



Veterinary  
Medicines  
Directorate

# Supplementary Material

## UK-VARSS 2019

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## S1.1: 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 (reports prior to UK-VARSS 2015). Table S1.1.1 summarises these differences.

**Table S1.1.1:** 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 <u>not included</u> as food-producing animals.	Horses <u>included</u> 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 ( <i>for all species</i> ) 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 S1.1.2 (World Health Organization, 2018).



**Table S1.1.2:** 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 S1.1.3 shows the sales for other antibiotic products, which include topical preparations and those for sensory organs, e.g. aerosols, creams, gels, shampoos and ear and eye medications. These are not included in the ESVAC calculation.

**Table S1.1.3:** Active ingredient (tonnes) of antibiotics sold for all animal species by ‘other’ routes of administration from 2015 to 2019

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

## S1.2: 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 C of the main report – 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 (see Table S1.2.3) 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 (data from 2005 to 2009):

<https://www.ema.europa.eu/en/veterinary-regulatory/overview/antimicrobial-resistance/european-surveillance-veterinary-antimicrobial-consumption-esvac>.

Table S1.2.1 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 (European Medicines Agency, 2011).

**Table S1.2.1:** PCU (1,000 tonnes) by food-producing animal species from 2015 to 2019

Animal species	2015	2016	2017	2018	2019
Sheep and goats	2,795.6	2,845.3	2,910.4	2832.7	2817.6
Cattle	1,743.0	1,792.3	1,785.2	1787.7	1774.7
Poultry	1,082.4	1,150.9	1,185.3	1233.0	1204.5
Pigs	769.7	788.9	766.4	781.0	795.5
Horses*	377.6	377.6	377.6	377.6	338.8
Fish	193.1	187.3	117.3	203.6	168.8
<b>Total PCU</b>	<b>6961.4</b>	<b>7142.4</b>	<b>7202.1</b>	<b>7215.7</b>	<b>7099.9</b>

\* Horse population data are obtained from the British Equestrian Trade Association survey which is run every 5 years.

Table S1.2.2 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<sup>1</sup> and mean adult cat and dog weights provided by the Small Animal Veterinary Surveillance Network (SAVSNET)<sup>2</sup>. 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 S1.2.2** Weights, in 1,000 tonnes, of a) dogs and b) cats from 2014 to 2019

a)

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

b)

Cats	2014	2015	2016	2017	2018	2019
Population (1,000s) heads	7,900	7,400	7,500	8,000	8,000	7,500
Mean weight (kg)	4.4	4.4	4.4	4.5	4.5	4.5
Total weight of cats (1,000 tonnes)	34.8	32.8	32.6	35.7	35.7	33.5
<b>Total combined weight of dogs and cats (1,000 tonnes)</b>	<b>207.7</b>	<b>195.0</b>	<b>192.4</b>	<b>192.8</b>	<b>200.6</b>	<b>197.2</b>

<sup>1</sup> <https://www.pfma.org.uk/statistics>

<sup>2</sup> University of Liverpool, Small Animal Veterinary Surveillance Network (SAVSNET) project, personal communication, 2020

**Table S1.2.3:** Average weight at time of treatment (kg) used to calculate the PCU for food-producing animals

a) Cattle

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

b) Pigs

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

c) Poultry

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

<sup>3</sup> Montforts, M. H. M. M. (1999). Environmental risk assessment for veterinary medicinal products. Part 1. Other than GMO-containing and immunological products. First update.

<sup>4</sup> European Medicines Agency (2016). Revised guideline on environmental impact assessment for veterinary medicinal products in support of the VICH guidelines GL6 and GL 38 (EMA/CVMP/ERA/418282/2005-Rev.1- Corr.).

\*Assume broilers.

\*\*Assume lambs.

d) Sheep and goats

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

e) Horses

Animal category	Average weight at treatment (kg)	Source
Living horses	400	Montforts (1999) <sup>3</sup> ; EMA <sup>2</sup>

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

### S1.3: Antibiotic Active Ingredients Authorised for Use in Animals

**Table S1.3.1.** 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: 1<sup>st</sup> 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: 3<sup>rd</sup> generation cephalosporins

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

e) Beta-lactams: 4<sup>th</sup> generation cephalosporins

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

f) 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

g) 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

#### h) 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

#### i) 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

#### j) Other: Amphenicols

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

#### k) 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

l) Other: Pleuromutilins

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

m) Other: Polymyxins

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

n) Other: other antibiotics

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

\* Denotes the classes of antibiotics which are considered 'Highest Priority Critically Important Antibiotics for people' (HP-CIAs) based on classification by the Antimicrobial Advice Ad Hoc Expert Group (AMEG) of the EMA.

Note: Non-food-producing animal species are indicated in italics.

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 man, or because no breakpoints are available for the antibiotic for which testing ideally should be taking place.

**Table S1.3.2.** Antibiotics not authorised for use in food-producing animals

Antibiotic class	Active ingredient
Aminoglycosides	Amikacin
Amphenicols	Chloramphenicol
3 <sup>rd</sup> generation cephalosporins	Cefotaxime
3 <sup>rd</sup> generation cephalosporins	Cefpodoxime
3 <sup>rd</sup> generation cephalosporins	Ceftazidime
Fluoroquinolones	Ciprofloxacin
Other anti-infectives and antiseptics	Furazolidone
Quinolones	Nalidixic acid



## S1.4: 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, e.g. 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.

### 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
<i>Salmonella</i> spp. – broilers	x		x		x		x
<i>Salmonella</i> spp. – layers	x		x		x		x
<i>Salmonella</i> spp. – fattening turkeys	x		x		x		x
<i>Salmonella</i> spp. – broiler carcasses	x		x		x		x
<i>Salmonella</i> spp. – fattening turkey carcasses	x		x		x		x
<i>Salmonella</i> spp. – pig carcasses		x		x		x	
<i>Campylobacter jejuni</i> – broilers	x		x		x		x
<i>Campylobacter jejuni</i> – fattening turkeys	x		x		x		x
<i>Escherichia coli</i> – broiler caeca	x		x		x		x
<i>Escherichia coli</i> – turkey caeca	x		x		x		x
<i>Escherichia coli</i> – pig caeca		x		x		x	
ESBL-, AmpC- or carbapenemase-producing <i>E. coli</i> – broiler caeca	x		x		x		x
ESBL-, AmpC- or carbapenemase-producing <i>E. coli</i> – turkey caeca	x		x		x		x
ESBL-, AmpC- or carbapenemase-producing <i>E. coli</i> – pig caeca		x		x		x	
ESBL-, AmpC- or carbapenemase-producing <i>E. coli</i> – fresh broiler meat, pig meat and bovine meat gathered at retail	x	x	x	x	x	x	x
<i>Campylobacter coli</i> – broilers	x		x		x		x
<i>Campylobacter coli</i> – pigs		x		x		x	
<i>E. faecium</i> and <i>E. faecalis</i> – 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.

## S3.2: UK 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.

**Table S3.2.1:** Susceptibility in *E. coli* (interpreted using EUCAST CBPs and ECOFFs) from caecal samples from pigs at slaughter. This table shows the number and percentage of resistant isolates, as defined by CBP, or less susceptible isolates, as defined by ECOFF for 2015, 2017 and 2019

Antibiotic	CBPs (2015, n=150)	ECOFFs (2015, n=150)	CBPs (2017, n= 186)	ECOFFs (2017, n= 186)	CBPs (2019, n=208)	ECOFFs (2019, n=208)
Ampicillin	57 (38.0)	57 (38.0)	57 (30.6)	57 (30.6)	75 (36.1)	75 (36.1)
Azithromycin	*	2 (1.3)	*	0	*	1 (0.5)
Cefotaxime <sup>^</sup>	0	0	0	0	3 (1.4)	5 (2.4)
Ceftazidime <sup>^</sup>	0	0	0	0	2 (1.0)	5 (2.4)
Chloramphenicol	48 (32.0)	47 (31.3)	43 (23.1)	38 (20.4)	38 (18.3)	34 (16.3)
Ciprofloxacin <sup>^</sup>	1 (0.7)	4 (2.7)	3 (1.6)	5 (2.7)	1 (0.5)	7 (3.4)
Colistin <sup>^</sup>	0	0	0	0	0	0
Gentamicin	10 (6.7)	11 (7.3)	7 (3.8)	7 (3.8)	3 (1.4)	3 (1.4)
Meropenem	0	0	0	0	0	0
Nalidixic acid	*	2 (1.3)	*	4 (2.2)	*	2 (1.0)
Sulfamethoxazole	*	87 (58.0)	*	88 (47.3)	*	89 (42.8)
Tetracycline	*	108 (72.0)	*	110 (59.1)	*	122 (58.7)
Tigecycline	0	0	0	0	0	0
Trimethoprim	73 (48.7)	73 (48.7)	67 (36.0)	68 (36.6)	83 (39.9)	83 (39.9)

<sup>^</sup> HP-CIA, \* No clinical breakpoint value available

**Table S3.2.2:** Distribution of ESBL/AmpC and CPE enzymes detected in *E. coli* from healthy pigs England, Wales and Scotland in in 2019. 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=58) (%)	Proportion of caecal samples (n=308) (%)	Number of unique STs	Sequence type (ST)
CMY-2	3	5	1	3	10, 23, 58
CTX-M-1	30	52	10	18	10, 23 (n=3), 48, 88 (n=2), 101 (n=6), 117 (n=4), 206, 295, 394, 398, 1771, 2016, 2496, 3205, 5285, unknown ST (n=3)
CTX-M-14	4	7	1	3	156, 224, 369 (n=2)
CTX-M-15	9	16	3	9	38, 58, 69, 88, 641, 2964, 3321, unknown ST (n=2)
CTX-M-55	1	2	<1	1	1771
CTX-M-65	1	2	<1	1	683
SHV-12	1	2	<1	1	136
Up-regulated <i>ampC</i>	8	14	3	6	23, 88 (n=2), 101 (n=2), 154, 453, one unknown ST

**Table S3.2.3:** Decreased susceptibility in ESBL-/AmpC-producing *E. coli* from caecal samples from healthy pigs at slaughter in the UK for 2019

Antibiotic	Number of AmpC isolates with decreased susceptibility* (n=11)	Proportion of AmpC isolates with decreased susceptibility (%)	Number of ESBL isolates with decreased susceptibility* (n=47)	Proportion of ESBL isolates with decreased susceptibility (%)
Ampicillin	11	100	47	100
Azithromycin	1	9	5	11
Cefepime <sup>^</sup>	6	55	47	100
Cefotaxime <sup>^</sup>	11	100	47	100
Cefoxitin <sup>^</sup>	11	100	0	0
Ceftazidime <sup>^</sup>	11	100	43	91
Chloramphenicol	2	18	6	13
Ciprofloxacin <sup>^</sup>	0	0	16	34
Colistin <sup>^</sup>	0	0	0	0
Ertapenem	0	0	0	0
Gentamicin	1	9	2	4
Imipenem	0	0	0	0
Meropenem	0	0	0	0
Nalidixic acid	0	0	8	17
Sulfamethoxazole	5	45	34	72
Tetracycline	9	81	31	66
Tigecycline	0	0	0	0
Trimethoprim	4	36	28	60

\* Interpreted using EUCAST ECOFFs

<sup>^</sup> HP-CIA

### S3.3: EU Harmonised Monitoring Results of Susceptibility Testing in *Salmonella* spp.

**Table S3.3.1:** Susceptibility in *Salmonella* spp. (interpreted using both EUCAST CBPs and ECOFFs) from samples from pig carcass swab samples in the UK for 2015, 2017 and 2019. This table shows the number and percentage of resistant isolates, as defined by CBP, or less susceptible isolates, as defined by ECOFF.

Antibiotic	CBPs (2015, n=9)	ECOFFs (2015, n=9)	CBPs (2017, n=4)	ECOFFs (2017, n=4)	CBPs (2019, n=9)	ECOFFs (2019, n=9)
Ampicillin	3 (33.3)	3 (33.3)	2 (50.0)	2 (50.0)	1 (11.1)	1 (11.1)
Azithromycin	-	-	-	-	-	0
Cefotaxime <sup>^</sup>	0	0	0	0	0	0
Ceftazidime <sup>^</sup>	0	0	0	0	0	0
Chloramphenicol	1 (11.1)	1 (11.1)	0	0	0	0
Ciprofloxacin <sup>^</sup>	0	1 (11.1)	0	0	0	0
Colistin <sup>^</sup>	0	0	0	0	2 (22.2)	2 (22.2)
Gentamicin	1 (11.1)	1 (11.1)	0	0	0	0
Meropenem	0	0	0	0	0	0
Nalidixic acid	1 (11.1)	1 (11.1)	0	0	-	0
Sulfamethoxazole	*	4 (44.4)	*	2 (50.0)	-	1 (11.1)
Tetracycline	3 (33.3)	3 (33.3)	2 (50.0)	2 (50.0)	-	3 (33.3)
Tigecycline	0	0	0	0	-	0
Trimethoprim	1 (11.1)	1 (11.1)	0	0	0	0

<sup>^</sup> HP-CIA

\* No clinical breakpoint value available

**Please note:** It should be noted within this section that the symbol ^ denotes an HP-CIA antibiotic and 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.

