, pigs, chickens, turkeys, cats, dogs, horses	Tablet, oral/water, premix, intramammary suspension

c) Beta-lactams: first generation cephalosporins

Active ingredient	Authorised species	Administration route
Cefalexin	Cattle, cats, dogs	Tablet, injectable, intramammary suspension
Cefalonium	Cattle	Intramammary suspension
Cefapirin	Cattle	Intramammary suspension, intrauterine suspension

d) Beta-lactams: third generation cephalosporins

Active ingredient	Authorised species	Administration route
Cefoperazone	Cattle	Intramammary suspension
Cefovecin	Cats, dogs	Injectable
Ceftiofur	Cattle, pigs, horses	Injectable

e) Beta-lactams: fourth generation cephalosporins

Active ingredient	Authorised species	Administration route
Cefquinome	Cattle, pigs, horses	Injectable, intramammary suspension/ointment

f) Beta-lactams: penicillins

Active ingredient	Authorised species	Administration route
Amoxicillin	Cattle, pigs, sheep, chickens, turkeys, ducks, salmon, cats, dogs, pigeons	Injectable, tablet, oral/water, premix, intramammary suspension, top dressing
Ampicillin	Cattle, pigs, sheep, cats, dogs	Injectable, tablet, intramammary suspension
Benzylpenicillin	Cattle, pigs, sheep, chickens, cats, dogs, horses	Injectable, oral/water, intramammary suspension
Cloxacillin	Cattle, sheep, cats, dogs, horses	Intramammary suspension, eye ointment
Nafcillin	Cattle	Intramammary suspension
Phenoxymethylpenicillin	Pigs	Premix

f) Aminoglycosides

Active ingredient	Authorised species	Administration route
Apramycin	Cattle, pigs, chickens	Premix, oral/water
Dihydrostreptomycin	Cattle, pigs, sheep, cats, dogs, horses	Injectable, intramammary suspension
Framycetin	Cattle, cats, dogs	Injectable, intramammary suspension, ear drops
Gentamicin	Cats, dogs, horses, rabbits	Injectable, eye drops, ear drops, gel
Kanamycin	Cattle	Intramammary suspension
Neomycin	Cattle, pigs, sheep, cats, dogs, horses	Injectable, oral/water, intramammary suspension, ear drops
Paromomycin	Cattle, pigs	Oral/water
Spectinomycin	Cattle, pigs, sheep, chickens	Injectable, premix, oral/water
Streptomycin	Cattle, sheep, cats, dogs, horses	Injectable, oral/water, intramammary suspension

g) Fluoroquinolones

Active ingredient	Authorised species	Administration route
Danofloxacin	Cattle, pigs	Injectable
Difloxacin	Cattle, chickens, turkeys, dogs	Injectable, tablet, oral/water
Enrofloxacin	Cattle, pigs, sheep, chickens, turkeys, goats, cats, dogs, rabbits, reptiles, ornamental birds, rodents	Injectable, tablet, oral/water
Ibafloxacin	No currently authorised products	-
Marbofloxacin	Cattle, pigs, cats, dogs	Tablet, injectable, ear drops
Orbifloxacin	Dogs	Ear drops, oral/water
Pradofloxacin	Cats, dogs	Tablet

h) Macrolides

Active ingredient	Authorised species	Administration route
Erythromycin	Chickens	Oral/water
Gamithromycin	Cattle	Injectable
Spiramycin	Cattle, dogs, cats	Injectable, tablet
Tildipirosin	Cattle, pigs	Injectable
Tilmicosin	Cattle, pigs, sheep, chickens, turkeys, rabbits	Injectable, premix, oral/water
Tulathromycin	Cattle, pigs	Injectable
Tylosin	Cattle, pigs, chickens, turkeys	Oral/water, premix, injectable
Tylvalosin	Pigs, chickens, turkeys, game birds	Oral/water, premix

i) Other: amphenicols

Active ingredient	Authorised species	Administration route
Florfenicol	Cattle, pigs, sheep, salmon	Injectable, oral/water, premix, ear gel

j) Other: lincomycins

Active ingredient	Authorised species	Administration route
Lincomycin	Cattle, pigs, chicken, cats, dogs	Oral/water, premix, injectable, intramammary solution
Clindamycin	Cats, dogs	Tablet, oral/water
Pirlimycin	Cattle	Intramammary solution

k) Other: pleuromutilins

Active ingredient	Authorised species	Administration route
Tiamulin	Pigs, chickens, turkeys, rabbits	Oral/water, premix, injectable
Valnemulin	Pigs, rabbits	Oral/water, premix

l) Other: polymyxins

Active ingredient	Authorised species	Administration route
Colistin	Cattle, pigs, sheep, chickens	Oral/water
Polymyxin B	Cats, dogs	Ear drops, cutaneous suspension

m) Other: other antibiotics

Active ingredient	Authorised species	Administration route
Fusidic acid	Cats, dogs, rabbits	Ear drops, gel
Novobiocin	Cattle	Intramammary suspension

Certain active ingredients included in the results in chapters 3 and 4 are not authorised for use in food-producing animals. These antibiotics (listed below) are however included in the test panels to monitor emergence or risk of resistance to those antibiotics in bacteria in people or because no breakpoints are available for the antibiotic for which testing ideally should be taking place.

Table S1.7.2. Antibiotics not authorised for use in food-producing animals

Antibiotic class	Active ingredient
Aminoglycosides	Amikacin
Amphenicols	Chloramphenicol
Beta-lactams: 3rd generation cephalosporins	Cefotaxime
Beta-lactams: 3rd generation cephalosporins	Cefpodoxime
Beta-lactams: 3rd generation cephalosporins	Ceftazidime
Beta-lactams: 4th generation cephalosporins	Cefepime
Beta-lactams: Carbapenems	Ertapenem
Beta-lactams: Carbapenems	Imipenem
Beta-lactams: Carbapenems	Meropenem
Fluoroquinolones	Ciprofloxacin
Macrolides	Azithromycin
Quinolones	Nalidixic acid
Other anti-infectives and antiseptics	Furazolidone
Other	Tigecycline

S1.8: Cascade prescribing

The Cascade is a legislative provision in the Veterinary Medicines Regulations that allows a veterinary surgeon to prescribe unauthorised medicines that would not otherwise be permitted, for example, imported medicines or a medicine licensed for another animal species or human use. The principle of the Cascade is that, if there is no suitable veterinary medicine authorised in the UK to treat a condition, the veterinary surgeon responsible for the animal may in particular circumstances (for example to avoid causing unacceptable suffering) treat with an unauthorised medicine. Food-producing animals may only be treated under the Cascade with medicines whose pharmacologically active substances are listed in the Table of Allowed Substances in Commission Regulation EU No. 37/2010.

The data used in this report do not include data on sales of imported or human antibiotics used in animals in accordance with the prescribing Cascade, as currently there is no mechanism by which such information can be obtained. The understanding is that use of human products in food-producing animal species is not extensive, due to issues with longer withdrawal periods when using such products. The VMD continues to explore methods that can accurately incorporate information on the amounts of antibiotics imported into or exported out of the UK, as well as methods that can accurately incorporate sales of antibiotics licensed for humans that are sold for animal use under the Cascade prescribing system.

S2.1: Usage of veterinary antibiotics for pigs (in mg/kg)

Table S2.1.1: Usage recorded for active ingredient in mg/kg of antibiotics in eMB Pigs by antibiotic class; 2015 to 2020

Please note that the antibiotic class referred to as “other” includes lincosamides, amphenicols, polymyxins, fluoroquinolones and third and fourth generation cephalosporins.

Antibiotic	2015	2016	2017	2018	2019	2020	Change 2015 to 2020
Tetracyclines	117.7	82.4	55.7	46.1	42.1	37.7	-68%
Penicillins	37.0	27.4	22.4	21.2	20.2	21.9	-41%
Trimethoprim-sulphonamides	66.2	29.2	20.8	18.3	17.9	16.5	-75%
Macrolides	31.0	28.8	16.0	10.5	9.1	11.2	-64%
Aminoglycosides	3.5	3.0	3.6	5.5	6.5	8.3	137%
Pleuromutilins	17.3	7.6	9.8	5.3	10.5	5.1	-71%
Other	5.1	4.3	2.5	3.2	4.0	4.4	-14%
Total	**278**	**183**	**131**	**110**	**110**	**105**	**-62%**

Table S2.1.2: HP-CIA usage, depicted in active ingredient of antibiotics, in mg/kg recorded in eMB Pigs from 2015 to 2020

Antibiotic	2015	2016	2017	2018	2019	2020	Change 2019 to 2020
Fluoroquinolones	0.106	0.047	0.074	0.051	0.034	0.045	31%
3rd/4th generation cephalosporins	0.018	0.008	0.014	0.010	0.005	0.007	28%
Colistin	0.855	0.210	0.010	0.013	0.002	0.000	-100%
Total	**0.979**	**0.266**	**0.097**	**0.074**	**0.042**	**0.052**	**25%**

S2.2: Usage of veterinary antibiotics for meat poultry (in tonnes and mg/kg)

Table S2.2.1: Active ingredient in tonnes of antibiotics used by all members of BPC Antibiotic Stewardship by antibiotic class from 2014 to 2020

Please note, the category penicillins includes amoxicillin and phenoxymethylpenicillin and antibiotics in the class referred to as “other” includes aminoglycosides, pleuromutilins, fluoroquinolones, colistin and products under the cascade. Also, both fluoroquinolones and colistin are HP-CIAs.

Antibiotic	2014	2015	2016	2017	2018	2019	2020	Change 2014 to 2020
Penicillins	19.8	14.1	10.6	8.2	10.2	12.7	15.0	-24%
Tetracyclines	30.6	23.9	9.0	3.3	2.5	3.9	2.5	-92%
Lincomycins	7.1	4.8	1.4	1.2	1.7	1.5	2.2	-69%
Potentiated sulphonamides	1.2	1.0	1.6	0.9	1.2	1.1	1.0	-17%
Macrolides	2.7	1.1	0.53	0.56	0.47	0.06	0.11	-96%
Other, including:	2.1	1.4	0.6	0.2	0.1	0.3	0.1	-95%
Fluoroquinolones (kg)	1,131	540	122	38	17.3	14.4	12.1	(-1119 kg)
Colistin (kg)	121	40	8	0	0	0	0	(-121 kg)
Total	**63.4**	**46.2**	**23.7**	**14.4**	**16.2**	**19.7**	**21.0**	**-67%**

Table S2.2.2: Active ingredient in mg/kg of antibiotics used by all members of BPC Antibiotic Stewardship by species from 2014 to 2020

Species	2014	2015	2016	2017	2018	2019	2020	Change 2014 to 2020
Turkey	219.5	199.8	86.4	45.2	46.7	42.0	25.7	-88%
Chicken	48.8	27.3	17.1	9.9	12.4	17.4	16.3	-67%
Duck	15.1	8.3	3.3	3.3	1.7	1.6	2.6	-83%

S2.3: Usage of veterinary antibiotics for laying hens (in % bird days)

Table S2.3.1: Antibiotic use in percentage bird days by members of the BEIC Lion Code from 2016 to 2020

Please note, the class referred to as “other” includes fluoroquinolones and colistin, both of which are HP-CIAs.

Antibiotic	2016	2017	2018	2019	2020	Change 2016 to 2020
Tetracyclines	0.26	0.31	0.33	0.41	0.26	-1%
Pleuromutilins	0.25	0.17	0.11	0.12	0.10	-59%
Macrolides	0.04	0.06	0.04	0.06	0.03	-23%
Pencillins	0.06	0.02	0.05	0.05	0.05	-10%
Aminoglycosides	0.02	0.01	0.02	0.04	0.03	32%
Other includes:	0.03	0.00	0.00	0.00	0.00	
Fluoroquinolones	0.002	0	0	0	0	-93%
Colistin	0.03	0	0	0	0	
Total	**0.67**	**0.57**	**0.55**	**0.68**	**0.47**	**-29%**

S2.4: Usage of veterinary antibiotics for gamebirds (in tonnes)

Table S2.4.1: Active ingredient in tonnes of antibiotics used by the gamebird industry, recorded by GFA from 2016 to 2020

Please note the class referred to as “other” includes aminoglycosides, amphenicols, colistin, fluoroquinolones, lincomycins, trimethoprim/sulphonamides. Also, both fluoroquinolones and colistin are HP-CIAs.

Antibiotic	2016	2017	2018	2019	2020	Change 2016 to 2020
Tetracyclines	14.4	8.2	5.5	5.5	3.0	-79%
Pleuromutilins	3.7	3.6	2.8	2.7	1.7	-54%
Penicillins	1.2	0.8	1.1	1.5	0.9	-25%
Macrolides	0.6	0.3	0.2	0.5	0.3	-53%
Other:	0.2	0.1	0.2	0.2	0.1	-40%
Fluoroquinolones (kg)	64	50	47	58	22	-66%
Colistin (kg)	0.6	0	0	0	0	-100%
Total	**20.2**	**13.0**	**9.7**	**10.4**	**6.0**	**-70%**

S2.5: Usage of veterinary antibiotics for Salmon (mg/kg)

Table S2.5.1: Active ingredient in mg/kg of antibiotics used on Scottish salmon farms from 2017 to 2020

Antibiotic	2017	2018	2019	2020	Change 2017 to 2020
Oxytetracycline	13.8	3.9	10.2	25.3	83%
Florfenicol	2.2	2.7	3.3	4.0	84%
Oxolinic acid	0.1	0.1	0.02	0.01	-89%
Amoxicillin	0.004	0.0	0.0	0.0	-100%
Total	**16.1**	**6.7**	**13.5**	**29.3**	**82%**

S2.6: Usage of veterinary antibiotics for trout (mg/kg)

Table S2.6.12: Active ingredient in mg/kg of antibiotics used on a sample of trout farms from 2017 to 2020

Antibiotic	2017	2018	2019	2020	Change 2017 to 2020
Oxytetracycline	7.3	3.8	5.1	7.7	4%
Oxolinic acid	6.6	5.8	2.4	4.3	-35%
Florfenicol	4.4	2.2	1.9	1.9	-56%
Amoxicillin	0.9	1.2	0.2	0.0	-100%
Total	**19.2**	**13.0**	**9.7**	**13.9**	**-28%**

S2.7: Usage of veterinary antibiotics for dogs and cats (% consults)

Table S2.7.1: Percentage of consults where systemic antibiotics were prescribed in a) cats and b) dogs from 2014 to 2020

a)

Antibiotic	2014	2015	2016	2017	2018	2019	2020	Change 2014 to 2020
Systemic antibiotic	18.6	14.8	13.8	12.6	12.0	11.6	12.0	-36%
Systemic HP-CIA	9.5	7.6	7.5	6.6	6.0	5.5	5.4	-43%
% HP-CIA	**51**	**52**	**54**	**52**	**50**	**47**	**45**	**-12%**

b)

Antibiotic	2014	2015	2016	2017	2018	2019	2020	Change 2014 to 2020
Systemic antibiotic	15.3	12.3	11.1	10.4	9.8	9.3	9.6	-37%
Systemic HP-CIA	1.0	0.8	0.6	0.6	0.4	0.4	0.5	-54%
% HP-CIA	**6**	**6**	**5**	**5**	**4**	**4**	**5**	**-26%**

S3.1: EU harmonised monitoring requirements of Decision 2013/652/EU

Table S3.1.1: Summary of requirements of European Commission Implementing Decision by sampling year 2013/652/EU

Pathogen/sample/animal species	2014*	2015	2016*	2017	2018*	2019	2020*
Salmonella spp. – broilers	x		x		x		x
Salmonella spp. – layers	x		x		x		x
Salmonella spp. – fattening turkeys	x		x		x		x
Salmonella spp. – broiler carcases	x		x		x		x
Salmonella spp. – fattening turkey carcases	x		x		x		x
Salmonella spp. – pig carcases		x		x		x	
Campylobacter jejuni – broilers	x		x		x		x
Campylobacter jejuni – fattening turkeys	x		x		x		x
Escherichia coli – broiler caeca	x		x		x		x
Escherichia coli – turkey caeca	x		x		x		x
Escherichia coli – pig caeca		x		x		x	
ESBL-, AmpC- or carbapenemase-producing *E. coli* – broiler caeca	x		x		x		x
ESBL-, AmpC- or carbapenemase-producing *E. coli* – turkey caeca	x		x		x		x
ESBL-, AmpC- or carbapenemase-producing *E. coli* – pig caeca		x		x		x	
ESBL-, AmpC- or carbapenemase-producing *E. coli* – fresh broiler meat, pig meat and bovine meat gathered at retail	x	x	x	x	x	x	x
Campylobacter coli – broilers	x		x		x		x
Campylobacter coli – pigs		x		x		x	
E. faecium and *E. faecalis* – broilers, fattening turkeys, fattening pigs, bovines <1 year of age	x	x	x	x	x	x	x

Key:
x = Mandatory
x = Voluntary
Pig and bovine year
*Poultry year

Note: The UK is exempt from the monitoring of resistance in isolates of bovine origin as we do not meet the cattle (<1 year of age) slaughter throughput as specified in the legislation.

S.3.2: Methodology - Antibiotic Susceptibility Testing (AST)

AST was carried out by the national reference laboratories (NRLs). Caecal samples were cultured for *E. coli* and *C. jejuni* using appropriate media and a single typical colony was selected for speciation and susceptibility testing. *Salmonella* isolates are not cultured from these caecal samples and are instead received by the NRLs for serotyping and susceptibility testing. Standardised broth microdilution was used to determine the minimum inhibitory concentration (MIC) against a panel of antibiotics in accordance with Decision 2013/652/EU and the EFSA manual[7].

In addition, caecal samples were cultured for ESBL-/AmpC-/carbapenemase-producing *E. coli* following the selective procedures outlined in Decision 2013/652/EU. This included a pre-enrichment step followed by inoculation of samples onto MacConkey agar plates supplemented with 1 mg/L cefotaxime for isolation of ESBL- or AmpC-producing *E. coli* and chromID OXA-48® and chromID CARBA® agars for isolation of carbapenemase-producing *E. coli*. An *E. coli* with an ESBL phenotype was defined as showing synergy with cefotaxime and clavulanate and/or ceftazidime and clavulanate. An *E. coli* with an AmpC phenotype was defined as showing decreased susceptibility to cefoxitin, cefotaxime and ceftazidime.

Whole genome sequencing (WGS) and *in silico* bioinformatic tools were used to detect the antibiotic resistance determinants present in the isolates with ESBL- or AmpC-phenotypes. The isolates were sequenced using the Illumina NextSeq platform followed by quality control steps and mapping of the raw reads to a database of antibiotic resistance genes, using the APHA SeqFinder pipeline[8,9]. The sequence of *E. coli* isolates negative for all known ESBL-, AmpC- and carbapenemase-encoding genes were investigated for promoter mutations in *ampC*, which is compatible with increased expression of the chromosomal *E. coli ampC*, using the APHA SeqFinder pipeline.

[7] Commission Implementing Decision of 12 November 2013 on the monitoring and reporting of antimicrobial resistance in zoonotic and commensal bacteria (notified under document C(2013) 7145)Text with EEA relevance (europa.eu)
[8] https://academic.oup.com/jac/article-abstract/71/8/2306/2238759?redirectedFrom=fulltext
[9] https://academic.oup.com/jac/article/72/3/691/2691389?login=true

S3.3: EU harmonised monitoring results of susceptibility testing in *Escherichia coli*

The epidemiological cut-off (ECOFF) and clinical breakpoint (CBP) values applied for this section were taken from the European Commission Implementing Decision 2013/652/EU.

