Veterinary Medicines Directorate

Supplementary Material

UK-VARSS 2017

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S1.1: Changes in 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. Table S1.1.1 summarises these differences, which are also highlighted in Figure S1.1.2 and Table S1.1.2.

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 not included as food-producing animals.	↓ Horses included as food-producing animals.
Calculation of mg/kg	↓ Only takes into account products which are authorised for use in food-producing animals only. Horses are excluded. Takes into account all administration routes.	↑ All formulations (*for all species*) other than tablets included; it is considered that tablets are primarily used in the treatment of non-food-producing animals.
Conclusion	Likely underestimates mg/kg.	Likely overestimates mg/kg.

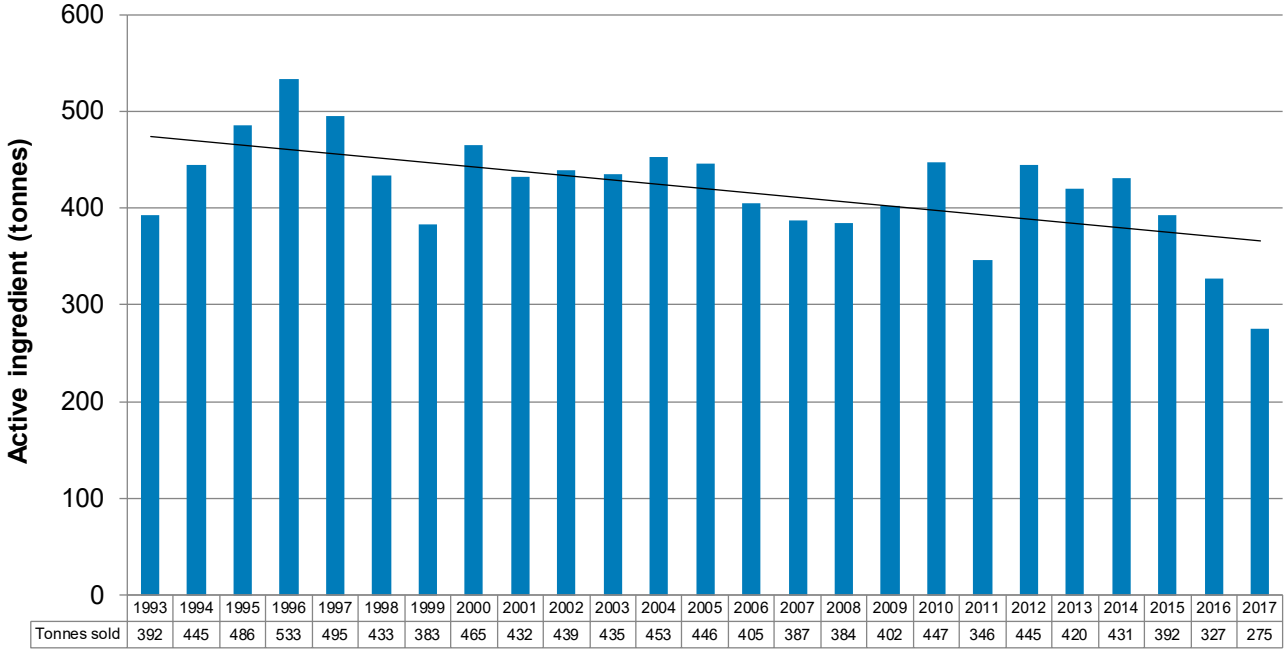
In order to harmonise national and European reporting, the ESVAC methodology has been adopted since the VARSS-2015 report. The historical data based on the traditional UK-VARSS methodology, as well as 2017 data calculated in the same way, can be seen in Figure S1.1.1.

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.

Data have been collected from Marketing Authorisation Holders (MAHs) since 1993, although this was only a statutory requirement from 2005. Data shown in Figure S1.1.1 represent sales of

antibiotics for therapeutic use only, and do not contain sales of products marketed as growth promoters, which were banned in 2006.

Figure S1.1.1: Tonnes of active ingredient (■; — linear trend) of antibiotics sold for all animal species using the original UK-VARSS methodology, 1993–2017



	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Tonnes sold	392	445	486	533	495	433	383	465	432	439	435	453	446	405	387	384	402	447	346	445	420	431	392	327	275

Figure S1.1.2 shows a comparison of mg/kg following from the two calculation methods, with Table S1.1.2 presenting the underlying data used for those calculations.

Figure S1.1.2: Active ingredient (mg/kg) of antibiotic sold for food-producing animal species, calculated using the ESVAC and original UK-VARSS methodology, 2013–2017

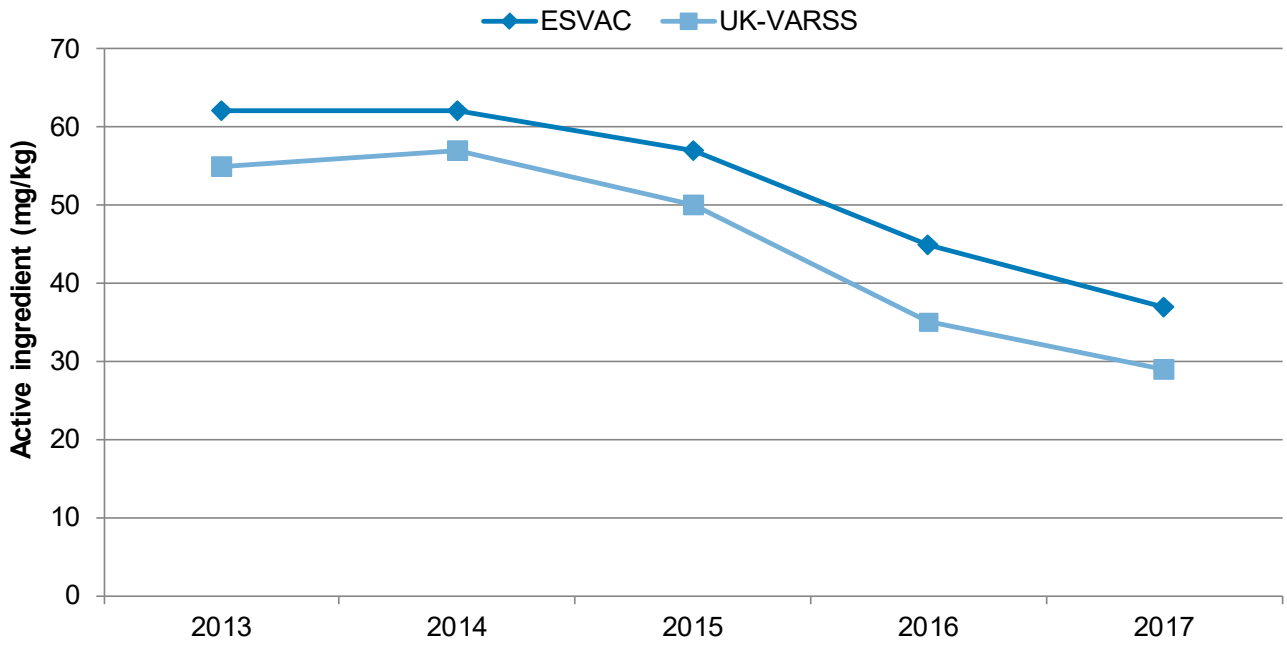


Table S1.1.2: Comparison of the UK-VARSS and ESVAC methodology for the calculation of tonnes of active ingredient sold, PCU, and milligrams (mg) of active ingredient sold per kg for food-producing animal species, 2013–2017

	2013		2014		2015		2016		2017	
	VARSS	ESVAC	VARSS	ESVAC	VARSS	ESVAC	VARSS	ESVAC	VARSS	ESVAC
Active ingredient (tonnes)	355	422	386	432	332	395	237	322	197	267
PCU (thousand tonnes)	6,404	6,799	6,518	6,915	6,584	6,961	6,765	7,142	6,824	7,202
mg/kg	55	62	57	62	50	57	35	45	29	37

Figure S1.1.3 shows historical data for mg/kg for 2005–2017, calculated using ESVAC methodology. The data presented account for sales of antibiotics for food-producing animals only, inclusive of horses.

Figure S1.1.3: Active ingredient (mg/kg) of antibiotics sold for food-producing animal species using the ESVAC methodology, 2005–2017

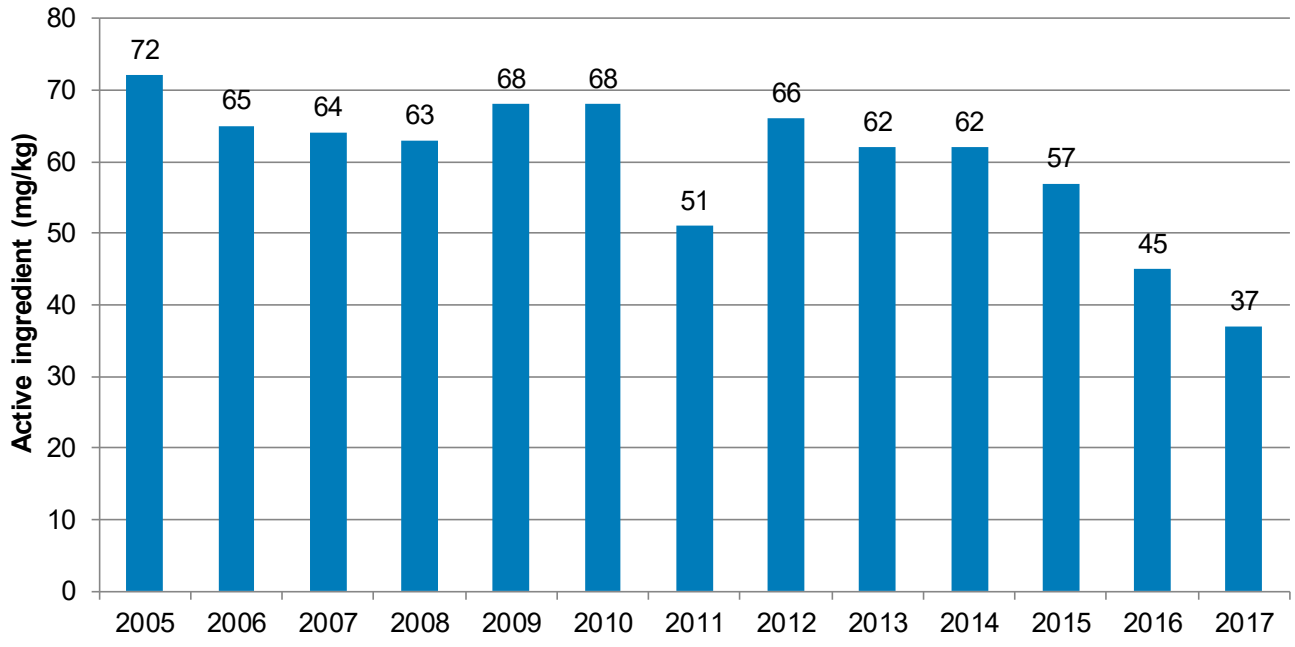


Table S1.1.3 shows the sales for other antibiotic products, which include topical preparations and those for sensory organs, e.g. aerosols, creams, gels, shampoos and ear and eye medications. These are not included in the ESVAC calculation.

Table S1.1.3: Active ingredient (tonnes) of antibiotics sold for all animal species by 'other' routes of administration, 2013–2017

	Tonnes of active ingredient				
	2013	2014	2015	2016	2017
Other routes	2.2	2.4	2.0	2.6	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 taken into account, (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 S1.2.2) with the associated annual animal/slaughter numbers. The calculation also takes into account 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 2005–2009): https://www.ema.europa.eu/en/veterinary-regulatory/overview/antimicrobial-resistance/european-surveillance-veterinary-antimicrobial-consumption-esvac.