### S4.1: Methodology Susceptibility Testing

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, e.g. amikacin (AK), are the set used for *Salmonella* susceptibility testing.

**Table S4.1.1:** Disc diffusion breakpoints, corresponding MIC breakpoints and breakpoints under review for the main bacteria covered in this report

Antibiotic	Disc charge (micrograms)	<i>Escherichia coli</i> , Enterobacteriaceae	<i>Salmonella</i>	<i>Staphylococci</i>	<i>Streptococci</i>	<i>Pasteurella, Mannheimia</i>
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 <sup>†</sup>
Cefalexin <sup>^</sup>	30	R ≤15 mm R >16 mg/l	NA	R ≤13 mm	R ≤24 mm R >2 mg/l	R ≤13 mm
Cefotaxime <sup>^</sup> (CTX)	30	R ≤29 mm R ≥2 mg/l	R ≤29 mm R ≥2 mg/l	NA	NA	NA
Cefpodoxime <sup>^</sup>	10	R ≤ 19 mm R >1 mg/l	NA	NA	NA	R ≤13 mm
Ceftazidime <sup>^</sup> (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 <sup>^</sup> (CIP)	1	NA	R ≤16 mm R ≥1 mg/l	NA	NA	NA



Antibiotic	Disc charge (micrograms)	<i>Escherichia coli</i> , Enterobacteriaceae	<i>Salmonella</i>	<i>Staphylococci</i>	<i>Streptococci</i>	<i>Pasteurella</i> , <i>Mannheimia</i>
Doxycycline	30	R ≤13 mm	NA	R ≤30 mm R ≥2 mg/l	NA	R ≤13 mm
Enrofloxacin <sup>^</sup>	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
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 <sup>†</sup>
Streptomycin (S)	10	R ≤12 mm R >8 mg/l	R ≤13 mm R > ~8 mg/l	NA	NA	R ≤13 mm <sup>†</sup>

Antibiotic	Disc charge (micrograms)	<i>Escherichia coli</i> , Enterobacteriaceae	<i>Salmonella</i>	<i>Staphylococci</i>	<i>Streptococci</i>	<i>Pasteurella, Mannheimia</i>
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

^ HP-CIA

\* Erythromycin R ≤21 mm for beta-haemolytic streptococci; R ≤19 mm for other streptococci.

\*\* Penicillin R ≤19 mm for beta-haemolytic streptococci; R ≤16 mm for other streptococci.

\*\*\* Tetracycline R ≤19 mm for beta-haemolytic streptococci; R ≤23 mm for other streptococci.

† Some *Haemophilus-Pasteurella-Actinobacillus* i.e. “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*.

**Table S4.1.2:** 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 <sup>^</sup>	CTX30	≤22	23–25	≥26
Ceftazidime <sup>^</sup>	CAZ30	≤17	18–20	≥21
Chloramphenicol	C30	≤12	13–17	≥18
Ciprofloxacin <sup>^</sup>	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

## S4.2: Clinical Surveillance Data for Isolates from Bovine Mastitis Cases

**Table S4.2.1:** Resistance (interpreted using breakpoints) in *Escherichia coli* mastitis isolates from England and Wales from 2017 to 2019. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	4/79 (5.1)	6/110 (5.5)	5/94 (5.3)
Ampicillin	17/79 (21.5)	24/110 (21.8)	37/94 (39.4)
Cefpodoxime <sup>^</sup>	1/79 (1.3)	1/110 (0.9)	1/94 (1.1)
Enrofloxacin <sup>^</sup>	2/79 (2.5)	3/110 (2.7)	0/94 (0)
Neomycin	3/79 (3.8)	3/110 (2.7)	5/94 (5.3)
Streptomycin	6/79 (7.6)	11/110 (10.0)	11/94 (11.7)
Tetracycline	12/79 (15.2)	15/110 (13.6)	12/94 (12.8)
Trimethoprim/sulphonamide	6/79 (7.6)	7/110 (6.4)	7/94 (7.4)

**Table S4.2.2:** Resistance (interpreted using breakpoints) in *Escherichia coli* mastitis isolates from Scotland for 2019

Antibiotic	No. resistant/No. tested (% resistant)
Amoxicillin/clavulanate	14/134 (10.4)
Ampicillin	32/134 (23.9)
Cefpodoxime <sup>^</sup>	2/134 (1.5)
Enrofloxacin <sup>^</sup>	2/134 (1.5)
Neomycin	2/134 (1.5)
Streptomycin	-
Tetracycline	40/134 (29.9)
Trimethoprim/sulphonamide	12/134 (9.0)

**Table S4.2.3:** Resistance (interpreted using breakpoints) of *Staphylococci* and *Streptococci* from mastitis cases from England and Wales from 2017 to 2019. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.a) *Streptococcus dysgalactiae*

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	0/39 (0)	0/32 (0)	0/18 (0)
Ampicillin	0/39 (0)	0/32 (0)	0/18 (0)
Neomycin	5/35 (14.3)	1/32 (3.1)	1/18 (5.6)
Novobiocin	0/35 (0)	0/32 (0)	0/18 (0)
Penicillin	0/39 (0)	0/32 (0)	0/18 (0)
Tetracycline	33/39 (84.6)	28/32 (87.5)	14/18 (77.8)
Tylosin	6/39 (15.4)	0/32 (0)	2/18 (11.1)

b) *Streptococcus uberis*

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	0/97 (0)	0/84 (0)	0/70 (0)
Ampicillin	0/97 (0)	0/84 (0)	1/70 (1.4)
Neomycin	67/96 (69.8)	38/84 (45.2)	19/69 (27.5)
Novobiocin	3/96 (3.1)	4/84 (4.8)	6/69 (8.7)
Penicillin	0/97 (0)	0/84 (0)	1/70 (1.4)
Tetracycline	42/97 (43.3)	29/84 (34.5)	32/70 (45.7)
Tylosin	9/97 (9.3)	10/84 (11.9)	2/70 (2.9)

c) *Staphylococcus aureus*

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	3/78 (3.8)	0/36 (0)	3/54 (5.6)
Ampicillin	16/78 (20.5)	10/36 (27.8)	14/54 (25.9)
Neomycin	0/78 (0)	0/36 (0)	1/54 (1.9)
Novobiocin	0/78 (0)	0/36 (0)	0/54 (0)
Penicillin	16/78 (20.5)	10/36 (27.8)	15/54 (27.8)
Tetracycline	1/78 (1.3)	1/36 (2.8)	5/54 (9.3)
Tylosin	0/78 (0)	1/36 (2.8)	2/54 (3.7)

**Table S4.2.4:** Resistance (interpreted using breakpoints) of a) *Klebsiella pneumoniae* and b) *Pseudomonas aeruginosa* from mastitis cases from England and Wales from 2017 to 2019. The table shows the number of resistant isolates out of the total number tested.

a) *Klebsiella pneumoniae*

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	2/13	1/11	2/6
Ampicillin	9/13	11/11	6/6
Cefalexin <sup>^</sup>	-	-	-
Cefotaxime <sup>^</sup>	0/1	-	-
Cefpodoxime <sup>^</sup>	0/9	0/9	0/5
Ceftazidime <sup>^</sup>	0/1	-	-
Enrofloxacin <sup>^</sup>	0/13	0/11	0/6
Neomycin	0/12	0/10	1/3
Streptomycin	0/9	1/8	0/2
Tetracycline	0/13	2/11	1/6
Trimethoprim/sulphonamide	0/13	2/11	0/6

b) *Pseudomonas aeruginosa*

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	2/2	5/5	2/2
Ampicillin	2/2	5/5	2/2
Cefalexin^	2/2	5/5	1/1
Cefotaxime^	2/2	5/5	1/1
Cefpodoxime^	2/2	5/5	1/1
Ceftazidime^	0/2	0/5	0/1
Enrofloxacin^	0/2	0/5	0/2
Neomycin	0/2	2/4	0/2
Streptomycin	0/2	0/4	0/1
Tetracycline	2/2	5/5	2/2
Trimethoprim/sulphonamide	2/2	5/5	2/2



### 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 2017 to 2019. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

a) *Pasteurella multocida*

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	0/75 (0)	0/76 (0)	0/74 (0)
Ampicillin	11/75 (14.7)	2/76 (2.6)	1/74 (1.4)
Cefalexin <sup>^</sup>	-	-	-
Cefpodoxime <sup>^</sup>	0/75 (0)	0/76 (0)	0/74 (0)
Enrofloxacin <sup>^</sup>	0/75 (0)	0/76 (0)	1/74 (1.4)
Florfenicol	0/75 (0)	0/74 (0)	0/73 (0)
Tetracycline	51/75 (68.0)	39/76 (51.3)	49/74 (66.2)
Trimethoprim/sulphonamide	1/75 (1.3)	0/76 (0)	1/74 (1.4)
Tylosin	-	0/1 (0)	-

b) *Mannheimia haemolytica*

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	0/43 (0)	0/44 (0)	0/70 (0)
Ampicillin	2/43 (4.7)	1/44 (2.3)	3/70 (4.3)
Cefalexin^	-	-	-
Cefpodoxime^	0/42 (0)	0/44 (0)	0/69 (0)
Enrofloxacin^	0/43 (0)	0/44 (0)	0/70 (0)
Florfenicol	1/42 (2.4)	0/44 (0)	0/69 (0)
Tetracycline	18/43 (41.9)	18/44 (40.9)	35/70 (50.0)
Trimethoprim/sulphonamide	0/43 (0)	0/44 (0)	1/70 (1.4)
Tylosin	-	-	-

c) *Trueperella pyogenes*

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	0/3 (0)	-	-
Ampicillin	0/3 (0)	-	-
Cefalexin^	0/3 (0)	-	-
Cefpodoxime^	-	-	-
Enrofloxacin^	-	-	-
Florfenicol	0/3 (0)	-	-
Tetracycline	2/3 (66.7)	-	-
Trimethoprim/sulphonamide	1/3 (33.3)	-	-
Tylosin	0/3 (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 2017 to 2019. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

### a) *Pasteurella multocida*

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	0/23 (0)	-	-
Ampicillin	5/40 (12.5)	3/35 (8.6)	2/26 (7.7)
Apramycin	4/40 (10.0)	0/35 (0)	1/26 (3.8)
Cefpodoxime <sup>^</sup>	0/40 (0)	0/35 (0)	0/26 (0)
Doxycycline	0/23 (0)	-	-
Enrofloxacin <sup>^</sup>	0/40 (0)	0/35 (0)	0/26 (0)
Florfenicol	0/23 (0)	-	-
Neomycin	0/40 (0)	0/35 (0)	0/26 (0)
Spectinomycin	0/40 (0)	2/35 (5.7)	1/26 (3.8)
Streptomycin	3/23 (13.0)	-	-
Tetracycline	32/40 (80.0)	21/35 (60.0)	16/26 (61.5)
Trimethoprim/sulphonamide	8/40 (20.0)	5/35 (14.3)	7/26 (26.9)
Tylosin	-	-	-

b) *Actinobacillus pleuropneumoniae*

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	0/8 (0)	-	-
Ampicillin	0/9 (0)	1/13 (7.7)	0/18 (0)
Apramycin	0/9 (0)	9/13 (69.2)	12/18 (66.7)
Cefpodoxime^	0/9 (0)	0/13 (0)	0/18 (0)
Doxycycline	1/8 (12.5)	-	-
Enrofloxacin^	0/9 (0)	0/13 (0)	0/18 (0)
Florfenicol	0/8 (0)	-	-
Neomycin	1/9 (11.1)	10/13 (76.9)	12/18 (66.7)
Spectinomycin	0/9 (0)	10/13 (76.9)	12/18 (66.7)
Streptomycin	1/8 (12.5)	-	-
Tetracycline	3/9 (33.3)	0/13 (0)	4/18 (22.2)
Trimethoprim/sulphonamide	0/9 (0)	1/13 (7.7)	2/18 (11.1)
Tylosin	5/8 (62.5)	-	-

## 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 2017 to 2019. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