Please note, cefotaxime, ceftazidime, cefepime, cefoxitin, ciprofloxacin and colistin are HP-CIAs. Also, nalidixic acid, sulfamethoxazole and tetracyclines have no CBP available, and so ECOFFs were applied for these antibiotics as denoted by an asterisk. For individuals using screen readers, please note that for cells that are read out as blank, this denotes that no isolates were tested, or that no data is available. Finally, data shown for azithromycin and ciprofloxacin has been retrospectively updated due to changes in clinical breakpoints (see section 3.2.3 for erratum)

Table S3.3.1: Susceptibility in *E. coli* interpreted using both EUCAST CBPs and ECOFFs from caecal samples from boilers at slaughter in the UK. This table shows the number and percentage of resistant isolates, as defined by CBP, or less susceptible isolates, as defined by ECOFF for 2014, 2016, 2018 and 2020

Antibiotic	CBP (2014, n=159)	ECOFF (2014, n=159)	CBP (2016, n=190)	ECOFF (2016, n=190)	CBP (2018, n=183)	ECOFF (2018, n=183)	CBP (2020, n=250)	ECOFF (2020, n=250)
Ampicillin	116 (73.0)	116 (73.0)	128 (67.4)	128 (67.4)	85 (46.4)	85 (46.4)	101 (40.4)	101 (40.4)
Azithromycin	-	-	-	-	-	-	-	-
Cefotaxime	0	0	0	0	3 (1.6)	4 (2.2)	1 (0.4)	1 (0.4)
Ceftazidime	0	0	0	0	1 (0.5)	4 (2.2)	1 (0.4)	1 (0.4)
Chloramphenicol	20 (12.6)	14 (8.8)	13 (6.8)	7 (3.7)	11 (6.0)	5 (2.7)	12 (4.8)	8 (3.2)
Ciprofloxacin	6 (3.8)	39 (24.5)	3 (1.6)	41 (21.6)	2 (1.1)	29 (15.8)	6 (2.4)	26 (10.4)
Colistin	0	0	0	0	0	0	0	0
Gentamicin	31 (19.5)	32 (20.1)	13 (6.8)	14 (7.4)	18 (9.8)	19 (10.4)	10 (4.0)	10 (4.0)
Meropenem	0	0	0	0	0	0	0	0
Nalidixic acid	*	39 (24.5)	*	40 (21.1)	*	27 (14.8)	*	25 (10.0)
Sulfamethoxazole	*	104 (65.4)	*	100 (52.6)	*	74 (40.4)	*	78 (31.2)
Tetracycline	*	97 (61.0)	*	84 (44.2)	*	49 (26.8)	*	55 (22.0)
Tigecycline	0	0	0	0	0	0	0	0
Trimethoprim	75 (47.2)	75 (47.2)	81 (42.6)	81 (42.6)	50 (27.3)	50 (27.3)	60 (24.0)	60 (24.0)

Table S3.3.2: Susceptibility in *E. coli* (interpreted using both EUCAST CBPs and ECOFFs) from caecal samples from turkeys at slaughter in the UK. This table shows the number and percentage of resistant isolates, as defined by CBP, or less susceptible isolates, as defined by ECOFF for 2014, 2016, 2018 and 2020

Antibiotic	CBP 2014 (n=168)	ECOFF 2014 (n=168)	CBP 2016 (n=224)	ECOFF 2016 (n=224)	CBP 2018 (n=176)	ECOFF 2018 (n=176)	CBP 2020 (n=197)	ECOFF 2020 (n=197)
Ampicillin	116 (69.0)	116 (69.0)	136 (60.7)	136 (60.7)	100 (56.8)	100 (56.8)	118 (59.9)	118 (59.9)
Azithromycin	-	-	-	-	-	-	-	-
Cefotaxime	0	0	1 (0.4)	1 (0.4)	0	0	2 (1.0)	2 (1.0)
Ceftazidime	0	0	1 (0.4)	1 (0.4)	0	0	1 (0.5)	2 (1.0)
Chloramphenicol	20 (11.9)	17 (10.1)	20 (8.9)	17 (7.6)	15 (8.5)	7 (4.0)	11 (5.6)	8 (4.1)
Ciprofloxacin	12 (7.1)	29 (17.3)	11 (4.9)	35 (15.6)	4 (2.3)	19 (10.8)	5 (2.5)	28 (14.2)
Colistin	0	0	0	0	0	0	0	0
Gentamicin	7 (4.2)	7 (4.2)	5 (2.2)	5 (2.2)	1 (0.6)	1 (0.6)	3 (1.5)	3 (1.5)
Meropenem	0	0	0	0	0	0	0	0
Nalidixic acid	*	31 (18.5)	*	32 (14.3)	*	11 (6.3)	*	13 (6.6)
Sulfamethoxazole	*	54 (32.1)	*	57 (25.4)	*	31 (17.6)	*	33 (16.8)
Tetracycline	*	132 (78.6)	*	150 (67.0)	*	82 (46.6)	*	109 (55.3)
Tigecycline	0	0	0	0	0	0	0	0
Trimethoprim	40 (23.8)	40 (23.8)	51 (22.8)	51 (22.8)	24 (13.6)	24 (13.6)	29 (14.7)	29 (14.7)

Table S3.3.3 Distribution of ESBL/AmpC and CPE enzymes detected in *E. coli* from healthy broilers in England, Wales and Scotland in 2020**.** Note - if more than one isolate was of an unknown sequence type (ST), it has been assumed that they belonged to different STs

Enzyme	Number of isolates	Proportion of isolates (n=17) (%)	Proportion of caecal samples (n=350) (%)	Number of unique STs	Sequence type (ST)
CMY-2	2	6	0.3	2	2040, 162
CTX-M-1	4	24	1.1	3	57, 665 (n=2), 1611
CTX-M-55	5	29	1.4	2	101, 752 (n=4)
SHV-12	3	12	0.6	3	939, 2165, 1421
Up regulated *ampC*	3	18	0.9	3	23, 115, 162

Table S3.3.4: Decreased susceptibility in ESBL-/AmpC-producing *E. coli* from caecal samples from healthy broilers at slaughter in the UK for 2020

Antibiotic	Number of AmpC isolates with decreased susceptibility (n=5)	Proportion of AmpC isolates with decreased susceptibility (%)	Number of ESBL isolates with decreased susceptibility (n=12)	Proportion of ESBL isolates with decreased susceptibility (%)
Ampicillin	5	100	12	100
Azithromycin	0	0	0	0
Cefepime	0	0	12	100
Cefotaxime	5	100	12	100
Cefoxitin	4	80	0	0
Ceftazidime	5	100	12	100
Chloramphenicol	1	20	6	50
Ciprofloxacin	1	20	6	50
Colistin	0	0	0	0
Ertapenem	0	0	0	0
Gentamicin	0	0	0	0
Imipenem	0	0	0	0
Meropenem	0	0	0	0
Nalidixic acid	0	0	5	42
Sulfamethoxazole	1	20	10	83
Tetracycline	1	20	8	67
Tigecycline	0	0	0	0
Trimethoprim	0	0	9	75

Table S3.3.5 Distribution of ESBL/AmpC and CPE enzymes detected in *E. coli* from healthy turkeys in England, Wales and Scotland in 2020. Note - if more than one isolate was of an unknown sequence type (ST), it has been assumed that they belonged to different STs

Enzyme	Number of isolates	Proportion of isolates (n=5) (%)	Proportion of caecal samples (n=334) (%)	Number of unique STs	Sequence type (ST)
CTX-M-1	1	20	0.3	1	602
CTX-M-15	2	40	0.6	1	1011 (n=2)
CTX-M-55	1	20	0.3	1	23
DHA-1	1	20	0.3	2	108

Table S3.3.6: Decreased susceptibility in ESBL-/AmpC-producing *E. coli* from caecal samples from healthy turkeys at slaughter in the UK for 2020

Antibiotic	Number of AmpC isolates with decreased susceptibility (n=1)	Percentage of AmpC isolates with decreased susceptibility (%)	Number of ESBL isolates with decreased susceptibility (n=4)	Percentage of ESBL isolates with decreased susceptibility (%)
Ampicillin	1	100	4	100
Azithromycin	1	100	0	0
Cefepime	0	0	4	100
Cefotaxime	1	100	4	100
Cefoxitin	1	100	0	0
Ceftazidime	1	100	4	100
Chloramphenicol	0	0	1	25
Ciprofloxacin	1	100	3	75
Colistin	0	0	0	0
Ertapenem	0	0	0	0
Gentamicin	0	0	0	0
Imipenem	0	0	0	0
Meropenem	0	0	0	0
Nalidixic acid	0	0	1	25
Sulfamethoxazole	0	0	2	50
Tetracycline	0	0	1	25
Tigecycline	0	0	0	0
Trimethoprim	1	100	2	50

S3.4: EU harmonised monitoring results of susceptibility testing in *Salmonella* spp.

Table S3.4.1: Susceptibility in *Salmonella* spp. interpreted using both EUCAST CBPs and ECOFFs from samples from broiler flocks in the UK for 2014, 2016, 2018 and 2020. This table shows the number and percentage of resistant isolates, as defined by CBP, or less susceptible isolates, as defined by ECOFF

Please note, nalidixic acid and tetracyclines have no CBP available, and so ECOFFs were applied for these antibiotics as denoted by an asterisk. Also, for azithromycin, ciprofloxacin, sulfamethoxazole and tigecycline data was retrospectively updated due to changes in clinical breakpoints (see section 3.2.3 for erratum).

Antibiotic	CBPs (2014, n=168)	ECOFFs (2014, n=168)	CBPs (2016, n=170)	ECOFFs (2016, n=170)	CBPs (2018, n=171)	ECOFFs (2018, n=171)	CBPs (2020, n=168)	ECOFFs (2020, n=168)
Ampicillin	6 (3.6)	6 (3.6)	6 (3.5)	6 (3.5)	5 (2.9)	5 (2.9)	7 (4.2)	7 (4.2)
Azithromycin	-	-	-	-	-	-	-	-
Cefotaxime	0	0	0	0	0	0	0	0
Ceftazidime	0	0	0	0	0	0	0	0
Chloramphenicol	12 (7.1)	2 (1.2)	10 (5.9)	1 (0.6)	26 (15.2)	0	11 (6.5)	1 (0.6)
Ciprofloxacin	0	0	1 (0.6)	15 (8.8)	0	11 (6.4)	0	4 (2.4)
Colistin	0	0	0	0	2 (1.2)	2 (1.2)	0	0
Gentamicin	12 (7.1)	14 (8.3)	2 (1.2)	2 (1.2)	0	0	0	0
Meropenem	0	0	0	0	0	0	0	0
Nalidixic acid	*	3.6	*	6 (3.5)	*	5 (2.9)	*	0
Sulfamethoxazole	-	-	-	-	-	-	-	-
Tetracycline	*	34 (20.2)	*	33 (19.4)	*	7 (4.1)	*	31 (18.5)
Tigecycline	0	10 (6.0)	0	0	0	0	0	4 (2.4)
Trimethoprim	31 (18.5)	32 (19.0)	0	0	6 (3.5)	6 (3.5)	33 (19.6)	33 (19.6)

Table S3.4.2: Susceptibility in *Salmonella* spp. interpreted using both EUCAST CBPs and ECOFFs from samples from layer flocks in the UK for 2014, 2016, 2018 and 2020. This table shows the number and percentage of resistant isolates, as defined by CBP, or less susceptible isolates, as defined by ECOFF

Antibiotic	CBPs (2014, n=58)	ECOFFs (2014, n=58)	CBPs (2016, n=34)	ECOFFs (2016, n=34)	CBPs (2018, n=52)	ECOFFs (2018, n=52)	CBPs (2020, n=74)	ECOFFs (2020, n=74)
Ampicillin	0	0	2 (5.9)	2 (5.9)	8 (15.4)	8 (15.4)	7 (9.5)	7 (9.5)
Azithromycin	-	-	-	-	-	-	-	-
Cefotaxime	0	0	0	0	0	0	0	0
Ceftazidime	0	0	0	0	0	0	0	0
Chloramphenicol	1 (1.7)	0	1 (2.9)	0	1 (1.9)	1 (1.9)	3 (4.1)	2 (2.7)
Ciprofloxacin	0	1 (1.7)	0	3 (8.8)	0	2 (3.8)	0	4 (5.4)
Colistin	3 (5.2)	3 (5.2)	0	0	0	0	9 (12.2)	9 (12.2)
Gentamicin	0	0	0	0	1 (1.9)	1 (1.9)	2 (2.7)	2 (2.7)
Meropenem	0	0	0	0	0	0	0	0
Nalidixic acid	*	1 (1.7)	*	1 (2.9)	*	1 (1.9)	*	0
Sulfamethoxazole	-	-	-	-	-	-	-	-
Tetracycline	*	0	*	2 (5.9)	*	6 (11.5)	*	7 (9.5)
Tigecycline	0	0	0	0	0	0	0	0
Trimethoprim	0	0	1 (2.9)	1 (2.9)	3 (5.8)	3 (5.8)	8 (10.8)	8 (10.8)

Table S3.4.3: Susceptibility in *Salmonella* spp. interpreted using both EUCAST CBPs and ECOFFs from samples from turkeys in the UK for 2014, 2016, 2018 and 2020. This table shows the number and percentage of resistant isolates, as defined by CBP, or less susceptible isolates, as defined by ECOFF

Antibiotic	CBPs (2014, n=162)	ECOFFs (2014, n=162)	CBPs (2016, n=169)	ECOFFs (2016, n=169)	CBPs (2018, n=170)	ECOFFs (2018, n=170)	CBPs (2020, n=166)	ECOFFs (2020, n=166)
Ampicillin	37 (22.8)	37 (22.8)	9 (5.3)	9 (5.3)	8 (4.7)	8 (4.7)	61 (36.7)	61 (36.7)
Azithromycin	-	-	-	-	-	-	-	-
Cefotaxime	0	0	0	0	0	0	0	0
Ceftazidime	0	0	0	0	0	0	0	0
Chloramphenicol	25 (15.4)	1 (0.6)	5 (3.0)	1 (0.6)	2 (1.2)	0	0	0
Ciprofloxacin	0	0	0	3 (1.8)	0	9 (5.3)	0	13 (7.8)
Colistin	0	0	0	0	0	0	0	0
Gentamicin	0	0	1 (0.6)	1 (0.6)	2 (1.2)	2 (1.2)	0	0
Meropenem	0	0	0	0	0	0	0	0
Nalidixic acid	*	33 (20.4)	*	3 (1.8)	*	7 (4.1)	*	10 (6.0)
Sulfamethoxazole	-	-	-	-	-	-	-	-
Tetracycline	*	79 (48.8)	*	128 (75.7)	*	128 (75.3)	*	62 (37.3)
Tigecycline	3 (1.9)	13 (8.0)	0	0	0	0	0	4 (2.4)
Trimethoprim	12 (7.4)	12 (7.4)	4 (2.4)	4 (2.4)	3 (1.8)	3 (1.8)	39 (23.5)	39 (23.5)

Table S3.4.4: Susceptibility in FBO *Salmonella* isolates interpreted using both EUCAST CBPs and ECOFFs from broiler neck skin samples in England and Wales; 2016, 2018 and 2020. No 2014 data is available. This table shows the number and percentage of resistant isolates, as defined by CBP, or less susceptible isolates, as defined by ECOFF

Antibiotic	CBPs 2016 (n=17)	ECOFFs 2016 (n=17)	CBPs 2018 (n=100)	ECOFFs 2018 (n=100)	CBPs 2020 (n=69)	ECOFFs 2020 (n=69)
Ampicillin	0	0	0	0	16 (23.2)	16 (23.2)
Azithromycin	-	-	-	-	-	-
Cefotaxime	0	0	0	0	0	0
Ceftazidime	0	0	0	0	0	0
Chloramphenicol	0	0	4 (4.0)	0	1 (1.4)	1 (1.4)
Ciprofloxacin	0	0	0	0	0	15 (21.7)
Colistin	0	0	0	0	1 (1.4)	1 (1.4)
Gentamicin	0	0	0	0	0	0
Meropenem	0	0	0	0	0	0
Nalidixic acid	*	0	*	0	*	0
Sulfamethoxazole	-	_	-	-	-	-
Tetracycline	*	1 (5.9)	*	0	*	18 (26.1)
Tigecycline	0	0	0	0	0	0
Trimethoprim	2 (11.8)	2 (11.8)	1 (1.0)	1 (1.0)	20 (29.0)	20 (29.0)

Table S3.4.5: Susceptibility in FBO *Salmonella* isolates interpreted using both EUCAST CBPs and ECOFFs from turkey neck skin samples in England and Wales for 2018 and 2020. No 2014 or 2016 data is available. This table shows the number and percentage of resistant isolates, as defined by CBP, or less susceptible isolates, as defined by ECOFF

Antibiotic	CBPs 2018 (n=3)	ECOFFs 2018 (n=3)	CBPs 2020 (n=0)	ECOFFs 2020 (n=0)
Ampicillin	0	0	0	0
Azithromycin	-	-	-	-
Cefotaxime	0	0	0	0
Ceftazidime	0	0	0	0
Chloramphenicol	0	0	0	0
Ciprofloxacin	0	0	0	0
Colistin	0	0	0	0
Gentamicin	0	0	0	0
Meropenem	0	0	0	0
Nalidixic acid	*	0	*	0
Sulfamethoxazole	-	-	-	-
Tetracycline	*	2 (66.6)	*	0
Tigecycline	0	0	0	0
Trimethoprim	0	0	0	0

S3.5: EU harmonised monitoring results of susceptibility testing in *Campylobacter jejuni*

Table S3.5.1: Susceptibility in *C. jejuni* interpreted using both EUCAST CBPs and ECOFFs from caecal samples from broilers at slaughter in the UK for 2014, 2016, 2018 and 2020. The table shows the number and percentage of resistant isolates as determined by CBPs, or less susceptible isolates as determined by ECOFFs, out of the total number of isolates tested

Antibiotic	CBP 2014 (n=165)	ECOFF 2014 (n=165)	CBP 2016 (n=180)	ECOFF 2016 (n=180)	CBP 2018 (n=171)	ECOFF 2018 (n=171)	CBP 2020 (n=179)	ECOFF 2020 (n=179)
Ciprofloxacin	72 (43.6)	72 (43.6)	73 (40.6)	73 (40.6)	82 (48.0)	82 (48.0)	106 (59.2)	106 (59.2)
Erythromycin	0	0	1 (0.6)	1 (0.6)	1 (0.6)	1 (0.6)	1 (0.6)	1 (0.6)
Gentamicin	*	0	*	0	*	1 (0.6)	*	0
Nalidixic acid	*	73 (44.2)	*	74 (41.1)	*	83 (48.5)	*	107 (59.8)
Streptomycin	*	0	*	2 (1.1)	*	5 (2.9)	*	1 (0.6)
Tetracyclines	95 (57.6)	97 (58.8)	101 (56.1)	101 (56.1)	110 (64.3)	111 (64.9)	119 (66.5)	119 (66.5)

Table S3.5.2: Susceptibility in *C. jejuni* interpreted using both EUCAST CBPs and ECOFFs from caecal samples from turkeys at slaughter in the UK from 2014, 2016 and 2018. The table shows the number and percentage of resistant isolates as determined by CBPs, or less susceptible isolates as determined by ECOFFs, out of the total number of isolates tested

Please note that for gentamicin, nalidixic acid, streptomycin and tetracyclines, data was retrospectively updated due to changes in clinical breakpoints (see section 3.2.3 for erratum)

Antibiotic	CBP 2014 (n=157)	ECOFF 2014 (n=157)	CBP 2016 (n=190)	ECOFF 2016 (n=190)	CBP 2018 (n=174)	ECOFF 2018 (n=174)	CBP 2020 (n=169)	ECOFF 2020 (n=169)
Ciprofloxacin	55 (35.0)	55 (35.0)	66 (34.7)	66 (34.7)	54 (31.0)	54 (31.0)	62 (36.7)	62 (36.7)
Erythromycin	1 (0.6)	1 (0.6)	2 (1.1)	2 (1.1)	1 (0.6)	1 (0.6)	1 (0.6)	1 (0.6)
Gentamicin	*	2 (1.3)	*	0	*	0	*	0
Nalidixic acid	*	55 (35.0)	*	62 (32.6)	*	55 (31.6)	*	60 (35.5)
Streptomycin	*	2 (1.3)	*	3 (1.6)	*	3 (1.7)	*	3 (1.8)
Tetracyclines	102 (65.0)	102 (65.0)	79 (41.6)	82 (43.2)	78 (44.8)	78 (44.8)	67 (39.6)	67 (39.6)

S4.1: Methodology susceptibility testing

S4.1.1 Core data

The susceptibility tests described in UK-VARSS (excluding Section 4.1.2 – MIC testing of veterinary pathogens, Section 4.1.3 – Private Laboratory Initiative and Section 4.1.4 – AMR in dogs and cats) were performed using the method formerly recommended by the British Society for Antimicrobial Chemotherapy (BSAC, www.bsac.org.uk).

Tests were performed (unless otherwise stated) by disc diffusion on Isosensitest Agar (Oxoid) with appropriate media supplementation where necessary for fastidious organisms. The disc antibiotic concentrations used were as stated in Table S4.1.1, and a semi-confluent inoculum was used.

The method used for assessing the susceptibility to antibiotics is, unless otherwise stated in the report, the disc diffusion method described by BSAC (www.bsac.org.uk). This assumes that the level of antibiotic achieved at the site of infection in the animal is similar to that achieved in a human treated with the same antibiotic. This assumption may not always be correct: different concentrations may be achieved at the site of infection in animals as a consequence of different dosing regimens or pharmacokinetics in different animal species.

Use of the susceptibility testing method formerly employed in human medicine in the UK in many hospitals and clinical medical establishments, enabled and facilitated direct comparison of veterinary susceptibility results with medical susceptibility results collected using similar methods. Direct comparison with the susceptibility results reported in other countries can be difficult because of differences in methodology and breakpoints. However, BSAC clinical breakpoints were harmonised and completely aligned with those of the European Committee on Antimicrobial Susceptibility Testing (EUCAST) which are commonly adopted across Europe. Thus, although different disc diffusion methods are employed in the BSAC and EUCAST procedures, the result obtained by either method should be the same because susceptibility is determined in both methods according to the same breakpoint.

Isolates were classed as either sensitive or resistant; intermediate isolates under the BSAC guidelines are considered resistant. The disc diffusion breakpoints used are given in Table S4.1.1.1 which also provides the MIC corresponding to that zone diameter breakpoint where this is known or has been estimated from APHA data on file.

Published breakpoints are not available for all animal species and for all of the bacterial organism/antibiotic combinations which may require testing. In these cases, a uniform cut-off point of 13mm zone size diameter has been used to discriminate between sensitive and resistant strains; an intermediate category of susceptibility has not been recorded. This breakpoint is the historical APHA veterinary breakpoint and although it has been used for a

considerable number of years, published validation data are not available for a number of organism/antibiotic combinations. However, where most isolates of a particular organism are either highly resistant or fully susceptible to an antibiotic, breakpoint issues may affect only a low number of isolates.

Breakpoints used to interpret the results from the antimicrobial susceptibility testing are reviewed on a regular basis. Data presented in this report and the supplementary material are retrospectively updated when required to reflect any changes to the interpretative criteria and ensure consistency and comparability of the data.

Susceptibility was determined for certain antibiotics not authorised for use in any food-producing animal species (for example, cefpodoxime) or not authorised for particular animal species (for example, tetracycline in sheep). This is to provide a full picture of resistance emergence and/or as a surrogate (for example, tetracycline, chlortetracycline and oxytetracycline are all equivalent for resistance testing purposes.).