Table S1.2.1 shows the combined 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).

Companion animals are not included in the PCU as sufficiently detailed, reliable population data cannot be collected and no agreed weights at time of treatment have been allocated for these species.

Table S1.2.1: PCU (1,000 tonnes) by food-producing animal species and total, 2013–2017

	PCU (1,000 tonnes)				
Animal species	**2013**	**2014**	**2015**	**2016**	**2017**
Sheep and goats	2,760	2,809	2,795	2,845	2,910
Cattle	1,692	1,731	1,743	1,792	1,785
Poultry	1,059	1,042	1,082	1,151	1,185
Pigs	716	745	770	789	766
Horses**	395	395	378	378	378
Fish	177	193	187	177	***
Total food-producing animal species + horses*	**6,799**	**6,915**	**6,961**	**7,142**	**7,202**

* Total food-producing animal species PCU includes cattle, pigs, sheep, goats, poultry (broilers), fish and horses.
** Horse population data are obtained from the British Equestrian Trade Association survey which is run every 5 years.
*** UK aquaculture population statistics for 2017 are not yet available as they are collated through 2018. Therefore, for fish PCU calculation purposes, 2016 data have been used.

Table S1.2.2: Average weight at time of treatment (kg) used to calculate the PCU

Animal category	Average weight at treatment (kg)	Source
Cattle		
Slaughter cows	425	Montforts (1999)[1]
Slaughter heifers	200	EMA[2]
Slaughter bullocks and bulls	425	Montforts (1999)[1]
Slaughter calves and young cattle	140	Montforts (1999)[1]; EMA[2]
Imported/exported cattle for slaughter	425	Montforts (1999)[1]
Imported/exported cattle for fattening	140	Montforts (1999)[1]
Livestock dairy cows	425	Montforts (1999)[1]; EMA[2]
Pigs		
Slaughter pigs	65	Montforts (1999)[1]
Imported/exported pigs for slaughter	65	Montforts (1999)[1]
Imported/exported pigs for fattening	25	M. Goll (Eurostat, personal comm.)
Livestock sows	240	Montforts (1999)[1]
Poultry		
Slaughter broilers	1	Montforts (1999)[1]; EMA[2]
Slaughter turkeys	6.5	Montforts (1999)[1]; EMA[2]
Imported/exported poultry for slaughter[3]	1	Montforts (1999)[1]; EMA[2]
Sheep and goats		
Slaughter sheep and goats[4]	20	Montforts (1999)[1]
Imported/exported sheep and goats for slaughter[4]	20	Montforts (1999)[1]
Livestock sheep	75	Montforts (1999)[1]
Horses		
Living horses	400	Montforts (1999)[1]; EMA[2]
Fish[5]		

[1] Montforts, M. H. M. M. (1999). Environmental risk assessment for veterinary medicinal products. Part 1. Other than GMO-containing and immunological products. First update.
[2] European Medicines Agency (2016). Revised guideline on environmental impact assessment for veterinary medicinal products in support of the VICH guidelines GL6 and GL 38 (EMEA/CVMP/ERA/418282/2005-Rev.1- Corr.).
[3] Assume broilers.
[4] Assume lambs.
[5] Data from Eurostat is given in 1,000 tonnes slaughtered fish (as live weight).

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

Antibiotic class/ active ingredient	Authorised species	Administration route
Tetracyclines		
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
Trimethoprim/sulphonamides		
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
Beta-lactams		
1st generation cephalosporins		
Cefalexin	Cattle, *cats, dogs*	Tablet, injectable, intramammary suspension
Cefalonium	Cattle	Intramammary suspension
Cefapirin	Cattle	Intramammary suspension, intrauterine suspension
*3rd generation cephalosporins**		
Cefoperazone	Cattle	Intramammary suspension
Cefovecin	Cats, *dogs*	Injectable
Ceftiofur	Cattle, pigs, *horses*	Injectable
*4th generation cephalosporins**		
Cefquinome	Cattle, pigs, *horses*	Injectable, intramammary suspension/ointment
Penicillins		
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

Antibiotic class/ active ingredient	Authorised species	Administration route
Penicillins (cont.)		
Cloxacillin	Cattle, sheep, *cats, dogs, horses*	Intramammary suspension, eye ointment
Nafcillin	Cattle	Intramammary suspension
Phenoxymethylpenicillin	Pigs	Premix
Aminoglycosides		
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
Spectinomycin	Cattle, pigs, sheep, chickens	Injectable, premix, oral/water
Streptomycin	Cattle, sheep, *cats, dogs, horses*	Injectable, oral/water, intramammary suspension
Fluoroquinolones*		
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
Macrolides		
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

Antibiotic class/ active ingredient	Authorised species	Administration route
Other		
Amphenicols		
Florfenicol	Cattle, pigs, sheep, salmon	Injectable, oral/water, premix, ear gel
Lincomycins		
Lincomycin	Cattle, pigs, chicken, *cats, dogs*	Oral/water, premix, injectable, intramammary solution
Clindamycin	*Cats, dogs*	Tablet, oral/water
Pirlimycin	Cattle	Intramammary solution
Pleuromutilins		
Tiamulin	Pigs, chickens, turkeys, *rabbits*	Oral/water, premix, injectable
Valnemulin	Pigs, *rabbits*	Oral/water, premix
Polymyxins		
Colistin*	Cattle, pigs, sheep, chickens	Oral/water
Polymyxin B	*Cats, dogs*	Ear drops, cutaneous suspension
Other antibiotics		
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.

Antibiotic class	Active ingredient
Aminoglycosides	Amikacin
Amphenicols	Chloramphenicol
3rd generation cephalosporins	Cefotaxime
	Cefpodoxime
	Ceftazidime
Fluoroquinolones	Ciprofloxacin
Other antiinfectives 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 2013/652/EU

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

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

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

S3.2: EU Harmonised Monitoring Results of Susceptibility Testing in *E. coli*

Table S3.2.1: Susceptibility in *E. coli* (interpreted using both EUCAST CBPs and ECOFFs) from caecal samples from pigs at slaughter in the UK, 2015 and 2017

	No. resistant (CBP) or less susceptible (ECOFF) isolates (%)			
	2015 (n=150)		2017 (n=186)	
Antibiotic	CBPs	ECOFFs	CBPs	ECOFFs
Ampicillin	57 (38.0)	57 (38.0)	57 (30.6)	57 (30.6)
Azithromycin	-	-	-	-
Cefotaxime	0	0	0	0
Ceftazidime	0	0	0	0
Chloramphenicol	48 (32.0)	47 (31.3)	43 (23.1)	38 (20.4)
Ciprofloxacin	1 (0.7)	4 (2.7)	3 (1.6)	5 (2.7)
Colistin	0	0	0	0
Gentamicin	10 (6.7)	11 (7.3)	7 (3.8)	7 (3.8)
Meropenem	0	0	0	0
Nalidixic acid	2 (1.3)	2 (1.3)	4 (2.2)	4 (2.2)
Sulfamethoxazole	*	87 (58.0)	*	88 (47.3)
Tetracycline	108 (72.0)	108 (72.0)	110 (59.1)	110 (59.1)
Tigecycline	0	0	0	0
Trimethroprim	73 (48.7)	73 (48.7)	67 (36.0)	68 (36.6)

* No clinical breakpoint value available
- Not applicable

Table S3.2.2: Distribution and sequence type of ESBL/AmpC and carbapenemase enzymes detected in *E. coli* from healthy pigs in the UK, 2017

Enzyme	Number of isolates	Proportion of isolates (n=75) (%)	Proportion of caecal samples (n=347) (%)	Number of unique STs	Sequence type (ST)
CMY-2	12	16	3	10	10 (n=1), 57 (n=1), 58 (n=1), 69 (n=1), 117 (n=3), 1196 (n=1), 2496 (n=1), 3377 (n=1), unknown (n=2)
CTX-M-1	32	43	9	22	10 (n=2), 20 (n=1), 23 (n=1), 46 (n=1), 48 (n=2), 58 (n=2), 88 (n=4), 93 (n=1), 101 (n=2), 117 (n=2), 131 (n=1), 410 (n=1), 847 (n=1), 1081 (n=1), 1114 (n=2), 1952 (n=1), 2077 (n=1), 2230 (n=1), 3057 (n=1), 3321 (n=1), 5876 (n=2), unknown (n=1)
CTX-M-2	1	1	0	1	93 (n=1)
CTX-M-14	5	7	1	4	117 (n=1), 278 (n=1), 410 (n=2), 3014 (n=1)
CTX-M-15	8	11	2	8	10 (n=1), 48 (n=1), 69 (n=1), 101 (n=1), 410 (n=1), 416 (n=1), 7488 (n=1), unknown (n=1)
CTX-M-32	2	3	1	2	206 (n=1), 710 (n=1)
CTX-M-55	4	5	1	3	101 (n=2), 3776 (n=1), unknown (n=1)
CTX-M-115	1	1	0	1	648 (n=1)
SHV-12	2	3	1	2	58 (n=1), 88 (n=1)
Upregulated *ampC*	10	13	3	10	23 (n=1), 88 (n=1), 156 (n=1), 453 (n=1), 2175 (n=1), 2313 (n=1), 2628 (n=1), 2766 (n=1), 3321 (n=1), 3541 (n=1)

S3.3: Food Business Operator *Salmonella* Testing

Table S3.3.1: Resistance in FBO *Salmonella* isolates in England and Wales, 2015 and 2017

	No. resistant (CBP) or less susceptible (ECOFF) isolates			
	2015 (n=9)		2017 (n=4)	
Antibiotic	CBPs	ECOFFs	CBPs	ECOFFs
Ampicillin	3	3	2	2
Azithromycin	-	-	-	-
Cefotaxime	0	0	0	0
Ceftazidime	0	0	0	0
Chloramphenicol	1	1	0	0
Ciprofloxacin	0	1	0	0
Colistin	0	0	0	0
Gentamicin	1	1	0	0
Meropenem	0	0	0	0
Nalidixic acid	1	1	0	0
Sulfamethoxazole	*	4	*	2
Tetracycline	3	3	2	2
Tigecycline	0	0	0	0
Trimethroprim	1	1	0	0

* No clinical breakpoint value available
- Not applicable

S4.1: Methodology 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)	*Escherichia coli*, Enterobacteriaceae	*Salmonella*	*Staphylococci*	*Streptococci*	*Pasteurella, Mannheimia, Histophilus, Actinobacillus*
Amikacin (AK)	30	R ≤18 mm R ≥16 mg/l	R ≤18 mm R ≥16 mg/l	NA	NA	NA
Amoxicillin/clavulanate (AMC)	20/10	R ≤14 mm R >8 mg/l	R ≤14 mm R > 8mg/l	NA	NA	R ≤13 mm
Amoxicillin/clavulanate	2/1	NA	NA	R ≤17 mm R >1 mg/l	R ≤13 mm	NA
Ampicillin (AM)	10	R ≤14 mm R >8 mg/l	R ≤14 mm R >8 mg/l	R ≤13 mm	R ≤13 mm	R ≤29 mm R >1 mg/l
Apramycin (APR)	15	R ≤13 mm R ≥32 mg/l	R ≤13 mm R ≥32 mg/l	NA	NA	R ≤13 mm†
Cefalexin	30	R ≤15 mm R >16 mg/l	NA	R ≤13 mm	R ≤24 mm R >2 mg/l	R ≤13 mm
Cefotaxime (CTX)	30	R ≤29 mm R ≥2 mg/l	R ≤29 mm R ≥2 mg/l	NA	NA	NA
Cefpodoxime	10	R ≤ 19 mm R >1 mg/l	NA	NA	NA	R ≤13 mm
Ceftazidime (CAZ)	30	R ≤ 26 mm R ≥2 mg/l	R ≤26 mm R ≥2 mg/l	NA	NA	NA