### a) *Pasteurella multocida*

Antibiotic	2017	2018	2019
Amoxicillin/ clavulanate	0/7 (0)	0/8 (0)	0/14 (0)
Ampicillin	2/7 (28.6)	0/8 (0)	0/14 (0)
Cefalexin <sup>^</sup>	-	-	-
Cefpodoxime <sup>^</sup>	0/7 (0)	0/8 (0)	0/14 (0)
Enrofloxacin <sup>^</sup>	0/7 (0)	0/8 (0)	0/14 (0)
Florfenicol	0/7 (0)	0/8 (0)	0/14 (0)
Tetracycline	3/7 (42.9)	3/8 (37.5)	4/14 (28.6)
Trimethoprim/sulphonamide	0/7 (0)	0/8 (0)	0/14 (0)
Tylosin	-	-	-

b) *Mannheimia haemolytica*

Antibiotic	2017	2018	2019
Amoxicillin/ clavulanate	0/71 (0)	0/81 (0)	0/90 (0)
Ampicillin	1/71 (1.4)	2/81 (2.5)	1/90 (1.1)
Cefalexin <sup>^</sup>	-	-	-
Cefpodoxime <sup>^</sup>	0/71 (0)	0/80 (0)	0/90 (0)
Enrofloxacin <sup>^</sup>	0/71 (0)	0/81 (0)	0/90 (0)
Florfenicol	0/70 (0)	1/76 (1.3)	0/89 (0)
Tetracycline	34/71 (47.9)	32/81 (39.5)	49/90 (54.4)
Trimethoprim/sulphonamide	0/71 (0)	0/81 (0)	0/90 (0)
Tylosin	-	-	-

c) *Bibersteinia trehalosi*

Antibiotic	2017	2018	2019
Amoxicillin/ clavulanate	0/75 (0)	0/50 (0)	0/33 (0)
Ampicillin	0/75 (0)	0/50 (0)	0/33 (0)
Cefalexin <sup>^</sup>	-	-	-
Cefpodoxime <sup>^</sup>	0/75 (0)	0/49 (0)	0/32 (0)
Enrofloxacin <sup>^</sup>	0/75 (0)	0/50 (0)	0/33 (0)
Florfenicol	0/75 (0)	1/49 (2.0)	0/32 (0)
Tetracycline	1/75 (1.3)	1/50 (2.0)	0/33 (0)
Trimethoprim/sulphonamide	0/75 (0)	0/50 (0)	0/33 (0)
Tylosin	-	-	-

d) *Trueperella pyogenes*

Antibiotic	2017	2018	2019
Amoxicillin/ clavulanate	0/1 (0)	0/1 (0)	0/2 (0)
Ampicillin	0/1 (0)	0/1 (0)	0/2 (0)
Cefalexin^	0/1 (0)	0/1 (0)	0/2 (0)
Cefpodoxime^	-	-	-
Enrofloxacin^	-	-	-
Florfenicol	0/1(0)	0/1 (0)	-
Tetracycline	1/1 (100)	0/1 (0)	0/2 (0)
Trimethoprim/sulphonamide	1/1 (100)	0/1 (0)	-
Tylosin	0/1 (0)	0/1 (0)	0/2 (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 2019. For those using screen-readers, a blank cell indicates that there were no isolates with this MIC value.

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	-	-	-	-	-



**Table S4.6.2:** Resistance (interpreted using breakpoints) of *Streptococcus suis* from infections of pigs in England and Wales from 2017 to 2019. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

Antibiotic	2017	2018	2019
Ampicillin	0/86 (0)	0/84 (0)	0/115 (0)
Enrofloxacin <sup>^</sup>	0/86 (0)	0/84 (0)	0/115 (0)
Lincomycin	40/86 (46.5)	32/84 (38.1)	48/115 (41.7)
Penicillin	0/86 (0)	1/84 (1.2)	0/115 (0)
Tetracycline	82/86 (95.3)	72/84 (85.7)	100/115 (87.0)
Trimethoprim/sulphonamide	16/86 (18.6)	17/84 (20.2)	16/115 (13.9)
Tylosin	48/86 (55.8)	43/84 (51.2)	54/115 (47.0)

**Table S4.6.3:** Resistance (interpreted using breakpoints) of *Erysipelothrix rhusiopathiae* from infections of pigs in England and Wales from 2017 to 2019. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

Antibiotic	2017	2018	2019
Ampicillin	0/6 (0)	0/3 (0)	0/11 (0)
Enrofloxacin <sup>^</sup>	0/6 (0)	0/3 (0)	0/11 (0)
Lincomycin	0/6 (0)	0/3 (0)	0/11 (0)
Tetracycline	1/6 (16.7)	0/3 (0)	4/11 (36.4)
Trimethoprim/sulphonamide	5/6 (83.3)	0/3 (0)	2/11 (18.2)
Tylosin	0/6 (0)	0/3 (0)	0/11 (0)

**Table S4.6.4:** Resistance (interpreted using breakpoints) of *Staphylococcus aureus* from infections of chickens in England and Wales from 2017 to 2019. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	0/6 (0)	-	-
Ampicillin	1/6 (16.7)	0/2 (0)	1/2 (50.0)
Doxycycline	2/6 (33.3)	0/2 (0)	1/2 (50.0)
Enrofloxacin^	0/6 (0)	0/2 (0)	0/2 (0)
Erythromycin	0/6 (0)	-	0/1 (0)
Lincomycin	0/6 (0)	0/2 (0)	1/2 (50.0)
Penicillin	-	-	1/2 (50.0)
Tetracycline	1/6 (16.7)	0/2 (0)	1/2 (50.0)
Trimethoprim/sulphonamide	0/6 (0)	0/2 (0)	1/2 (50.0)
Tylosin	-	0/2 (0)	1/2 (50.0)

**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 2017 to 2019. The table shows the number of resistant isolates out of the total number tested and the percentage of resistant isolates.

a) *Listeria monocytogenes*

Antibiotic	2017	2018	2019
Amoxicillin/ clavulanate	0/19 (0)	0/11 (0)	0/5 (0)
Ampicillin	0/19 (0)	0/11 (0)	0/5 (0)
Cefalexin^	3/19 (15.8)	9/11 (81.8)	3/5 (60.0)
Florfenicol	0/10 (0)	0/11 (0)	0/5 (0)
Penicillin	0/19 (0)	0/11 (0)	0/5 (0)
Tetracycline	0/19 (0)	0/11 (0)	0/5 (0)
Trimethoprim/sulphonamide	0/10 (0)	0/11 (0)	0/5 (0)
Tylosin	0/19 (0)	0/11 (0)	0/5 (0)

b) *Streptococcus dysgalactiae*

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	0/33 (0)	0/22 (0)	0/31 (0)
Ampicillin	0/33 (0)	0/22 (0)	0/31 (0)
Cefalexin^	2/33 (6.1)	1/22 (4.5)	1/31 (3.2)
Florfenicol	0/15 (0)	-	0/6 (0)
Neomycin	-	-	0/25 (0)
Novobocin	-	-	1/25 (4.0)
Penicillin	-	-	0/31 (0)
Tetracycline	31/33 (93.9)	17/22 (77.3)	23/31 (74.2)
Trimethoprim/sulphonamide	0/15 (0)	0/5 (0)	0/6 (0)
Tylosin	4/33 (12.1)	0/22 (0)	1/31 (3.2)

**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 2013 to 2018

a) England and Wales

Clonal complex	Year	Species	Source of the sample
CC398	2013	Poultry (n=1)	Clinical investigation
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

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

c) Scotland have had one isolation of MRSA. This was detected in 2017 in a clinical investigation of a pheasant. The clonal complex was identified as CC398.

## S4.7 Clinical Surveillance Data for *E. coli*

**Table S4.7.1:** 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 2017 to 2019. 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	2017	2018	2019
Amikacin	0/266 (0)	1/280 (0.4)	0/220 (0)
Amoxicillin/clavulanate	149/694 (21.5)	137/484 (28.3)	97/474 (20.5)
Ampicillin	420/810 (51.9)	450/788 (57.1)	564/998 (56.5)
Apramycin	39/756 (5.2)	49/737 (6.6)	70/949 (7.4)
Cefotaxime <sup>^</sup>	32/267 (12.0)	27/282 (9.6)	17/225 (7.6)
Cefpodoxime <sup>^</sup>	8/377 (2.1)	10/316 (3.2)	10/547 (1.8)
Ceftazidime <sup>^</sup>	18/267 (6.7)	12/282 (4.3)	7/225 (3.1)
Chloramphenicol	104/266 (39.1)	108/280 (38.6)	63/220 (28.6)
Colistin <sup>^</sup>	-	1/712 (0.1)	-
Doxycycline	151/323 (46.7)	25/79 (31.6)	48/108 (44.4)
Enrofloxacin <sup>^</sup>	48/810 (5.9)	32/788 (4.1)	63/998 (6.3)
Florfenicol	88/479 (18.4)	86/329 (26.1)	56/266 (21.1)
Neomycin	134/695 (19.3)	114/679 (16.8)	151/868 (17.4)
Spectinomycin	233/756 (30.8)	267/737 (36.2)	296/949 (31.2)
Streptomycin	198/429 (46.2)	149/282 (52.8)	114/222 (51.4)
Tetracycline	463/810 (57.2)	447/788 (56.7)	587/998 (58.8)
Trimethoprim/sulphonamide	271/810 (33.5)	293/788 (37.2)	381/988 (38.2)

b) Northern Ireland

Antibiotic	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	426/816 (52.2)	333/794 (41.9)	357/815 (43.8)
Ampicillin	633/817 (77.5)	585/794 (73.7)	612/816 (75.0)
Apramycin	64/634 (10.1)	64/647 (9.9)	60/609 (9.9)
Cefotaxime^	-	-	-
Cefpodoxime^	499/807 (61.8)	435/780 (55.8)	530/812 (65.3)
Ceftazidime^	-	-	-
Chloramphenicol	-	-	-
Colistin^	-	-	-
Doxycycline	-	-	-
Enrofloxacin^	319/816 (39.1)	267/795 (33.6)	239/817 (29.3)
Florfenicol	328/609 (53.9)	290/615 (47.2)	261/575 (45.4)
Neomycin	803/810 (99.1)	787/789 (99.7)	811/816 (99.4)
Spectinomycin	6/177 (3.4)	9/132 (6.8)	11/201 (5.5)
Streptomycin	172/176 (97.7)	130/132 (98.5)	204/206 (99.0)
Tetracycline	442/817 (54.1)	512/792 (64.6)	506/815 (62.1)
Trimethoprim/sulphonamide	440/817 (53.9)	421/795 (53.0)	378/817 (46.3)

c) Scotland

Antibiotic	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	71/461 (15.4)	165/624 (26.4)	73/301 (24.3)
Ampicillin	136/461 (29.5)	270/628 (43.0)	123/302 (40.7)
Apramycin	-	-	1/154 (0.6)
Cefotaxime^	-	-	-
Cefpodoxime^	11/461 (2.4)	14/611 (2.3)	8/300 (2.7)
Ceftazidime^	-	-	-
Chloramphenicol	-	-	-
Colistin^	-	-	-
Doxycycline	-	-	-
Enrofloxacin^	9/461 (2.0)	35/622 (5.6)	16/301 (5.3)
Florfenicol	26/123 (21.1)	68/316 (21.5)	27/124 (21.8)
Neomycin	17/461 (3.7)	41/622 (6.6)	4/81 (4.9)
Spectinomycin	63/461 (13.7)	115/466 (24.7)	18/80 (22.5)
Streptomycin	3/118 (2.5)	16/188 (8.5)	17/146 (11.6)
Tetracycline	162/461 (35.1)	304/626 (48.6)	135/301 (44.9)
Trimethoprim/sulphonamide	66/461 (14.3)	151/622 (24.3)	61/302 (20.2)



**Table S4.7.2:** Resistance (interpreted using breakpoints) in all *E. coli* from cattle (all ages) in a) England and Wales, b) Northern Ireland and c) Scotland from 2017 to 2019. 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	2017	2018	2019
Amikacin	0/206 (0)	0/208 (0)	0/140 (0)
Amoxicillin/clavulanate	118/285 (41.4)	112/304 (36.8)	83/278 (29.9)
Ampicillin	204/285 (71.6)	215/304 (70.7)	181/278 (65.1)
Apramycin	6/261 (2.3)	14/282 (5.0)	7/253 (2.8)
Cefotaxime <sup>^</sup>	30/207 (14.5)	25/209 (12.0)	17/145 (11.7)
Cefpodoxime <sup>^</sup>	-	-	-
Ceftazidime <sup>^</sup>	17/207 (8.2)	12/209 (5.7)	7/145 (4.8)
Chloramphenicol	95/206 (46.1)	91/208 (43.8)	54/140 (38.6)
Colistin <sup>^</sup>	-	0/315 (0)	-
Doxycycline	-	-	-
Enrofloxacin <sup>^</sup>	30/285 (10.5)	20/304 (6.6)	20/278 (7.2)
Florfenicol	69/230 (30.0)	73/230 (31.7)	51/165 (30.9)
Neomycin	95/261 (36.4)	77/282 (27.3)	99/253 (39.1)
Spectinomycin	86/261 (33.0)	111/282 (39.4)	72/253 (28.5)
Streptomycin	118/206 (57.3)	112/208 (53.8)	77/140 (55.0)
Tetracycline	199/285 (69.8)	198/304 (65.1)	180/278 (64.7)
Trimethoprim/sulphonamide	123/285 (43.2)	125/304 (41.1)	121/278 (43.5)

b) Northern Ireland

Antibiotic	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	360/655 (55.0)	265/586 (45.2)	292/640 (45.6)
Ampicillin	511/656 (77.9)	449/586 (76.6)	479/641 (74.7)
Apramycin	45/479 (9.4)	42/460 (9.1)	34/435 (7.8)
Cefotaxime^	-	-	-
Cefpodoxime^	406/649 (62.6)	326/585 (55.7)	413/638 (64.7)
Ceftazidime^	-	-	-
Chloramphenicol	-	-	-
Colistin^	-	-	-
Doxycycline	-	-	-
Enrofloxacin^	287/656 (43.8)	226/586 (38.6)	208/641 (32.4)
Florfenicol	292/477 (61.2)	245/456 (53.7)	241/436 (55.3)
Neomycin	645/650 (99.2)	580/582 (99.7)	636/641 (99.2)
Spectinomycin	6/174 (3.4)	8/126 (6.3)	11/200 (5.5)
Streptomycin	169/173 (97.7)	124/126 (98.4)	203/205 (99.0)
Tetracycline	342/656 (52.1)	394/586 (67.2)	393/639 (61.5)
Trimethoprim/sulphonamide	374/656 (57.0)	333/586 (56.8)	301/641 (47.0)

c) Scotland

Antibiotic	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	37/181 (20.4)	97/309 (31.4)	58/220 (26.4)
Ampicillin	59/181 (32.6)	154/313 (49.2)	93/221 (42.1)
Apramycin	-	-	1/74 (1.4)
Cefotaxime^	-	-	-
Cefpodoxime^	4/181 (2.2)	5/301 (1.7)	6/220 (2.7)
Ceftazidime^	-	-	-
Chloramphenicol	-	-	-
Colistin^	-	-	-
Doxycycline	-	-	-
Enrofloxacin^	7/181 (3.9)	15/307 (4.9)	14/220 (6.4)
Florfenicol	23/63 (36.5)	47/162 (29.0)	25/73 (34.2)
Neomycin	15/181 (8.3)	31/307 (10.1)	-
Spectinomycin	23/181 (12.7)	55/157 (35.0)	-
Streptomycin	3/118 (2.5)	14/184 (7.6)	17/146 (11.6)
Tetracycline	64/181 (35.4)	168/311 (54.0)	99/220 (45.0)
Trimethoprim/sulphonamide	28/181 (15.5)	76/307 (24.8)	48/221 (21.7)