Multiple antibacterial resistance, or multi-drug resistance, where referred to in the core data, is defined in this report as resistance to any of four or more separate antibiotics which were tested for a particular isolate. There is no internationally agreed definition of multiple resistance and the term has been used differently in different studies[10]. The panels of antimicrobials which may be tested at a particular APHA laboratory can also show slight variation, dependent on the circumstances of the case and the requirements of the veterinary surgeon administering treatment. The multiple resistance figures should therefore be regarded as subject to a degree of variation.

[10] Assessing the antimicrobial susceptibility of bacteria obtained from animals - ScienceDirect

Please note that throughout this section, cefalexin, cefotaxime, ceftazidime, cefpodoxime, ceftiofur, ciprofloxacin, colistin and enrofloxacin are all HP-CIAs. It should also be noted within this section that a hyphen denotes that no isolates were tested, or that no data is available. For individuals using screen readers, please note that for cells that are read out as blank, this denotes that no isolates were tested, or that no data is available.

Table S4.1.1.1: Disc diffusion breakpoints, corresponding MIC breakpoints and breakpoints under review for the main bacteria covered in the core data of this report

Please note that regarding the erythromycin R ≤21 mm for beta-haemolytic streptococci; R ≤19 mm for other streptococci, regarding the penicillin R ≤19 mm for beta-haemolytic streptococci; R ≤16 mm for other streptococci and regarding the tetracycline R ≤19 mm for beta-haemolytic streptococci; R ≤23 mm for other streptococci. Additionally, some *Haemophilus-Pasteurella-Actinobacillus*, that is to say "HPA" organisms, for example *Actinobacillus pleuropneumoniae,* show a degree of intrinsic resistance to aminoglycosides. The historical veterinary breakpoint was used for *H. somni* and *A. pleuropneumoniae*.

Antibiotic	Disc charge (micrograms)	*Escherichia coli,* Enterobacteriaceae	*Salmonella*	*Staphylococci*	*Streptococci*	*Pasteurella, Mannheimia*
Amikacin (AK)	30	R ≤18 mm* R ≥16 mg/l*	R ≤18 mm* R ≥16 mg/l*	NA	NA	NA
Amoxicillin/clavulanate (AMC)	20/10	R ≤14 mm* R >8 mg/l*	R ≤14 mm* R > 8mg/l*	NA	NA	R ≤13 mm***
Amoxicillin/clavulanate	2/1	NA	NA	R ≤17 mm* R >1 mg/l*	R ≤13 mm***	NA
Ampicillin (AM)	10	R ≤14 mm* R >8 mg/l*	R ≤14 mm* R >8 mg/l*	R ≤13 mm***	R ≤13 mm***	R ≤29 mm* R >1 mg/l*
Apramycin (APR)	15	R ≤13 mm** R ≥32 mg/l**	R ≤13 mm** R ≥32 mg/l**	NA	NA	R ≤13 mm***
Cefalexin	30	R ≤15 mm* R >16 mg/l*	NA	R ≤13 mm***	R ≤24 mm* R >2 mg/l*	R ≤13 mm***

Antibiotic	Disc charge (micrograms)	*Escherichia coli*, Enterobacteriaceae	*Salmonella*	*Staphylococci*	*Streptococci*	*Pasteurella, Mannheimia*
Cefotaxime (CTX)	30	R ≤29 mm* R ≥2 mg/l*	R ≤29 mm* R ≥2 mg/l*	NA	NA	NA
Cefpodoxime	10	R ≤ 19 mm* R >1 mg/l*	NA	NA	NA	R ≤13 mm***
Ceftazidime (CAZ)	30	R ≤ 26 mm* R ≥2 mg/l*	R ≤26 mm* R ≥2 mg/l*	NA	NA	NA
Chloramphenicol (C)	30	R ≤20 mm* R >8 mg/l*	R ≤20 mm* R >8 mg/l*	NA	NA	NA
Ciprofloxacin (CIP)	1	NA	R ≤16 mm* R ≥1 mg/l*	NA	NA	NA
Doxycycline	30	R ≤13 mm***	NA	R ≤30 mm* R ≥2 mg/l*	NA	R ≤13 mm***
Enrofloxacin	5	R ≤13 mm** R ≥4 mg/l**	NA	R ≤13 mm***	R ≤13 mm***	R ≤13 mm***
Erythromycin	5	NA	NA	R ≤19 mm* R ≥2 mg/l*	R ≤21 mm* R ≥0.5 mg/l*	R ≤13 mm***
Florfenicol	30	R ≤13 mm** R >32 mg/l**	NA	NA	R ≤13 mm***	R ≤13 mm***
Furazolidone (FR)	15	NA	≤13 mm	NA	NA	NA
Gentamicin (CN)	10	NA	R ≤19 mm* R ≥4 mg/l*	NA	NA	NA
Lincomycin	10	NA	NA	R ≤13 mm***	R ≤13 mm***	R ≤13 mm***

Antibiotic	Disc charge (micrograms)	*Escherichia coli*, Enterobacteriaceae	*Salmonella*	*Staphylococci*	*Streptococci*	*Pasteurella*, *Mannheimia*
Nalidixic acid (NA)	NA	NA	≤13 mm	NA	NA	NA
Neomycin (N)	10	R ≤13 mm** R >8 mg/l**	R ≤13 mm** R >8 mg/l**	NA	NA	NA
Neomycin	30	NA	NA	R ≤13 mm***	R ≤13 mm***	NA
Novobiocin	30	NA	NA	R ≤13 mm***	R ≤13 mm***	NA
Penicillin	1IU	NA	NA	R ≤24 mm* R >0.12 mg/l*	R ≤19 mm* R >0.25 mg/l*	NA
Spectinomycin	25	R ≤13 mm***	NA	NA	NA	R ≤13 mm***
Streptomycin (S)	10	R ≤12 mm* R >8 mg/l*	R ≤13 mm* R > ~8 mg/l*	NA	NA	R ≤13 mm***
Sulphonamide compounds (SU)	300	NA	≤13 mm	NA	NA	NA
Tetracycline (T)	10	R ≤13 mm** R >8 mg/l**	R ≤13 mm** R >8 mg/l**	R ≤19 mm* R ≥2 mg/l*	R ≤19 mm* R ≥2 mg/l*	R ≤25 mm* R >1 mg/l*
Trimethoprim/ sulphonamide (TM)	25	R ≤15 mm* R ≥4 mg/l*	R ≤15 mm* R ≥4 mg/l*	R ≤16 mm* R ≥4 mg/l*	R ≤19 mm* R ≥2 mg/l*	R ≤13 mm***
Tylosin	30	NA	NA	R ≤13 mm***	R ≤13 mm***	R ≤13 mm***

Key:

* BSAC human clinical breakpoint

** APHA historical veterinary disc diffusion zone size breakpoint and MIC corresponding to that zone size breakpoint, derived from studies of zone size and MIC

*** Animal Health and Veterinary Laboratories Agency (AHVLA) historical veterinary breakpoint (under ongoing review)

Notes:

- Where zone size disc diffusion data collected using the BSAC method and MIC data are both available then it is possible to draw regression lines and investigate the MIC which approximately corresponds to the historical veterinary breakpoint of 13 mm. This has been done for several compounds (highlighted in blue in the table above).
- BSAC state that all *Salmonella* isolates should be reported as resistant to gentamicin and amikacin; resistance traits are used for epidemiological purposes (correlation with particular resistance mechanisms) in this report.
- The 16 antibiotics with antibiotic code, for example, amikacin (AK), are the set used for *Salmonella* susceptibility testing.
- A breakpoint of resistance > 4 mg/l tiamulin has been suggested for MIC determination by agar dilution[11] this has also been quoted in a Dutch study of swine dysentery in pigs[12] whilst for broth microdilution the suggested clinical breakpoint is one dilution lower at > 2 mg/l tiamulin. An epidemiological cut-off value of wild type $\leq$ 0.25 has been suggested for broth dilution MIC determination of tiamulin versus *B. hyodysenteriae*[13].
- *S. aureus* isolates resistant to amoxicillin/clavulanate are currently screened for susceptibility to cefoxitin and by agglutination tests for altered penicillin binding protein in order to detect *mecA* and *mecC* MRSA

[11] Rønne, H. and Szancer, J. (1990) In vitro susceptibility of Danish field isolates of Treponema hyodysenteriae to chemotherapeutics in swine dysentery (SD) therapy. Interpretation of MIC results based on the pharmacokinetic properties of the antibacterial agents. Proceedings of the 11th IPVS Congress. Lausanne, Switzerland, July 1 to 5, 1990. p 126

[12] Duinhof TF, Dierikx CM, Koene MGJ, van Bergen MAP, Mevius DJ, Veldman KT, van Beers-Schreurs HMG and de Winne RTJA. (2008). Multiresistentie bij Brachyspira hyodysenteriae-isolaten op een varkensvermeerderingsbedrijf in Nederland. Tijdschrift voor Diergeneeskunde 133:604-608.

[13] Antimicrobial susceptibility of porcine Brachyspira hyodysenteriae and Brachyspira pilosicoli isolated in Sweden between 1990 and 2010 | Acta Veterinaria Scandinavica | Full Text (biomedcentral.com)

Table S4.1.1.2: Antibiotic disc concentrations used in Northern Ireland, defined by expected zone diameter in millimetres

Antibiotic	Disc	Resistant	Intermediate	Susceptible
Amoxicillin	AMC30	≤13	14–17	≥18
Ampicillin	AMP10	≤13	14–16	≥17
Apramycin	APR15	N/A	N/A	N/A
Cefotaxime	CTX30	≤22	23–25	≥26
Ceftazidime	CAZ30	≤17	18–20	≥21
Chloramphenicol	C30	≤12	13–17	≥18
Ciprofloxacin	CIP5	≤15	16–20	≥21
Framycetin	FY100	N/A	N/A	N/A
Furazolidone	FR100	N/A	N/A	≥17
Gentamicin	CN10	≤12	13–14	≥15
Kanamycin	K30	≤13	14–17	≥18
Nalidixic acid	NA30	≤13	14–18	≥19
Spectinomycin	SH100	N/A	N/A	N/A
Streptomycin	S10	≤11	12–14	≥15
Sulphonamides	S3.300	≤12	13–16	≥17
Tetracycline	TE30	≤11	12–14	≥15
Trimethoprim	W5	≤10	11–15	≥16

S4.1.2 MIC testing of veterinary pathogens

Summary susceptibility data is presented in the UK-VARSS report for bacterial respiratory pathogens of cattle, sheep and pigs isolated from diagnostic submissions to a network of six laboratories in England and Wales in 2020. The population of bacterial organisms described in this report has therefore originated, for the most part, from samples of field cases of clinical disease undergoing investigation by veterinary surgeons for diagnostic purposes. The figures thus reflect the AMR of respiratory bacterial pathogens of clinical veterinary significance recovered from farm animals in England and Wales. In some instances, the samples may originate from animals that have already been treated with antibiotics and therefore may have been under selective pressure.

Susceptibility testing was performed using broth microdilution to determine MIC values, on microtitre plates, with cation adjusted Mueller-Hinton broth. Appropriate media supplementation with Veterinary Fastidious Medium was performed for *A. pleuropneumoniae* (CLSI VET01S ED5:2020). Broth microdilution methods conforming to the International Standards Organisation[14] provide a robust and reliable means of determining susceptibility and are commonly used in harmonised monitoring programmes.

For the purposes of presenting results in the main report, resistance has been interpreted using clinical breakpoints. Isolates have been classed as either sensitive or resistant using veterinary CBPs[15] from CLSI in the first instance, or CASFM[16] when these are not available; if veterinary breakpoints were not available, human CBPs[17] were used (see Table S4.1.2.1). For some veterinary antibiotic and organism combinations, there are no published breakpoints available and in these cases, resistance cannot be interpreted from MIC distributions. EUCAST has also recently published ECOFFs for some of the organisms (see https://www.eucast.org/mic_distributions_and_ecoffs/). The CBP relates to efficacy of treatment in each animal species, whereas the ECOFFs differentiate non-wild type from wild-type organisms, that is to say ECOFFs detect those bacteria which have any degree of increased resistance. The ECOFFs are therefore useful to demonstrate an emerging decline in susceptibility. Results in UK-VARSS have not been interpreted using ECOFF breakpoints. Future reports may be expanded to include these data.

Multi-drug resistance (MDR) was considered to indicate resistance to three or more classes of antimicrobials. For the purposes of assessing MDR the macrolides gamithromycin, tildipirosin, tilmicosin and tulathromycin were considered as a single class (because common or linked resistance mechanisms have been described to these compounds), as were tetracycline and doxycycline and ampicillin and amoxicillin/clavulanate (because hyper-expression of beta-lactamase can overcome the inhibitor clavulanate).

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[14] ISO - ISO 20776-1:2006

[15] http://clsivet.org/Login.aspx

[16] https://www.sfm-microbiologie.org/wp-content/uploads/2020/09/CASFM_VET2020.pdf

[17] https://www.eucast.org/fileadmin/src/media/PDFs/EUCAST_files/Breakpoint_tables/v_11.0_Breakpoint_Tables.pdf

Table S4.1.2.1 MIC breakpoints used for the interpretation of antibacterial susceptibility for respiratory pathogens from cattle, pigs and sheep

Please note, for amoxicillin/clavulanate, the clavulanate concentration is fixed at 2 mg/ml. For tilmicosin in cattle and sheep, a breakpoint for porcine isolates was used. For spectinomycin and gamithromycin in pigs, breakpoint for bovine isolates was used. Also, cattle breakpoints applied to sheep isolates unless indicated otherwise.

Antibiotic	***Pasteurella multocida***			***Mannheimia haemolytica***		***Actinobacillus pleuropneumoniae***	***Bibersteinia trehalosi***
	Cattle	**Pigs**	**Sheep**	**Cattle**	**Sheep**	**Pigs**	**Sheep**
Ampicillin	R > 1***	R ≥ 2* R > 1***	R > 1***	R > 1***	R > 1***	R ≥ 2***	R > 1***
Amoxicillin/clavulanate	R > 16/2** R > 1***	R > 16/2** R > 1***	R > 16/2** R > 1***	R > 16/2** R > 1***	R > 16/2** R > 1***	NA	R > 16/2** R > 1***
Ceftiofur	R ≥ 8* R > 4**	R ≥ 8* R > 4**	R ≥ 8* R > 4**	R ≥ 8* R > 4**	R ≥ 8* R > 4**	R ≥ 8***	R ≥ 8* R > 4**
Tetracycline	R ≥ 8* R > 8**	R ≥ 8* R > 8**	R ≥ 8* R > 8**	R ≥ 8* R > 8**	R ≥ 8* R > 8**	R ≥ 2***	R ≥ 8* R > 8**
Doxycycline	R >8** R > 1***	R >8** R > 1***	R >8** R > 1***	R >8**	R >8**	R >8**	R >8**
Spectinomycin	R ≥ 128*	R ≥ 128*	R ≥ 128*	R ≥ 128*	R ≥ 128*	NA	R ≥ 128*
Enrofloxacin	R ≥ 2 * R > 2**	R ≥ 1* R > 2**	R ≥ 2* R > 2**	R ≥ 2 * R > 2**	R ≥ 2* R > 2**	R ≥ 1*** R > 2**	R ≥ 2* R > 2**

Antibiotic	*Pasteurella multocida*			*Mannheimia haemolytica*		*Actinobacillus pleuropneumoniae*	*Bibersteinia trehalosi*
Trimethoprim/ Sulphonamide	R >8**	R >8**	R >8**	R >8**	R >8**	R >8**	R >8**
	R > 0.25***	R > 0.25***	R > 0.25***				
Florfenicol	R ≥ 8*	R ≥ 8*	R ≥ 8*	R ≥ 8*	R ≥ 8*	R ≥ 8***	R ≥ 8*
	R > 4**	R > 4**	R > 4**	R > 4**	R > 4**	R > 4**	R > 4**
Gamithromycin	R ≥ 16*	R ≥ 16*	R ≥ 16*	R ≥ 16*	R ≥ 16*	NA	R ≥ 16*
Tildipirosin	R ≥ 32*	S < 4*	R ≥ 32*	R ≥ 16*	R ≥ 16*	S ≤ 16***	R ≥ 16*
Tilmicosin	R ≥ 32*	R ≥ 32*	R ≥ 32*	R ≥ 32*	R ≥ 32*	R ≥ 32*	R ≥ 32*
	R > 16**	R > 16**	R > 16**	R > 16**	R > 16**	R > 16**	R > 16**
Tulathromycin	R ≥ 64*	R ≥ 64*	R ≥ 64*	R ≥ 64*	R ≥ 64*	S ≤ 64***	R ≥ 64*
Tiamulin	NA	NA	NA	NA	NA	R ≥ 32***	NA

Key:

* * CLSI veterinary clinical breakpoint
* ** CASFM veterinary clinical breakpoint
* *** EUCAST human breakpoint

S4.1.3 Private Laboratory Initiative

The methods used to determine antimicrobial susceptibility, are based on those in CLSI Vet01 July 2013[18]. Tests were performed by disc diffusion on Mueller-Hinton agar (MHA) without supplements for *Enterobacteriaceae* and staphylococci, and Mueller-Hinton agar with blood (MH-F) for streptococci. The inoculum used gives confluent growth of bacterial colonies. Zone edges are read at the point of complete inhibition[14]. A summary of the disc diffusion breakpoints applied by the Vale Veterinary Laboratory are found in Table S4.1.3.1 below.

Table 4.1.3.1: Disc diffusion breakpoints applied by Vale Veterinary Laboratories for the interpretation of resistance of bovine mastitis pathogens

Antibiotic	*E. coli*	*S. dysgalactiae*	*S. aureus*	*S. uberis*
Amoxicillin/clavulanate	R < 19mm	NA	20mm	NA
Ampicillin	R < 14mm	24mm	13-17mm	24mm
Cefaprin	14-18mm	14-18mm	14-18mm	14-18mm
Cloxacillin	NA	18mm	18mm	18mm
Penicillin	NA	18mm	18mm	18mm
Trimethoprim/ sulphonamide	R < 13mm	R < 15mm	R < 14mm	R < 15mm
Oxytetracycline	11-15mm	NA	14-19mm	NA
Spectinomycin	20mm	NA	20mm	NA
Neomycin	R < 11mm	NA	R < 14mm	NA

[18] The Vale Veterinary Laboratory, personal communications, 2021

S4.1.4 AMR in dogs and cats

Data relating to bacterial culture and subsequent AST of clinical samples originating from dogs and cats (amongst other animal species) were collated by the Small Animal Veterinary Surveillance Network (SAVSNET[19]) in near real-time from five veterinary diagnostic laboratories (A, B, C, D and E) based in the UK between 1st April 2016 and 31st December 2020. Data was supplied in two electronic formats: in comma-separated files (for one laboratory) and in extensible mark-up language (XML) broadly conforming to the vetXML Consortium schema (for four laboratories). For all laboratories a range of information was provided including a unique submission identification code; postcode of the submitting veterinary practice site; date a results report was produced; animal species; breed; sex and neuter status; the type or anatomical location of the submitted sample for example, urine, ears (hence, 'sampling type/site'); the bacterial species isolated from the sample, and AST results for each antimicrobial tested.

The postcode associated with each AST result was compared against the Royal College of Veterinary Surgeons (RCVS) Practice register. This enabled comparison of AST results in relation to whether the submitting veterinary practice site was primarily first opinion or consulted referred cases; treated companion animals alone; was accredited by the RCVS; employed 'advanced veterinary practitioners' or employed RCVS specialists. The postcode was additionally compared against the National Statistics Postcode Lookup (NSPL) to ascertain the location of each veterinary practice site, and whether such practices were located in primarily urban or rural locations.

Considering sampling type/site, whilst some sample types (for example, urine, blood, faeces) and sites (for example ear) were clearly recorded, sampling type/site was also frequently supplied in free text format. In these instances, a mixed method approach was utilised via use of regular expressions and manual reading to where possible categorise every unique value into six broad categories: urine; ear(s); oronasopharyngeal and respiratory sites; faeces; the anal region including anal glands, and other/mixed sites. It was found that information quality provided in this respect was variable; hence, categories were used where there was reasonable confidence that the sample did indeed originate from that anatomical region or type of sample.

As this study was retrospective in nature, data contributing laboratories utilised a range of techniques including standard disc diffusion (laboratories B, C and D) and mean inhibitory concentration (MIC) (laboratory A and E); also interpreting these using a variety of guidelines, including CLSI and EUCAST and, where necessary, in-house methodologies. Although laboratories A and E provided both an AST numerical value and subsequent AST interpretation, laboratories B, C and D only provided an interpretation; hence, for this study only interpreted AST results were analysed. Tested antimicrobial agents were grouped to class-level, with results being classified as 'resistant' at class-level if one or more of the individual agents expressed phenotypic non-susceptibility. It should be noted that some

[19] Small Animal Veterinary Surveillance Network (SAVSNET) - University of Liverpool

individual antimicrobial agents were tested considerably more frequently than others; any ‘intermediate’ results were further classified as being ‘sensitive’ in this study.

Hence, classes analysed in the current study were as follows: fluoroquinolones (consisting of enrofloxacin, marbofloxacin, pradofloxacin, orbifloxacin, ofloxacin, ciprofloxacin, moxifloxacin); glycopeptides (vancomycin); tetracyclines (tetracycline, doxycycline, oxytetracycline, minocycline, chlortetracycline); potentiated sulphonamides; aminoglycosides (gentamicin, amikacin, tobramycin, neomycin, framycetin); nitrofurantoin; amphenicols (chloramphenicol, florfenicol); lincosamides (clindamycin, lincomycin); macrolides (azithromycin, erythromycin, tylosin, spiramycin); metronidazole, mupirocin, rifamycin, and polymyxin B.