Antibiotic	Disc charge (micrograms)	*Escherichia coli*, Enterobacteriaceae	*Salmonella*	*Staphylococci*	*Streptococci*	*Pasteurella, Mannheimia, Histophilus, Actinobacillus*
Chloramphenicol (C)	30	R ≤20 mm R >8 mg/l	R ≤20 mm R >8 mg/l	NA	NA	NA
Ciprofloxacin (CIP)	1	NA	R ≤16 mm R ≥1 mg/l	NA	NA	NA
Doxycycline	30	R ≤13 mm	NA	R ≤30 mm R ≥2 mg/l	NA	R ≤13 mm
Enrofloxacin	5	R ≤13 mm R ≥4 mg/l	NA	R ≤13 mm	R ≤13 mm	R ≤13 mm
Erythromycin	5	NA	NA	R ≤19 mm R ≥2 mg/l	R ≤21 mm* R ≥0.5 mg/l	R ≤13 mm
Florfenicol	30	R ≤13 mm R >32 mg/l	NA	NA	R ≤13 mm	R ≤13 mm
Furazolidone (FR)	15	NA	≤13 mm	NA	NA	NA
Gentamicin (CN)	10	NA	R ≤19 mm R ≥4 mg/l	NA	NA	NA
Lincomycin	10	NA	NA	R ≤13 mm	R ≤13 mm	R ≤13 mm
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	R ≤21 mm R >0.12 mg/l
Spectinomycin	25	R ≤13 mm	NA	NA	NA	R ≤13 mm†
Streptomycin (S)	10	R ≤12 mm R >8 mg/l	R ≤13 mm R > ~8 mg/l	NA	NA	R ≤13 mm†

Antibiotic	Disc charge (micrograms)	*Escherichia coli*, Enterobacteriaceae	*Salmonella*	*Staphylococci*	*Streptococci*	*Pasteurella, Mannheimia, Histophilus, Actinobacillus*
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
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

* 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.

Key:

- BSAC human clinical breakpoint
- APHA historical veterinary disc diffusion zone size breakpoint and MIC corresponding to that zone size breakpoint
- 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.
- Some *Haemophilus-Pasteurella-Actinobacillus* i.e. “HPA” organisms, for example *Actinobacillus pleuropneumoniae*, show a degree of intrinsic resistance to aminoglycosides.

Table S4.1.2: Antibiotic disc concentrations used in Northern Ireland

		Expected zone diameter (mm)		
Antibiotic	**Disc**	**Resistant**	**Intermediate**	**Susceptible**
Amoxicillin	AMC30	≤13	14–17	≥18
Ampicillin	AMP10	≤13	14–16	≥17
Apramycin	APR15	Not available		
Cefotaxime	CTX30	≤22	23–25	≥26
Ceftazidime	CAZ30	≤17	18–20	≥21
Chloramphenicol	C30	≤12	13–17	≥18
Ciprofloxacin	CIP5	≤15	16–20	≥21
Framycetin	FY100	Not available		
Furazolidone	FR100	Not available		≥17
Gentamicin	CN10	≤12	13–14	≥15
Kanamycin	K30	≤13	14–17	≥18
Nalidixic acid	NA30	≤13	14–18	≥19
Spectinomycin	SH100	Not available		
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, 2015–2017

	No. resistant/No. tested (% resistant)		
Antibiotic	**2015**	**2016**	**2017**
Amoxicillin/clavulanate	13/88 (14.8)	6/106 (5.7)	4/79 (5.1)
Ampicillin	23/88 (26.1)	29/106 (27.4)	17/79 (21.5)
Cefalexin	-	-	-
Cefotaxime	-	-	-
Cefpodoxime	2/88 (2.3)	0/106 (0)	1/79 (1.3)
Ceftazidime	-	-	-
Enrofloxacin	0/88 (0)	2/106 (1.9)	2/79 (2.5)
Neomycin	4/88 (4.5)	8/106 (7.5)	3/79 (3.8)
Streptomycin	11/88 (12.5)	15/106 (14.2)	6/79 (7.6)
Tetracycline	16/88 (18.2)	18/106 (17.0)	12/79 (15.2)
Trimethoprim/sulphonamide	9/88 (10.2)	14/106 (13.2)	6/79 (7.6)

- No isolates tested

Table S4.2.2: Resistance (interpreted using breakpoints) of *Staphylococci* and *Streptococci* from mastitis cases from England and Wales, 2015–2017

	No. resistant/No. tested (% resistant)								
	Staphylococcus aureus			*Streptococcus uberis*			*Streptococcus dysgalactiae*		
Antibiotic	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Amoxicillin/ clavulanate	9/77 (11.7)	4/62 (6.5)	3/78 (3.8)	0/123 (0)	0/94 (0)	0/97 (0)	0/36 (0)	0/41 (0)	0/39 (0)
Ampicillin	25/77 (32.5)	7/62 (11.3)	16/78 (20.5)	0/123 (0)	0/94 (0)	0/97 (0)	0/36 (0)	0/41 (0)	0/39 (0)
Neomycin	2/77 (2.6)	0/62 (0)	0/78 (0)	79/119 (66.4)	47/93 (50.5)	67/96 (69.8)	3/36 (8.3)	10/40 (25.0)	5/35 (14.3)
Novobiocin	0/77 (0)	0/62 (0)	0/78 (0)	10/119 (8.4)	6/93 (6.5)	3/96 (3.1)	1/36 (2.8)	4/40 (10.0)	0/35 (0)
Penicillin	25/77 (32.5)	8/62 (12.9)	16/78 (20.5)	0/123 (0)	0/94 (0)	0/97 (0)	0/36 (0)	0/41 (0)	0/39 (0)
Tetracycline	4/77 (5.2)	1/62 (1.6)	1/78 (1.3)	62/123 (50.4)	37/94 (39.4)	42/97 (43.3)	34/36 (94.4)	40/41 (97.6)	33/39 (84.6)
Tylosin	2/77 (2.6)	0/62 (0)	0/78 (0)	14/123 (11.4)	8/94 (8.5)	9/97 (9.3)	2/36 (5.6)	4/41 (9.8)	6/39 (15.4)

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, 2015–2017

	No. resistant/No. tested (% resistant)								
	Pasteurella multocida			*Mannheimia haemolytica*			*Trueperella pyogenes*		
Antibiotic	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Amoxicillin/ clavulanate	0/42 (0)	0/76 (0)	0/75 (0)	0/28 (0)	0/35 (0)	0/43 (0)	0/8 (0)	0/4 (0)	0/3 (0)
Ampicillin	0/42 (0)	2/76 (2.6)	11/75 (14.7)	1/28 (3.6)	0/35 (0)	2/43 (4.7)	0/8 (0)	0/4 (0)	0/3 (0)
Cefalexin	-	-	-	-	-	-	0/8 (0)	0/4 (0)	0/3 (0)
Cefpodoxime	0/42 (0)	0/76 (0)	0/75 (0)	0/28 (0)	0/35 (0)	0/42 (0)	-	-	-
Enrofloxacin	0/42 (0)	0/76 (0)	0/75 (0)	0/28 (0)	0/35 (0)	0/43 (0)	-	-	-
Florfenicol	1/42 (2.5)	2/70 (2.9)	0/75 (0)	0/28 (0)	1/35 (2.9)	1/42 (2.4)	0/8 (0)	0/4 (0)	0/3 (0)
Tetracycline	16/42 (38.1)	44/76 (57.9)	51/75 (68.0)	0/28 (0)	3/35 (8.6)	18/43 (41.9)	5/8 (62.5)	2/4 (50.0)	2/3 (66.7)
Trimethoprim/ sulphonamide	1/42 (2.4)	0/76 (0)	1/75 (1.3)	0/28 (0)	0/35 (0)	0/43 (0)	3/8 (37.5)	0/4 (0)	1/3 (33.3)
Tylosin	-	-	-	-	-	-	1/8 (12.5)	1/4 (25.0)	0/3 (0)

* No resistant *H. somni* isolates were detected in 2015 and 2016 but a single isolate in 2017 was resistant to tetracycline

- No isolates tested

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, 2015–2017

	No. resistant/No. tested (% resistant)					
	Pasteurella multocida			*Actinobacillus pleuropneumoniae*		
Antibiotic	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Amoxicillin/clavulanate	0/11 (0)	0/19 (0)	0/23 (0)	0/22 (0)	0/14 (0)	0/8 (0)
Ampicillin	0/12 (0)	6/31 (19.4)	5/40 (12.5)	2/22 (9.1)	1/15 (6.7)	0/9 (0)
Apramycin	0/12 (0)	1/31 (3.2)	4/40 (10.0)	2/22 (9.1)	3/15 (20.0)	0/9 (0)
Cefpodoxime	0/12 (0)	0/31 (0)	0/40 (0)	0/22 (0)	0/15 (0)	0/9 (0)
Doxycycline	0/11 (0)	0/19 (0)	0/23 (0)	0/22 (0)	0/14 (0)	1/8 (12.5)
Enrofloxacin	0/12 (0)	0/31 (0)	0/40 (0)	0/22 (0)	0/15 (0)	0/9 (0)
Florfenicol	0/11 (0)	0/19 (0)	0/23 (0)	0/22 (0)	0/14 (0)	0/8 (0)
Lincomycin	-	-	-	-	-	-
Neomycin	1/12 (8.3)	3/31 (9.7)	0/40 (0)	2/22 (9.1)	3/15 (20.0)	1/9 (11.1)
Spectinomycin	0/12 (0)	0/31 (0)	0/40 (0)	2/22 (9.1)	2/15 (13.3)	0/9 (0)
Streptomycin	2/11 (18.2)	6/19 (31.6)	3/23 (13.0)	2/22 (9.1)	2/14 (14.3)	1/8 (12.5)
Tetracycline	8/12 (66.7)	25/31 (80.6)	32/40 (80.0)	8/22 (36.4)	7/15 (46.7)	3/9 (33.3)
Trimethoprim/sulphonamide	1/12 (8.3)	7/31 (22.6)	8/40 (20.0)	9/22 (40.9)	7/15 (46.7)	0/9 (0)
Tylosin	3/11 (27.3)	7/19 (36.8)	-	20/22 (90.9)	14/14 (100)	5/8 (62.5)