**Table S4.7.3:** Resistance (interpreted using breakpoints) in all *E. coli* from pigs (all ages) in a) England and Wales, b) Northern Ireland and c) Scotland from 2017 to 2019. The table shows the number of resistant isolates out of the total number tested and the percentage of resistance.

a) England and Wales

Antibiotic	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	6/161 (3.7)	-	-
Ampicillin	105/215 (48.8)	134/244 (54.9)	268/441 (60.8)
Apramycin	30/215 (14.0)	30/244 (12.3)	58/440 (13.2)
Cefotaxime <sup>^</sup>	-	-	-
Cefpodoxime <sup>^</sup>	2/215 (0.9)	7/244 (2.9)	4/440 (0.9)
Ceftazidime <sup>^</sup>	-	-	-
Chloramphenicol	-	-	-
Colistin <sup>^</sup>	-	1/216 (0.5)	-
Doxycycline	105/161 (65.2)	-	0/1 (0)
Enrofloxacin <sup>^</sup>	9/215 (4.2)	8/244 (3.3)	26/441 (5.9)
Florfenicol	14/161 (8.7)	-	-
Neomycin	16/215 (7.4)	21/244 (8.6)	36/440 (8.2)
Spectinomycin	82/215 (38.1)	90/244 (36.9)	159/440 (36.1)
Streptomycin	56/161 (34.8)	-	-
Tetracycline	135/215 (62.8)	149/244 (61.1)	283/441 (64.2)
Trimethoprim/sulphonamide	98/215 (45.6)	116/244 (47.5)	202/441 (45.8)

b) Northern Ireland

Antibiotic	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	28/54 (51.9)	31/71 (43.7)	30/82 (36.6)
Ampicillin	46/54 (85.2)	52/71 (73.2)	70/82 (85.4)
Apramycin	10/52 (19.2)	16/71 (22.5)	18/82 (22.0)
Cefotaxime^	-	-	-
Cefpodoxime^	27/52 (51.9)	37/71 (52.1)	44/81 (54.3)
Ceftazidime^	-	-	-
Chloramphenicol	-	-	-
Colistin^	-	-	-
Doxycycline	-	-	-
Enrofloxacin^	10/53 (18.9)	20/71 (28.2)	15/82 (18.3)
Florfenicol	6/54 (11.1)	20/71 (28.2)	13/82 (15.9)
Neomycin	52/54 (96.3)	71/71 (100)	81/81 (100)
Spectinomycin	-	-	-
Streptomycin	-	-	-
Tetracycline	44/54 (81.5)	57/71 (80.3)	60/82 (73.2)
Trimethoprim/sulphonamide	34/54 (63.0)	54/72 (75.0)	52/82 (63.4)

c) Scotland

Antibiotic	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	4/11 (36.4)	37/91 (40.7)	6/22 (27.3)
Ampicillin	6/11 (54.5)	53/91 (58.2)	14/22 (63.6)
Apramycin	-	-	0/22 (0)
Cefotaxime^	-	-	-
Cefpodoxime^	1/11 (9.1)	8/87 (9.2)	1/22 (4.5)
Ceftazidime^	-	-	-
Chloramphenicol	-	-	-
Colistin^	-	-	-
Doxycycline	-	-	-
Enrofloxacin^	0/11 (0)	16/91 (17.6)	1/22 (4.5)
Florfenicol	1/11 (9.1)	12/89 (13.5)	2/22 (9.1)
Neomycin	0/11 (0)	2/91 (2.2)	2/22 (9.1)
Spectinomycin	4/11 (36.4)	24/89 (27.0)	8/22 (36.4)
Streptomycin	-	-	-
Tetracycline	3/11(27.3)	57/91 (62.6)	11/22 (50.0)
Trimethoprim/sulphonamide	5/11 (45.5)	45/91 (49.5)	8/22 (36.4)

**Table S4.7.4:** Resistance (interpreted using breakpoints) in all *E. coli* from sheep (all ages) in a) England and Wales, b) Northern Ireland and c) Scotland from 2017 to 2019. 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	2017	2018	2019
Amikacin	0/60 (0)	1/72 (1.4)	0/80 (0)
Amoxicillin/clavulanate	22/148 (14.9)	24/161 (14.9)	11/172 (6.4)
Ampicillin	64/148 (43.2)	75/161 (46.6)	63/172 (36.6)
Apramycin	0/118 (0)	4/132 (3.0)	1/149 (0.7)
Cefotaxime <sup>^</sup>	2/60 (3.3)	2/73 (2.7)	0/80 (0)
Cefpodoxime <sup>^</sup>	-	-	-
Ceftazidime <sup>^</sup>	1/60 (1.7)	0/73 (0)	0/80 (0)
Chloramphenicol	9/60 (15.0)	17/72 (23.6)	9/80 (11.3)
Colistin <sup>^</sup>	-	0/130 (0)	-
Doxycycline	-	-	-
Enrofloxacin <sup>^</sup>	5/148 (3.4)	2/161 (1.2)	6/172 (3.5)
Florfenicol	5/88 (5.7)	13/99 (13.1)	5/101 (5.0)
Neomycin	11/120 (9.2)	16/134 (11.9)	14/151 (9.3)
Spectinomycin	44/118 (37.3)	47/132 (35.6)	46/149 (30.9)
Streptomycin	24/62 (38.7)	37/74 (50.0)	37/82 (45.1)
Tetracycline	82/148 (55.4)	78/161 (48.4)	77/172 (44.8)
Trimethoprim/sulphonamide	24/148 (16.2)	36/161 (22.4)	31/172 (18.0)

b) Northern Ireland

Antibiotic	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	31/73 (42.5)	26/79 (32.9)	23/58 (39.7)
Ampicillin	53/73 (72.6)	52/79 (65.8)	43/58 (74.1)
Apramycin	8/72 (11.1)	4/78 (5.1)	2/56 (3.6)
Cefotaxime^	-	-	-
Cefpodoxime^	41/73 (56.2)	40/80 (50.0)	41/58 (70.7)
Ceftazidime^	-	-	-
Chloramphenicol	-	-	-
Colistin^	-	-	-
Doxycycline	-	-	-
Enrofloxacin^	14/73 (19.2)	15/80 (18.8)	6/58 (10.3)
Florfenicol	26/71 (36.6)	22/78 (28.2)	7/57 (12.3)
Neomycin	73/73 (100)	78/78 (100)	58/58 (100)
Spectinomycin	-	1/1 (100)	0/1 (0)
Streptomycin	-	1/1 (100)	1/1 (100)
Tetracycline	41/73 (56.2)	43/79 (54.4)	33/58 (56.9)
Trimethoprim/sulphonamide	27/73 (37.0)	26/79 (32.9)	15/58 (25.9)



c) Scotland

Antibiotic	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	17/49 (34.7)	28/67 (41.8)	8/29 (27.6)
Ampicillin	22/49 (44.9)	37/67 (55.2)	12/29 (41.4)
Apramycin	-	-	0/29 (0)
Cefotaxime^	-	-	-
Cefpodoxime^	0/49 (0)	0/66 (0)	1/29 (3.4)
Ceftazidime^	-	-	-
Chloramphenicol	-	-	-
Colistin^	-	-	-
Doxycycline	-	-	-
Enrofloxacin^	1/49 (2.0)	2/67 (3.0)	1/29 (3.4)
Florfenicol	2/49 (4.1)	9/64 (14.1)	0/29 (0)
Neomycin	1/49 (2.0)	5/67 (7.5)	2/29 (6.9)
Spectinomycin	17/49 (34.7)	31/63 (49.2)	7/29 (24.1)
Streptomycin	-	2/3 (66.7)	-
Tetracycline	24/49 (49.0)	38/67 (56.7)	15/29 (51.7)
Trimethoprim/sulphonamide	9/49 (18.4)	19/67 (28.4)	3/29 (10.3)

**Table S4.7.5:** Resistance (interpreted using breakpoints) in all *E. coli* from chickens (all ages) in a) England and Wales, b) Northern Ireland and c) Scotland from 2017 to 2019. 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	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	3/96 (3.1)	1/17 (5.9)	3/24 (12.5)
Ampicillin	41/144 (28.5)	21/72 (29.2)	50/102 (49.0)
Apramycin	3/144 (2.1)	1/72 (1.4)	4/102 (3.9)
Cefotaxime <sup>^</sup>	-	-	-
Cefpodoxime <sup>^</sup>	6/144 (4.2)	3/72 (4.2)	6/102 (5.9)
Ceftazidime <sup>^</sup>	-	-	-
Chloramphenicol	-	-	-
Colistin <sup>^</sup>	-	0/48 (0)	-
Doxycycline	37/144 (25.7)	21/72 (29.2)	46/102 (45.1)
Enrofloxacin <sup>^</sup>	1/144 (0.7)	2/72 (2.8)	11/102 (10.8)
Florfenicol	-	-	-
Neomycin	12/96 (12.5)	0/17 (0)	2/24 (8.3)
Spectinomycin	19/144 (13.2)	19/72 (26.4)	18/102 (17.6)
Tetracycline	37/144 (25.7)	19/72 (26.4)	45/102 (44.1)
Trimethoprim/sulphonamide	20/144 (13.9)	14/72 (19.4)	26/102 (25.5)

b) Northern Ireland

Antibiotic	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	2/16 (12.5)	2/22 (9.1)	12/35 (34.3)
Ampicillin	9/16 (56.3)	9/22 (40.9)	20/35 (57.1)
Apramycin	0/16 (0)	0/21 (0)	6/36 (16.7)
Cefotaxime^	-	-	-
Cefpodoxime^	12/16 (75.0)	18/22 (81.8)	32/35 (91.4)
Ceftazidime^	-	-	-
Chloramphenicol	-	-	-
Colistin^	-	-	-
Doxycycline	-	-	-
Enrofloxacin^	4/16 (25.0)	1/22 (4.5)	10/36 (27.8)
Florfenicol	1/1 (100)	0/2 (0)	0/0 (0)
Neomycin	16/16 (100)	22/22 (100)	36/36 (100)
Spectinomycin	-	-	0/0 (0)
Tetracycline	6/16 (37.5)	5/22 (22.7)	20/36 (55.6)
Trimethoprim/sulphonamide	3/16 (18.8)	0/22 (0)	10/36 (27.8)

c) Scotland

Antibiotic	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	13/212 (6.1)	3/156 (1.9)	1/29 (3.4)
Ampicillin	47/212 (22.2)	26/156 (16.7)	4/29 (13.8)
Apramycin	-	-	0/28 (0)
Cefotaxime^	-	-	-
Cefpodoxime^	6/212 (2.8)	1/156 (0.6)	0/28 (0)
Ceftazidime^	-	-	-
Chloramphenicol	-	-	-
Colistin^	-	-	-
Doxycycline	-	-	-
Enrofloxacin^	1/212 (0.5)	2/156 (1.3)	0/29 (0)
Florfenicol	-	-	-
Neomycin	1/212 (0.5)	3/156 (1.9)	0/29 (0)
Spectinomycin	19/212 (9.0)	5/156 (3.2)	3/28 (10.7)
Tetracycline	70/212 (33.0)	41/156 (26.3)	9/29 (31.0)
Trimethoprim/sulphonamide	22/212 (10.4)	11/156 (7.1)	2/29 (6.9)