The beta-lactams were considered in total and by sub-class as follows: narrow spectrum penicillins (methicillin, cloxacillin, oxacillin, penicillin); extended spectrum penicillins (amoxicillin, ampicillin, carbenicillin, piperacillin, ticarcillin); first and second generation cephalosporins (cephalexin, cefadroxil, cefuroxime, cephapirin, cephalonium, cefoxitin); third≤ generation cephalosporins (cefovecin, ceftiofur, cefpodoxime, ceftazidime, cefpirome, ceftaroline, cefquinome, cefotaxime, cefoperazone); potentiated penicillins (clavulanic acid potentiated amoxicillin, clavulanic acid potentiated ticarcillin), and carbapenems (imipenem, meropenem).

S4.2: Clinical surveillance data for isolates from bovine mastitis cases

Table S4.2.1: Resistance (interpreted using breakpoints) in *E. coli* mastitis isolates from England and Wales from 2018 to 2020. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	6/110 (5.5)	5/94 (5.3)	4/55 (7.3)
Ampicillin	24/110 (21.8)	37/94 (39.4)	25/55 (45.5)
Cefpodoxime	1/110 (0.9)	1/94 (1.1)	1/55 (1.8)
Enrofloxacin	3/110 (2.7)	0/94 (0)	1/55 (1.8)
Neomycin	3/110 (2.7)	5/94 (5.3)	3/55 (5.5)
Streptomycin	11/110 (10.0)	11/94 (11.7)	7/55 (12.7)
Tetracycline	15/110 (13.6)	12/94 (12.8)	8/55 (14.5)
Trimethoprim/sulphonamide	7/110 (6.4)	7/94 (7.4)	6/55 (10.9)

Table S4.2.2: Resistance (interpreted using breakpoints) in *E. coli* mastitis isolates from Scotland for 2020

Antibiotic	No. resistant/No. tested (% resistant)
Amoxicillin/clavulanate	11/118 (9.3)
Ampicillin	27/118 (22.9)
Cefpodoxime	3/118 (2.5)
Enrofloxacin	3/118 (2.5)
Neomycin	2/118 (1.7)
Streptomycin	18/118 (15.3)
Tetracycline	20/118 (16.9)
Trimethoprim/sulphonamide	14/118 (11.9)

Table S4.2.3: Resistance (interpreted using breakpoints) of *Staphylococci* and *Streptococci* from mastitis cases from England and Wales from 2018 to 2020. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates

a) *Streptococcus dysgalactiae*

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/32 (0)	0/18 (0)	0/21 (0)
Ampicillin	0/32 (0)	0/18 (0)	0/21 (0)
Neomycin	1/32 (3.1)	1/18 (5.6)	1/19 (5.3)
Novobiocin	0/32 (0)	0/18 (0)	1/19 (5.3)
Penicillin	0/32 (0)	0/18 (0)	0/19 (0)
Tetracycline	28/32 (87.5)	14/18 (77.8)	19/21 (90.5)
Tylosin	0/32 (0)	2/18 (11.1)	1/21 (4.8)

b) *Streptococcus uberis*

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/84 (0)	0/70 (0)	0/44 (0)
Ampicillin	0/84 (0)	1/70 (1.4)	0/44 (0)
Neomycin	38/84 (45.2)	19/69 (27.5)	17/43 (39.5)
Novobiocin	4/84 (4.8)	6/69 (8.7)	4/43 (9.3)
Penicillin	0/84 (0)	1/70 (1.4)	0/44 (0)
Tetracycline	29/84 (34.5)	32/70 (45.7)	15/44 (34.1)
Tylosin	10/84 (11.9)	2/70 (2.9)	1/44 (2.3)

c) *Staphylococcus aureus*

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/36 (0)	3/54 (5.6)	2/28 (7.1)
Ampicillin	10/36 (27.8)	14/54 (25.9)	5/28 (17.9)
Neomycin	0/36 (0)	1/54 (1.9)	0/28 (0)
Novobiocin	0/36 (0)	0/54 (0)	0/28 (0)
Penicillin	10/36 (27.8)	15/54 (27.8)	5/28 (17.9)
Tetracycline	1/36 (2.8)	5/54 (9.3)	2/28 (7.1)
Tylosin	1/36 (2.8)	2/54 (3.7)	0/28 (0)

Table S4.2.4: Resistance (interpreted using breakpoints) of a) *Klebsiella pneumoniae* and b) *Pseudomonas aeruginosa* from mastitis cases from England and Wales from 2018 to 2020. The table shows the number of resistant isolates out of the total number tested

a) Klebsiella pneumoniae

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	1/11	2/6	0/12
Ampicillin	11/11	6/6	12/12
Cefalexin	-	-	-
Cefotaxime	-	-	-
Cefpodoxime	0/9	0/5	0/3
Ceftazidime	-	-	-
Enrofloxacin	0/11	0/6	0/12
Neomycin	0/10	1/3	0/10
Streptomycin	1/8	0/2	0/1
Tetracycline	2/11	1/6	1/12
Trimethoprim/sulphonamide	2/11	0/6	0/12

b) Pseudomonas aeruginosa

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	5/5	2/2	3/3
Ampicillin	5/5	2/2	3/3
Cefalexin	5/5	1/1	2/2
Cefotaxime	5/5	1/1	-
Cefpodoxime	5/5	1/1	2/2
Ceftazidime	0/5	0/1	-
Enrofloxacin	0/5	0/2	0/3
Neomycin	2/4	0/2	0/2
Streptomycin	0/4	0/1	0/1
Tetracycline	5/5	2/2	3/3
Trimethoprim/sulphonamide	5/5	2/2	3/3

S4.3: Clinical surveillance data for isolates from respiratory infections of cattle

Table S4.3.1: Resistance (interpreted using breakpoints) of *Pasteurella multocida*, *Mannheimia haemolytica* and *Trueperella pyogenes* from respiratory infections of cattle in England and Wales from 2018 to 2020. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates

a) Pasteurella multocida

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/76 (0)	0/74 (0)	0/76 (0)
Ampicillin	2/76 (2.6)	1/74 (1.4)	2/76 (2.6)
Cefalexin	-	-	-
Cefpodoxime	0/76 (0)	0/74 (0)	0/76 (0)
Enrofloxacin	0/76 (0)	1/74 (1.4)	0/76 (0)
Florfenicol	0/74 (0)	0/73 (0)	0/75 (0)
Tetracycline	39/76 (51.3)	49/74 (66.2)	60/76 (78.9)
Trimethoprim/sulphonamide	0/76 (0)	1/74 (1.4)	1/76 (1.3)
Tylosin	0/1 (0)	-	-

b) Mannheimia haemolytica

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/44 (0)	0/70 (0)	0/59 (0)
Ampicillin	1/44 (2.3)	3/70 (4.3)	3/59 (5.1)
Cefalexin	-	-	-
Cefpodoxime	0/44 (0)	0/69 (0)	0/59 (0)
Enrofloxacin	0/44 (0)	0/70 (0)	0/59 (0)
Florfenicol	0/44 (0)	0/69 (0)	0/59 (0)
Tetracycline	18/44 (40.9)	35/70 (50.0)	45/59 (76.3)
Trimethoprim/sulphonamide	0/44 (0)	1/70 (1.4)	1/59 (1.7)
Tylosin	-	-	-

c) Trueperella pyogenes

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	-	-	0/1 (0)
Ampicillin	-	-	0/1 (0)
Cefalexin	-	-	0/1 (0)
Cefpodoxime	-	-	-
Enrofloxacin	-	-	-
Florfenicol	-	-	0/1 (0)
Tetracycline	-	-	1/1 (100)
Trimethoprim/sulphonamide	-	-	1/1 (100)
Tylosin	-	-	0/1 (0)

S4.4: Clinical surveillance data for isolates from respiratory infections of pigs

Table S4.4.1: Resistance (interpreted using breakpoints) of *Pasteurella multocida* and *Actinobacillus pleuropneumoniae* from respiratory infections of pigs in England and Wales from 2018 to 2020. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates

a) *Pasteurella multocida*

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	-	-	-
Ampicillin	3/35 (8.6)	2/26 (7.7)	2/35 (5.7)
Apramycin	0/35 (0)	1/26 (3.8)	1/35 (2.9)
Cefpodoxime	0/35 (0)	0/26 (0)	0/35 (0)
Doxycycline	-	-	-
Enrofloxacin	0/35 (0)	0/26 (0)	0/35 (0)
Florfenicol	-	-	-
Neomycin	0/35 (0)	0/26 (0)	0/35 (0)
Spectinomycin	2/35 (5.7)	1/26 (3.8)	0/35 (0)
Streptomycin	-	-	-
Tetracycline	21/35 (60.0)	16/26 (61.5)	29/35 (82.9)
Trimethoprim/sulphonamide	5/35 (14.3)	7/26 (26.9)	5/35 (14.3)
Tylosin	-	-	-

b) *Actinobacillus pleuropneumoniae*

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	-	-	-
Ampicillin	1/13 (7.7)	0/18 (0)	7/35 (20.0)
Apramycin	9/13 (69.2)	12/18 (66.7)	33/35 (94.3)
Cefpodoxime	0/13 (0)	0/18 (0)	0/35 (0)
Doxycycline	-	-	-
Enrofloxacin	0/13 (0)	0/18 (0)	0/35 (0)
Florfenicol	-	-	-
Neomycin	10/13 (76.9)	12/18 (66.7)	33/35 (94.3)
Spectinomycin	10/13 (76.9)	12/18 (66.7)	32/35 (91.4)
Streptomycin	-	-	-
Tetracycline	0/13 (0)	4/18 (22.2)	9/35 (25.7)
Trimethoprim/sulphonamide	1/13 (7.7)	2/18 (11.1)	6/35 (17.1)
Tylosin	-	-	-

S4.5: Clinical surveillance data for isolates from respiratory infections of sheep

Table S4.5.1: Resistance (interpreted using breakpoints) of *Pasteurella multocida*, *Mannheimia haemolytica*, *Bibersteinia trehalosi* and *Trueperella pyogenes* from sheep in England and Wales from 2018 to 2020. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates

a) *Pasteurella multocida*

Antibiotic	2018	2019	2020
Amoxicillin/ clavulanate	0/8 (0)	0/14 (0)	0/12 (0)
Ampicillin	0/8 (0)	0/14 (0)	0/12 (0)
Cefalexin	-	-	-
Cefpodoxime	0/8 (0)	0/14 (0)	0/12 (0)
Enrofloxacin	0/8 (0)	0/14 (0)	0/12 (0)
Florfenicol	0/8 (0)	0/14 (0)	0/12 (0)
Tetracycline	3/8 (37.5)	4/14 (28.6)	9/12 (75.0)
Trimethoprim/sulphonamide	0/8 (0)	0/14 (0)	0/12 (0)
Tylosin	-	-	-

b) *Mannheimia haemolytica*

Antibiotic	2018	2019	2020
Amoxicillin/ clavulanate	0/81 (0)	0/90 (0)	0/144 (0)
Ampicillin	2/81 (2.5)	1/90 (1.1)	3/144 (2.1)
Cefalexin	-	-	-
Cefpodoxime	0/80 (0)	0/90 (0)	0/144 (0)
Enrofloxacin	0/81 (0)	0/90 (0)	0/144 (0)
Florfenicol	1/76 (1.3)	0/89 (0)	0/142 (0)
Tetracycline	32/81 (39.5)	49/90 (54.4)	99/144 (68.8)
Trimethoprim/sulphonamide	0/81 (0)	0/90 (0)	2/144 (1.4)
Tylosin	-	-	-

c) *Bibersteinia trehalosi*

Antibiotic	2018	2019	2020
Amoxicillin/ clavulanate	0/50 (0)	0/33 (0)	0/59 (0)
Ampicillin	0/50 (0)	0/33 (0)	2/59 (3.4)
Cefalexin	-	-	-
Cefpodoxime	0/49 (0)	0/32 (0)	0/59 (0)
Enrofloxacin	0/50 (0)	0/33 (0)	0/59 (0)
Florfenicol	1/49 (2.0)	0/32 (0)	0/59 (0)
Tetracycline	1/50 (2.0)	0/33 (0)	1/59 (1.7)
Trimethoprim/sulphonamide	0/50 (0)	0/33 (0)	1/59 (1.7)
Tylosin	-	-	-

d) *Trueperella pyogenes*

Antibiotic	2018	2019	2020
Amoxicillin/ clavulanate	0/1 (0)	0/2 (0)	0/1 (0)
Ampicillin	0/1 (0)	0/2 (0)	0/1 (0)
Cefalexin	0/1 (0)	0/2 (0)	0/1 (0)
Cefpodoxime	-	-	-
Enrofloxacin	-	-	-
Florfenicol	0/1 (0)	-	-
Tetracycline	0/1 (0)	0/2 (0)	0/1 (0)
Trimethoprim/sulphonamide	0/1 (0)	-	-
Tylosin	0/1 (0)	0/2 (0)	0/1 (0)

S4.6: Clinical surveillance data for other veterinary pathogens

Table S4.6.1: MIC values in mg/ml of *Brachyspira hyodysenteriae* isolates from infections of pigs to tiamulin in England and Wales from 2010 to 2020

Year	<0.06	0.125	0.25	0.5	1	2	4	8	>8
2010	10	1	-	1	1	-	-	-	-
2011	10	-	-	-	-	2	-	-	-
2012	2	-	2	-	-	2	1	-	2
2013	-	-	1	2	1	-	1	-	3
2014	-	-	-	-	-	2	-	1	1
2015	-	-	3	-	-	1	-	1	-
2016	1	-	-	-	1	-	1	-	-
2017	3	-	1	2	1	1	-	-	-
2018	8	1	1	2	-	-	1	-	-
2019	25	10	9	1	-	-	-	-	-
2020	9	2	2	1	-	-	-	1	-

Table S4.6.2: Resistance (interpreted using breakpoints) of *Streptococcus suis* from infections of pigs in England and Wales from 2018 to 2020. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates

Antibiotic	2018	2019	2020
Ampicillin	0/84 (0)	0/115 (0)	0/105 (0)
Enrofloxacin	0/84 (0)	0/115 (0)	0/105 (0)
Lincomycin	32/84 (38.1)	48/115 (41.7)	28/105 (26.7)
Penicillin	1/84 (1.2)	0/115 (0)	0/105 (0)
Tetracycline	72/84 (85.7)	100/115 (87.0)	97/105 (92.4)
Trimethoprim/sulphonamide	17/84 (20.2)	16/115 (13.9)	21/105 (20.0)
Tylosin	43/84 (51.2)	54/115 (47.0)	30/105 (28.6)

Table S4.6.3: Resistance (interpreted using breakpoints) of *Erysipelothrix rhusiopathiae* from infections of pigs in England and Wales from 2018 to 2020. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates

Antibiotic	2018	2019	2020
Ampicillin	0/3 (0)	0/11 (0)	0/6 (0)
Enrofloxacin	0/3 (0)	0/11 (0)	0/6 (0)
Lincomycin	0/3 (0)	0/11 (0)	0/6 (0)
Tetracycline	0/3 (0)	4/11 (36.4)	2/6 (33.3)
Trimethoprim/sulphonamide	0/3 (0)	2/11 (18.2)	3/6 (50.0)
Tylosin	0/3 (0)	0/11 (0)	0/6 (0)

Table S4.6.4: Resistance (interpreted using breakpoints) of *Staphylococcus aureus* from infections of chickens in England and Wales from 2018 to 2020. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	-	-	-
Ampicillin	0/2 (0)	1/2 (50.0)	0/2 (0)
Doxycycline	0/2 (0)	1/2 (50.0)	0/2 (0)
Enrofloxacin	0/2 (0)	0/2 (0)	0/2 (0)
Erythromycin	-	0/1 (0)	0/2 (0)
Lincomycin	0/2 (0)	1/2 (50.0)	0/2 (0)
Penicillin	-	1/2 (50.0)	0/2 (0)
Tetracycline	0/2 (0)	1/2 (50.0)	0/2 (0)
Trimethoprim/sulphonamide	0/2 (0)	1/2 (50.0)	0/2 (0)
Tylosin	0/2 (0)	1/2 (50.0)	0/2 (0)

Table S4.6.5 Resistance (interpreted using breakpoints) of a) *Listeria monocytogenes* and b) *Streptococcus dysgalactiae* from infections of sheep in England and Wales from 2018 to 2020. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates

a) *Listeria monocytogenes*

Antibiotic	2018	2019	2020
Amoxicillin/ clavulanate	0/11 (0)	0/5 (0)	0/4 (0)
Ampicillin	0/11 (0)	0/5 (0)	0/4 (0)
Cefalexin	9/11 (81.8)	3/5 (60.0)	1/4 (25.0)
Florfenicol	0/11 (0)	0/5 (0)	0/4 (0)
Penicillin	0/11 (0)	0/5 (0)	0/4 (0)
Tetracycline	0/11 (0)	0/5 (0)	0/4 (0)
Trimethoprim/sulphonamide	0/11 (0)	0/5 (0)	0/4 (0)
Tylosin	0/11 (0)	0/5 (0)	0/4 (0)

b) *Streptococcus dysgalactiae*

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/22 (0)	0/31 (0)	0/20 (0)
Ampicillin	0/22 (0)	0/31 (0)	0/20 (0)
Cefalexin	1/22 (4.5)	1/31 (3.2)	4/20 (20.0)
Florfenicol	-	0/6 (0)	0/4 (0)
Neomycin	-	0/25 (0)	1/16 (6.3)
Novobiocin	-	1/25 (4.0)	1/16 (6.3)
Penicillin	-	0/31 (0)	0/20 (0)
Tetracycline	17/22 (77.3)	23/31 (74.2)	18/20 (90.0)
Trimethoprim/sulphonamide	0/5 (0)	0/6 (0)	0/4 (0)
Tylosin	0/22 (0)	1/31 (3.2)	0/20 (0)

Table S4.6.6: Findings of LA-MRSA in the UK by government laboratories for a) England and Wales, b) Northern Ireland and c) Scotland; from 2014 to 2020

a) England and Wales

Clonal complex	Year	Species	Source of the sample
CC398	2014	Pig (n=1)	Clinical investigation
CC398	2015	Pig (n=1)	Research project
CC398	2016	Turkey (n=1), beef cattle (n=1)	Clinical investigation
CC398	2016	Pig (n=1)	Other investigation
CC398	2017	Pig (n=1)	Clinical investigation
CC398	2018	Turkey (n=1)	Clinical investigation
CC398	2020	Pig (n=4)	Clinical investigation

b) Northern Ireland

Clonal complex	Year	Species	Source of the sample
CC398	2014	Pig (n=1)	Clinical investigation
CC30	2015	Pig (n=1)	Clinical investigation
CC398	2015	Pig (n=2), dairy cattle (n=1)	Clinical investigation
CC398	2016	Pig (n=2)	Clinical investigation
CC398	2017	Pig (n=3)	Clinical investigation
CC398	2018	Pig (n=4), bovine (n=1)	Clinical investigation
CC398	2019	Pig (n=4)	Clinical investigation
CC398	2020	Pig (n=2)	Diagnostic investigations

c) Scotland

Clonal complex	Year	Species	Source of the sample
CC398	2017	Pheasant (n=1)	Clinical investigation

S4.7 Clinical surveillance data for *E. coli*

Table S4.7.1: Age categories of food-producing animals

Animal	Neonatal	Pre-weaned	Post-weaned	Adult
Cattle	< 1 week	Unweaned and not known to be less than 1 week	From weaning to adult	≥ 24 months
Sheep	< 1 week	Unweaned and not known to be less than 1 week	From weaning to adult	≥ 12 months
Pigs	< 1 week	Unweaned and not known to be less than 1 week	From weaning to adult	≥ 5 months