- No isolates tested

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, 2015–2017

	No. resistant/No. tested (% resistant)											
	Pasteurella multocida			*Mannheimia haemolytica*			*Bibersteinia trehalosi*			*Trueperella pyogenes*		
Antibiotic	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Amoxicillin/ clavulanate	0/3 (0)	0/4 (0)	0/7 (0)	0/35 (0)	0/49 (0)	0/71 (0)	0/40 (0)	0/95 (0)	0/75 (0)	0/1 (0)	0/2 (0)	0/1 (0)
Ampicillin	1/3 (33.3)	0/4 (0)	2/7 (28.6)	0/35 (0)	0/49 (0)	1/71 (1.4)	0/40 (0)	0/95 (0)	0/75 (0)	0/1 (0)	0/2 (0)	0/1 (0)
Cefalexin	-	-	-	-	-	-	-	-	-	0/1 (0)	0/2 (0)	0/1 (0)
Cefpodoxime	0/3 (0)	0/4 (0)	0/7 (0)	0/35 (0)	0 /49 (0)	0/71 (0)	0/40 (0)	0/95 (0)	0/75 (0)	-	-	-
Enrofloxacin	0/3 (0)	0/4 (0)	0/7 (0)	0/35 (0)	0/49 (0)	0/71 (0)	0/40 (0)	1/95 (1.1)	0/75 (0)	-	-	-
Florfenicol	0/3 (0)	0/4 (0)	0/7 (0)	0/35 (0)	0/47 (0)	0/70 (0)	0/40 (0)	0/95 (0)	0/75 (0)	0/1 (0)	0/2 (0)	0/1 (0)
Tetracycline	0/3 (0)	2/4 (50.0)	3/7 (42.9)	1/35 (2.9)	2/49 (4.1)	34/71 (47.9)	1/40 (2.5)	2/95 (2.1)	1/75 (1.3)	0/1 (0)	1/2 (50.0)	1/1 (100)
Trimethoprim/ sulphonamide	0/3 (0)	0/4 (0)	0/7 (0)	1/35 (2.9)	0/49 (0)	0/71 (0)	1/40 (2.5)	0/95 (0)	0/75 (0)	0/1 (0)	0/2 (0)	1/1 (100)
Tylosin	-	-	-	-	-	-	-	-	-	0/1 (0)	1/2 (50.0)	0/1 (0)

- No isolates tested

S4.6: Clinical Surveillance Data for Other Veterinary Pathogens

Table S4.6.1: MIC values of *Brachyspira hyodysenteriae* isolates from infections of pigs to tiamulin in England and Wales, 2010–2017

	MIC								
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	-	-	-

- No isolates with this MIC value

Table S4.6.2: Resistance (interpreted using breakpoints) of *Streptococcus suis* from infections of pigs in England and Wales, 2015–2017

	No. resistant/No. tested (% resistant) *Streptococcus suis*		
Antibiotic	**2015**	**2016**	**2017**
Ampicillin	0/63 (0)	0/86 (0)	0/86 (0)
Cefalexin	-	-	-
Enrofloxacin	0/63 (0)	0/86 (0)	0/86 (0)
Lincomycin	26/63 (41.3)	30/86 (34.9)	40/86 (46.5)
Penicillin	0/63 (0)	0/86 (0)	0/86 (0)
Tetracycline	59/63 (93.7)	78/86 (90.7)	82/86 (95.3)
Trimethoprim/sulphonamide	14/63 (22.2)	11/86 (12.8)	16/86 (18.6)
Tylosin	37/63 (58.7)	37/86 (43.0)	48/86 (55.8)

- No isolates tested

Table S4.6.3: Resistance (interpreted using breakpoints) of *Erysipelothrix rhusiopathiae* from infections of pigs in England and Wales, 2015–2017

	No. resistant/No. tested (% resistant) *Erysipelothrix rhusiopathiae*		
Antibiotic	**2015**	**2016**	**2017**
Amoxicillin/clavulanate	-	-	-
Ampicillin	0/6 (0)	0/18 (0)	0/6 (0)
Enrofloxacin	0/6 (0)	0/18 (0)	0/6 (0)
Lincomycin	0/6 (0)	0/18 (0)	0/6 (0)
Tetracycline	2/6 (33.3)	6/18 (33.3)	1/6 (16.7)
Trimethoprim/sulphonamide	2/6 (33.3)	8/18 (44.4)	5/6 (83.3)
Tylosin	0/6 (0)	0/18 (0)	0/6 (0)

- No isolates tested

Table S4.6.4: Resistance (interpreted using breakpoints) of *Staphylococcus aureus* from infections of chickens in England and Wales, 2015–2017

	No. resistant/No. tested (% resistant) *Staphylococcus aureus*		
Antibiotic	**2015**	**2016**	**2017**
Amoxicillin/clavulanate	0/8 (0)	1/12 (8.3)	0/6 (0)
Ampicillin	0/8 (0)	1/15 (6.7)	1/6 (16.7)
Doxycycline	0/8 (0)	1/15 (6.7)	2/6 (33.3)
Enrofloxacin	0/8 (0)	1/15 (6.7)	0/6 (0)
Erythromycin	1/8 (12.5)	1/12 (8.3)	0/6 (0)
Lincomycin	1/8 (12.5)	0/15 (0)	0/6 (0)
Tetracycline	1/8 (12.5)	3/15 (20.0)	1/6 (16.7)
Trimethoprim/sulphonamide	0/8 (0)	0/15 (0)	0/6 (0)
Tylosin	0/8 (0)	1/15 (6.7)	-

Table S4.6.5 Resistance (interpreted using breakpoints) of *Listeria monocytogenes* and *Streptococcus dysgalactiae* from infections of sheep in England and Wales, 2015–2017

	No. resistant/No. tested (% resistant)					
	Listeria monocytogenes			*Streptococcus dysgalactiae*		
Antibiotic	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Amoxicillin/ clavulanate	0/4 (0)	0/49 (0)	0/19 (0)	0/18 (0)	0/35 (0)	0/33 (0)
Ampicillin	0/4 (0)	0/49 (0)	0/19 (0)	0/18 (0)	0/35 (0)	0/33 (0)
Cefalexin	3/4 (75.0)	7/49 (14.3)	3/19 (15.8)	0/18 (0)	0/35 (0)	2/33 (6.1)
Florfenicol	0/4 (0)	0/49 (0)	0/10 (0)	0/18 (0)	0/35 (0)	0/15 (0)
Penicillin	-	-	0/19 (0)	-	-	-
Tetracycline	0/4 (0)	2/49 (4.1)	0/19 (0)	18/18 (100)	34/35 (97.1)	31/33 (93.9)
Trimethoprim/ sulphonamide	0/4 (0)	0/49 (0)	0/10 (0)	0/18 (0)	0/35 (0)	0/15 (0)
Tylosin	0/4 (0)	0/49 (0)	0/19 (0)	0/18 (0)	4/35 (11.4)	4/33 (12.1)

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 England and Wales, Northern Ireland and Scotland, 2015–2017

	No. resistant/No. tested (% resistant)								
	England & Wales			Northern Ireland			Scotland		
Antibiotic	2015	2016	2017	2015	2016	2017	2015	2016	2017
Amikacin	3/524 (0.6)	4/467 (0.9)	0/266 (0)	-	-	-	-	-	-
Amoxicillin/ clavulanate	282/1034 (27.3)	221/1123 (19.7)	149/694 (21.5)	471/931 (50.6)	504/906 (55.6)	426/816 (52.2)	69/346 (19.9)	69/485 (14.2)	71/461 (15.4)
Ampicillin	713/1101 (64.8)	683/1200 (56.7)	420/810 (51.9)	748/931 (80.3)	733/906 (80.9)	633/817 (77.5)	130/346 (37.6)	183/484 (37.8)	136/461 (29.5)
Apramycin	60/1073 (5.6)	68/1135 (6.0)	39/756 (5.2)	138/917 (15.0)	97/865 (11.2)	64/634 (10.1)	3/271 (1.1)	7/426 (1.6)	-
Cefotaxime	49/526 (9.3)	62/469 (13.2)	32/267 (12.0)	-	-	-	-	-	-
Cefpodoxime	34/474 (7.2)	7/314 (2.2)	8/377 (2.1)	403/912 (44.2)	387/891 (43.4)	499/807 (61.8)	8/271 (3.0)	12/427 (2.8)	11/461 (2.4)
Ceftazidime	34/526 (6.5)	41/469 (8.7)	18/267 (6.7)	-	-	-	-	-	-
Chloramphenicol	244/524 (46.6)	200/467 (42.8)	104/266 (39.1)	-	-	-	0/1 (0)	0/4 (0)	-
Doxycycline	132/451 (29.3)	165/538 (30.7)	151/323 (46.7)	-	-	-	-	-	-
Enrofloxacin	118/1101 (10.7)	78/1200 (6.5)	48/810 (5.9)	414/931 (44.5)	380/908 (41.9)	319/816 (39.1)	12/346 (3.5)	17/485 (3.5)	9/461 (2.0)
Florfenicol	174/709 (24.5)	164/792 (20.7)	88/479 (18.4)	413/878 (47.0)	404/808 (50.0)	328/609 (53.9)	28/257 (10.9)	31/202 (15.4)	26/123 (21.1)
Neomycin	266/1030 (25.8)	249/1100 (22.6)	134/695 (19.3)	932/932 (100)	583/586 (99.5)	803/810 (99.1)	26/346 (7.5)	28/485 (5.8)	17/461 (3.7)
Spectinomycin	462/1073 (43.1)	423/1135 (37.3)	233/756 (30.8)	-	3/35 (8.6)	6/177 (3.4)	60/271 (22.1)	78/426 (18.3)	63/461 (13.7)

Streptomycin	443/685 (64.7)	394/743 (53.0)	198/429 (46.2)	-	33/33 (100)	172/176 (97.7)	2/73 (2.7)	4/54 (7.4)	3/118 (2.5)
Tetracycline	708/1101 (64.3)	727/1200 (60.6)	463/810 (57.2)	745/927 (80.4)	687/907 (75.7)	442/817 (54.1)	160/346 (46.2)	175/485 (36.1)	162/461 (35.1)
Trimethoprim/ sulphonamide	420/1101 (38.1)	461/1200 (38.4)	271/810 (33.5)	615/926 (66.4)	551/907 (60.7)	440/817 (53.9)	64/346 (18.5)	99/485 (20.4)	66/461 (14.3)

- No isolates tested

Table S4.7.2: Resistance (interpreted using breakpoints) in all *E. coli* from cattle (all ages) in England and Wales, Northern Ireland and Scotland, 2015–2017

	No. resistant/No. tested (% resistant)								
	England & Wales			Northern Ireland			Scotland		
Antibiotic	2015	2016	2017	2015	2016	2017	2015	2016	2017
Amikacin	2/441 (0.5)	3/365 (0.8)	0/206 (0)	-	-	-	-	-	-
Amoxicillin/ clavulanate	223/494 (45.1)	175/450 (38.9)	118/285 (41.4)	443/714 (62.0)	410/685 (59.9)	360/655 (55.0)	44/150 (29.3)	48/161 (29.8)	37/181 (20.4)
Ampicillin	392/494 (79.4)	343/450 (76.2)	204/285 (71.6)	602/714 (84.3)	571/684 (83.5)	511/656 (77.9)	58/150 (38.7)	76/161 (47.2)	59/181 (32.6)
Apramycin	22/480 (4.6)	17/425 (4.0)	6/261 (2.3)	105/709 (14.8)	71/655 (10.8)	45/479 (9.4)	2/77 (2.6)	3/102 (2.9)	-
Cefotaxime	46/443 (10.4)	48/367 (15.8)	30/207 (14.5)	-	-	-	-	-	-
Cefpodoxime	-	-	-	328/704 (46.6)	304/680 (44.7)	406/649 (62.6)	0/78 (0)	10/103 (9.7)	4/181 (2.2)
Ceftazidime	32/443 (7.2)	38/367 (10.4)	17/207 (8.2)	-	-	-	-	-	-
Chloramphenicol	228/441 (51.7)	173/365 (47.4)	95/206 (46.1)	-	-	-	-	0/4 (0)	-
Doxycycline	-	-	-	-	-	-	-	-	-
Enrofloxacin	58/494 (11.7)	47/450 (10.4)	30/285 (10.5)	361/714 (50.6)	337/686 (49.1)	287/656 (43.8)	6/150 (4.0)	13/161 (8.1)	7/181 (3.9)
Florfenicol	147/455 (32.3)	132/392 (33.7)	69/230 (30.0)	402/712 (56.5)	373/653 (57.1)	292/477 (61.2)	22/77 (28.6)	28/104 (26.9)	23/63 (36.5)
Neomycin	217/480 (45.2)	174/425 (40.9)	95/261 (36.4)	714/714 (100)	420/422 (99.5)	645/650 (99.2)	20/150 (13.3)	22/161 (13.7)	15/181 (8.3)
Spectinomycin	218/480 (45.4)	166/425 (39.1)	86/261 (33.0)	-	2/33 (6.1)	6/174 (3.4)	29/77 (37.7)	31/102 (30.4)	23/181 (12.7)
Streptomycin	315/441 (71.4)	221/365 (60.5)	118/206 (57.3)	-	31/31 (100)	169/173 (97.7)	1/72 (2.4)	4/54 (7.4)	3/118 (2.5)