**Table S4.7.6:** Resistance (interpreted using breakpoints) in all *E. coli* from turkeys (all ages) in a) England and Wales, b) Northern Ireland and c) Scotland from 2017 to 2019. 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	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	0/4 (0)	0/2 (0)	-
Ampicillin	6/18 (33.3)	5/7 (71.4)	2/5 (40.0)
Apramycin	0/18 (0)	0/7 (0)	0/5 (0)
Cefotaxime <sup>^</sup>	-	-	-
Cefpodoxime <sup>^</sup>	0/18 (0)	-	0/5 (0)
Ceftazidime <sup>^</sup>	-	-	-
Chloramphenicol	-	-	-
Colistin <sup>^</sup>	-	0/3 (0)	-
Doxycycline	9/18 (50)	4/7 (57.1)	2/5 (40.0)
Enrofloxacin <sup>^</sup>	3/18 (16.7)	0/7 (0)	0/5 (0)
Florfenicol	-	-	-
Neomycin	0/3 (0)	0/2 (0)	-
Spectinomycin	2/18 (11.1)	0/7 (0)	1/5 (20.0)
Streptomycin	-	-	-
Tetracycline	10/18 (55.6)	3/7 (42.9)	2/5 (40.0)
Trimethoprim/sulphonamide	6/18 (33.3)	2/7 (28.6)	1/5 (20.0)

b) Northern Ireland

Antibiotic	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	1/7 (14.3)	0/2 (0)	0/0
Ampicillin	5/7 (71.4)	2/2 (100)	0/0
Apramycin	0/6 (0)	0/2 (0)	0/0
Cefotaxime^	-	-	-
Cefpodoxime^	4/6 (66.7)	2/2 (100)	0/0
Ceftazidime^	-	-	-
Chloramphenicol	-	-	-
Colistin^	-	-	-
Doxycycline	-	-	-
Enrofloxacin^	1/7 (14.3)	0/2 (0)	0/0
Florfenicol	-	-	0/0
Neomycin	7/7 (100)	2/2 (100)	0/0
Spectinomycin	-	-	0/0
Streptomycin	-	-	0/0
Tetracycline	3/7 (42.9)	1/2 (50.0)	0/0
Trimethoprim/sulphonamide	2/7 (28.6)	0/2 (0)	0/0

c) Scotland

Antibiotic	2017	2018	2019
Amikacin	-	-	-
Amoxicillin/clavulanate	0/8 (0)	0/1 (0)	0/1 (0)
Ampicillin	2/8 (25.0)	0/1 (0)	0/1 (0)
Apramycin	-	-	0/1 (0)
Cefotaxime^	-	-	-
Cefpodoxime^	0/8 (0)	0/1 (0)	0/1 (0)
Ceftazidime^	-	-	-
Chloramphenicol	-	-	-
Colistin^	-	-	-
Doxycycline	-	-	-
Enrofloxacin^	0/8 (0)	0/1 (0)	0/1 (0)
Florfenicol	-	0/1 (0)	-
Neomycin	0/8 (0)	0/1 (0)	0/1 (0)
Spectinomycin	0/8 (0)	0/1 (0)	0/1 (0)
Streptomycin	-	0/1 (0)	-
Tetracycline	1/8 (12.5)	0/1 (0)	1/1 (100)
Trimethoprim/sulphonamide	2/8 (25.0)	0/1 (0)	0/1 (0)

**Table S4.7.7:** 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.

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 <sup>^</sup>	9/118 (7.6)	5/16 (31.3)	1/1 (100)
Ceftazidime <sup>^</sup>	3/118 (2.5)	2/16 (12.5)	0/1 (0)
Chloramphenicol	47/117 (40.2)	5/13 (38.5)	-
Enrofloxacin <sup>^</sup>	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<sup>1</sup>

Antibiotic	Neonatal
Amikacin	-
Amoxicillin/clavulanate	59/108 (54.6)
Ampicillin	94/108 (87.0)
Apramycin	8/108 (7.4)
Cefotaxime <sup>^</sup>	-
Cefpodoxime	66/108 (61.1)
Ceftazidime <sup>^</sup>	-
Chloramphenicol	-
Enrofloxacin <sup>^</sup>	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)

<sup>1</sup> No pre-weaning or adult data available for Northern Ireland

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^	-	-	-
Cefpodoxime	1/35 (2.9)	2/30 (6.7)	0/14 (0)
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 S4.7.8:** 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.

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 <sup>^</sup>	18/159 (11.3)	3/30 (10.0)	1/1 (100)
Cefpodoxime <sup>^</sup>	-	-	-
Ceftazidime <sup>^</sup>	7/159 (4.4)	1/30 (3.3)	1/1 (100)
Chloramphenicol	69/159 (43.4)	13/30 (43.3)	-
Enrofloxacin <sup>^</sup>	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<sup>1</sup>

Antibiotic	Neonatal
Amikacin	-
Amoxicillin/clavulanate	203/365 (55.6)
Ampicillin	322/366 (88.0)
Apramycin	37/366 (10.1)
Cefotaxime <sup>^</sup>	-
Cefpodoxime <sup>^</sup>	206/365 (56.4)
Ceftazidime <sup>^</sup>	-
Chloramphenicol	-
Enrofloxacin <sup>^</sup>	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)

<sup>1</sup> No pre-weaning or adult data available for Northern Ireland

c) Scotland

Antibiotic	Neonatal	Pre-weaning	Adult <sup>2</sup>
Amikacin	-	-	-
Amoxicillin/clavulanate	25/48 (52.1)	16/28 (57.1)	-
Ampicillin	41/50 (82.0)	22/28 (78.6)	-
Apramycin	-	-	-
Cefotaxime <sup>^</sup>	-	-	-
Cefpodoxime <sup>^</sup>	2/45 (4.4)	0/27 (0)	-
Ceftazidime <sup>^</sup>	-	-	-
Chloramphenicol	-	-	-
Enrofloxacin <sup>^</sup>	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)	-

<sup>2</sup> All *E. coli* obtained from adult cattle were from mastitis cases and results are presented in Table S4.2.2

**Table S4.7.9:** Resistance (interpreted using breakpoints) in *E. coli* from cattle in England and Wales, Northern Ireland and Scotland for 2017. 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	Neonatal	Pre-weaning	Adult
Amikacin	0/164 (0)	0/23 (0)	0/3 (0)
Amoxicillin/clavulanate	81/184 (44.0)	23/48 (47.9)	2/26 (7.7)
Ampicillin	144/184 (78.3)	34/48 (70.8)	9/26 (34.6)
Apramycin	3/177 (1.7)	3/38 (7.9)	0/23 (0)
Cefotaxime <sup>^</sup>	20/164 (12.2)	5/23 (21.7)	0/3 (0)
Cefpodoxime <sup>^</sup>	-	-	-
Ceftazidime <sup>^</sup>	11/164 (6.7)	3/23 (13.0)	0/3 (0)
Chloramphenicol	75/164 (45.7)	12/23 (52.2)	0/3 (0)
Enrofloxacin <sup>^</sup>	17/184 (9.2)	9/48 (18.8)	1/26 (3.8)
Florfenicol	47/171 (27.5)	15/33 (45.5)	1/6 (16.7)
Neomycin	68/177 (38.4)	18/38 (47.4)	1/23 (4.3)
Spectinomycin	66/177 (37.3)	11/38 (28.9)	3/23 (13.0)
Streptomycin	94/164 (57.3)	16/23 (69.6)	1/3 (33.3)
Tetracycline	137/184 (74.5)	37/48 (77.1)	9/26 (34.6)
Trimethoprim/sulphonamide	83/184 (45.1)	26/48 (54.2)	5/26 (19.2)

b) Northern Ireland<sup>1</sup>

Antibiotic	Neonatal
Amikacin	-
Amoxicillin/clavulanate	261/364 (71.7)
Ampicillin	338/364 (92.9)
Apramycin	40/364 (11.0)
Cefotaxime <sup>^</sup>	-
Cefpodoxime <sup>^</sup>	242/362 (66.9)
Ceftazidime <sup>^</sup>	-
Chloramphenicol	-
Enrofloxacin <sup>^</sup>	213/364 (58.5)
Florfenicol	226/364 (62.1)
Neomycin	359/361 (99.4)
Spectinomycin	-
Streptomycin	-
Tetracycline	321/364 (88.2)
Trimethoprim/sulphonamide	272/364 (74.7)

<sup>1</sup> No pre-weaning or adult data available for Northern Ireland

c) Scotland

Antibiotic	Neonatal	Pre-weaning	Adult
Amikacin	-	-	-
Amoxicillin/clavulanate	23/38 (60.5)	5/13 (38.5)	9/130 (6.9)
Ampicillin	32/38 (84.2)	7/13 (53.8)	20/130 (15.4)
Apramycin	-	-	-
Cefotaxime <sup>^</sup>	-	-	-
Cefpodoxime <sup>^</sup>	1/38 (2.6)	2/13 (15.4)	1/130 (0.8)
Ceftazidime <sup>^</sup>	-	-	-
Chloramphenicol	-	-	-
Enrofloxacin <sup>^</sup>	3/38 (7.9)	2/13 (15.4)	2/130 (1.5)
Florfenicol	14/38 (36.8)	6/13 (46.2)	3/12 (25.0)
Neomycin	12/38 (31.6)	2/13 (15.4)	1/130 (0.8)
Spectinomycin	15/38 (39.5)	2/13 (15.4)	6/130 (4.6)
Streptomycin	-	-	3/118 (2.5)
Tetracycline	33/38 (86.8)	10/13 (76.9)	21/130 (16.2)
Trimethoprim/sulphonamide	15/38 (39.5)	5/13 (38.5)	8/130 (6.2)



**Table S4.7.10:** 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.

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 <sup>^</sup>	1/94 (1.1)	2/239 (0.8)	0/19 (0)
Doxycycline	-	-	-
Enrofloxacin <sup>^</sup>	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<sup>1</sup>

Antibiotic	Neonatal
Amoxicillin/clavulanate	0/1 (0)
Ampicillin	1/1 (100)
Apramycin	0/1 (0)
Cefpodoxime <sup>^</sup>	1/1 (100)
Doxycycline	-
Enrofloxacin <sup>^</sup>	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)

<sup>1</sup> No post-weaning or adult data available for Northern Ireland

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 S4.7.11:** 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.

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 <sup>^</sup>	2/59 (3.4)	2/115 (1.7)	0/10 (0)
Doxycycline	1/2 (50.0)	-	-
Enrofloxacin <sup>^</sup>	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<sup>1</sup>

Antibiotic	Neonatal
Amoxicillin/clavulanate	7/16 (43.8)
Ampicillin	11/16 (68.8)
Apramycin	3/16 (18.8)
Cefpodoxime <sup>^</sup>	7/16 (43.8)
Doxycycline	-
Enrofloxacin <sup>^</sup>	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)

<sup>1</sup> No post-weaning or adult data available for Northern Ireland

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 S4.7.12:** Resistance (interpreted using breakpoints) in *E. coli* from pigs in a) England and Wales, b) Northern Ireland and c) Scotland for 2017. 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	Neonatal	Post-weaning	Adult
Amikacin	-	-	-
Amoxicillin/clavulanate	2/32 (6.3)	2/95 (2.1)	1/2 (50.0)
Ampicillin	18/40 (45.0)	61/119 (51.3)	2/3 (66.7)
Apramycin	1/40 (2.5)	27/119 (22.7)	0/3 (0)
Cefotaxime <sup>^</sup>	-	-	-
Cefpodoxime <sup>^</sup>	1/40 (2.5)	1/119 (0.8)	0/3 (0)
Ceftazidime <sup>^</sup>	-	-	-
Chloramphenicol	-	-	-
Doxycycline	19/32 (59.4)	62/95 (65.3)	1/2 (50.0)
Enrofloxacin <sup>^</sup>	6/40 (15.0)	3/119 (2.5)	0/3 (0)
Florfenicol	1/32 (3.1)	13/95 (13.7)	0/2 (0)
Neomycin	3/40 (7.5)	10/119 (8.4)	0/3 (0)
Spectinomycin	20/40 (50.0)	46/119 (38.7)	0/3 (0)
Streptomycin	8/32 (25.0)	29/95 (30.5)	2/2 (100)
Tetracycline	22/40 (55.0)	77/119 (64.7)	1/3 (33.3)
Trimethoprim/sulphonamide	16/40 (40.0)	60/119 (50.4)	2/3 (66.7)

b) Northern Ireland<sup>1</sup>

Antibiotic	Adult
Amikacin	-
Amoxicillin/clavulanate	2/9 (22.2)
Ampicillin	8/9 (88.9)
Apramycin	2/9 (22.2)
Cefotaxime <sup>^</sup>	-
Cefpodoxime <sup>^</sup>	2/9 (22.2)
Ceftazidime <sup>^</sup>	-
Chloramphenicol	-
Doxycycline	-
Enrofloxacin <sup>^</sup>	2/9 (22.2)
Florfenicol	2/9 (22.2)
Neomycin	9/9 (100)
Spectinomycin	-
Streptomycin	-
Tetracycline	9/9 (100)
Trimethoprim/sulphonamide	5/9 (55.6)