Table S4.7.2: Resistance (interpreted using breakpoints) in all *E. coli* from cattle, sheep, pigs, chickens and turkeys (combined) in a) England and Wales, b) Northern Ireland and c) Scotland from 2018 to 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

a) England and Wales

Antibiotic	2018	2019	2020
Amikacin	1/280 (0.4)	0/220 (0)	0/209 (0)
Amoxicillin/clavulanate	137/484 (28.3)	97/474 (20.5)	85/474 (17.9)
Ampicillin	450/788 (57.1)	564/998 (56.5)	560/1024 (54.7)
Apramycin	49/737 (6.6)	70/949 (7.4)	79/943 (8.4)
Cefotaxime	27/282 (9.6)	17/225 (7.6)	14/210 (6.7)
Cefpodoxime	10/316 (3.2)	10/547 (1.8)	13/577 (2.3)
Ceftazidime	12/282 (4.3)	7/225 (3.1)	7/210 (3.3)
Chloramphenicol	108/280 (38.6)	63/220 (28.6)	61/202 (30.2)
Colistin	1/712 (0.1)	-	-
Doxycycline	25/79 (31.6)	48/108 (44.4)	48/118 (40.7)
Enrofloxacin	32/788 (4.1)	63/998 (6.3)	29/1024 (2.8)
Florfenicol	86/329 (26.1)	56/266 (21.1)	64/290 (22.1)
Neomycin	114/679 (16.8)	151/868 (17.4)	149/858 (17.4)
Spectinomycin	267/737 (36.2)	296/949 (31.2)	257/943 (27.3)
Streptomycin	149/282 (52.8)	114/222 (51.4)	125/209 (59.8)
Tetracycline	447/788 (56.7)	587/998 (58.8)	518/1024 (50.6)
Trimethoprim/sulphonamide	293/788 (37.2)	381/988 (38.2)	367/1024 (35.8)

b) Northern Ireland

Antibiotic	2018	2019	2020
Amikacin	-	-	-
Amoxicillin/clavulanate	333/794 (41.9)	357/815 (43.8)	285/532 (53.6)
Ampicillin	585/794 (73.7)	612/816 (75.0)	410/532 (77.1)
Apramycin	64/647 (9.9)	60/609 (9.9)	27/380 (7.1)
Cefotaxime	-	-	-
Cefpodoxime	435/780 (55.8)	530/812 (65.3)	305/530 (57.5)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	-	-	-
Doxycycline	-	-	-
Enrofloxacin	267/795 (33.6)	239/817 (29.3)	149/532 (28.0)
Florfenicol	290/615 (47.2)	261/575 (45.4)	194/346 (56.1)
Neomycin	787/789 (99.7)	811/816 (99.4)	510/510 (100)
Spectinomycin	9/132 (6.8)	11/201 (5.5)	6/151 (4.0)
Streptomycin	130/132 (98.5)	204/206 (99.0)	151/151 (100)
Tetracycline	512/792 (64.6)	506/815 (62.1)	369/532 (69.4)
Trimethoprim/sulphonamide	421/795 (53.0)	378/817 (46.3)	276/531 (52.0)

c) Scotland

Antibiotic	2018	2019	2020
Amikacin	-	-	-
Amoxicillin/clavulanate	165/624 (26.4)	73/301 (24.3)	47/243 (19.3)
Ampicillin	270/628 (43.0)	123/302 (40.7)	98/243 (40.3)
Apramycin	-	1/154 (0.6)	2/124 (1.6)
Cefotaxime	-	-	-
Cefpodoxime	14/611 (2.3)	8/300 (2.7)	7/243 (2.9)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	-	-	-
Doxycycline	-	-	-
Enrofloxacin	35/622 (5.6)	16/301 (5.3)	6/243 (2.5)
Florfenicol	68/316 (21.5)	27/124 (21.8)	14/118 (11.9)
Neomycin	41/622 (6.6)	4/81 (4.9)	10/243 (4.1)
Spectinomycin	115/466 (24.7)	18/80 (22.5)	28/124 (22.6)
Streptomycin	16/188 (8.5)	17/146 (11.6)	18/118 (15.3)
Tetracycline	304/626 (48.6)	135/301 (44.9)	89/243 (36.6)
Trimethoprim/sulphonamide	151/622 (24.3)	61/302 (20.2)	36/243 (14.8)

Table S4.7.3: Resistance (interpreted using breakpoints) in all *E. coli* from cattle (all ages) in a) England and Wales, b) Northern Ireland and c) Scotland from 2018 to 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

a) England and Wales

Antibiotic	2018	2019	2020
Amikacin	0/208 (0)	0/140 (0)	0/147 (0)
Amoxicillin/clavulanate	112/304 (36.8)	83/278 (29.9)	74/287 (25.8)
Ampicillin	215/304 (70.7)	181/278 (65.1)	192/287 (66.9)
Apramycin	14/282 (5.0)	7/253 (2.8)	3/248 (1.2)
Cefotaxime	25/209 (12.0)	17/145 (11.7)	13/148 (8.8)
Cefpodoxime	-	-	-
Ceftazidime	12/209 (5.7)	7/145 (4.8)	6/148 (4.1)
Chloramphenicol	91/208 (43.8)	54/140 (38.6)	54/140 (38.6)
Colistin	0/315 (0)	-	-
Doxycycline	-	-	-
Enrofloxacin	20/304 (6.6)	20/278 (7.2)	11/287 (3.8)
Florfenicol	73/230 (31.7)	51/165 (30.9)	59/186 (31.7)
Neomycin	77/282 (27.3)	99/253 (39.1)	92/248 (37.1)
Spectinomycin	111/282 (39.4)	72/253 (28.5)	70/248 (28.2)
Streptomycin	112/208 (53.8)	77/140 (55.0)	100/147 (68.0)
Tetracycline	198/304 (65.1)	180/278 (64.7)	154/287 (53.7)
Trimethoprim/sulphonamide	125/304 (41.1)	121/278 (43.5)	132/287 (46.0)

b) Northern Ireland

Antibiotic	2018	2019	2020
Amikacin	-	-	-
Amoxicillin/clavulanate	265/586 (45.2)	292/640 (45.6)	227/418 (54.3)
Ampicillin	449/586 (76.6)	479/641 (74.7)	316/418 (75.6)
Apramycin	42/460 (9.1)	34/435 (7.8)	18/270 (6.7)
Cefotaxime	-	-	-
Cefpodoxime	326/585 (55.7)	413/638 (64.7)	238/417 (57.1)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	-	-	-
Doxycycline	-	-	-
Enrofloxacin	226/586 (38.6)	208/641 (32.4)	132/418 (31.6)
Florfenicol	245/456 (53.7)	241/436 (55.3)	171/271 (63.1)
Neomycin	580/582 (99.7)	636/641 (99.2)	399/399 (100)
Spectinomycin	8/126 (6.3)	11/200 (5.5)	6/147 (4.1)
Streptomycin	124/126 (98.4)	203/205 (99.0)	147/147 (100)
Tetracycline	394/586 (67.2)	393/639 (61.5)	274/418 (65.6)
Trimethoprim/sulphonamide	333/586 (56.8)	301/641 (47.0)	221/417 (53.0)

c) Scotland

Antibiotic	2018	2019	2020
Amikacin	-	-	-
Amoxicillin/clavulanate	97/309 (31.4)	58/220 (26.4)	37/193 (19.2)
Ampicillin	154/313 (49.2)	93/221 (42.1)	78/198 (40.4)
Apramycin	-	1/74 (1.4)	1/75 (1.3)
Cefotaxime	-	-	-
Cefpodoxime	5/301 (1.7)	6/220 (2.7)	7/193 (3.6)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	-	-	-
Doxycycline	-	-	-
Enrofloxacin	15/307 (4.9)	14/220 (6.4)	6/193 (3.1)
Florfenicol	47/162 (29.0)	25/73 (34.2)	13/75 (17.3)
Neomycin	31/307 (10.1)	-	9/193 (4.7)
Spectinomycin	55/157 (35.0)	-	17/75 (22.7)
Streptomycin	14/184 (7.6)	17/146 (11.6)	18/118 (15.3)
Tetracycline	168/311 (54.0)	99/220 (45.0)	65/193 (33.7)
Trimethoprim/sulphonamide	76/307 (24.8)	48/221 (21.7)	30/193 (15.5)

Table S4.7.4: Resistance (interpreted using breakpoints) in all *E. coli* from pigs (all ages) in a) England and Wales, b) Northern Ireland and c) Scotland from 2018 to 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistance.

a) England and Wales

Antibiotic	2018	2019	2020
Amikacin	-	-	-
Amoxicillin/clavulanate	-	-	-
Ampicillin	134/244 (54.9)	268/441 (60.8)	245/465 (52.7)
Apramycin	30/244 (12.3)	58/440 (13.2)	71/465 (15.3)
Cefotaxime	-	-	-
Cefpodoxime	7/244 (2.9)	4/440 (0.9)	12/465 (2.6)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	1/216 (0.5)	-	-
Doxycycline	-	0/1 (0)	6/6 (100)
Enrofloxacin	8/244 (3.3)	26/441 (5.9)	10/465 (2.2)
Florfenicol	-	-	-
Neomycin	21/244 (8.6)	36/440 (8.2)	48/465 (10.3)
Spectinomycin	90/244 (36.9)	159/440 (36.1)	143/465 (30.8)
Streptomycin	-	-	-
Tetracycline	149/244 (61.1)	283/441 (64.2)	261/465 (56.1)
Trimethoprim/sulphonamide	116/244 (47.5)	202/441 (45.8)	196/465 (42.2)

b) Northern Ireland

Antibiotic	2018	2019	2020
Amikacin	-	-	-
Amoxicillin/clavulanate	31/71 (43.7)	30/82 (36.6)	15/30 (50.0)
Ampicillin	52/71 (73.2)	70/82 (85.4)	26/30 (86.7)
Apramycin	16/71 (22.5)	18/82 (22.0)	4/30 (13.3)
Cefotaxime	-	-	-
Cefpodoxime	37/71 (52.1)	44/81 (54.3)	7/29 (24.1)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	-	-	-
Doxycycline	-	-	-
Enrofloxacin	20/71 (28.2)	15/82 (18.3)	4/30 (13.3)
Florfenicol	20/71 (28.2)	13/82 (15.9)	6/30 (20.0)
Neomycin	71/71 (100)	81/81 (100)	29/29 (100)
Spectinomycin	-	-	-
Streptomycin	-	-	-
Tetracycline	57/71 (80.3)	60/82 (73.2)	25/30 (83.3)
Trimethoprim/sulphonamide	54/72 (75.0)	52/82 (63.4)	25/30 (83.3)

c) Scotland

Antibiotic	2018	2019	2020
Amikacin	-	-	-
Amoxicillin/clavulanate	37/91 (40.7)	6/22 (27.3)	3/20 (15.0)
Ampicillin	53/91 (58.2)	14/22 (63.6)	9/20 (45.0)
Apramycin	-	0/22 (0)	2/20 (10.0)
Cefotaxime	-	-	-
Cefpodoxime	8/87 (9.2)	1/22 (4.5)	0/20 (0)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	-	-	-
Doxycycline	-	-	-
Enrofloxacin	16/91 (17.6)	1/22 (4.5)	0/20 (0)
Florfenicol	12/89 (13.5)	2/22 (9.1)	0/20 (0)
Neomycin	2/91 (2.2)	2/22 (9.1)	0/20 (0)
Spectinomycin	24/89 (27.0)	8/22 (36.4)	3/20 (15.0)
Streptomycin	-	-	-
Tetracycline	57/91 (62.6)	11/22 (50.0)	9/20 (45.0)
Trimethoprim/sulphonamide	45/91 (49.5)	8/22 (36.4)	3/20 (15.0)

Table S4.7.5: Resistance (interpreted using breakpoints) in all *E. coli* from sheep (all ages) in a) England and Wales, b) Northern Ireland and c) Scotland from 2018 to 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

a) England and Wales

Antibiotic	2018	2019	2020
Amikacin	1/72 (1.4)	0/80 (0)	0/62 (0)
Amoxicillin/clavulanate	24/161 (14.9)	11/172 (6.4)	10/160 (6.3)
Ampicillin	75/161 (46.6)	63/172 (36.6)	73/160 (45.6)
Apramycin	4/132 (3.0)	1/149 (0.7)	2/118 (1.7)
Cefotaxime	2/73 (2.7)	0/80 (0)	1/62 (1.6)
Cefpodoxime	-	-	-
Ceftazidime	0/73 (0)	0/80 (0)	1/62 (1.6)
Chloramphenicol	17/72 (23.6)	9/80 (11.3)	7/62 (11.3)
Colistin	0/130 (0)	-	-
Doxycycline	-	-	-
Enrofloxacin	2/161 (1.2)	6/172 (3.5)	3/160 (1.9)
Florfenicol	13/99 (13.1)	5/101 (5.0)	5/104 (4.8)
Neomycin	16/134 (11.9)	14/151 (9.3)	7/118 (5.9)
Spectinomycin	47/132 (35.6)	46/149 (30.9)	29/118 (24.6)
Streptomycin	37/74 (50.0)	37/82 (45.1)	25/62 (40.3)
Tetracycline	78/161 (48.4)	77/172 (44.8)	64/160 (40.0)
Trimethoprim/sulphonamide	36/161 (22.4)	31/172 (18.0)	20/160 (12.5)

b) Northern Ireland

Antibiotic	2018	2019	2020
Amikacin	-	-	-
Amoxicillin/clavulanate	26/79 (32.9)	23/58 (39.7)	22/43 (51.2)
Ampicillin	52/79 (65.8)	43/58 (74.1)	38/43 (88.4)
Apramycin	4/78 (5.1)	2/56 (3.6)	2/42 (4.8)
Cefotaxime	-	-	-
Cefpodoxime	40/80 (50.0)	41/58 (70.7)	26/43 (60.5)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	-	-	-
Doxycycline	-	-	-
Enrofloxacin	15/80 (18.8)	6/58 (10.3)	8/43 (18.6)
Florfenicol	22/78 (28.2)	7/57 (12.3)	15/42 (35.7)
Neomycin	78/78 (100)	58/58 (100)	42/42 (100)
Spectinomycin	1/1 (100)	0/1 (0)	-
Streptomycin	1/1 (100)	1/1 (100)	-
Tetracycline	43/79 (54.4)	33/58 (56.9)	37/43 (86.0)
Trimethoprim/sulphonamide	26/79 (32.9)	15/58 (25.9)	17/43 (39.5)

c) Scotland

Antibiotic	2018	2019	2020
Amikacin	-	-	-
Amoxicillin/clavulanate	28/67 (41.8)	8/29 (27.6)	7/24 (29.2)
Ampicillin	37/67 (55.2)	12/29 (41.4)	11/24 (45.8)
Apramycin	-	0/29 (0)	0/23 (0)
Cefotaxime	-	-	-
Cefpodoxime	0/66 (0)	1/29 (3.4)	0/24 (0)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	-	-	-
Doxycycline	-	-	-
Enrofloxacin	2/67 (3.0)	1/29 (3.4)	0/24 (0)
Florfenicol	9/64 (14.1)	0/29 (0)	1/23 (4.3)
Neomycin	5/67 (7.5)	2/29 (6.9)	1/24 (4.2)
Spectinomycin	31/63 (49.2)	7/29 (24.1)	8/23 (34.8)
Streptomycin	2/3 (66.7)	-	-
Tetracycline	38/67 (56.7)	15/29 (51.7)	12/24 (50.0)
Trimethoprim/sulphonamide	19/67 (28.4)	3/29 (10.3)	2/24 (8.3)

Table S4.7.6: Resistance (interpreted using breakpoints) in all *E. coli* from chickens (all ages) in a) England and Wales, b) Northern Ireland and c) Scotland from 2018 to 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

a) England and Wales

Antibiotic	2018	2019	2020
Amikacin	-	-	-
Amoxicillin/clavulanate	1/17 (5.9)	3/24 (12.5)	1/27 (3.7)
Ampicillin	21/72 (29.2)	50/102 (49.0)	43/93 (46.2)
Apramycin	1/72 (1.4)	4/102 (3.9)	2/93 (2.2)
Cefotaxime	-	-	-
Cefpodoxime	3/72 (4.2)	6/102 (5.9)	1/93 (1.1)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	0/48 (0)	-	-
Doxycycline	21/72 (29.2)	46/102 (45.1)	36/93 (38.7)
Enrofloxacin	2/72 (2.8)	11/102 (10.8)	5/93 (5.4)
Florfenicol	-	-	-
Neomycin	0/17 (0)	2/24 (8.3)	2/27 (7.4)
Spectinomycin	19/72 (26.4)	18/102 (17.6)	14/93 (15.1)
Tetracycline	19/72 (26.4)	45/102 (44.1)	33/93 (35.5)
Trimethoprim/sulphonamide	14/72 (19.4)	26/102 (25.5)	16/93 (17.2)

b) Northern Ireland

Antibiotic	2018	2019	2020
Amikacin	-	-	-
Amoxicillin/clavulanate	2/22 (9.1)	12/35 (34.3)	13/26 (50.0)
Ampicillin	9/22 (40.9)	20/35 (57.1)	19/26 (73.1)
Apramycin	0/21 (0)	6/36 (16.7)	2/26 (7.7)
Cefotaxime	-	-	-
Cefpodoxime	18/22 (81.8)	32/35 (91.4)	22/26 (84.6)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	-	-	-
Doxycycline	-	-	-
Enrofloxacin	1/22 (4.5)	10/36 (27.8)	3/26 (11.5)
Florfenicol	0/2 (0)	0/0 (0)	-
Neomycin	22/22 (100)	36/36 (100)	26/26 (100)
Spectinomycin	-	0/0 (0)	-
Tetracycline	5/22 (22.7)	20/36 (55.6)	23/26 (88.5)
Trimethoprim/sulphonamide	0/22 (0)	10/36 (27.8)	7/26 (26.9)

c) Scotland

Antibiotic	2018	2019	2020
Amikacin	-	-	-
Amoxicillin/clavulanate	3/156 (1.9)	1/29 (3.4)	0/6 (0)
Ampicillin	26/156 (16.7)	4/29 (13.8)	0/6 (0)
Apramycin	-	0/28 (0)	0/6 (0)
Cefotaxime	-	-	-
Cefpodoxime	1/156 (0.6)	0/28 (0)	0/6 (0)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	-	-	-
Doxycycline	-	-	-
Enrofloxacin	2/156 (1.3)	0/29 (0)	0/6 (0)
Florfenicol	-	-	-
Neomycin	3/156 (1.9)	0/29 (0)	0/6 (0)
Spectinomycin	5/156 (3.2)	3/28 (10.7)	0/6 (0)
Tetracycline	41/156 (26.3)	9/29 (31.0)	-
Trimethoprim/sulphonamide	11/156 (7.1)	2/29 (6.9)	3/6 (50.0)

Table S4.7.7: Resistance (interpreted using breakpoints) in all *E. coli* from turkeys (all ages) in a) England and Wales, b) Northern Ireland and c) Scotland from 2018 to 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

a) England and Wales

Antibiotic	2018	2019	2020
Amikacin	-	-	-
Amoxicillin/clavulanate	0/2 (0)	-	-
Ampicillin	5/7 (71.4)	2/5 (40.0)	7/19 (36.8)
Apramycin	0/7 (0)	0/5 (0)	1/19 (5.3)
Cefotaxime	-	-	-
Cefpodoxime	-	0/5 (0)	0/19 (0)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	0/3 (0)	-	-
Doxycycline	4/7 (57.1)	2/5 (40.0)	6/19 (31.6)
Enrofloxacin	0/7 (0)	0/5 (0)	0/19 (0)
Florfenicol	-	-	-
Neomycin	0/2 (0)	-	-
Spectinomycin	0/7 (0)	1/5 (20.0)	1/19 (5.3)
Streptomycin	-	-	-
Tetracycline	3/7 (42.9)	2/5 (40.0)	6/19 (31.6)
Trimethoprim/sulphonamide	2/7 (28.6)	1/5 (20.0)	3/19 (15.8)

b) Northern Ireland

Antibiotic	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	0/2 (0)	0/0	1/1 (100)
Ampicillin	2/2 (100)	0/0	1/1 (100)
Apramycin	0/2 (0)	0/0	0/1 (0)
Cefotaxime	-	-	-
Cefpodoxime	2/2 (100)	0/0	1/1 (100)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	-	-	-
Doxycycline	-	-	-
Enrofloxacin	0/2 (0)	0/0	0/1 (0)
Florfenicol	-	0/0	-
Neomycin	2/2 (100)	0/0	1/1 (100)
Spectinomycin	-	0/0	-
Streptomycin	-	0/0	-
Tetracycline	1/2 (50.0)	0/0	1/1 (100)
Trimethoprim/sulphonamide	0/2 (0)	0/0	1/1 (100)

c) Scotland

Antibiotic	2018	2019	2020
Amikacin	-	-	-
Amoxicillin/clavulanate	0/1 (0)	0/1 (0)	-
Ampicillin	0/1 (0)	0/1 (0)	-
Apramycin	-	0/1 (0)	-
Cefotaxime	-	-	-
Cefpodoxime	0/1 (0)	0/1 (0)	-
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Colistin	-	-	-
Doxycycline	-	-	-
Enrofloxacin	0/1 (0)	0/1 (0)	-
Florfenicol	0/1 (0)	-	-
Neomycin	0/1 (0)	0/1 (0)	-
Spectinomycin	0/1 (0)	0/1 (0)	-
Streptomycin	0/1 (0)	-	-
Tetracycline	0/1 (0)	1/1 (100)	-
Trimethoprim/sulphonamide	0/1 (0)	0/1 (0)	-

Table S4.7.8: Resistance (interpreted using breakpoints) in *E. coli* from cattle in a) England and Wales, b) Northern Ireland and c) Scotland for 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates. Please note that no pre-weaning or adult data is available for Northern Ireland.