Tetracycline	369/494 (74.7)	331/450 (73.6)	199/285 (69.8)	593/711 (83.4)	542/685 (79.1)	342/656 (52.1)	65/150 (43.3)	74/161 (46.0)	64/181 (35.4)
Trimethoprim/ sulphonamide	224/494 (45.3)	210/450 (46.7)	123/285 (43.2)	505/711 (71.0)	452/685 (66.0)	374/656 (57.0)	26/150 (17.3)	39/161 (24.2)	28/181 (15.5)

- No isolates tested

Table S4.7.3: Resistance (interpreted using breakpoints) in all *E. coli* from pigs (all ages) in England and Wales, Northern Ireland and Scotland, 2015–2017

	No. resistant/No. tested (% resistant)								
	England & Wales			Northern Ireland			Scotland		
Antibiotic	2015	2016	2017	2015	2016	2017	2015	2016	2017
Amikacin	-	-	-	-	-	-	-	-	-
Amoxicillin/ clavulanate	8/159 (5.0)	11/267 (4.1)	6/161 (3.7)	21/93 (22.6)	39/77 (50.6)	28/54 (51.9)	5/22 (22.7)	4/28 (14.3)	4/11 (36.4)
Ampicillin	102/182 (56.0)	165/300 (55.0)	105/215 (48.8)	67/93 (72.0)	61/78 (78.2)	46/54 (85.2)	6/22 (27.3)	9/28 (32.1)	6/11 (54.5)
Apramycin	31/182 (17.0)	40/300 (13.3)	30/215 (14.0)	20/93 (21.5)	13/77 (16.9)	10/52 (19.2)	0/22 (0)	0/28 (0)	-
Cefotaxime	-		-	-	-	-	-	-	-
Cefpodoxime	3/182 (1.6)	7/300 (2.3)	2/215 (0.9)	26/93 (28.0)	19/77 (24.7)	27/52 (51.9)	0/21 (0)	0/28 (0)	1/11 (9.1)
Ceftazidime	-	-	-	-	-	-	-	-	-
Chloramphenicol	-	-	-	-	-	-	-	-	-
Doxycycline	79/159 (49.7)	128/267 (47.9)	105/161 (65.2)	-	-	-	-	-	-
Enrofloxacin	7/182 (3.8)	17/300 (5.7)	9/215 (4.2)	28/93 (30.1)	16/78 (20.5)	10/53 (18.9)	2/22 (9.1)	3/28 (10.7)	0/11 (0)
Florfenicol	16/159 (10.1)	21/267 (7.9)	14/161 (8.7)	12/93 (12.9)	8/77 (10.4)	6/54 (11.1)	1/22 (4.5)	0/28 (0)	1/11 (9.1)
Neomycin	15/182 (8.2)	19/300 (6.3)	16/215 (7.4)	93/93 (100)	74/74 (100)	52/54 (96.3)	0/22 (0)	0/28 (0)	0/11 (0)
Spectinomycin	78/182 (42.9)	138/300 (46.0)	82/215 (38.1)	-	-	-	3/22 (13.6)	6/28 (21.4)	4/11 (36.4)
Streptomycin	71/159 (44.7)	116/267 (43.4)	56/161 (34.8)	-	-	-	-	-	-

Tetracycline	121/182 (66.5)	199/300 (66.3)	135/215 (62.8)	76/93 (81.7)	60/78 (76.9)	44/54 (81.5)	9/22 (40.9)	12/28 (42.9)	3/11 (27.3)
Trimethoprim/ sulphonamide	99/182 (54.4)	163/300 (54.3)	98/215 (45.6)	70/92 (76.1)	50/78 (64.1)	34/54 (63.0)	3/22 (13.6)	11/28 (39.3)	5/11 (45.5)

- No isolates tested

Table S4.7.4: Resistance (interpreted using breakpoints) in all *E. coli* from sheep (all ages) in England and Wales, Northern Ireland and Scotland, 2015–2017

	No. resistant/No. tested (% resistant)								
	England & Wales			Northern Ireland			Scotland		
Antibiotic	2015	2016	2017	2015	2016	2017	2015	2016	2017
Amikacin	1/83 (1.2)	1/102 (1.0)	0/60 (0)	-	-	-	-	-	-
Amoxicillin/ clavulanate	21/133 (15.8)	26/179 (14.5)	22/148 (14.9)	24/66 (36.4)	30/68 (44.1)	31/73 (42.5)	11/48 (22.9)	13/70 (18.6)	17/49 (34.7)
Ampicillin	74/133 (55.6)	86/179 (48.0)	64/148 (43.2)	44/66 (66.7)	54/68 (79.4)	53/73 (72.6)	19/48 (39.6)	27/70 (38.6)	22/49 (44.9)
Apramycin	1/119 (0.8)	5/139 (3.6)	0/118 (0)	7/66 (10.6)	6/67 (9.0)	8/72 (11.1)	1/46 (2.2)	0/70 (0)	-
Cefotaxime	3/83 (3.6)	4/102 (3.9)	2/60 (3.3)	-	-	-	-	-	-
Cefpodoxime	-	-	-	25/66 (37.9)	21/68 (30.9)	41/73 (56.2)	0/46 (0)	2/70 (2.9)	0/49 (0)
Ceftazidime	2/83 (2.4)	3/102 (2.9)	1/60 (1.7)	-	-	-	-	-	-
Chloramphenicol	16/83 (19.3)	27/102 (26.5)	9/60 (15.0)	-	-	-	0/1 (0)	-	-
Doxycycline	-	-	-	-	-	-	-	-	-
Enrofloxacin	2/133 (1.5)	7/179 (3.9)	5/148 (3.4)	11/66 (16.7)	9/68 (13.2)	14/73 (19.2)	2/48 (3.6)	1/70 (1.4)	1/49 (2.0)
Florfenicol	11/95 (11.6)	11/133 (8.3)	5/88 (5.7)	19/66 (28.8)	16/67 (23.9)	26/71 (36.6)	5/44 (11.4)	3/70 (4.3)	2/49 (4.1)
Neomycin	21/121 (17.4)	23/148 (15.5)	11/120 (9.2)	66/66 (100)	38/38 (100)	73/73 (100)	4/48 (8.3)	5/70 (7.1)	1/49 (2.0)
Spectinomycin	67/119 (56.3)	63/139 (45.3)	44/118 (37.3)	-	-	-	13/46 (28.3)	18/70 (25.7)	17/49 (34.7)
Streptomycin	57/85 (67.1)	57/111 (51.4)	24/62 (38.7)	-	-	-	1/1 (100)	-	-
Tetracycline	86/133 (64.7)	111/179 (62.0)	82/148 (55.4)	48/66 (72.7)	47/68 (69.1)	41/73 (56.2)	26/48 (54.2)	34/70 (48.6)	24/49 (49.0)

Trimethoprim/ sulphonamide	36/133 (27.1)	39/179 (21.8)	24/148 (16.2)	22/66 (33.3)	26/68 (38.2)	27/73 (37.0)	7/48 (14.6)	12/70 (17.1)	9/49 (18.4)

- No isolates tested

Table S4.7.5: Resistance (interpreted using breakpoints) in all *E. coli* from chickens (all ages) in England and Wales, Northern Ireland and Scotland, 2015–2017

	No. resistant/No. tested (% resistant)								
	England & Wales			Northern Ireland			Scotland		
Antibiotic	2015	2016	2017	2015	2016	2017	2015	2016	2017
Amikacin	-	-	-	-	-	-	-	-	-
Amoxicillin/ clavulanate	30/248 (12.1)	8/223 (3.6)	3/96 (3.1)	5/25 (20.0)	5/30 (16.7)	2/16 (12.5)	9/114 (7.9)	4/212 (1.9)	13/212 (6.1)
Ampicillin	143/287 (49.8)	82/264 (31.1)	41/144 (28.5)	18/26 (69.2)	13/30 (43.3)	9/16 (56.3)	38/114 (33.3)	63/212 (29.7)	47/212 (22.2)
Apramycin	6/287 (2.1)	6/264 (2.3)	3/144 (2.1)	2/26 (7.7)	1/30 (3.3)	0/16 (0)	0/114 (0)	3/212 (1.4)	-
Cefotaxime	-	-	-	-	-	-	-	-	-
Cefpodoxime	31/287 (10.8)	9/264 (3.4)	6/144 (4.2)	14/26 (53.8)	21/31 (67.7)	12/16 (75.0)	8/114 (7.0)	0/212 (0)	6/212 (2.8)
Ceftazidime	-	-	-	-	-	-	-	-	-
Chloramphenicol	-	-	-	-	-	-	-	-	-
Doxycycline	49/287 (17.1)	34/264 (12.9)	37/144 (25.7)	-	-	-	-	-	-
Enrofloxacin	50/287 (17.4)	7/264 (2.7)	1/144 (0.7)	6/26 (23.1)	6/30 (20.0)	4/16 (25.0)	1/114 (0.9)	0/212 (0)	1/212 (0.5)
Florfenicol	-	-	-	-	3/3 (100)	1/1 (100)	0/114 (0)	-	-
Neomycin	13/247 (5.3)	32/223 (14.3)	12/96 (12.5)	26/26 (100)	15/15 (100)	16/16 (100)	2/114 (1.8)	1/212 (0.5)	1/212 (0.5)
Spectinomycin	99/287 (34.5)	53/264 (20.1)	19/144 (13.2)	-	-	-	14/114 (12.3)	20/212 (9.4)	19/212 (9.0)
Streptomycin	-	-	-	-	-	-	-	-	-
Tetracycline	128/287 (44.6)	81/264 (30.7)	37/144 (25.7)	13/26 (50.0)	11/30 (36.7)	6/16 (37.5)	52/114 (45.6)	47/212 (22.2)	70/212 (33.0)
Trimethoprim/ sulphonamide	60/287 (20.9)	48/264 (18.1)	20/144 (13.9)	7/26 (26.9)	5/30 (16.7)	3/16 (18.8)	20/114 (17.5)	31/212 (14.6)	22/212 (10.4)

- No isolates tested

Table S4.7.6: Resistance (interpreted using breakpoints) in all *E. coli* from turkeys (all ages) in England and Wales, Northern Ireland and Scotland, 2015–2017