<sup>1</sup> No post-weaning or adult data available for Northern Ireland



c) Scotland

Antibiotic	Neonatal	Post-weaning	Adult
Amikacin	-	-	-
Amoxicillin/clavulanate	1/6 (16.7)	2/4 (50.0)	1/1 (100)
Ampicillin	2/6 (33.3)	3/4 (75.0)	1/1 (100)
Apramycin	-	-	-
Cefotaxime^	-	-	-
Cefpodoxime^	0/6 (0)	1/4 (25.0)	0/1 (0)
Ceftazidime^	-	-	-
Chloramphenicol	-	-	-
Doxycycline	-	-	-
Enrofloxacin^	0/6 (0)	0/4 (0)	0/1 (0)
Florfenicol	0/6 (0)	1/4 (25.0)	0/1 (0)
Neomycin	0/6 (0)	0/4 (0)	0/1 (0)
Spectinomycin	1/6 (16.7)	3/4 (75.0)	0/1 (0)
Streptomycin	-	-	-
Tetracycline	4/6 (66.7)	2/4 (50.0)	1/1 (100)
Trimethoprim/sulphonamide	1/6 (16.7)	2/4 (50.0)	0/1 (0)

**Table S4.7.13:** 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.

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 <sup>^</sup>	0/71 (0)	0/2 (0)	0/3 (0)
Ceftazidime <sup>^</sup>	0/71 (0)	0/2 (0)	0/3 (0)
Chloramphenicol	8/71 (11.3)	-	0/3 (0)
Enrofloxacin <sup>^</sup>	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<sup>1</sup>

Antibiotic	Neonatal
Amoxicillin/clavulanate	3/6 (50.0)
Ampicillin	5/6 (83.3)
Apramycin	0/6 (0)
Cefotaxime <sup>^</sup>	-
Cefpodoxime	6/6 (100)
Ceftazidime <sup>^</sup>	-
Chloramphenicol	-
Enrofloxacin <sup>^</sup>	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)

<sup>1</sup> No pre-weaning or adult data available for Northern Ireland

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 S4.7.14:** 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.

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 <sup>^</sup>	1/58 (1.7)	1/7 (14.3)	0/2 (0)
Cefpodoxime <sup>^</sup>	-	-	-
Ceftazidime <sup>^</sup>	0/58 (0)	0/7 (0)	0/2 (0)
Chloramphenicol	13/58 (22.4)	4/7 (57.1)	0/2 (0)
Enrofloxacin <sup>^</sup>	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<sup>1</sup>

Antibiotic	Neonatal
Amoxicillin/clavulanate	20/52 (38.5)
Ampicillin	36/52 (69.2)
Apramycin	3/52 (5.8)
Cefotaxime <sup>^</sup>	-
Cefpodoxime <sup>^</sup>	26/52 (50.0)
Ceftazidime <sup>^</sup>	-
Chloramphenicol	-
Enrofloxacin <sup>^</sup>	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)

<sup>1</sup> No pre-weaning or adult data available for Northern Ireland

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)

**Table S4.7.15:** Resistance (interpreted using breakpoints) in *E. coli* from sheep in a) England and Wales, b) Northern Ireland and c) Scotland for 2017. 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	Neonatal	Pre-weaning	Adult
Amikacin	0/56 (0)	0/1 (0)	-
Amoxicillin/clavulanate	15/75 (20.0)	4/17 (23.5)	2/36 (5.6)
Ampicillin	38/75 (50.7)	8/17 (47.1)	11/36 (30.6)
Apramycin	0/71 (0)	0/7 (0)	0/25 (0)
Cefotaxime <sup>^</sup>	2/56 (3.6)	0/1 (0)	-
Cefpodoxime <sup>^</sup>	-	-	-
Ceftazidime <sup>^</sup>	1/56 (1.8)	0/1 (0)	-
Chloramphenicol	9/56 (16.1)	0/1 (0)	-
Enrofloxacin <sup>^</sup>	3/75 (4.0)	1/17 (5.9)	1/36 (2.8)
Florfenicol	4/60 (6.7)	1/11 (9.1)	0/9 (0)
Neomycin	8/71 (11.3)	1/7 (14.3)	2/27 (7.4)
Spectinomycin	35/71 (49.3)	3/7 (42.9)	4/25 (16.0)
Streptomycin	22/56 (39.3)	0/1 (0)	1/2 (50.0)
Tetracycline	48/75 (64.0)	11/17 (64.7)	14/36 (38.9)
Trimethoprim/sulphonamide	19/75 (25.3)	0/17 (0)	4/36 (11.1)



b) Northern Ireland<sup>1</sup>

Antibiotic	Adult
Amikacin	-
Amoxicillin/clavulanate	21/32 (65.6)
Ampicillin	26/32 (81.3)
Apramycin	6/32 (18.8)
Cefotaxime <sup>^</sup>	-
Cefpodoxime <sup>^</sup>	18/32 (56.3)
Ceftazidime <sup>^</sup>	-
Chloramphenicol	-
Enrofloxacin <sup>^</sup>	9/32 (28.1)
Florfenicol	15/31 (48.4)
Neomycin	32/32 (100)
Spectinomycin	-
Streptomycin	-
Tetracycline	22/32 (68.8)
Trimethoprim/sulphonamide	17/32 (53.1)

<sup>1</sup> No pre-weaning or adult data available for Northern Ireland

c) Scotland

Antibiotic	Neonatal	Pre-weaning	Adult
Amikacin	-	-	-
Amoxicillin/clavulanate	4/21 (19.0)	6/10 (60.0)	7/18 (38.9)
Ampicillin	6/21 (28.6)	8/10 (80.0)	8/18 (44.4)
Apramycin	-	-	-
Cefotaxime^	-	-	-
Cefpodoxime^	0/21 (0)	0/10 (0)	0/18 (0)
Ceftazidime^	-	-	-
Chloramphenicol	-	-	-
Enrofloxacin^	1/21 (4.8)	0/10 (0)	0/18 (0)
Florfenicol	1/21 (4.8)	0/10 (0)	1/18 (5.6)
Neomycin	1/21 (4.8)	0/10 (0)	0/18 (0)
Spectinomycin	6/21 (28.6)	4/10 (40.0)	7/18 (38.9)
Streptomycin	-	-	-
Tetracycline	11/21 (52.4)	9/10 (90.0)	8/18 (44.4)
Trimethoprim/sulphonamide	2/21 (9.5)	4/10 (40.0)	3/18 (16.7)

## 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 2017 to 2019. 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	2017	2018	2019
Amoxicillin/clavulanate	3/1707 (0.2)	3/2789 (0.1)	0/2730 (0)
Ampicillin	231/1707 (13.5)	284/2789 (10.2)	208/2730 (7.6)
Apramycin	38/1707 (2.2)	35/2789 (1.3)	43/2730 (1.6)
Cefotaxime <sup>^</sup>	0/1707 (0)	2/2789 (0.1)	0/2730 (0)
Ceftazidime <sup>^</sup>	0/1707 (0)	2/2789 (0.1)	0/2730 (0)
Chloramphenicol	128/1707 (7.5)	156/2789 (5.6)	145/2730 (5.3)
Ciprofloxacin <sup>^</sup>	5/1707 (0.3)	3/2789 (0.1)	9/2730 (0.33)
Furazolidone	14/1707 (0.8)	13/2789 (0.5)	7/2730 (0.3)
Gentamicin	40/1707 (2.3)	48/2789 (1.7)	43/2730 (1.6)
Nalidixic acid	62/1707 (3.6)	22/2789 (0.8)	63/2730 (2.3)
Neomycin	34/1707 (2.0)	50/2789 (1.8)	72/2730 (2.6)
Spectinomycin	-	-	-
Streptomycin	353/1707 (20.7)	460/2789 (16.5)	451/2730 (16.5)
Sulphonamide compounds	447/1707 (26.2)	561/2789 (20.1)	657/2730 (24.1)
Tetracycline	393/1707 (23.0)	480/2789 (17.2)	597/2730 (21.9)
Trimethoprim/sulphonamide	162/1707 (9.5)	212/2789 (7.6)	397/2730 (14.6)

b) Northern Ireland

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	8/86 (9.3)	4/103 (3.9)	3/82 (3.7)
Ampicillin	9/86 (10.5)	17/103 (16.5)	16/82 (19.5)
Apramycin	3/86 (3.5)	7/103 (6.8)	7/82 (8.5)
Cefotaxime^	0/86 (0)	0/103 (0)	2/83 (2.4)
Ceftazidime^	0/86 (0)	0/103 (0)	0/82 (0)
Chloramphenicol	3/86 (3.5)	9/103 (8.7)	9/82 (11.0)
Ciprofloxacin^	0/86 (0)	0/103 (0)	5/83 (6.0)
Furazolidone	0/86 (0)	0/103 (0)	3/83 (3.6)
Gentamicin	3/86 (3.5)	7/103 (6.8)	7/83 (8.4)
Nalidixic acid	9/86 (10.5)	4/103 (3.9)	9/83 (10.8)
Neomycin	-	-	-
Spectinomycin	-	10/103 (9.7)	9/83 (10.8)
Streptomycin	13/86 (15.1)	19/103 (18.4)	30/83 (36.1)
Sulphonamide compounds	9/86 (10.5)	-	18/83 (21.7)
Tetracycline	9/86 (10.5)	18/103 (17.5)	17/83 (20.5)
Trimethoprim/sulphonamide	3/86 (3.5)	7/103 (6.8)	8/83 (9.6)

c) Scotland

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	22/164 (13.4)	13/210 (6.2)	23/241 (9.5)
Ampicillin	26/164 (15.9)	67/282 (23.8)	38/242 (15.7)
Apramycin	-	-	2/239 (0.8)
Cefotaxime^	-	0/282 (0)	-
Cefpodoxime	0/164 (0)	0/210 (0)	0/238 (0)
Ceftazidime^	-	-	-
Chloramphenicol	-	24/282 (8.5)	-
Ciprofloxacin^	-	8/282 (2.8)	-
Enrofloxacin^	0/164 (0)	0/210 (0)	2/242 (0.8)
Florfenicol	21/164 (12.8)	19/210 (9.0)	24/241 (10.0)
Furazolidone	-	3/282 (1.1)	-
Gentamicin	-	1/282 (0.4)	-
Nalidixic acid	2/164 (1.2)	8/282 (2.8)	-
Neomycin	0/164 (0)	0/282 (0)	1/242 (0.4)
Spectinomycin	-	30/282 (10.6)	29/239 (12.1)
Streptomycin	-	75/282 (26.6)	-
Sulphonamide compounds	-	82/282 (29.1)	-
Tetracycline	31/164 (18.9)	84/282 (29.8)	31/241 (12.9)
Trimethoprim/sulphonamide	2/164 (1.2)	3/282 (1.1)	2/241 (0.8)

**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 2017 to 2019. 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	2017	2018	2019
Amoxicillin/clavulanate	1/392 (0.3)	3/489 (0.6)	0/464 (0)
Ampicillin	54/392 (13.8)	45/489 (9.2)	37/464 (8.0)
Apramycin	0/392 (0)	3/489 (0.6)	0/464 (0)
Cefotaxime <sup>^</sup>	0/392 (0)	0/489 (0)	0/464 (0)
Ceftazidime <sup>^</sup>	0/392 (0)	0/489 (0)	0/464 (0)
Chloramphenicol	4/392 (10.7)	32/489 (6.5)	30/464 (6.5)
Ciprofloxacin <sup>^</sup>	0/392 (0)	0/489 (0)	0/464 (0)
Furazolidone	0/392 (0)	0/489 (0)	0/464 (0)
Gentamicin	0/392 (0)	3/489 (0.6)	0/464 (0)
Nalidixic acid	1/392 (0.5)	5/489 (1.0)	0/464 (0)
Neomycin	0/392 (0)	5/489 (1.0)	0/464 (0)
Spectinomycin	-	-	-
Streptomycin	58/392 (14.8)	68/489 (13.9)	41/464 (8.8)
Sulphonamide compounds	58/392 (14.8)	68/489 (13.9)	39/464 (8.4)
Tetracycline	55/392 (14.0)	56/489 (11.5)	46/464 (9.9)
Trimethoprim/sulphonamide	0/392 (0)	2/489 (0.4)	3/464 (0.6)

b) Northern Ireland

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	2/73 (2.7)	0/76 (0)	2/59 (3.4)
Ampicillin	2/73 (2.7)	4/76 (5.3)	3/59 (5.1)
Apramycin	0/73 (0)	2/76 (2.6)	1/59 (1.7)
Cefotaxime^	0/73 (0)	0/76 (0)	1/59 (1.7)
Ceftazidime^	0/73 (0)	0/76 (0)	0/59 (0)
Chloramphenicol	0/73 (0)	2/76 (2.6)	2/59 (3.4)
Ciprofloxacin^	0/73 (0)	0/76 (0)	1/59 (1.7)
Furazolidone	0/73 (0)	0/76 (0)	1/59 (1.7)
Gentamicin	0/73 (0)	2/76 (2.6)	0/59 (0)
Nalidixic acid	8/73 (11.0)	1/76 (1.3)	3/59 (5.1)
Neomycin	-	-	-
Spectinomycin	-	2/76 (2.6)	2/59 (3.4)
Streptomycin	5/73 (6.8)	5/76 (6.6)	13/59 (22.0)
Sulphonamide compounds	2/73 (2.7)	-	4/59 (6.8)
Tetracycline	1/73 (1.4)	4/76 (5.3)	3/59 (5.1)
Trimethoprim/sulphonamide	0/73 (0)	2/76 (2.6)	1/59 (1.7)

c) Scotland

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	21/114 (18.4)	9/130 (6.9)	22/179 (12.3)
Ampicillin	21/114 (18.4)	13/140 (9.3)	30/180 (16.7)
Apramycin	-	-	1/178 (0.6)
Cefotaxime^	-	0/140 (0)	-
Cefpodoxime	0/114 (0)	0/130 (0)	0/177 (0)
Ceftazidime^	-	-	-
Chloramphenicol	-	20/140 (14.3)	-
Ciprofloxacin^	-	0/140 (0)	-
Enrofloxacin^	0/114 (0)	0/130 (0)	2/180 (1.1)
Florfenicol	20/114 (17.5)	15/130 (3.1)	21/179 (11.7)
Furazolidone	-	0/140 (0)	-
Gentamicin	-	1/140 (0.7)	-
Nalidixic acid	2/114 (1.8)	4/140 (2.9)	-
Neomycin	0/114 (0)	0/140 (0)	0/180 (0)
Spectinomycin	-	15/140 (10.7)	26/178 (14.6)
Streptomycin	-	17/140 (12.1)	-
Sulphonamide compounds	-	22/140 (15.7)	-
Tetracycline	24/114 (21.1)	19/140 (13.6)	24/179 (13.4)
Trimethoprim/sulphonamide	1/114 (0.9)	1/140 (0.7)	1/179 (0.6)