a) England and Wales

Antibiotic	Neonatal	Pre-weaning	Adult
Amikacin	0/100 (0)	0/39 (0)	0/2 (0)
Amoxicillin/clavulanate	40/114 (35.1)	24/95 (25.3)	1/30 (3.3)
Ampicillin	93/114 (81.6)	64/95 (67.4)	12/30 (40.0)
Apramycin	0/114 (0)	3/82 (3.7)	0/21 (0)
Cefotaxime	7/100 (7.0)	6/39 (15.4)	0/3 (0)
Ceftazidime	2/100 (2.0)	4/39 (10.3)	0/3 (0)
Chloramphenicol	42/100 (42.0)	18/39 (46.2)	-
Enrofloxacin	4/114 (3.5)	6/95 (6.3)	1/30 (3.3)
Florfenicol	28/100 (28.0)	24/52 (46.2)	0/11 (0)
Neomycin	55/114 (48.2)	31/82 (37.8)	3/21 (14.3)
Spectinomycin	37/114 (32.5)	23/82 (28.0)	2/21 (9.5)
Streptomycin	68/100 (68.0)	28/39 (71.8)	0/2 (0)
Tetracycline	75/114 (65.8)	53/95 (55.8)	8/30 (26.7)
Trimethoprim/sulphonamide	64/114 (56.1)	49/95 (51.6)	6/30 (20.0)

b) Northern Ireland

Antibiotic	Neonatal
Amikacin	-
Amoxicillin/clavulanate	45/67 (67.2)
Ampicillin	67/67 (100)
Apramycin	5/66 (7.6)
Cefotaxime	-
Cefpodoxime	47/67 (70.1)
Ceftazidime	-
Chloramphenicol	-
Enrofloxacin	21/67 (31.3)
Florfenicol	48/67 (71.6)
Neomycin	67/67 (100)
Spectinomycin	-
Streptomycin	-
Tetracycline	62/67 (92.5)
Trimethoprim/sulphonamide	53/67 (79.1)

c) Scotland

Antibiotic	Neonatal	Pre-weaning	Adult
Amikacin	-	-	-
Amoxicillin/clavulanate	9/30 (30.0)	13/28 (46.4)	15/135 (11.1)
Ampicillin	24/30 (80.0)	21/28 (75.0)	33/135 (24.4)
Apramycin	0/30 (0)	1/28 (3.6)	0/17 (0)
Cefotaxime	-	-	-
Cefpodoxime	0/30 (0)	2/28 (7.1)	5/135 (3.7)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Enrofloxacin	0/30 (0)	2/28 (7.1)	4/135 (3.0
Florfenicol	6/30 (20.0)	5/28 (17.9)	2/17 (11.8)
Neomycin	3/30 (10.0)	4/28 (14.3)	2/135 (1.5)
Spectinomycin	10/30 (33.3)	6/28 (21.4)	1/17 (5.9)
Streptomycin	-	-	18/118 (15.3)
Tetracycline	19/30 (63.3)	21/28 (75.0)	25/135 (18.5)
Trimethoprim/sulphonamide	7/30 (23.3)	7/28 (25.0)	16/135 (11.9)

Table S4.7.9: Resistance (interpreted using breakpoints) in *E. coli* from cattle in a) England and Wales, b) Northern Ireland and c) Scotland for 2019

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates. Please note that no pre-weaning or adult data is available for Northern Ireland.

a) England and Wales

Antibiotic	Neonatal	Pre-weaning	Adult
Amikacin	0/117 (0)	0/13 (0)	-
Amoxicillin/clavulanate	58/150 (38.7)	17/59 (28.8)	1/30 (3.3)
Ampicillin	115/150 (76.7)	39/59 (66.1)	13/30 (43.3)
Apramycin	3/143 (2.1)	2/47 (4.3)	1/27 (3.7)
Cefotaxime	9/118 (7.6)	5/16 (31.3)	1/1 (100)
Ceftazidime	3/118 (2.5)	2/16 (12.5)	0/1 (0)
Chloramphenicol	47/117 (40.2)	5/13 (38.5)	-
Enrofloxacin	8/150 (5.3)	8/59 (13.6)	2/30 (6.7)
Florfenicol	37/124 (29.8)	11/25 (44.0)	0/3 (0)
Neomycin	66/143 (46.2)	20/47 (42.6)	6/27 (22.2)
Spectinomycin	47/143 (32.9)	16/47 (34.0)	4/27 (14.8)
Streptomycin	64/117 (54.7)	7/13 (53.8)	-
Tetracycline	105/150 (70.0)	41/59 (69.5)	13/30 (43.3)
Trimethoprim/sulphonamide	69/150 (46.0)	32/59 (54.2)	7/30 (23.3)

b) Northern Ireland

Antibiotic	Neonatal
Amikacin	-
Amoxicillin/clavulanate	59/108 (54.6)
Ampicillin	94/108 (87.0)
Apramycin	8/108 (7.4)
Cefotaxime	-
Ceftazidime	-
Chloramphenicol	-
Enrofloxacin	50/108 (46.3)
Florfenicol	61/108 (56.5)
Neomycin	108/108 (100)
Spectinomycin	0/0 (0)
Streptomycin	0/0 (0)
Tetracycline	87/107 (81.3)
Trimethoprim/sulphonamide	68/108 (63.0)

c) Scotland

Antibiotic	Neonatal	Pre-weaning	Adult
Amikacin	-	-	-
Amoxicillin/clavulanate	18/34 (52.9)	19/31 (61.3)	3/14 (21.4)
Ampicillin	30/35 (85.7)	23/31 (74.2)	6/14 (42.9)
Apramycin	0/35 (0)	0/30 (0)	1/5 (20.0)
Cefotaxime	-	-	-
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Enrofloxacin	8/34 (23.5)	7/31 (22.6)	0/14 (0)
Florfenicol	11/34 (32.4)	16/30 (53.3)	1/5 (20.0)
Neomycin	4/35 (11.4)	6/31 (19.4)	2/14 (14.3)
Spectinomycin	16/34 (47.1)	12/30 (40.0)	2/5 (40.0)
Streptomycin	-	-	1/9 (11.1)
Tetracycline	24/34 (70.6)	26/31 (83.9)	6/14 (42.9)
Trimethoprim/sulphonamide	16/35 (45.7)	17/31 (54.8)	2/14 (14.3)

Table S4.7.10: Resistance (interpreted using breakpoints) in *E. coli* from cattle in England and Wales, Northern Ireland and Scotland for 2018

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates. Please note that no pre-weaning or adult data is available for Northern Ireland.

a) England and Wales

Antibiotic	Neonatal	Pre-weaning	Adult
Amikacin	0/159 (0)	0/30 (0)	-
Amoxicillin/clavulanate	73/181 (40.3)	21/65 (32.3)	3/20 (15.0)
Ampicillin	144/181 (79.6)	37/65 (56.9)	6/20 (30.0)
Apramycin	8/173 (4.6)	3/58 (5.2)	1/17 (5.9)
Cefotaxime	18/159 (11.3)	3/30 (10.0)	1/1 (100)
Cefpodoxime	-	-	-
Ceftazidime	7/159 (4.4)	1/30 (3.3)	1/1 (100)
Chloramphenicol	69/159 (43.4)	13/30 (43.3)	-
Enrofloxacin	8/181 (4.4)	4/65 (6.2)	1/20 (5.0)
Florfenicol	50/167 (29.9)	14/37 (37.8)	1/3 (33.3)
Neomycin	53/173 (30.6)	15/58 (25.9)	1/17 (5.9)
Spectinomycin	72/173 (41.6)	24/58 (41.4)	1/17 (5.9)
Streptomycin	86/159 (54.1)	14/30 (46.7)	-
Tetracycline	127/181 (70.2)	41/65 (63.1)	7/20 (35.0)
Trimethoprim/sulphonamide	77/181 (42.5)	28/65 (43.1)	5/20 (25.0)

b) Northern Ireland

Antibiotic	Neonatal
Amikacin	-
Amoxicillin/clavulanate	203/365 (55.6)
Ampicillin	322/366 (88.0)
Apramycin	37/366 (10.1)
Cefotaxime	-
Cefpodoxime	206/365 (56.4)
Ceftazidime	-
Chloramphenicol	-
Enrofloxacin	173/366 (47.3)
Florfenicol	198/363 (54.5)
Neomycin	361/362 (99.7)
Spectinomycin	-
Streptomycin	-
Tetracycline	305/366 (83.3)
Trimethoprim/sulphonamide	265/366 (72.4)

c) Scotland

Antibiotic	Neonatal	Pre-weaning	Adult
Amikacin	-	-	-
Amoxicillin/clavulanate	25/48 (52.1)	16/28 (57.1)	-
Ampicillin	41/50 (82.0)	22/28 (78.6)	-
Apramycin	-	-	-
Cefotaxime	-	-	-
Cefpodoxime	2/45 (4.4)	0/27 (0)	-
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Enrofloxacin	2/47 (4.3)	4/28 (14.3)	-
Florfenicol	14/48 (29.2)	9/28 (32.1)	-
Neomycin	10/47 (21.3)	4/28 (14.3)	-
Spectinomycin	20/46 (43.5)	7/27 (25.9)	-
Streptomycin	-	-	-
Tetracycline	40/49 (81.6)	26/28 (92.9)	-
Trimethoprim/sulphonamide	17/47 (36.2)	13/28 (46.4)	-

Table S4.7.11: Resistance (interpreted using breakpoints) in *E. coli* from pigs in England and Wales, Northern Ireland and Scotland for 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates. Please note that no post-weaning or adult data is available for Northern Ireland.

a) England and Wales

Antibiotic	Neonatal	Post-weaning	Adult
Amoxicillin/clavulanate	-	-	-
Ampicillin	45/93 (48.4)	136/240 (56.7)	12/25 (48.0)
Apramycin	12/93 (12.9)	48/240 (20.0)	0/25 (0)
Cefpodoxime	3/93 (3.2)	3/240 (1.3)	1/25 (4.0)
Doxycycline	-	-	-
Enrofloxacin	2/93 (2.2)	4/240 (1.7)	0/25 (0)
Florfenicol	-	-	-
Neomycin	3/93 (3.2)	36/240 (15.0)	0/25 (0)
Spectinomycin	34/93 (36.6)	78/240 (32.5)	2/25 (8.0)
Streptomycin	-	-	-
Tetracycline	49/93 (52.7)	144/240 (60.0)	11/25 (44.0)
Trimethoprim/sulphonamide	35/93 (37.6)	118/240 (49.2)	5/25 (20.0)

b) Northern Ireland

Antibiotic	Neonatal
Amoxicillin/clavulanate	2/6 (33.3)
Ampicillin	5/6 (83.3)
Apramycin	1/6 (16.7)
Cefpodoxime	1/6 (16.7)
Doxycycline	-
Enrofloxacin	1/6 (16.7)
Florfenicol	1/6 (16.7)
Neomycin	6/6 (100)
Spectinomycin	-
Streptomycin	-
Tetracycline	4/6 (66.7)
Trimethoprim/sulphonamide	6/6 (100)

c) Scotland

Antibiotic	Neonatal	Post-weaning	Adult
Amoxicillin/clavulanate	1/1 (100)	0/8 (0)	2/11 (18.2)
Ampicillin	1/1 (100)	3/8 (37.5)	5/11 (45.5)
Apramycin	0/1 (0)	1/8 (12.5)	1/11 (9.1)
Cefpodoxime	0/1 (0)	0/8 (0)	0/11 (0)
Doxycycline	-	-	-
Enrofloxacin	0/1 (0)	0/8 (0)	0/11 (0)
Florfenicol	0/1 (0)	0/8 (0)	0/11 (0)
Neomycin	0/1 (0)	0/8 (0)	0/11 (0)
Spectinomycin	1/1 (100)	0/8 (0)	2/11 (18.2)
Streptomycin	-	-	-
Tetracycline	1/1 (100)	1/8 (12.5)	7/11 (63.6)
Trimethoprim/sulphonamide	1/1 (100)	0/8 (0)	2/11 (18.2)

Table S4.7.12: Resistance (interpreted using breakpoints) in *E. coli* from pigs in England and Wales, Northern Ireland and Scotland for 2019

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates. Please note that no post-weaning or adult data is available for Northern Ireland.

a) England and Wales

Antibiotic	Neonatal	Post-weaning	Adult
Amoxicillin/clavulanate	-	-	-
Ampicillin	57/94 (60.6)	161/239 (67.4)	9/19 (47.4)
Apramycin	2/94 (2.1)	51/239 (21.3)	1/19 (5.3)
Cefpodoxime	1/94 (1.1)	2/239 (0.8)	0/19 (0)
Doxycycline	-	-	-
Enrofloxacin	9/94 (9.6)	13/239 (5.4)	0/19 (0)
Florfenicol	-	-	-
Neomycin	6/94 (6.4)	25/239 (10.5)	1/19 (5.3)
Spectinomycin	38/94 (40.4)	93/239 (38.9)	4/19 (21.1)
Streptomycin	-	-	-
Tetracycline	61/94 (64.9)	169/239 (70.7)	8/19 (42.1)
Trimethoprim/sulphonamide	41/94 (43.6)	126/239 (52.7)	5/19 (26.3)

b) Northern Ireland

Antibiotic	Neonatal
Amoxicillin/clavulanate	0/1 (0)
Ampicillin	1/1 (100)
Apramycin	0/1 (0)
Cefpodoxime	1/1 (100)
Doxycycline	-
Enrofloxacin	0/1 (0)
Florfenicol	0/1 (0)
Neomycin	1/1 (100)
Spectinomycin	0/0 (0)
Streptomycin	0/0 (0)
Tetracycline	0/1 (0)
Trimethoprim/sulphonamide	0/1 (0)

c) Scotland

Antibiotic	Neonatal	Post-weaning	Adult
Amoxicillin/clavulanate	0/2 (0)	3/14 (21.4)	-
Ampicillin	2/2 (100)	7/14 (50.0)	-
Apramycin	0/2 (0)	0/14 (0)	-
Cefpodoxime	0/2 (0)	1/14 (7.1)	-
Doxycycline	-	-	-
Enrofloxacin	1/2 (50.0)	0/14 (0)	-
Florfenicol	0/2 (0)	2/14 (14.3)	-
Neomycin	1/2 (50.0)	1/14 (7.1)	-
Spectinomycin	1/2 (50.0)	4/14 (28.6)	-
Streptomycin	-	-	-
Tetracycline	2/2 (100)	5/14 (35.7)	-
Trimethoprim/sulphonamide	2/2 (100)	4/14 (28.6)	-

Table S4.7.13: Resistance (interpreted using breakpoints) in *E. coli* from pigs in England and Wales, Northern Ireland and Scotland for 2018

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates. Please note that no post-weaning or adult data is available for Northern Ireland.

a) England and Wales

Antibiotic	Neonatal	Post-weaning	Adult
Amoxicillin/clavulanate	2/2 (100)	-	-
Ampicillin	29/59 (49.2)	63/115 (54.8)	5/10 (50.0)
Apramycin	1/59 (1.7)	23/115 (20.0)	1/10 (10.0)
Cefpodoxime	2/59 (3.4)	2/115 (1.7)	0/10 (0)
Doxycycline	1/2 (50.0)	-	-
Enrofloxacin	5/59 (8.5)	2/115 (1.7)	0/10 (0)
Florfenicol	0/2 (0)	-	-
Neomycin	3/59 (5.1)	14/115 (12.2)	0/10 (0)
Spectinomycin	29/59 (49.2)	42/115 (36.5)	1/10 (10.0)
Streptomycin	1/2 (50.0)	-	-
Tetracycline	35/59 (59.3)	74/115 (64.3)	4/10 (40.0)
Trimethoprim/sulphonamide	20/59 (33.9)	63/115 (54.8)	2/10 (20.0)

b) Northern Ireland

Antibiotic	Neonatal
Amoxicillin/clavulanate	7/16 (43.8)
Ampicillin	11/16 (68.8)
Apramycin	3/16 (18.8)
Cefpodoxime	7/16 (43.8)
Doxycycline	-
Enrofloxacin	9/16 (56.3)
Florfenicol	4/16 (25.0)
Neomycin	15/15 (100)
Spectinomycin	-
Streptomycin	-
Tetracycline	15/16 (93.8)
Trimethoprim/sulphonamide	15/16 (93.8)

c) Scotland

Antibiotic	Neonatal	Post-weaning	Adult
Amoxicillin/clavulanate	18/44 (40.9)	-	19/47 (40.4)
Ampicillin	25/44 (56.8)	-	28/47 (59.6)
Apramycin	-	-	-
Cefpodoxime	4/42 (9.5)	-	4/45 (8.9)
Doxycycline	-	-	-
Enrofloxacin	8/44 (18.2)	-	8/47 (17.0)
Florfenicol	6/43 (14.0)	-	6/46 (13.0)
Neomycin	1/44 (2.3)	-	1/47 (2.1)
Spectinomycin	12/43 (27.9)	-	12/46 (26.1)
Streptomycin	-	-	-
Tetracycline	27/44 (61.4)	-	30/47 (63.8)
Trimethoprim/sulphonamide	22/44 (50.0)	-	23/47 (48.9)

Table S4.7.14: Resistance (interpreted using breakpoints) in *E. coli* from sheep in a) England and Wales, b) Northern Ireland and c) Scotland from 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates. Please note that no pre-weaning or adult data is available for Northern Ireland.

a) England and Wales

Antibiotic	Neonatal	Pre-weaning	Adult
Amoxicillin/clavulanate	5/59 (8.5)	2/30 (6.7)	1/28 (3.6)
Ampicillin	29/59 (49.2)	14/30 (46.7)	11/28 (39.3)
Apramycin	0/59 (0)	1/17 (5.9)	0/17 (0)
Cefotaxime	1/50 (2.0)	0/6 (0)	-
Ceftazidime	1/50 (2.0)	0/6 (0)	-
Chloramphenicol	5/50 (10.0)	-	-
Enrofloxacin	2/59 (3.4)	1/30 (3.3)	0/28 (0)
Florfenicol	3/52 (5.8)	1/19 (5.3)	0/11 (0)
Neomycin	3/57 (5.3)	2/17 (11.8)	2/17 (11.8)
Spectinomycin	22/57 (38.6)	2/17 (11.8)	1/17 (5.9)
Streptomycin	18/50 (36.0)	3/6 (50.0)	-
Tetracycline	28/59 (47.5)	13/30 (43.3)	9/28 (32.1)
Trimethoprim/sulphonamide	8/59 (13.6)	3/30 (10.0)	4/28 (14.3)

b) Northern Ireland

Antibiotic	Neonatal
Amoxicillin/clavulanate	2/3 (66.7)
Ampicillin	3/3 (100)
Apramycin	0/3 (0)
Cefotaxime	-
Cefpodoxime	2/3 (66.7)
Ceftazidime	-
Chloramphenicol	-
Enrofloxacin	0/3 (0)
Florfenicol	0/3 (0)
Neomycin	3/3 (100)
Spectinomycin	-
Streptomycin	-
Tetracycline	3/3 (100)
Trimethoprim/sulphonamide	0/3 (0)

c) Scotland

Antibiotic	Neonatal	Pre-weaning	Adult
Amoxicillin/clavulanate	3/10 (30.0)	2/5 (40.0)	1/8 (12.5)
Ampicillin	6/10 (60.0)	3/5 (60.0)	1/8 (12.5)
Apramycin	0/10 (0)	0/5 (0)	0/7 (0)
Cefotaxime	-	-	-
Cefpodoxime	0/10 (0)	0/5 (0)	0/8 (0)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Enrofloxacin	0/10 (0)	0/5 (0)	0/8 (0)
Florfenicol	1/10 (10.0)	0/5 (0)	0/7 (0)
Neomycin	0/10 (0)	0/5 (0)	1/8 (12.5)
Spectinomycin	6/10 (60.0)	1/5 (20.0)	0/7 (0)
Streptomycin	-	-	-
Tetracycline	6/10 (60.0)	3/5 (60.0)	3/8 (37.5)
Trimethoprim/sulphonamide	1/10 (10.0)	0/5 (0)	1/8 (12.5)

Table S4.7.15: Resistance (interpreted using breakpoints) in *E. coli* from sheep in a) England and Wales, b) Northern Ireland and c) Scotland from 2019

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates. Please note that no pre-weaning or adult data is available for Northern Ireland.

a) England and Wales

Antibiotic	Neonatal	Pre-weaning	Adult
Amoxicillin/clavulanate	9/84 (10.7)	2/29 (6.9)	0/31 (0)
Ampicillin	33/84 (39.3)	13/29 (44.8)	12/31 (38.7)
Apramycin	1/83 (1.2)	0/24 (0)	0/21 (0)
Cefotaxime	0/71 (0)	0/2 (0)	0/3 (0)
Ceftazidime	0/71 (0)	0/2 (0)	0/3 (0)
Chloramphenicol	8/71 (11.3)	-	0/3 (0)
Enrofloxacin	4/84 (4.8)	1/29 (3.4)	1/31 (3.2)
Florfenicol	5/71 (7.0)	0/7 (0)	0/12 (0)
Neomycin	10/84 (11.9)	1/24 (4.2)	3/22 (13.6)
Spectinomycin	33/83 (39.8)	6/24 (25.0)	5/21 (23.8)
Streptomycin	31/72 (43.1)	2/2 (100)	4/4 (100)
Tetracycline	43/84 (51.2)	13/29 (44.8)	13/31 (41.9)
Trimethoprim/sulphonamide	15/84 (17.9)	6/29 (20.7)	8/31 (25.8)

b) Northern Ireland

Antibiotic	Neonatal
Amoxicillin/clavulanate	3/6 (50.0)
Ampicillin	5/6 (83.3)
Apramycin	0/6 (0)
Cefotaxime	-
Cefpodoxime	6/6 (100)
Ceftazidime	-
Chloramphenicol	-
Enrofloxacin	1/6 (16.7)
Florfenicol	1/6 (16.7)
Neomycin	6/6 (100)
Spectinomycin	-
Streptomycin	-
Tetracycline	5/6 (83.3)
Trimethoprim/sulphonamide	4/6 (66.7)

c) Scotland

Antibiotic	Neonatal	Pre-weaning	Adult
Amoxicillin/clavulanate	1/9 (11.1)	1/2 (50.0)	0/5 (0)
Ampicillin	3/9 (33.3)	1/2 (50.0)	0/5 (0)
Apramycin	0/9 (0)	0/2 (0)	0/5 (0)
Cefotaxime	-	-	-
Cefpodoxime	0/9 (0)	1/2 (50.0)	0/5 (0)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Enrofloxacin	0/9 (0)	0/2 (0)	0/5 (0)
Florfenicol	0/9 (0)	0/2 (0)	0/5 (0)
Neomycin	0/9 (0)	0/2 (0)	0/5 (0)
Spectinomycin	2/9 (22.2)	1/2 (50.0)	0/5 (0)
Streptomycin	-	-	-
Tetracycline	3/9 (33.3)	1/2 (50.0)	1/5 (20.0)
Trimethoprim/sulphonamide	1/9 (11.1)	0/2 (0)	0.5 (0)