	No. resistant/No. tested (% resistant)								
	England & Wales			Northern Ireland			Scotland		
Antibiotic	2015	2016	2017	2015	2016	2017	2015	2016	2017
Amikacin	-	-	-	-	-	-	-	-	-
Amoxicillin/clavulanate	-	1/4 (25.0)	0/4 (0)	1/3 (33.3)	3/8 (37.5)	1/7 (14.3)	0/12 (0)	0/14 (0)	0/8 (0)
Ampicillin	2/5 (40.0)	7/7 (100)	6/18 (33.3)	2/3 (66.7)	7/8 (87.5)	5/7 (71.4)	9/12 (75.0)	8/13 (61.5)	2/8 (25.0)
Apramycin	0/5 (0)	0/7 (0)	0/18 (0)	1/3 (33.3)	3/8 (37.5)	0/6 (0)	0/12 (0)	1/14 (7.1)	-
Cefotaxime	-		-	-	-	-	-	-	-
Cefpodoxime	0/5 (0)	0/7 (0)	0/18 (0)	2/3 (66.7)	6/8 (75.0)	4/6 (66.7)	0/12 (0)	0/14 (0)	0/8 (0)
Ceftazidime	-		-	-	-	-	-	-	-
Chloramphenicol	-		-	-	-	-	-	-	-
Doxycycline	4/5 (80.0)	3/7 (42.9)	9/18 (50.0)	-	-	-	-	-	-
Enrofloxacin	1/5 (20.0)	0/7 (0)	3/18 (16.7)	-	2/8 (25.0)	1/7 (14.3)	1/12 (8.3)	0/14 (0)	0/8 (0)
Florfenicol	-		-	-	-	-	-	-	-
Neomycin	-	1/4 (25.0)	0/3 (0)	3/3 (100)	6/6 (100)	7/7 (100)	0/12 (0)	0/14 (0)	0/8 (0)
Spectinomycin	0/5 (0)	3/7 (42.9)	2/18 (11.1)	-	-	-	1/12 (8.3)	3/14 (21.4)	0/8 (0)
Streptomycin	-		-	-	-	-	-	-	-
Tetracycline	4/5 (80.0)	5/7 (71.4)	10/18 (55.6)	2/3 (66.7)	6/8 (75.0)	3/7 (42.9)	8/12 (66.7)	8/14 (57.1)	1/8 (12.5)
Trimethoprim/sulphonamide	1/5 (20.0)	1/7 (14.3)	6/18 (33.3)	2/3 (66.7)	3/8 (37.5)	2/7 (28.6)	8/12 (66.7)	6/14 (42.9)	2/8 (25.0)

- No isolates tested

Table S4.7.7: Resistance (interpreted using breakpoints) in *E. coli* from cattle in England and Wales, Northern Ireland and Scotland, 2015

	No. resistant/No. tested (% resistant)						
	England & Wales			Northern Ireland[1]	Scotland		
Antibiotic	Neonatal	Pre-weaning	Adult	Neonatal	Neonatal	Pre-weaning	Adult
Amikacin	2/352 (0.6)	0/59 (0)	0/7 (0)	-	-	-	-
Amoxicillin/clavulanate	181/376 (48.1)	23/75 (30.7)	5/15 (33.3)	201/331 (60.7)	28/114 (24.6)	15/30 (50.0)	1/6 (16.7)
Ampicillin	310/376 (82.4)	52/75 (69.3)	10/15 (66.7)	296/331 (89.4)	40/114 (35.1)	16/30 (53.3)	2/6 (33.3)
Apramycin	12/369 (3.3)	8/73 (11.0)	1/13 (7.7)	34/329 (10.3)	2/45 (4.4)	0/30 (0)	0/2 (0)
Cefotaxime	37/352 (10.5)	3/59 (5.1)	2/9 (22.2)	-	-	-	-
Ceftazidime	28/352 (8.0)	2/59 (3.4)	1/9 (11.1)	-	-	-	-
Chloramphenicol	174/352 (49.4)	35/59 (59.3)	3/7 (42.9)	-	-	-	-
Enrofloxacin	38/376 (10.1)	11/75 (14.7)	4/15 (26.7)	167/331 (50.5)	2/114 (1.8)	4/30 (13.3)	0/6 (0)
Florfenicol	105/359 (29.2)	25/61 (41.0)	3/9 (33.3)	187/331 (56.5)	10/45 (22.2)	12/30 (40.0)	0/2 (0)
Neomycin	161/369 (43.6)	39/73 (53.4)	6/13 (46.2)	331/331 (100)	11/114 (9.6)	8/30 (26.7)	1/6 (16.7)
Spectinomycin	173/369 (46.9)	29/73 (39.7)	4/13 (30.8)	-	20/45 (44.4)	8/30 (26.7)	1/2 (50.0)
Streptomycin	250/352 (71.0)	46/59 (78.0)	4/7 (57.1)	-	1/68 (1.5)	-	0/4 (0)
Tetracycline	284/376 (75.5)	55/75 (73.3)	11/15 (73.3)	284/331 (85.8)	46/114 (40.4)	18/30 (60.0)	1/6 (16.7)
Trimethoprim/sulphonamide	168/376 (44.7)	34/75 (45.3)	7/15 (46.7)	245/331 (74.0)	17/114 (14.9)	9/30 (30.0)	0/6 (0)

[1] No pre-weaning or adult data available for Northern Ireland

- No isolates tested

Table S4.7.8: Resistance (interpreted using breakpoints) in *E. coli* from cattle in England and Wales, Northern Ireland and Scotland, 2016

	No. resistant/No. tested (% resistant)						
	England & Wales			Northern Ireland[1]	Scotland		
Antibiotic	Neonatal	Pre-weaning	Adult	Neonatal	Neonatal	Pre-weaning	Adult
Amikacin	3/305 (1.0)	0/33 (0)	0/1 (0)	-	-	-	-
Amoxicillin/clavulanate	136/336 (40.5)	30/62 (48.4)	0/16 (0)	338/524 (64.5)	33/103 (32.0)	11/38 (29.0)	4/20 (20.0)
Ampicillin	266/336 (79.2)	53/62 (85.5)	5/16 (31.3)	457/523 (87.4)	48/103 (46.6)	20/38 (52.6)	8/20 (40.0)
Apramycin	15/328 (4.6)	1/54 (1.9)	0/12 (0)	60/525 (11.4)	3/52 (5.8)	0/35 (0)	0/15 (0)
Cefotaxime	49/306 (16.0)	5/34 (14.7)	0/1 (0)	-	-	-	-
Ceftazidime	31/306 (10.1)	5/34 (14.7)	0/1 (0)	-	-	-	0/3 (0)
Chloramphenicol	147/305 (48.2)	12/33 (36.4)	0/1 (0)	-	0/1 (0)	0/3 (0)	-
Enrofloxacin	35/336 (10.4)	8/62 (12.9)	2/16 (12.5)	227/525 (43.2)	6/103 (5.8)	4/38 (10.5)	3/20 (15.0)
Florfenicol	107/314 (34.1)	12/42 (28.6)	0/5 (0)	308/525 (58.7)	11/53 (20.8)	14/35 (40.0)	3/16 (18.8)
Neomycin	145/328 (44.2)	18/54 (33.3)	1/12 (8.3)	337/338 (99.7)	10/103 (9.7)	10/38 (26.3)	2/20 (10.0)
Spectinomycin	131/328 (39.9)	21/54 (38.9)	3/12 (25.0)	-	18/52 (34.6)	11/35 (31.4)	2/15 (13.3)
Streptomycin	186/305 (61.0)	20/33 (60.6)	1/1 (100)	-	3/50 (6.0)	-	1/4 (25.0)
Tetracycline	257/336 (76.5)	47/62 (75.8)	7/16 (43.8)	437/524 (83.4)	44/103 (42.7)	24/38 (63.2)	6/20 (30.0)
Trimethoprim/sulphonamide	161/336 (47.9)	29/62 (46.8)	6/16 (37.5)	365/524 (69.7)	19/103 (18.5)	17/38 (44.7)	3/20 (15.0)

[1] No pre-weaning or adult data available for Northern Ireland

- No isolates tested

Table S4.7.9: Resistance (interpreted using breakpoints) in *E. coli* from cattle in England and Wales, Northern Ireland and Scotland, 2017

	No. resistant/No. tested (% resistant)						
	England & Wales			Northern Ireland[1]	Scotland		
Antibiotic	Neonatal	Pre-weaning	Adult	Neonatal	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)	261/364 (71.7)	23/38 (60.5)	5/13 (38.5)	9/130 (6.9)
Ampicillin	144/184 (78.3)	34/48 (70.8)	9/26 (34.6)	338/364 (92.9)	32/38 (84.2)	7/13 (53.8)	20/130 (15.4)
Apramycin	3/177 (1.7)	3/38 (7.9)	0/23 (0)	40/364 (11.0)	-	-	-
Cefotaxime	20/164 (12.2)	5/23 (21.7)	0/3 (0)	-	-	-	-
Cefpodoxime	-	-	-	242/362 (66.9)	1/38 (2.6)	2/13 (15.4)	1/130 (0.8)
Ceftazidime	11/164 (6.7)	3/23 (13.0)	0/3 (0)	-	-	-	-
Chloramphenicol	75/164 (45.7)	12/23 (52.2)	0/3 (0)	-	-	-	-
Enrofloxacin	17/184 (9.2)	9/48 (18.8)	1/26 (3.8)	213/364 (58.5)	3/38 (7.9)	2/13 (15.4)	2/130 (1.5)
Florfenicol	47/171 (27.5)	15/33 (45.5)	1/6 (16.7)	226/364 (62.1)	14/38 (36.8)	6/13 (46.2)	3/12 (25.0)
Neomycin	68/177 (38.4)	18/38 (47.4)	1/23 (4.3)	359/361 (99.4)	12/38 (31.6)	2/13 (15.4)	1/130 (0.8)
Spectinomycin	66/177 (37.3)	11/38 (28.9)	3/23 (13.0)	-	15/38 (39.5)	2/13 (15.4)	6/130 (4.6)
Streptomycin	94/164 (57.3)	16/23 (69.6)	1/3 (33.3)	-	-	-	3/118 (2.5)
Tetracycline	137/184 (74.5)	37/48 (77.1)	9/26 (34.6)	321/364 (88.2)	33/38 (86.8)	10/13 (76.9)	21/130 (16.2)
Trimethoprim/sulphonamide	83/184 (45.1)	26/48 (54.2)	5/26 (19.2)	272/364 (74.7)	15/38 (39.5)	5/13 (38.5)	8/130 (6.2)

[1] No pre-weaning or adult data available for Northern Ireland

- No isolates tested

Table S4.7.10: Resistance (interpreted using breakpoints) in *E. coli* from pigs in England and Wales, Northern Ireland and Scotland, 2015