**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 2017 to 2019. 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	2017	2018	2019
Amoxicillin/clavulanate	1/158 (0.6)	0/202 (0)	0/206 (0)
Ampicillin	124/158 (78.5)	146/202 (72.3)	143/206 (69.4)
Apramycin	37/158 (23.4)	29/202 (14.4)	41/206 (19.9)
Cefotaxime <sup>^</sup>	0/158 (0)	0/202 (0)	0/206 (0)
Ceftazidime <sup>^</sup>	0/158 (0)	0/202 (0)	0/206 (0)
Chloramphenicol	63/158 (39.9)	104/202 (51.5)	110/206 (53.4)
Ciprofloxacin <sup>^</sup>	0/158 (0)	0/202 (0)	0/206 (0)
Furazolidone	0/158 (0)	0/202 (0)	0/206 (0)
Gentamicin	38/158 (24.1)	34/202 (16.8)	41/206 (19.9)
Nalidixic acid	2/158 (1.3)	0/202 (0)	0/206 (0)
Neomycin	31/158 (19.6)	24/202 (11.9)	40/206 (19.4)
Spectinomycin	-	-	-
Streptomycin	123/158 (77.8)	144/202 (71.3)	136/206 (66.0)
Sulphonamide compounds	139/158 (88.0)	161/202 (79.7)	156/206 (75.7)
Tetracycline	124/158 (78.5)	151/202 (74.8)	139/206 (67.5)
Trimethoprim/sulphonamide	79/158 (50.0)	105/202 (52.0)	118/206 (57.3)

b) Northern Ireland

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	6/8 (75.0)	4/13 (30.8)	1/14 (7.1)
Ampicillin	7/8 (87.5)	11/13 (84.6)	13/14 (92.9)
Apramycin	3/8 (37.5)	5/13 (38.5)	6/14 (42.9)
Cefotaxime^	0/8 (0)	0/13 (0)	0/15 (0)
Ceftazidime^	0/8 (0)	0/13 (0)	0/14 (0)
Chloramphenicol	3/8 (37.5)	7/13 (53.8)	7/14 (50.0)
Ciprofloxacin^	0/8 (0)	0/13 (0)	4/15 (26.7)
Furazolidone	0/8 (0)	0/13 (0)	2/15 (13.3)
Gentamicin	3/8 (37.5)	5/13 (38.5)	0/15 (0)
Nalidixic acid	1/8 (12.5)	3/13 (23.1)	6/15 (40.0)
Neomycin	-	-	-
Spectinomycin	-	8/13 (61.5)	7/15 (46.7)
Streptomycin	7/8 (87.5)	12/13 (92.3)	14/15 (93.3)
Sulphonamide compounds	7/8 (87.5)	-	14/15 (93.3)
Tetracycline	8/8 (100)	12/13 (92.3)	14/15 (93.3)
Trimethoprim/sulphonamide	3/8 (37.5)	5/13 (38.5)	7/15 (46.7)

c) Scotland

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	1/7 (14.3)	0/19 (0)	0/14 (0)
Ampicillin	5/7 (71.4)	48/74 (64.9)	6/14 (42.9)
Apramycin	-	-	0/13 (0)
Cefotaxime^	-	0/74 (0)	-
Cefpodoxime	0/7 (0)	0/19 (0)	0/13 (0)
Ceftazidime^	-	-	-
Chloramphenicol	-	0/74 (0)	-
Ciprofloxacin^	-	0/74 (0)	-
Enrofloxacin^	0/7 (0)	0/19 (0)	0/14 (0)
Florfenicol	1/7 (14.3)	0/19 (0)	1/14 (7.1)
Furazolidone	-	0/74 (0)	-
Gentamicin	-	0/74 (0)	-
Nalidixic acid	0/7 (0)	1/74 (1.4)	-
Neomycin	0/7 (0)	0/74 (0)	1/14 (7.1)
Spectinomycin	-	9/74 (12.2)	1/13 (7.7)
Streptomycin	-	52/74 (70.3)	-
Sulphonamide compounds	-	52/74 (70.3)	-
Tetracycline	4/7 (57.1)	58/74 (78.4)	5/14 (35.7)
Trimethoprim/sulphonamide	1/7 (14.3)	1/74 (1.4)	1/14 (7.1)

**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 2017 to 2019. 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	2017	2018	2019
Amoxicillin/clavulanate	0/104 (0)	0/276 (0)	0/82 (0)
Ampicillin	17/104 (16.3)	18/276 (6.5)	0/82 (0)
Apramycin	0/104 (0)	2/276 (0.7)	0/82 (0)
Cefotaxime <sup>^</sup>	0/104 (0)	0/276 (0)	0/82 (0)
Ceftazidime <sup>^</sup>	0/104 (0)	0/276 (0)	0/82 (0)
Chloramphenicol	17/104 (16.3)	15/276 (5.4)	0/82 (0)
Ciprofloxacin <sup>^</sup>	0/104 (0)	0/276 (0)	0/82 (0)
Furazolidone	0/104 (0)	1/276 (0.4)	0/82 (0)
Gentamicin	0/104 (0)	1/276 (0.4)	0/82 (0)
Nalidixic acid	0/104 (0)	0/276 (0)	0/82 (0)
Neomycin	0/104 (0)	1/276 (0.4)	0/82 (0)
Spectinomycin	-	-	-
Streptomycin	17/104 (16.3)	21/276 (7.6)	1/82 (1.2)
Sulphonamide compounds	17/104 (16.3)	20/276 (7.2)	1/82 (1.2)
Tetracycline	17/104 (16.3)	19/276 (6.9)	0/82 (0)
Trimethoprim/sulphonamide	0/104 (0)	1/276 (0.4)	0/82 (0)

b) Northern Ireland

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	0/3 (0)	0/11 (0)	0/7 (0)
Ampicillin	0/3 (0)	2/11 (18.2)	0/7 (0)
Apramycin	0/3 (0)	0/11 (0)	0/7 (0)
Cefotaxime^	0/3 (0)	0/11 (0)	1/7 (14.3)
Ceftazidime^	0/3 (0)	0/11 (0)	0/7 (0)
Chloramphenicol	0/3 (0)	0/11 (0)	0/7 (0)
Ciprofloxacin^	0/3 (0)	0/11 (0)	0/7 (0)
Furazolidone	0/3 (0)	0/11 (0)	0/7 (0)
Gentamicin	0/3 (0)	0/11 (0)	0/7 (0)
Nalidixic acid	0/3 (0)	0/11 (0)	0/7 (0)
Neomycin	-	-	-
Spectinomycin	-	0/11 (0)	0/7 (0)
Streptomycin	0/3 (0)	2/11 (18.2)	3/7 (42.9)
Sulphonamide compounds	0/3 (0)	0/11 (0)	0/7 (0)
Tetracycline	0/3 (0)	2/11 (18.2)	0/7 (0)
Trimethoprim/sulphonamide	0/3 (0)	0/11 (0)	0/7 (0)

c) Scotland

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	0/43 (0)	4/61 (6.6)	0/38 (0)
Ampicillin	0/43 (0)	6/68 (8.8)	1/37 (2.7)
Apramycin	-	-	1/38 (2.6)
Cefotaxime^	-	0/68 (0)	-
Cefpodoxime	0/43 (0)	0/61 (0)	0/38 (0)
Ceftazidime^	-	-	-
Chloramphenicol	-	4/68 (5.9)	-
Ciprofloxacin^	-	0/68 (0)	-
Enrofloxacin^	0/43 (0)	0/61 (0)	0/38 (0)
Florfenicol	0/43 (0)	4/61 (6.6)	1/38 (2.6)
Furazolidone	-	3/68 (4.4)	-
Gentamicin	-	0/68 (0)	-
Nalidixic acid	0/43 (0)	3/68 (4.4)	-
Neomycin	0/43 (0)	0/68 (0)	0/38 (0)
Spectinomycin	-	6/68 (8.8)	1/38 (2.6)
Streptomycin	-	6/68 (8.8)	-
Sulphonamide compounds	-	8/68 (11.8)	-
Tetracycline	3/43 (7.0)	7/68 (10.3)	1/38 (2.6)
Trimethoprim/sulphonamide	-	1/68 (1.5)	0/38 (0)

**Table S4.8.5:** Resistance (interpreted using breakpoints) in all *Salmonella* from chickens (all ages) in England and Wales from 2017 to 2019. 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 and Northern Ireland from 2017 to 2019.

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	1/873 (0.1)	0/1640 (0)	0/1708 (0)
Ampicillin	25/873 (2.9)	49/1640 (3.0)	32/1708 (1.9)
Apramycin	1/873 (0.1)	0/1640 (0)	2/1708 (0.1)
Cefotaxime <sup>^</sup>	0/873 (0)	2/1640 (0.1)	0/1708 (0)
Ceftazidime <sup>^</sup>	0/873 (0)	2/1640 (0.1)	0/1708 (0)
Chloramphenicol	6/873 (0.7)	3/1640 (0.2)	5/1708 (0.3)
Ciprofloxacin <sup>^</sup>	4/873 (0.5)	2/1640 (0.1)	0/1708 (0)
Furazolidone	14/873 (1.6)	11/1640 (0.7)	7/1708 (0.4)
Gentamicin	1/873 (0.1)	8/1640 (0.5)	2/1708 (0.1)
Nalidixic acid	25/873 (2.9)	7/1640 (0.4)	10/1708 (0.6)
Neomycin	2/873 (0.2)	18/1640 (1.1)	31/1708 (1.8)
Streptomycin	74/873 (8.5)	97/1640 (5.9)	145/1708 (8.5)
Sulphonamide compounds	130/873 (14.9)	185/1640 (11.3)	307/1708 (18.0)
Tetracycline	94/873 (10.8)	128/1640 (7.8)	265/1708 (15.5)
Trimethoprim/sulphonamide	79/873 (9.0)	98/1640 (6.0)	224/1708 (13.1)

**Table S4.8.6:** Resistance (interpreted using breakpoints) in all *Salmonella* from turkeys (all ages) in England and Wales from 2017 to 2019. 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 and Northern Ireland.