Table S4.7.16: Resistance (interpreted using breakpoints) in *E. coli* from sheep in England and Wales, Northern Ireland and Scotland for 2018

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates. Please note that no pre-weaning or adult data is available for Northern Ireland.

a) England and Wales

Antibiotic	Neonatal	Pre-weaning	Adult
Amoxicillin/clavulanate	14/69 (20.3)	6/32 (18.8)	1/26 (3.8)
Ampicillin	34/69 (49.3)	14/32 (43.8)	11/26 (42.3)
Apramycin	2/68 (2.9)	1/23 (4.3)	0/19 (0)
Cefotaxime	1/58 (1.7)	1/7 (14.3)	0/2 (0)
Cefpodoxime	-	-	-
Ceftazidime	0/58 (0)	0/7 (0)	0/2 (0)
Chloramphenicol	13/58 (22.4)	4/7 (57.1)	0/2 (0)
Enrofloxacin	1/69 (1.4)	0/32 (0)	1/26 (3.8)
Florfenicol	8/59 (13.6)	4/16 (25.0)	0/7 (0)
Neomycin	12/68 (17.6)	1/23 (4.3)	2/21 (9.5)
Spectinomycin	30/68 (44.1)	8/23 (34.8)	3/19 (15.8)
Streptomycin	27/58 (46.6)	4/7 (57.1)	1/4 (25.0)
Tetracycline	40/69 (58.0)	17/32 (53.1)	8/26 (30.8)
Trimethoprim/sulphonamide	18/69 (26.1)	9/32 (28.1)	4/26 (15.4)

b) Northern Ireland

Antibiotic	Neonatal
Amoxicillin/clavulanate	20/52 (38.5)
Ampicillin	36/52 (69.2)
Apramycin	3/52 (5.8)
Cefotaxime	-
Cefpodoxime	26/52 (50.0)
Ceftazidime	-
Chloramphenicol	-
Enrofloxacin	14/52 (26.9)
Florfenicol	17/51 (33.3)
Neomycin	50/50 (100)
Spectinomycin	-
Streptomycin	-
Tetracycline	30/52 (57.7)
Trimethoprim/sulphonamide	19/52 (36.5)

c) Scotland

Antibiotic	Neonatal	Pre-weaning	Adult
Amoxicillin/clavulanate	11/21 (52.4)	1/4 (25.0)	16/42 (38.1)
Ampicillin	14/21 (66.7)	2/4 (50.0)	21/42 (50.0)
Apramycin	-	-	-
Cefotaxime	-	-	-
Cefpodoxime	0/21 (0)	0/4 (0)	0/41 (0)
Ceftazidime	-	-	-
Chloramphenicol	-	-	-
Enrofloxacin	0/21 (0)	0/4 (0)	2/42 (4.8)
Florfenicol	2/21 (9.5)	2/4 (50.0)	5/39 (12.8)
Neomycin	2/21 (9.5)	0/4 (0)	3/42 (7.1)
Spectinomycin	14/21 (66.7)	1/4 (25.0)	16/38 (42.1)
Streptomycin	-	-	2/3 (66.7)
Tetracycline	14/21 (66.7)	2/4 (50.0)	22/42 (52.4)
Trimethoprim/sulphonamide	7/21 (33.3)	1/4 (25.0)	11/42 (26.2)

S4.8: Clinical surveillance data for *Salmonella*

Table S4.8.1: Resistance (interpreted using breakpoints) in all *Salmonella* from cattle, pigs, sheep, chickens and turkeys (combined) in a) England and Wales, b) Northern Ireland and c) Scotland from 2018 to 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

a) England and Wales

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	3/2789 (0.1)	0/2730 (0)	3/2515 (0.1)
Ampicillin	284/2789 (10.2)	208/2730 (7.6)	379/2515 (15.1)
Apramycin	35/2789 (1.3)	43/2730 (1.6)	42/2515 (1.7)
Cefotaxime	2/2789 (0.1)	0/2730 (0)	2/2515 (0.1)
Ceftazidime	2/2789 (0.1)	0/2730 (0)	2/2515 (0.1)
Chloramphenicol	156/2789 (5.6)	145/2730 (5.3)	204/2515 (8.1)
Ciprofloxacin	3/2789 (0.1)	9/2730 (0.33)	5/2515 (0.2)
Furazolidone	13/2789 (0.5)	7/2730 (0.3)	8/2515 (0.3)
Gentamicin	48/2789 (1.7)	43/2730 (1.6)	45/2515 (1.8)
Nalidixic acid	22/2789 (0.8)	63/2730 (2.3)	40/2515 (1.6)
Neomycin	50/2789 (1.8)	72/2730 (2.6)	84/2515 (3.3)
Spectinomycin	-	-	-
Streptomycin	460/2789 (16.5)	451/2730 (16.5)	385/2515 (15.3)
Sulphonamide compounds	561/2789 (20.1)	657/2730 (24.1)	670/2515 (26.6)
Tetracycline	480/2789 (17.2)	597/2730 (21.9)	534/2515 (21.6)
Trimethoprim/sulphonamide	212/2789 (7.6)	397/2730 (14.6)	446/2512 (17.7)

b) Northern Ireland

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	4/103 (3.9)	3/82 (3.7)	5/143 (3.5)
Ampicillin	17/103 (16.5)	16/82 (19.5)	15/143 (10.5)
Apramycin	7/103 (6.8)	7/82 (8.5)	4/143 (2.8)
Cefotaxime	0/103 (0)	2/83 (2.4)	0/143 (0)
Ceftazidime	0/103 (0)	0/82 (0)	0/143 (0)
Chloramphenicol	9/103 (8.7)	9/82 (11.0)	7/143 (4.9)
Ciprofloxacin	0/103 (0)	5/83 (6.0)	3/143 (2.1)
Furazolidone	0/103 (0)	3/83 (3.6)	16/143 (11.2)
Gentamicin	7/103 (6.8)	7/83 (8.4)	4/143 (2.8)
Nalidixic acid	4/103 (3.9)	9/83 (10.8)	20/143 (14.0)
Neomycin	-	-	-
Spectinomycin	10/103 (9.7)	9/83 (10.8)	25/143 (17.5)
Streptomycin	19/103 (18.4)	30/83 (36.1)	29/143 (20.3)
Sulphonamide compounds	-	18/83 (21.7)	29/143 (20.3)
Tetracycline	18/103 (17.5)	17/83 (20.5)	24/143 (16.8)
Trimethoprim/sulphonamide	7/103 (6.8)	8/83 (9.6)	17/143 (11.9)

c) Scotland

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	13/210 (6.2)	23/241 (9.5)	11/168 (6.5)
Ampicillin	67/282 (23.8)	38/242 (15.7)	21/168 (12.5)
Apramycin	-	2/239 (0.8)	0/168 (0)
Cefotaxime	0/282 (0)	-	0/168 (0)
Cefpodoxime	0/210 (0)	0/238 (0)	0/168 (0)
Ceftazidime	-	-	0/168 (0)
Chloramphenicol	24/282 (8.5)	-	-
Ciprofloxacin	8/282 (2.8)	-	0/168 (0)
Enrofloxacin	0/210 (0)	2/242 (0.8)	0/168 (0)
Florfenicol	19/210 (9.0)	24/241 (10.0)	11/168 (6.5)
Furazolidone	3/282 (1.1)	-	-
Gentamicin	1/282 (0.4)	-	-
Nalidixic acid	8/282 (2.8)	-	0/168 (0)
Neomycin	0/282 (0)	1/242 (0.4)	0/168 (0)
Spectinomycin	30/282 (10.6)	29/239 (12.1)	11/168 (6.5)
Streptomycin	75/282 (26.6)	-	-
Sulphonamide compounds	82/282 (29.1)	-	-
Tetracycline	84/282 (29.8)	31/241 (12.9)	23/168 (13.7)
Trimethoprim/sulphonamide	3/282 (1.1)	2/241 (0.8)	1/168 (0.6)

Table S4.8.2: Resistance (interpreted using breakpoints) in all *Salmonella* from cattle (all ages) in a) England and Wales, b) Northern Ireland and c) Scotland from 2018 to 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

a) England and Wales

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	3/489 (0.6)	0/464 (0)	1/404 (0.2)
Ampicillin	45/489 (9.2)	37/464 (8.0)	53/404 (13.1)
Apramycin	3/489 (0.6)	0/464 (0)	0/404 (0)
Cefotaxime	0/489 (0)	0/464 (0)	0/404 (0)
Ceftazidime	0/489 (0)	0/464 (0)	0/404 (0)
Chloramphenicol	32/489 (6.5)	30/464 (6.5)	46/404 (11.4)
Ciprofloxacin	0/489 (0)	0/464 (0)	0/404 (0)
Furazolidone	0/489 (0)	0/464 (0)	0/404 (0)
Gentamicin	3/489 (0.6)	0/464 (0)	1/404 (0.2)
Nalidixic acid	5/489 (1.0)	0/464 (0)	13/404 (3.2)
Neomycin	5/489 (1.0)	0/464 (0)	30/404 (7.4)
Spectinomycin	-	-	-
Streptomycin	68/489 (13.9)	41/464 (8.8)	69/404 (17.1)
Sulphonamide compounds	68/489 (13.9)	39/464 (8.4)	67/404 (16.6)
Tetracycline	56/489 (11.5)	46/464 (9.9)	81/404 (20.0)
Trimethoprim/sulphonamide	2/489 (0.4)	3/464 (0.6)	7/404 (1.7)

b) Northern Ireland

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/76 (0)	2/59 (3.4)	1/50 (2.0)
Ampicillin	4/76 (5.3)	3/59 (5.1)	1/50 (2.0)
Apramycin	2/76 (2.6)	1/59 (1.7)	0/50 (0)
Cefotaxime	0/76 (0)	1/59 (1.7)	0/50 (0)
Ceftazidime	0/76 (0)	0/59 (0)	0/50 (0)
Chloramphenicol	2/76 (2.6)	2/59 (3.4)	0/50 (0)
Ciprofloxacin	0/76 (0)	1/59 (1.7)	0/50 (0)
Furazolidone	0/76 (0)	1/59 (1.7)	0/50 (0)
Gentamicin	2/76 (2.6)	0/59 (0)	0/50 (0)
Nalidixic acid	1/76 (1.3)	3/59 (5.1)	2/50 (4.0)
Neomycin	-	-	-
Spectinomycin	2/76 (2.6)	2/59 (3.4)	0/50 (0)
Streptomycin	5/76 (6.6)	13/59 (22.0)	4/50 (8.0)
Sulphonamide compounds	-	4/59 (6.8)	2/50 (4.0)
Tetracycline	4/76 (5.3)	3/59 (5.1)	2/50 (4.0)
Trimethoprim/sulphonamide	2/76 (2.6)	1/59 (1.7)	0/50 (0)

c) Scotland

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	9/130 (6.9)	22/179 (12.3)	11/132 (8.3)
Ampicillin	13/140 (9.3)	30/180 (16.7)	11/132 (8.3)
Apramycin	-	1/178 (0.6)	0/132 (0)
Cefotaxime	0/140 (0)	-	0/132 (0)
Cefpodoxime	0/130 (0)	0/177 (0)	0/132 (0)
Ceftazidime	-	-	0/132 (0)
Chloramphenicol	20/140 (14.3)	-	-
Ciprofloxacin	0/140 (0)	-	0/132 (0)
Enrofloxacin	0/130 (0)	2/180 (1.1)	0/132 (0)
Florfenicol	15/130 (3.1)	21/179 (11.7)	11/132 (8.3)
Furazolidone	0/140 (0)	-	-
Gentamicin	1/140 (0.7)	-	-
Nalidixic acid	4/140 (2.9)	-	0/132 (0)
Neomycin	0/140 (0)	0/180 (0)	0/132 (0)
Spectinomycin	15/140 (10.7)	26/178 (14.6)	11/132 (8.3)
Streptomycin	17/140 (12.1)	-	-
Sulphonamide compounds	22/140 (15.7)	-	-
Tetracycline	19/140 (13.6)	24/179 (13.4)	12/132 (9.1)
Trimethoprim/sulphonamide	1/140 (0.7)	1/179 (0.6)	0/132 (0)

Table S4.8.3: Resistance (interpreted using breakpoints) in all *Salmonella* from pigs (all ages) in a) England and Wales, b) Northern Ireland and c) Scotland from 2018 to 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

a) England and Wales

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/202 (0)	0/206 (0)	0/242 (0)
Ampicillin	146/202 (72.3)	143/206 (69.4)	185/242 (76.4)
Apramycin	29/202 (14.4)	41/206 (19.9)	34/242 (14.0)
Cefotaxime	0/202 (0)	0/206 (0)	0/242 (0)
Ceftazidime	0/202 (0)	0/206 (0)	0/242 (0)
Chloramphenicol	104/202 (51.5)	110/206 (53.4)	125/242 (51.7)
Ciprofloxacin	0/202 (0)	0/206 (0)	0/242 (0)
Furazolidone	0/202 (0)	0/206 (0)	0/242 (0)
Gentamicin	34/202 (16.8)	41/206 (19.9)	36/242 (14.9)
Nalidixic acid	0/202 (0)	0/206 (0)	1/242 (0.4)
Neomycin	24/202 (11.9)	40/206 (19.4)	46/242 (19.0)
Spectinomycin	-	-	-
Streptomycin	144/202 (71.3)	136/206 (66.0)	151/242 (62.4)
Sulphonamide compounds	161/202 (79.7)	156/206 (75.7)	183/242 (75.6)
Tetracycline	151/202 (74.8)	139/206 (67.5)	157/242 (64.9)
Trimethoprim/sulphonamide	105/202 (52.0)	118/206 (57.3)	124/242 (51.2)

b) Northern Ireland

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	4/13 (30.8)	1/14 (7.1)	0/9 (0)
Ampicillin	11/13 (84.6)	13/14 (92.9)	4/9 (44.4)
Apramycin	5/13 (38.5)	6/14 (42.9)	4/9 (44.4)
Cefotaxime	0/13 (0)	0/15 (0)	0/9 (0)
Ceftazidime	0/13 (0)	0/14 (0)	0/9 (0)
Chloramphenicol	7/13 (53.8)	7/14 (50.0)	4/9 (44.4)
Ciprofloxacin	0/13 (0)	4/15 (26.7)	0/9 (0)
Furazolidone	0/13 (0)	2/15 (13.3)	0/9 (0)
Gentamicin	5/13 (38.5)	0/15 (0)	4/9 (44.4)
Nalidixic acid	3/13 (23.1)	6/15 (40.0)	2/9 (22.2)
Neomycin	-	-	-
Spectinomycin	8/13 (61.5)	7/15 (46.7)	6/9 (66.7)
Streptomycin	12/13 (92.3)	14/15 (93.3)	6/9 (66.7)
Sulphonamide compounds	-	14/15 (93.3)	6/9 (66.7)
Tetracycline	12/13 (92.3)	14/15 (93.3)	5/9 (55.6)
Trimethoprim/sulphonamide	5/13 (38.5)	7/15 (46.7)	4/9 (44.4)

c) Scotland

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/19 (0)	0/14 (0)	0/20 (0)
Ampicillin	48/74 (64.9)	6/14 (42.9)	10/20 (50.0)
Apramycin	-	0/13 (0)	0/20 (0)
Cefotaxime	0/74 (0)	-	0/20 (0)
Cefpodoxime	0/19 (0)	0/13 (0)	0/20 (0)
Ceftazidime	-	-	0/20 (0)
Chloramphenicol	0/74 (0)	-	-
Ciprofloxacin	0/74 (0)	-	0/20 (0)
Enrofloxacin	0/19 (0)	0/14 (0)	0/20 (0)
Florfenicol	0/19 (0)	1/14 (7.1)	0/20 (0)
Furazolidone	0/74 (0)	-	-
Gentamicin	0/74 (0)	-	-
Nalidixic acid	1/74 (1.4)	-	0/20 (0)
Neomycin	0/74 (0	1/14 (7.1)	0/20 (0)
Spectinomycin	9/74 (12.2)	1/13 (7.7)	0/20 (0)
Streptomycin	52/74 (70.3)	-	-
Sulphonamide compounds	52/74 (70.3)	-	-
Tetracycline	58/74 (78.4)	5/14 (35.7)	10/20 (50.0)
Trimethoprim/sulphonamide	1/74 (1.4)	1/14 (7.1)	1/20 (5.0)

Table S4.8.4: Resistance (interpreted using breakpoints) in all *Salmonella* from sheep (all ages) in a) England and Wales, b) Northern Ireland and c) Scotland from 2018 to 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

a) England and Wales

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/276 (0)	0/82 (0)	0/69 (0)
Ampicillin	18/276 (6.5)	0/82 (0)	2/69 (2.9)
Apramycin	2/276 (0.7)	0/82 (0)	0/69 (0)
Cefotaxime	0/276 (0)	0/82 (0)	0/69 (0)
Ceftazidime	0/276 (0)	0/82 (0)	0/69 (0)
Chloramphenicol	15/276 (5.4)	0/82 (0)	2/69 (2.9)
Ciprofloxacin	0/276 (0)	0/82 (0)	0/69 (0)
Furazolidone	1/276 (0.4)	0/82 (0)	0/69 (0)
Gentamicin	1/276 (0.4)	0/82 (0)	0/69 (0)
Nalidixic acid	0/276 (0)	0/82 (0)	1/69 (1.4)
Neomycin	1/276 (0.4)	0/82 (0)	0/69 (0)
Spectinomycin	-	-	-
Streptomycin	21/276 (7.6)	1/82 (1.2)	3/69 (4.3)
Sulphonamide compounds	20/276 (7.2)	1/82 (1.2)	3/69 (4.3)
Tetracycline	19/276 (6.9)	0/82 (0)	3/69 (4.3)
Trimethoprim/sulphonamide	1/276 (0.4)	0/82 (0)	1/69 (1.4)

b) Northern Ireland

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/11 (0)	0/7 (0)	0/5 (0)
Ampicillin	2/11 (18.2)	0/7 (0)	0/5 (0)
Apramycin	0/11 (0)	0/7 (0)	0/5 (0)
Cefotaxime	0/11 (0)	1/7 (14.3)	0/5 (0)
Ceftazidime	0/11 (0)	0/7 (0)	0/5 (0)
Chloramphenicol	0/11 (0)	0/7 (0)	0/5 (0)
Ciprofloxacin	0/11 (0)	0/7 (0)	0/5 (0)
Furazolidone	0/11 (0)	0/7 (0)	0/5 (0)
Gentamicin	0/11 (0)	0/7 (0)	0/5 (0)
Nalidixic acid	0/11 (0)	0/7 (0)	0/5 (0)
Neomycin	-	-	-
Spectinomycin	0/11 (0)	0/7 (0)	0/5 (0)
Streptomycin	2/11 (18.2)	3/7 (42.9)	0/5 (0)
Sulphonamide compounds	0/11 (0)	0/7 (0)	0/5 (0)
Tetracycline	2/11 (18.2)	0/7 (0)	0/5 (0)
Trimethoprim/sulphonamide	0/11 (0)	0/7 (0)	0/5 (0)

c) Scotland

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	4/61 (6.6)	0/38 (0)	0/16 (0)
Ampicillin	6/68 (8.8)	1/37 (2.7)	0/16 (0)
Apramycin	-	1/38 (2.6)	0/16 (0)
Cefotaxime	0/68 (0)	-	0/16 (0)
Cefpodoxime	0/61 (0)	0/38 (0)	0/16 (0)
Ceftazidime	-	-	0/16 (0)
Chloramphenicol	4/68 (5.9)	-	-
Ciprofloxacin	0/68 (0)	-	0/16 (0)
Enrofloxacin	0/61 (0)	0/38 (0)	0/16 (0)
Florfenicol	4/61 (6.6)	1/38 (2.6)	0/16 (0)
Furazolidone	3/68 (4.4)	-	-
Gentamicin	0/68 (0)	-	-
Nalidixic acid	3/68 (4.4)	-	0/16 (0)
Neomycin	0/68 (0)	0/38 (0)	0/16 (0)
Spectinomycin	6/68 (8.8)	1/38 (2.6)	-
Streptomycin	6/68 (8.8)	-	-
Sulphonamide compounds	8/68 (11.8)	-	-
Tetracycline	7/68 (10.3)	1/38 (2.6)	1/16 (6.3)
Trimethoprim/sulphonamide	1/68 (1.5)	0/38 (0)	0/16 (0)

Table S4.8.5: Resistance (interpreted using breakpoints) in all *Salmonella* from chickens (all ages) in England and Wales and Northern Ireland from 2018 to 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates. Insufficient data was available from Scotland from 2018 to 2020 and from Northern Ireland from 2018 to 2019. Data from 2018 and 2019 were retrospectively updated.