	No. resistant/No. tested (% resistant)						
	England & Wales			Northern Ireland[1]	Scotland		
Antibiotic	Neonatal	Post-weaning	Adult	Neonatal	Neonatal	Post-weaning	Adult
Amoxicillin/clavulanate	2/30 (6.7)	4/93 (4.3)	1/7 (14.3)	10/47 (21.3)	1/5 (20.0)	3/15 (20.0)	1/1 (100)
Ampicillin	18/39 (46.2)	63/97 (64.9)	3/7 (42.9)	36/47 (76.6)	1/5 (20.0)	4/15 (26.7)	1/1 (100)
Apramycin	0/39 (0)	25/97 (25.8)	0/7 (0)	10/47 (21.3)	0/5 (0)	0/15 (0)	1/1 (100)
Cefpodoxime	0/39 (0)	2/97 (2.1)	0/7 (0)	9/47 (19.1)	0/5 (0)	0/15 (0)	-
Doxycycline	13/30 (43.3)	51/93 (54.8)	2/7 (28.6)	-	-	-	-
Enrofloxacin	1/39 (2.6)	5/97 (5.2)	0/7 (0)	16/47 (34.0)	0/5 (0)	2/15 (13.3)	0/1 (0)
Florfenicol	1/30 (3.3)	13/93 (14.0)	1/7 (14.3)	4/47 (8.5)	0/5 (0)	0/15 (0)	1/1 (100)
Neomycin	1/39 (2.6)	12/97 (12.4)	0/7 (0)	47/47 (100)	0/5 (0)	0/15 (0)	0/1 (0)
Spectinomycin	15/39 (38.5)	48/97 (49.5)	2/7 (28.6)	-	0/5 (0)	0/15 (0)	0/1 (0)
Streptomycin	10/30 (33.3)	45/93 (48.4)	4/7 (57.1)	-	-	-	-
Tetracycline	28/39 (71.8)	67/97 (69.1)	3/7 (42.9)	40/47 (85.1)	3/5 (60.0)	5/15 (33.3)	1/1 (100)
Trimethoprim/sulphonamide	17/39 (43.6)	63/97 (64.9)	3/7 (42.9)	37/47 (78.7)	0/5 (0)	3/15 (20.0)	0/1 (0)

[1] No post-weaning or adult data available for Northern Ireland

- No isolates tested

Table S4.7.11: Resistance (interpreted using breakpoints) in *E. coli* from pigs in England and Wales, Northern Ireland and Scotland, 2016

	No. resistant/No. tested (Percentage resistant)						
	England & Wales			Northern Ireland[1]	Scotland		
Antibiotic	Neonatal	Post-weaning	Adult	Neonatal	Neonatal	Post-weaning	Adult
Amoxicillin/clavulanate	2/62 (3.2)	8/155 (5.2)	-	12/21 (57.1)	0/3 (0)	3/19 (15.8)	1/6 (16.7)
Ampicillin	40/71 (56.3)	94/168 (56)	1/1 (100)	14/21 (66.7)	1/3 (33.3)	7/19 (36.8)	1/6 (16.7)
Apramycin	1/71 (1.4)	33/168 (19.6)	0/1 (0)	6/21 (28.6)	0/3 (0)	0/19 (0)	0/6 (0)
Cefpodoxime	2/71 (2.8)	4/168 (2.4)	0/1 (0)	6/21 (28.6)	0/3 (0)	0/19 (0)	0/6 (0)
Doxycycline	33/62 (53.2)	78/155 (50.3)	-	-	-	-	-
Enrofloxacin	9/71 (12.7)	4/168 (2.4)	0/1 (0)	6/21 (28.6)	1/3 (33.3)	2/19 (10.5)	0/6 (0)
Florfenicol	3/62 (4.8)	15/155 (9.7)	-	2/21 (9.5)	0/3 (0)	0/19 (0)	0/6 (0)
Neomycin	3/71 (4.2)	12/168 (7.1)	0/1 (0)	21/21 (100)	0/3 (0)	0/19 (0)	0/6 (0)
Spectinomycin	29/71 (40.8)	88/168 (52.4)	0/1 (0)	-	1/3 (33.3)	4/19 (21.1)	1/6 (16.7)
Streptomycin	22/62 (35.5)	71/155 (45.8)	-	-	-	-	-
Tetracycline	51/71 (71.8)	116/168 (69.0)	0/1 (0)	17/21 (81.0)	2/3 (66.7)	9/19 (47.4)	1/6 (16.7)
Trimethoprim/sulphonamide	36/71 (50.7)	101/168 (60.1)	0/1 (0)	14/21 (66.7)	3/3 (100)	7/19 (36.8)	1/6 (16.7)

[1] No post-weaning or adult data available for Northern Ireland

- No isolates tested

Table S4.7.12: Resistance (interpreted using breakpoints) in *E. coli* from pigs in England and Wales, Northern Ireland and Scotland, 2017

	No. resistant/No. tested (% resistant)						
	England & Wales			Northern Ireland[1]	Scotland		
Antibiotic	Neonatal	Post-weaning	Adult	Adult	Neonatal	Post-weaning	Adult
Amikacin	-	-	-	-	-	-	-
Amoxicillin/clavulanate	2/32 (6.3)	2/95 (2.1)	1/2 (50.0)	2/9 (22.2)	1/6 (16.7)	2/4 (50.0)	1/1 (100)
Ampicillin	18/40 (45.0)	61/119 (51.3)	2/3 (66.7)	8/9 (88.9)	2/6 (33.3)	3/4 (75.0)	1/1 (100)
Apramycin	1/40 (2.5)	27/119 (22.7)	0/3 (0)	2/9 (22.2)	-	-	-
Cefotaxime	-	-	-	-	-	-	-
Cefpodoxime	1/40 (2.5)	1/119 (0.8)	0/3 (0)	2/9 (22.2)	0/6 (0)	1/4 (25.0)	0/1 (0)
Ceftazidime	-	-	-	-	-	-	-
Chloramphenicol	-	-	-	-	-	-	-
Doxycycline	19/32 (59.4)	62/95 (65.3)	1/2 (50.0)	-	-	-	-
Enrofloxacin	6/40 (15.0)	3/119 (2.5)	0/3 (0)	2/9 (22.2)	0/6 (0)	0/4 (0)	0/1 (0)
Florfenicol	1/32 (3.1)	13/95 (13.7)	0/2 (0)	2/9 (22.2)	0/6 (0)	1/4 (25.0)	0/1 (0)
Neomycin	3/40 (7.5)	10/119 (8.4)	0/3 (0)	9/9 (100)	0/6 (0)	0/4 (0)	0/1 (0)
Spectinomycin	20/40 (50.0)	46/119 (38.7)	0/3 (0)	-	1/6 (16.7)	3/4 (75.0)	0/1 (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)	9/9 (100)	4/6 (66.7)	2/4 (50.0)	1/1 (100)
Trimethoprim/sulphonamide	16/40 (40.0)	60/119 (50.4)	2/3 (66.7)	5/9 (55.6)	1/6 (16.7)	2/4 (50.0)	0/1 (0)

[1] No post-weaning or adult data available for Northern Ireland

- No isolates tested

Table S4.7.13: Resistance (interpreted using breakpoints) in *E. coli* from sheep in England and Wales, Northern Ireland and Scotland, 2015

	No. resistant/No. tested (% resistant)						
	England & Wales			Northern Ireland[1]	Scotland		
Antibiotic	Neonatal	Pre-weaning	Adult	Neonatal	Neonatal	Pre-weaning	Adult
Amoxicillin/clavulanate	19/93 (20.4)	0/13 (0)	1/15 (6.7)	3/9 (33.3)	9/37 (24.3)	1/4 (25.0)	1/7 (14.3)
Ampicillin	60/93 (64.5)	8/13 (61.5)	4/15 (26.7)	7/9 (77.8)	17/37 (45.9)	1/4 (25.0)	1/7 (14.3)
Apramycin	0/93 (0)	1/12 (8.3)	0/6 (0)	0/9 (0)	1/35 (2.9)	0/4 (0)	0/7 (0)
Cefotaxime	2/74 (2.7)	0/6 (0)	0/1 (0)	-	-	-	-
Ceftazidime	1/74 (1.4)	0/6 (0)	0/1 (0)	-	-	-	-
Chloramphenicol	14/74 (18.9)	1/6 (16.7)	1/1 (100)	-	0/1 (0)	-	-
Enrofloxacin	2/93 (2.2)	0/13 (0)	0/15 (0)	0/9 (0)	2/37 (5.4)	0/4 (0)	0/7 (0)
Florfenicol	10/74 (13.5)	0/7 (0)	1/8 (12.5)	2/9 (22.2)	4/33 (12.1)	1/4 (25.0)	0/7 (0)
Neomycin	20/93 (21.5)	1/12 (8.3)	0/8 (0)	9/9 (100)	2/37 (5.4)	1/4 (25.0)	1/7 (14.3)
Spectinomycin	58/93 (62.4)	5/12 (41.7)	2/6 (33.3)	-	12/35 (34.3)	0/4 (0)	1/7 (14.3)
Streptomycin	51/74 (68.9)	3/6 (50.0)	1/3 (33.3)	-	1/1 (100)	-	-
Tetracycline	69/93 (74.2)	8/13 (61.5)	5/15 (33.3)	5/9 (55.5)	21/37 (56.8)	1/4 (25.0)	4/7 (57.1)
Trimethoprim/sulphonamide	32/93 (34.4)	2/13 (15.4)	1/15 (6.7)	4/9 (44.4)	6/37 (16.2)	1/4 (25.0)	0/7 (0)

[1] No pre-weaning or adult data available for Northern Ireland

- No isolates tested

Table S4.7.14: Resistance (interpreted using breakpoints) in *E. coli* from sheep in England and Wales, Northern Ireland and Scotland, 2016

	No. resistant/No. tested (% resistant)						
	England & Wales			Northern Ireland[1]	Scotland		
Antibiotic	Neonatal	Pre-weaning	Adult	Neonatal	Neonatal	Pre-weaning	Adult
Amoxicillin/clavulanate	18/101 (17.8)	2/26 (7.7)	3/30 (10.0)	24/44 (54.5)	9/42 (21.4)	4/13 (30.8)	0/15 (0)
Ampicillin	60/101 (59.4)	10/26 (38.5)	9/30 (30.0)	36/44 (81.8)	19/42 (45.2)	7/13 (53.9)	1/15 (6.7)
Apramycin	3/98 (3.1)	1/17 (5.9)	1/13 (7.7)	3/44 (6.8)	0/42 (0)	0/13 (0)	0/15 (0)
Cefotaxime	3/86 (3.5)	0/11 (0)	-	-	-	-	-
Ceftazidime	2/86 (2.3)	0/11 (0)	-	-	-	-	-
Chloramphenicol	21/86 (24.4)	5/11 (45.5)	-	-	-	-	-
Enrofloxacin	5/101 (5.0)	0/26 (0)	1/30 (3.3)	8/44 (18.2)	1/42 (2.4)	0/13 (0)	0/15 (0)
Florfenicol	7/88 (8.0)	2/18 (11.1)	1/13 (7.7)	10/44 (22.7)	1/42 (2.4)	2/13 (15.4)	0/15 (0)
Neomycin	20/99 (20.2)	0/19 (0)	1/17 (5.9)	27/27 (100)	4/42 (9.5)	1/13 (7.7)	0/15 (0)
Spectinomycin	51/98 (52.0)	6/17 (35.3)	2/13 (15.4)	-	13/42 (31.0)	3/13 (23.1)	2/15 (13.3)
Streptomycin	48/87 (55.2)	6/13 (46.2)	1/4 (25.0)	-	-	-	-
Tetracycline	79/101 (78.2)	13/26 (50.0)	11/30 (36.7)	31/44 (70.5)	20/42 (47.6)	9/13 (69.2)	5/15 (33.3)
Trimethoprim/sulphonamide	30/101 (29.7)	3/26 (11.5)	2/30 (6.7)	22/44 (50.0)	10/42 (23.8)	2/13 (15.4)	0/15 (0)

[1] No pre-weaning or adult data available for Northern Ireland

- No isolates tested

Table S4.7.15: Resistance (interpreted using breakpoints) in *E. coli* from sheep in England and Wales, Northern Ireland and Scotland, 2017