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	0/180 (0)	0/182 (0)	0/270 (0)
Ampicillin	11/180 (6.1)	26/182 (14.4)	33/270 (12.2)
Apramycin	0/180 (0)	1/182 (0.6)	0/270 (0)
Cefotaxime <sup>^</sup>	0/180 (0)	0/182 (0)	0/270 (0)
Ceftazidime <sup>^</sup>	0/180 (0)	0/182 (0)	0/270 (0)
Chloramphenicol	0/180 (0)	2/182 (1.1)	0/270 (0)
Ciprofloxacin <sup>^</sup>	1/180 (0.6)	1/182 (0.6)	9/270 (3.3)
Furazolidone	0/180 (0)	0/182 (0)	0/270 (0)
Gentamicin	1/180 (0.6)	2/182 (1.1)	0/270 (0)
Nalidixic acid	33/180 (18.3)	11/182 (6.0)	53/270 (19.6)
Neomycin	1/180 (0.6)	2/182 (1.1)	1/270 (0.4)
Streptomycin	81/180 (45.0)	131/182 (71.8)	128/270 (47.4)
Sulphonamide compounds	103/180 (57.2)	127/182 (69.6)	154/270 (57.0)
Tetracycline	103/180 (57.2)	126/182 (69.1)	147/270 (54.4)
Trimethoprim/sulphonamide	4/180 (2.2)	5/182 (2.8)	53/270 (19.6)



**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 from 2017 to 2019. 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	2017	2018	2019
Amoxicillin/clavulanate	-	0/320 (0)	0/269 (0)
Ampicillin	0/272 (0)	0/320 (0)	0/269 (0)
Apramycin	-	0/320 (0)	0/269 (0)
Cefotaxime <sup>^</sup>	-	0/320 (0)	0/269 (0)
Ceftazidime <sup>^</sup>	-	0/320 (0)	0/269 (0)
Chloramphenicol	0/272 (0)	1/320 (0.3)	1/269 (0.4)
Ciprofloxacin <sup>^</sup>	-	0/320 (0)	0/269 (0)
Furazolidone	0/272 (0)	0/320 (0)	0/269 (0)
Gentamicin	-	0/320 (0)	0/269 (0)
Nalidixic acid	0/272 (0)	7/320 (2.2)	0/269 (0)
Neomycin	0/272 (0)	1/320 (0.3)	0/269 (0)
Streptomycin	0/272 (0)	1/320 (0.3)	1/269 (0.4)
Sulphonamide compounds	0/272 (0)	1/320 (0.3)	1/269 (0.4)
Tetracycline	0/272 (0)	1/320 (0.3)	1/269 (0.4)
Trimethoprim/sulphonamide	0/272 (0)	0/320 (0)	2/269 (0.7)

b) Northern Ireland

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	-	0/68 (0)	0/48 (0)
Ampicillin	0/72 (0)	0/68 (0)	0/48 (0)
Apramycin	-	0/68 (0)	0/48 (0)
Cefotaxime^	-	0/68 (0)	0/48 (0)
Ceftazidime^	-	0/68 (0)	0/48 (0)
Chloramphenicol	0/72 (0)	0/68 (0)	0/48 (0)
Ciprofloxacin^	-	0/68 (0)	1/48 (2.1)
Furazolidone	0/72 (0)	0/68 (0)	0/48 (0)
Gentamicin	-	0/68 (0)	0/48 (0)
Nalidixic acid	8/72 (11.1)	1/68 (1.5)	3/48 (6.3)
Neomycin	-	-	-
Streptomycin	3/72 (4.2)	1/68 (1.5)	8/48 (16.7)
Sulphonamide compounds	0/72 (0)	-	0/48 (0)
Tetracycline	0/72 (0)	0/68 (0)	0/48 (0)
Trimethoprim/sulphonamide	-	0/68 (0)	0/48 (0)

c) Scotland

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	-	0/109 (0)	0/91 (0)
Ampicillin	0/68 (0)	2/118 (1.7)	0/91 (0)
Apramycin	-	-	0/90 (0)
Cefotaxime^	-	0/118 (0)	-
Ceftazidime^	-	-	-
Chloramphenicol	-	10/118 (8.5)	-
Ciprofloxacin^	-	0/118 (0)	-
Furazolidone	-	0/118 (0)	-
Gentamicin	-	1/118 (0.8)	-
Nalidixic acid	2/68 (2.9)	4/118 (3.4)	-
Neomycin	0/68 (0)	0/118 (0)	0/91 (0)
Streptomycin	-	4/118 (3.4)	-
Sulphonamide compounds	-	10/118 (8.5)	-
Tetracycline	2/68 (2.9)	7/118 (5.9)	1/91 (1.1)
Trimethoprim/sulphonamide	0/68 (0)	1/118 (0.8)	0/91 (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 2017 to 2019. 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	2017	2018	2019
Amoxicillin/clavulanate	-	3/504 (0.6)	0/254 (0)
Ampicillin	109/187 (58.3)	152/504 (30.2)	117/254 (46.1)
Apramycin	0/187 (0)	9/504 (1.8)	2/254 (0.8)
Cefotaxime <sup>^</sup>	-	0/504 (0)	0/254 (0)
Ceftazidime <sup>^</sup>	-	0/504 (0)	0/254 (0)
Chloramphenicol	100/187 (53.5)	151/504 (30.0)	112/254 (44.1)
Ciprofloxacin <sup>^</sup>	-	1/504 (0.2)	0/254 (0)
Furazolidone	0/187 (0)	0/504 (0)	0/254 (0)
Gentamicin	-	8/504 (1.6)	2/254 (0.8)
Nalidixic acid	3/187 (1.6)	2/504 (0.4)	0/254 (0)
Neomycin	0/187 (0)	9/504 (1.8)	2/254 (0.8)
Streptomycin	107/187 (57.1)	205/504 (40.7)	102/254 (40.2)
Sulphonamide compounds	117/187 (62.6)	222/504 (44.0)	117/254 (46.1)
Tetracycline	102/187 (54.5)	183/504 (36.3)	107/254 (42.1)
Trimethoprim/sulphonamide	37/187 (19.8)	79/504 (15.7)	61/254 (24.0)

b) Northern Ireland

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	-	4/15 (26.7)	3/20 (15.0)
Ampicillin	9/11 (81.8)	15/15 (100)	16/20 (80.0)
Apramycin	3/11 (27.3)	6/15 (40.0)	7/20 (35.0)
Cefotaxime^	-	0/15 (0)	2/20 (10.0)
Ceftazidime^	-	0/15 (0)	0/20 (0)
Chloramphenicol	3/11 (27.3)	8/15 (53.3)	9/20 (45.0)
Ciprofloxacin^	-	0/15 (0)	3/20 (15.0)
Furazolidone	0/11 (0)	0/15 (0)	3/20 (15.0)
Gentamicin	-	6/15 (40.0)	7/20 (35.0)
Nalidixic acid	1/11 (9.1)	3/15 (20.0)	4/20 (20.0)
Neomycin	-	-	-
Streptomycin	10/11 (90.9)	15/15 (100)	17/20 (85.0)
Sulphonamide compounds	9/11 (81.8)	-	16/20 (80.0)
Tetracycline	8/11 (72.7)	15/15 (100)	16/20 (80.0)
Trimethoprim/sulphonamide	-	6/15 (40.)	7/20 (35.0)

c) Scotland

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	-	13/32 (40.6)	18/28 (64.3)
Ampicillin	20/27 (74.1)	63/82 (76.8)	24/28 (85.7)
Apramycin	-	-	0/28 (0)
Cefotaxime^	-	0/82 (0)	-
Ceftazidime^	-	-	-
Chloramphenicol	-	14/82 (17.1)	-
Ciprofloxacin^	-	0/82 (0)	-
Furazolidone	-	1/82 (1.2)	-
Gentamicin	-	0/82 (0)	-
Nalidixic acid	0/27 (0)	2/82 (2.4)	-
Neomycin	0/27 (0)	0/82 (0)	0/28 (0)
Streptomycin	-	70/82 (85.4)	-
Sulphonamide compounds	-	67/82 (81.7)	-
Tetracycline	25/27 (92.6)	73/82 (89.0)	20/28 (71.4)
Trimethoprim/sulphonamide	0/27 (0)	0/82 (0)	0/28 (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 2017 to 2019. 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	2017	2018	2019
Amoxicillin/clavulanate	-	2/3589 (0.1)	0/4010 (0)
Ampicillin	273/2652 (10.3)	276/3589 (7.7)	297/4010 (7.4)
Apramycin	42/2652 (1.6)	29/3589 (0.8)	52/4010 (1.3)
Cefotaxime	-	2/3589 (0.1)	2/4010 (0.05)
Ceftazidime	-	3/3589 (0.1)	0/4010 (0)
Chloramphenicol	53/2652 (2.0)	54/3589 (1.5)	84/4010 (2.1)
Ciprofloxacin	-	6/3589 (0.2)	16/4010 (0.4)
Furazolidone	42/2652 (1.6)	43/3589 (1.2)	64/4010 (1.6)
Gentamicin	-	42/3589 (1.2)	53/4010 (1.3)
Nalidixic acid	154/2652 (5.8)	50/3589 (1.4)	108/4010 (2.7)
Neomycin	53/2652 (2.0)	65/3589 (1.8)	104/4010 (2.6)
Streptomycin	347/2652 (13.1)	420/3589 (11.7)	602/4010 (15.0)
Sulphonamide compounds	504/2652 (19.0)	563/3589 (15.7)	810/4010 (20.2)
Tetracycline	520/2652 (19.6)	535/3589 (14.9)	810/4010 (20.2)
Trimethoprim/ sulphonamides	164/2652 (6.2)	190/3589 (5.3)	409/4010 (10.2)

b) Northern Ireland

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	-	0/17 (0)	0/14 (0)
Ampicillin	0/3 (0)	0/17 (0)	0/14 (0)
Apramycin	0/3 (0)	0/17 (0)	0/14 (0)
Cefotaxime	-	0/17 (0)	0/14 (0)
Ceftazidime	-	0/17 (0)	0/14 (0)
Chloramphenicol	0/3 (0)	0/17 (0)	0/14 (0)
Ciprofloxacin	-	0/17 (0)	0/14 (0)
Furazolidone	0/3 (0)	0/17 (0)	0/14 (0)
Gentamicin	-	0/17 (0)	0/14 (0)
Nalidixic acid	0/3 (0)	0/17 (0)	1/14 (7.1)
Neomycin	-	-	-
Streptomycin	0/3 (0)	0/17 (0)	4/14 (28.6)
Sulphonamide compounds	0/3 (0)	-	1/14 (7.1)
Tetracycline	1/3 (33.3)	1/17 (5.9)	0/14 (0)
Trimethoprim/sulphonamides	-	0/17 (0)	0/14 (0)



c) Scotland

Antibiotic	2017	2018	2019
Amoxicillin/clavulanate	-	0/69 (0)	5/122 (4.1)
Ampicillin	2/69 (2.9)	2/82 (2.4)	14/123 (11.4)
Apramycin	-	-	2/121 (1.7)
Cefotaxime	-	0/82 (0)	-
Ceftazidime	-	-	-
Chloramphenicol	-	0/82 (0)	-
Ciprofloxacin	-	0/82 (0)	-
Furazolidone	-	2/82 (2.4)	-
Gentamicin	-	0/82 (0)	-
Nalidixic acid	0/69 (0)	2/82 (2.4)	-
Neomycin	0/69 (0)	0/82 (0)	1/123 (0.8)
Streptomycin	-	1/82 (1.2)	-
Sulphonamide compounds	-	5/82 (6.1)	-
Tetracycline	4/69 (5.8)	4/82 (4.9)	10/122 (8.2)
Trimethoprim/sulphonamides	0/69 (0)	2/82 (2.4)	2/122 (1.6)

**Table S4.8.10:** Top ten *Salmonella* serovars isolated in Northern Ireland from 2017 to 2019

Rank	2017	2018	2019
1	Dublin (173 isolations)	Dublin (69 isolations)	Dublin (51 isolations)
2	(Monophasic) Typhimurium (26 isolations)	Monophasic ST (10 isolations)	Monophasic ST (15 isolations)
3	<i>Salmonella</i> sp. (8 isolations)	Mbandaka (6 isolations) Agama (6 isolations)	Typhimurium (8 isolations)
4	Derby (3 isolations)	Typhimurium (5 isolations)	Montevideo (5 isolations)
5	Newport (2 isolations)	Diarizonae o 61 (2 isolations) Montevideo (2 isolations) Newport (2 isolations)	Mbandaka (4 isolations)
6	No other serovars detected in 2017	Anatum (1 isolation) Ruiru (1 isolation)	Agama (2 isolations)
7	No other serovars detected in 2017	No other serovars detected in 2018	Nima (2 isolations)
8	No other serovars detected in 2017	No other serovars detected in 2018	Agona (1 isolation)
9	No other serovars detected in 2017	No other serovars detected in 2018	Newport (1 isolation)
10	No other serovars detected in 2017	No other serovars detected in 2018	Derby (1 isolation)

**Table S4.8.11:** Top ten *Salmonella* serovars isolated in Scotland from 2017 to 2019

Rank	2017	2018	2019
1	Dublin (74 isolations)	Dublin (118 isolations)	Dublin (91 isolations)
2	Typhimurium (30 isolations)	Typhimurium (82 isolations)	Mbandaka (42 isolations)
3	Arizonae (28 isolations)	Arizonae (36 isolations)	Typhimurium (28 isolations)
4	Bovismorbificans (19 isolations)	Montevideo (18 isolations)	Arizonae (27 isolations)
5	Montevideo (16 isolations)	Bovismorbificans (8 isolations)	Monophasic group B 4,(5),12 :l : - (17 isolations)
6	Mbandaka (9 isolations)	Mbandaka (7 isolations)	Montevideo (9 isolations)
7	Urbana (7 isolations)	Derby (4 isolations)	Bovismorbificans (7 isolations)
8	Derby (2 isolations)	Reading (3 isolations)	Group B (6 isolations)
9	Enteritidis/Minnesota/ Reading/Agama (1 isolation each)	Panama (2 isolations)	Enteritidis (2 isolations)
10	No other serovars detected in 2017	Enteritidis (1 isolation)	Derby (1 isolation)