a) England and Wales

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/1640 (0)	0/1708 (0)	2/1659 (0.1)
Ampicillin	49/1640 (3.0)	32/1708 (1.9)	95/1659 (5.7)
Apramycin	0/1640 (0)	2/1708 (0.1)	8/1659 (0.5)
Cefotaxime	2/1640 (0.1)	0/1708 (0)	2/1659 (0.1)
Ceftazidime	2/1640 (0.1)	0/1708 (0)	2/1659 (0.1)
Chloramphenicol	3/1640 (0.2)	5/1708 (0.3)	30/1659 (1.8)
Ciprofloxacin	2/1640 (0.1)	0/1708 (0)	5/1659 (0.3)
Furazolidone	11/1640 (0.7)	7/1708 (0.4)	8/1659 (0.5)
Gentamicin	8/1640 (0.5)	2/1708 (0.1)	8/1659 (0.5)
Nalidixic acid	7/1640 (0.4)	10/1708 (0.6)	13/1659 (0.8)
Neomycin	18/1640 (1.1)	31/1708 (1.8)	8/1659 (0.5)
Streptomycin	97/1640 (5.9)	145/1708 (8.5)	103/1656 (6.2)
Sulphonamide compounds	185/1640 (11.3)	307/1708 (18.0)	370/1659 (22.3)
Tetracycline	128/1640 (7.8)	265/1708 (15.5)	30/1659 (1.8)
Trimethoprim/sulphonamide	98/1640 (6.0)	224/1708 (13.1)	289/1659 (17.4)

b) Northern Ireland

Antibiotic	2018[1]	2019[1]	2020
Amoxicillin/clavulanate	-	-	1/45 (2.2)
Ampicillin	-	-	2/45 (4.4)
Apramycin	-	-	0/45 (0)
Cefotaxime	-	-	0/45 (0)
Ceftazidime	-	-	0/45 (0)
Chloramphenicol	-	-	1/45 (2.2)
Ciprofloxacin	-	-	1/45 (2.2)
Furazolidone	-	-	3/45 (6.7)
Gentamicin	-	-	0/45 (0)
Nalidixic acid	-	-	3/45 (6.7)
Neomycin	-	-	-
Streptomycin	-	-	3/45 (6.7)
Sulphonamide compounds	-	-	5/45 (11.1)
Tetracycline	-	-	4/45 (8.)
Trimethoprim/sulphonamide	-	-	3/45 (6.7)

Table S4.8.6: Resistance (interpreted using breakpoints) in all *Salmonella* from turkeys (all ages) in England and Wales and Northern Ireland from 2018 to 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates. Insufficient data was available from Scotland from 2018 to 2020 and from Northern Ireland from 2018 to 2019.

a) England and Wales

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/182 (0)	0/270 (0)	0/141 (0)
Ampicillin	26/182 (14.4)	33/270 (12.2)	44/141 (31.2)
Apramycin	1/182 (0.6)	0/270 (0)	0/141 (0)
Cefotaxime	0/182 (0)	0/270 (0)	0/141 (0)
Ceftazidime	0/182 (0)	0/270 (0)	0/141 (0)
Chloramphenicol	2/182 (1.1)	0/270 (0)	1/141 (0.7)
Ciprofloxacin	1/182 (0.6)	9/270 (3.3)	0/141 (0)
Furazolidone	0/182 (0)	0/270 (0)	0/141 (0)
Gentamicin	2/182 (1.1)	0/270 (0)	0/141 (0)
Nalidixic acid	11/182 (6.0)	53/270 (19.6)	12/141 (8.5)
Neomycin	2/182 (1.1)	1/270 (0.4)	0/141 (0)
Streptomycin	131/182 (71.8)	128/270 (47.4)	59/141 (41.8)
Sulphonamide compounds	127/182 (69.6)	154/270 (57.0)	47/141 (33.3)
Tetracycline	126/182 (69.1)	147/270 (54.4)	1/141 (0.7)
Trimethoprim/sulphonamide	5/182 (2.8)	53/270 (19.6)	25/141 (17.7)

b) Northern Ireland

Antibiotic	2018[1]	2019[1]	2020
Amoxicillin/clavulanate	-	-	0/1 (0)
Ampicillin	-	-	0/1 (0)
Apramycin	-	-	0/1 (0)
Cefotaxime	-	-	0/1 (0)
Ceftazidime	-	-	0/1 (0)
Chloramphenicol	-	-	0/1 (0)
Ciprofloxacin	-	-	0/1 (0)
Furazolidone	-	-	0/1 (0)
Gentamicin	-	-	0/1 (0)
Nalidixic acid	-	-	0/1 (0)
Neomycin	-	-	-
Streptomycin	-	-	0/1 (0)
Sulphonamide compounds	-	-	0/1 (0)
Tetracycline	-	-	0/1 (0)
Trimethoprim/sulphonamide	-	-	0/1 (0)

Table S4.8.7: Resistance (interpreted using breakpoints) in all *Salmonella* Dublin from cattle, pigs, sheep, chickens and turkeys (combined) in a) England and Wales, b) Northern Ireland and c) Scotland

For England and Wales data is available for 2015 to 2020. For Northern Ireland and Scotland data is from 2018 to 2020. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

a) England and Wales

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/320 (0)	0/269 (0)	0/256 (0)
Ampicillin	0/320 (0)	0/269 (0)	3/256 (1.2)
Apramycin	0/320 (0)	0/269 (0)	0/256 (0)
Cefotaxime	0/320 (0)	0/269 (0)	0/256 (0)
Ceftazidime	0/320 (0)	0/269 (0)	0/256 (0)
Chloramphenicol	1/320 (0.3)	1/269 (0.4)	6/256 (2.3)
Ciprofloxacin	0/320 (0)	0/269 (0)	0/256 (0)
Furazolidone	0/320 (0)	0/269 (0)	0/256 (0)
Gentamicin	0/320 (0)	0/269 (0)	0/256 (0)
Nalidixic acid	7/320 (2.2)	0/269 (0)	4/256 (1.6)
Neomycin	1/320 (0.3)	0/269 (0)	13/256 (5.1)
Streptomycin	1/320 (0.3)	1/269 (0.4)	2/256 (0.8)
Sulphonamide compounds	1/320 (0.3)	1/269 (0.4)	2/256 (0.8)
Tetracycline	1/320 (0.3)	1/269 (0.4)	10/256 (3.9)
Trimethoprim/sulphonamide	0/320 (0)	2/269 (0.7)	2/256 (0.8)

b) Northern Ireland

Antibiotic	2018	2018	2020
Amoxicillin/clavulanate	0/68 (0)	0/48 (0)	0/44 (0)
Ampicillin	0/68 (0)	0/48 (0)	0/44 (0)
Apramycin	0/68 (0)	0/48 (0)	0/44 (0)
Cefotaxime	0/68 (0)	0/48 (0)	0/44 (0)
Ceftazidime	0/68 (0)	0/48 (0)	0/44 (0)
Chloramphenicol	0/68 (0)	0/48 (0)	0/44 (0)
Ciprofloxacin	0/68 (0)	1/48 (2.1)	0/44 (0)
Furazolidone	0/68 (0)	0/48 (0)	0/44 (0)
Gentamicin	0/68 (0)	0/48 (0)	0/44 (0)
Nalidixic acid	1/68 (1.5)	3/48 (6.3)	2/44 (4.5)
Neomycin	-	-	-
Streptomycin	1/68 (1.5)	8/48 (16.7)	2/44 (4.5)
Sulphonamide compounds	-	0/48 (0)	0/44 (0)
Tetracycline	0/68 (0)	0/48 (0)	0/44 (0)
Trimethoprim/sulphonamide	0/68 (0)	0/48 (0)	0/44 (0)

c) Scotland

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/109 (0)	0/91 (0)	0/84 (0)
Ampicillin	2/118 (1.7)	0/91 (0)	0/84 (0)
Apramycin	-	0/90 (0)	0/84 (0)
Cefotaxime	0/118 (0)	-	0/84 (0)
Ceftazidime	-	-	0/84 (0)
Chloramphenicol	10/118 (8.5)	-	-
Ciprofloxacin	0/118 (0)	-	0/84 (0)
Furazolidone	0/118 (0)	-	-
Gentamicin	1/118 (0.8)	-	-
Nalidixic acid	4/118 (3.4)	-	0/84 (0)
Neomycin	0/118 (0)	0/91 (0)	0/84 (0)
Streptomycin	4/118 (3.4)	-	-
Sulphonamide compounds	10/118 (8.5)	-	-
Tetracycline	7/118 (5.9)	1/91 (1.1)	0/84 (0)
Trimethoprim/sulphonamide	1/118 (0.8)	0/91 (0)	0/84 (0)

Table S4.8.8: Resistance (interpreted using breakpoints) in all *Salmonella* Typhimurium from cattle, pigs, sheep, chickens and turkeys (combined) in a) England and Wales, b) Northern Ireland and c) Scotland from 2018 to 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

a) England and Wales

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	3/504 (0.6)	0/254 (0)	0/340 (0)
Ampicillin	152/504 (30.2)	117/254 (46.1)	170/340 (50.0)
Apramycin	9/504 (1.8)	2/254 (0.8)	3/340 (0.9)
Cefotaxime	0/504 (0)	0/254 (0)	2/340 (0.6)
Ceftazidime	0/504 (0)	0/254 (0)	2/340 (0.6)
Chloramphenicol	151/504 (30.0)	112/254 (44.1)	154/340 (45.3)
Ciprofloxacin	1/504 (0.2)	0/254 (0)	4/340 (1.2)
Furazolidone	0/504 (0)	0/254 (0)	0/340 (0)
Gentamicin	8/504 (1.6)	2/254 (0.8)	7/340 (2.1)
Nalidixic acid	2/504 (0.4)	0/254 (0)	10/340 (2.9)
Neomycin	9/504 (1.8)	2/254 (0.8)	26/340 (7.6)
Streptomycin	205/504 (40.7)	102/254 (40.2)	169/340 (49.7)
Sulphonamide compounds	222/504 (44.0)	117/254 (46.1)	199/340 (58.5)
Tetracycline	183/504 (36.3)	107/254 (42.1)	172/340 (50.6)
Trimethoprim/sulphonamide	79/504 (15.7)	61/254 (24.0)	115/340 (33.8)

b) Northern Ireland

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	4/15 (26.7)	3/20 (15.0)	2/24 (8.3)
Ampicillin	15/15 (100)	16/20 (80.0)	7/24 (29.2)
Apramycin	6/15 (40.0)	7/20 (35.0)	4/24 (16.7)
Cefotaxime	0/15 (0)	2/20 (10.0)	0/24 (0)
Ceftazidime	0/15 (0)	0/20 (0)	0/24 (0)
Chloramphenicol	8/15 (53.3)	9/20 (45.0)	5/24 (20.8)
Ciprofloxacin	0/15 (0)	3/20 (15.0)	0/24 (0)
Furazolidone	0/15 (0)	3/20 (15.0)	0/24 (0)
Gentamicin	6/15 (40.0)	7/20 (35.0)	4/24 (16.7)
Nalidixic acid	3/15 (20.0)	4/20 (20.0)	2/24 (8.3)
Neomycin	-	-	-
Streptomycin	15/15 (100)	17/20 (85.0)	10/24 (41.7)
Sulphonamide compounds	-	16/20 (80.0)	10/24 (41.7)
Tetracycline	15/15 (100)	16/20 (80.0)	8/24 (33.3)
Trimethoprim/sulphonamide	6/15 (40.0)	7/20 (35.0)	4/24 (16.7)

c) Scotland

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	13/32 (40.6)	18/28 (64.3)	11/13 (84.6)
Ampicillin	63/82 (76.8)	24/28 (85.7)	11/13 (84.6)
Apramycin	-	0/28 (0)	0/13 (0)
Cefotaxime	0/82 (0)	-	0/13 (0)
Ceftazidime	-	-	0/13 (0)
Chloramphenicol	14/82 (17.1)	-	-
Ciprofloxacin	0/82 (0)	-	0/13 (0)
Furazolidone	1/82 (1.2)	-	-
Gentamicin	0/82 (0)	-	-
Nalidixic acid	2/82 (2.4)	-	0/13 (0)
Neomycin	0/82 (0)	0/28 (0)	0/13 (0)
Streptomycin	70/82 (85.4)	-	-
Sulphonamide compounds	67/82 (81.7)	-	-
Tetracycline	73/82 (89.0)	20/28 (71.4)	11/13 (84.6)
Trimethoprim/sulphonamide	0/82 (0)	0/28 (0)	0/13 (0)

Table S4.8.9: Resistance (interpreted using breakpoints) in all *Salmonella* other than Dublin and Typhimurium from cattle, pigs, sheep, chickens and turkeys (combined) in a) England and Wales, b) Northern Ireland and c) Scotland from 2018 to 2020

The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates. Data from 2018 was retrospectively updated.

a) England and Wales

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	2/3589 (0.1)	0/4010 (0)	2/3617 (0.1)
Ampicillin	276/3589 (7.7)	297/4010 (7.4)	373/3617 (10.3)
Apramycin	29/3589 (0.8)	52/4010 (1.3)	44/3617 (1.2)
Cefotaxime	2/3589 (0.1)	2/4010 (0)	1/3617 (0)
Ceftazidime	3/3589 (0.1)	0/4010 (0)	1/3617 (0)
Chloramphenicol	54/3589 (1.5)	84/4010 (2.1)	86/3617 (2.4)
Ciprofloxacin	6/3589 (0.2)	16/4010 (0.4)	16/3617 (0.4)
Furazolidone	43/3589 (1.2)	64/4010 (1.6)	36/3617 (1.0)
Gentamicin	42/3589 (1.2)	53/4010 (1.3)	46/3617 (1.3)
Nalidixic acid	50/3589 (1.4)	108/4010 (2.7)	121/3617 (3.3)
Neomycin	65/3589 (1.8)	104/4010 (2.6)	109/3617 (3.0)
Streptomycin	420/3589 (11.7)	602/4010 (15.0)	414/3617 (11.4)
Sulphonamide compounds	563/3589 (15.7)	810/4010 (20.2)	716/3617 (19.8)
Tetracycline	535/3589 (14.9)	810/4010 (20.2)	698/3617 (19.3)
Trimethoprim/ sulphonamides	190/3589 (5.3)	409/4010 (10.2)	422/3617 (11.7)

b) Northern Ireland

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/17 (0)	0/14 (0)	0/44 (0)
Ampicillin	0/17 (0)	0/14 (0)	0/44 (0)
Apramycin	0/17 (0)	0/14 (0)	0/44 (0)
Cefotaxime	0/17 (0)	0/14 (0)	0/44 (0)
Ceftazidime	0/17 (0)	0/14 (0)	0/44 (0)
Chloramphenicol	0/17 (0)	0/14 (0)	0/44 (0)
Ciprofloxacin	0/17 (0)	0/14 (0)	1/44 (2.3)
Furazolidone	0/17 (0)	0/14 (0)	3/44 (6.8)
Gentamicin	0/17 (0)	0/14 (0)	0/44 (0)
Nalidixic acid	0/17 (0)	1/14 (7.1)	4/44 (9.1)
Neomycin	-	-	-
Streptomycin	0/17 (0)	4/14 (28.6)	2/44 (4.5)
Sulphonamide compounds	-	1/14 (7.1)	3/44 (6.8)
Tetracycline	1/17 (5.9)	0/14 (0)	3/44 (6.8)
Trimethoprim/sulphonamides	0/17 (0)	0/14 (0)	3/44 (6.8)

c) Scotland

Antibiotic	2018	2019	2020
Amoxicillin/clavulanate	0/69 (0)	5/122 (4.1)	0/51 (0)
Ampicillin	2/82 (2.4)	14/123 (11.4)	1/51 (2.0)
Apramycin	-	2/121 (1.7)	0/51 (0)
Cefotaxime	0/82 (0)	-	0/51 (0)
Ceftazidime	-	-	0/51 (0)
Chloramphenicol	0/82 (0)	-	-
Ciprofloxacin	0/82 (0)	-	0/51 (0)
Furazolidone	2/82 (2.4)	-	-
Gentamicin	0/82 (0)	-	-
Nalidixic acid	2/82 (2.4)	-	0/51 (0)
Neomycin	0/82 (0)	1/123 (0.8)	0/51 (0)
Streptomycin	1/82 (1.2)	-	-
Sulphonamide compounds	5/82 (6.1)	-	-
Tetracycline	4/82 (4.9)	10/122 (8.2)	2/51 (3.9)
Trimethoprim/sulphonamides	2/82 (2.4)	2/122 (1.6)	1/51 (2.0)

Table S4.8.10: Top ten *Salmonella* serovars isolated in Northern Ireland from 2018 to 2020

Rank	2018	2019	2020
1	Dublin (69 isolations)	Dublin (51 isolations)	Dublin (120 isolations)
2	Monophasic ST (10 isolations)	Monophasic ST (15 isolations)	Typhimurium (94 isolations)
3	Mbandaka (6 isolations) Agama (6 isolations)	Typhimurium (8 isolations)	Infantis (59 isolations)
4	Typhimurium (5 isolations)	Montevideo (5 isolations)	Enteritidis (47 isolations)
5	Diarizonae o 61 (2 isolations) Montevideo (2 isolations) Newport (2 isolations)	Mbandaka (4 isolations)	Mbandaka (17 isolations)
6	Anatum (1 isolation) Ruiru (1 isolation)	Agama (2 isolations)	Senftenberg (12 isolations)
7	No other serovars detected in 2018	Nima (2 isolations)	Muenster (10 isolations)
8	No other serovars detected in 2018	Agona (1 isolation)	Livingstone (9 isolations)
9	No other serovars detected in 2018	Newport (1 isolation)	Cerro (8 isolations)
10	No other serovars detected in 2018	Derby (1 isolation)	Newport (4 isolations)

Table S4.8.11: Top ten *Salmonella* serovars isolated in Scotland from 2018 to 2020

Rank	2018	2019	2020
1	Dublin (118 isolations)	Dublin (91 isolations)	Dublin (89 isolations)
2	Typhimurium (82 isolations)	Mbandaka (42 isolations)	Mbandaka (30 isolations)
3	Arizonae (36 isolations)	Typhimurium (28 isolations)	Bovismorbificans (16 isolations)
4	Montevideo (18 isolations)	Arizonae (27 isolations)	Typhimurium (15 isolations)
5	Bovismorbificans (8 isolations)	Monophasic group B 4,(5),12 :I : - (17 isolations)	Monophasic group B ST34 (12 isolations)
6	Mbandaka (7 isolations)	Montevideo (9 isolations)	Arizonae (12 isolations)
7	Derby (4 isolations)	Bovismorbificans (7 isolations)	Bredeney (5 isolations)
8	Reading (3 isolations)	Group B (6 isolations)	Montevideo (4 isolations)
9	Panama (2 isolations)	Enteritidis (2 isolations)	Derby (4 isolations)
10	Enteritidis (1 isolation)	Derby (1 isolation)	Kottbus (2 isolations)

S4.9 AMR in dogs and cats

The data presented below was kindly shared by the Small Animal Veterinary Surveillance Network (SAVSNET) with the VMD.

Table 4.9.1: Resistance of *E. coli* isolates from dogs and cats in the UK

The table shows the total number tested and the percentage of resistant isolates.

Antibiotic	Dogs	Cats
Aminoglycosides	16,478 (3.7)	2,250 (2.2)
Amphenicols	39,63 (7.2)	385 (4.6)
Beta-lactams: first and second generation cephalosporins	44,137 (13.4)	15,495 (13.7)
Beta-lactams: third generation cephalosporins	37,921 (7.6)	14,693 (7.2)
Beta-lactams: carbapenems	104 (0)	13 (0)
Beta-lactams: extended spectrum penicillins	42,460 (31.6)	16,118 (26.9)
Beta-lactams: potentiated penicillins	46,356 (12.4)	16,470 (11.1)
Fluoroquinolones	46,455 (5.6)	16,482 (2.0)
Nitrofurantoin	24,953 (0.8)	12,835 (0.3)
Polymyxins	894 (29.2)	51 (9.6)
Potentiated sulphonamides	42,598 (9.2)	16,136 (3.7)
Tetracycline	41,017 (11.7)	15,821 (5.6)

Table 4.9.2: Resistance of *Staphylococcus pseudintermedius* isolates from dogs and cats in the UK

The table shows the total number tested and the percentage of resistant isolates.

Antibiotic	Dogs	Cats
Aminoglycosides	61,330 (4.1)	961 (5.5)
Amphenicols	27,232 (5.8)	308 (6.1)
Beta-lactams: first and second generation cephalosporins	61,879 (6.2)	1,014 (9.9)
Beta-lactams: third generation cephalosporins	33,757 (3.9)	638 (4.2)
Beta-lactams: carbapenems	5 (0)	-
Beta-lactams: extended spectrum penicillins	6,532 (78.8)	215 (48.9)
Beta-lactams: narrow spectrum penicillins	60,805 (24.7)	923 (31.5)
Beta-lactams: potentiated penicillins	61,911 (6.1)	1,018 (10.0)
Fluoroquinolones	62,382 (4.9)	1,049 (7.5)
Fusidic acid	46,891 (9.6)	645 (6.2)
Lincosamides	30,891 (16.7)	589 (18.5)
Macrolides	940 (30.3)	51 (11.8)
Mupirocin	1,190 (0.8)	45 (2.3)
Nitrofurantoin	5,898 (0.2)	142 (0)
Polymyxins	544 (7.6)	39 (0)
Potentiated sulphonamides	36,015 (6.9)	746 (10.6)
Rifamycin	2,071 (1.9)	72 (0)
Tetracycline	39,847 (20.2)	784 (16.3)

Table 4.9.3: Resistance of *Pseudomonas aeruginosa* isolates from dogs and cats in the UK

The table shows the total number tested and the percentage of resistant isolates.

Antibiotic	Dogs	Cats
Aminoglycosides	39,651 (9.9)	1,677 (3.4)
Beta-lactams: third generation cephalosporins	548 (23.5)	52 (33.1)
Beta-lactams: carbapenems	68 (1.4)	9 (21.8)
Fluoroquinolones	40,493 (19.8)	1,843 (9.0)
Polymyxins	38,456 (2.4)	1,398 (1.0)