	No. resistant/No. tested (% resistant)						
	England & Wales			Northern Ireland[1]	Scotland		
Antibiotic	Neonatal	Pre-weaning	Adult	Adult	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)	21/32 (65.6)	4/21 (19.0)	6/10 (60.0)	7/18 (38.9)
Ampicillin	38/75 (50.7)	8/17 (47.1)	11/36 (30.6)	26/32 (81.3)	6/21 (28.6)	8/10 (80.0)	8/18 (44.4)
Apramycin	0/71 (0)	0/7 (0)	0/25 (0)	6/32 (18.8)	-	-	-
Cefotaxime	2/56 (3.6)	0/1 (0)	-	-	-	-	-
Cefpodoxime	-	-	-	18/32 (56.3)	0/21 (0)	0/10 (0)	0/18 (0)
Ceftazidime	1/56 (1.8)	0/1 (0)	-	-	-	-	-
Chloramphenicol	9/56 (16.1)	0/1 (0)	-	-	-	-	-
Enrofloxacin	3/75 (4.0)	1/17 (5.9)	1/36 (2.8)	9/32 (28.1)	1/21 (4.8)	0/10 (0)	0/18 (0)
Florfenicol	4/60 (6.7)	1/11 (9.1)	0/9 (0)	15/31 (48.4)	1/21 (4.8)	0/10 (0)	1/18 (5.6)
Neomycin	8/71 (11.3)	1/7 (14.3)	2/27 (7.4)	32/32 (100)	1/21 (4.8)	0/10 (0)	0/18 (0)
Spectinomycin	35/71 (49.3)	3/7 (42.9)	4/25 (16.0)	-	6/21 (28.6)	4/10 (40.0)	7/18 (38.9)
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)	22/32 (68.8)	11/21 (52.4)	9/10 (90.0)	8/18 (44.4)
Trimethoprim/sulphonamide	19/75 (25.3)	0/17 (0)	4/36 (11.1)	17/32 (53.1)	2/21 (9.5)	4/10 (40.0)	3/18 (16.7)

[1] No pre-weaning or adult data available for Northern Ireland

- No isolates tested

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 England and Wales, Northern Ireland and Scotland, 2015–2017

	No. resistant/No. tested (% resistant)								
	England & Wales			Northern Ireland			Scotland		
Antibiotic	2015	2016	2017	2015	2016	2017	2015	2016	2017
Amoxicillin/ clavulanate	1/1594 (0.1)	1/1394 (0.1)	3/1707 (0.2)	3/218 (1.4)	5/228 (2.2)	8/86 (9.3)	17/167 (10.2)	2/131 (1.5)	22/164 (13.4)
Ampicillin	281/1594 (17.6)	192/1394 (13.8)	231/1707 (13.5)	16/218 (7.3)	20/228 (8.8)	9/86 (10.5)	61/167 (36.5)	4/131 (3.1)	26/164 (15.9)
Apramycin	59/1594 (3.7)	38/1394 (2.7)	38/1707 (2.2)	2/218 (0.9)	7/228 (3.1)	3/86 (3.5)	10/164 (6.1)	2/128 (1.6)	-
Cefotaxime	1/1594 (0.1)	1/1394 (0.1)	0/1707 (0)	0/218 (0)	1/228 (0.4)	0/86 (0)	-	-	-
Ceftazidime	1/1594 (0.1)	1/1394 (0.1)	0/1707 (0)	0/218 (0)	0/228 (0)	0/86 (0)	-	-	-
Ciprofloxacin	20/1594 (1.3)	8/1394 (0.6)	5/1707 (0.3)	0/218 (0)	0/228 (0)	0/86 (0)	-	-	-
Chloramphenicol	95/1594 (6.0)	114/1394 (8.2)	128/1707 (7.5)	6/218 (2.8)	15/228 (6.6)	3/86 (3.5)	-	-	-
Furazolidone	11/1594 (0.7)	9/1394 (0.6)	14/1707 (0.8)	0/218 (0)	1/228 (0.4)	0/86 (0)	-	-	-
Gentamicin	67/1594 (4.2)	42/1394 (3.0)	40/1707 (2.3)	2/218 (0.9)	7/228 (3.1)	3/86 (3.5)	-	-	-
Nalidixic acid	98/1594 (6.1)	31/1394 (2.2)	62/1707 (3.6)	12/218 (5.5)	13/228 (5.7)	9/86 (10.5)	4/164 (2.4)	0/128 (0)	2/164 (1.2)
Neomycin	54/1594 (3.4)	14/1394 (1.0)	34/1707 (2.0)	-	-	-	1/167 (0.6)	1/131 (0.8)	0/164 (0)
Streptomycin	475/1594 (29.8)	304/1394 (21.8)	353/1707 (20.7)	37/218 (17.0)	44/228 (19.3)	13/86 (15.1)	-	-	-
Sulphonamide compounds	525/1594 (32.9)	421/1394 (30.2)	447/1707 (26.2)	25/218 (11.5)	36/228 (15.8)	9/86 (10.5)	-	-	-
Tetracycline	474/1594 (29.7)	370/1394 (26.5)	393/1707 (23.0)	17/218 (7.8)	18/228 (7.9)	9/86 (10.5)	77/167 (46.1)	7/131 (5.3)	31/164 (18.9)
Trimethoprim/ sulphonamide	199/1594 (12.5)	177/1394 (12.7)	162/1707 (9.5)	-	-	3/86 (3.5)	26/167 (15.6)	0/131 (0)	2/164 (1.2)

- No isolates tested

Table S4.8.2: Resistance (interpreted using breakpoints) in all *Salmonella* from cattle (all ages) in England and Wales, Northern Ireland and Scotland, 2015–2017

	No. resistant/No. tested (% resistant)								
	England & Wales			Northern Ireland			Scotland		
Antibiotic	2015	2016	2017	2015	2016	2017	2015	2016	2017
Amoxicillin/ clavulanate	0/346 (0)	0/336 (0)	1/392 (0.3)	1/81 (1.2)	0/75 (0)	2/73 (2.7)	11/73 (15.1)	0/88 (0)	21/114 (18.4)
Ampicillin	23/346 (6.6)	36/336 (10.7)	54/392 (13.8)	2/81 (2.5)	2/75 (2.7)	2/73 (2.7)	12/73 (16.4)	0/88 (0)	21/114 (18.4)
Apramycin	0/346 (0)	0/336 (0)	0/392 (0)	0/81 (0)	1/75 (1.3)	0/73 (0)	0/73 (0)	1/87 (1.2)	-
Cefotaxime	0/346 (0)	0/336 (0)	0/392 (0)	0/81 (0)	0/75 (0)	0/73 (0)	-	-	-
Ceftazidime	0/346 (0)	0/336 (0)	0/392 (0)	0/81 (0)	0/75 (0)	0/73 (0)	-	-	-
Ciprofloxacin	1/346 (0.3)	0/336 (0)	0/392 (0)	0/81 (0)	0/75 (0)	0/73 (0)	-	-	-
Chloramphenicol	10/346 (2.9)	23/336 (6.8)	4/392 (10.7)	0/81 (0)	1/75 (1.3)	0/73 (0)	-	-	-
Furazolidone	0/346 (0)	0/336 (0)	0/392 (0)	0/81 (0)	0/75 (0)	0/73 (0)	-	-	-
Gentamicin	0/346 (0)	0/336 (0)	0/392 (0)	0/81 (0)	0/75 (0)	0/73 (0)	-	-	-
Nalidixic acid	6/346 (1.7)	3/336 (0.9)	1/392 (0.5)	4/81 (4.9)	4/75 (5.3)	8/73 (11.0)	4/73 (5.5)	0/87 (0)	2/114 (1.8)
Neomycin	7/346 (2.0)	0/336 (0)	0/392 (0)	-	-	-	0/73 (0)	0/88 (0)	0/114 (0)
Streptomycin	20/346 (5.8)	41/336 (12.2)	58/392 (14.8)	8/81 (9.9)	8/75 (10.7)	5/73 (6.8)	-	1/87 (1.2)	-
Sulphonamide compounds	18/346 (5.2)	37/336 (11.0)	58/392 (14.8)	2/81 (2.5)	2/75 (2.7)	2/73 (2.7)	-	-	-
Tetracycline	21/346 (6.1)	35/336 (10.4)	55/392 (14.0)	2/81 (2.5)	2/75 (2.7)	1/73 (1.4)	13/73 (17.8)	3/88 (3.4)	24/114 (21.1)
Trimethoprim/ sulphonamide	0/346 (0)	2/336 (0.6)	0/392 (0)	-	-	0/73 (0)	12/73 (0)	0/88 (0)	1/114 (0.9)

- No isolates tested

Table S4.8.3: Resistance (interpreted using breakpoints) in all *Salmonella* from pigs (all ages) in England and Wales, Northern Ireland and Scotland, 2015–2017

	No. resistant/No. tested (% resistant)								
	England & Wales			Northern Ireland			Scotland		
Antibiotic	2015	2016	2017	2015	2016	2017	2015	2016	2017
Amoxicillin/ clavulanate	1/172 (0.6)	1/160 (0.6)	1/158 (0.6)	2/14 (14.3)	3/16 (18.8)	6/8 (75.0)	0/10 (0)	1/5 (20.0)	1/7 (14.3)
Ampicillin	146/172 (84.9)	116/160 (72.5)	124/158 (78.5)	9/14 (64.3)	11/16 (68.8)	7/8 (87.5)	6/10 (60.0)	3/5 (60.0)	5/7 (71.4)
Apramycin	44/172 (25.6)	35/160 (21.9)	37/158 (23.4)	2/14 (14.3)	5/16 (31.3)	3/8 (37.5)	2/10 (20.0)	0/5 (0)	-
Cefotaxime	1/172 (0.6)	0/160 (0)	0/158 (0)	0/14 (0)	0/16 (0)	0/8 (0)	-	-	-
Ceftazidime	1/172 (0.6)	0/160 (0)	0/158 (0)	0/14 (0)	0/16 (0)	0/8 (0)	-	-	-
Ciprofloxacin	0/172 (0)	0/160 (0)	0/158 (0)	0/14 (0)	0/16 (0)	0/8 (0)	-	-	-
Chloramphenicol	73/172 (42.4)	70/160 (43.8)	63/158 (39.9)	5/14 (35.7)	12/16 (75.0)	3/8 (37.5)	-	-	-
Gentamicin	48/172 (27.9)	35/160 (21.9)	38/158 (24.1)	2/14 (14.3)	5/16 (31.3)	3/8 (37.5)	-	-	-
Furazolidone	0/172 (0)	0/160 (0)	0/158 (0)	0/14 (0)	0/16 (0)	0/8 (0)	-	-	-
Nalidixic acid	1/172 (0.6)	3/160 (1.9)	2/158 (1.3)	2/14 (14.3)	2/16 (12.5)	1/8 (12.5)	0/10 (0)	0/5 (0)	0/7 (0)
Neomycin	12/172 (7.0)	10/160 (6.3)	31/158 (19.6)	-	-	-	1/10 (10.0)	0/5 (0)	0/7 (0)
Streptomycin	155/172 (90.1)	123/160 (76.9)	123/158 (77.8)	11/14 (78.6)	14/16 (87.5)	7/8 (87.5)	-	-	-
Sulphonamide compounds	156/172 (90.7)	137/160 (85.6)	139/158 (88.0)	11/14 (78.6)	14/16 (87.5)	7/8 (87.5)	-	-	-
Tetracycline	142/172 (82.6)	128/160 (80.0)	124/158 (78.5)	10/14 (71.4)	14/16 (87.5)	8/8 (100)	10/10 (100)	3/5 (60.0)	4/7 (57.1)
Trimethoprim/ sulphonamide	83/172 (48.3)	76/160 (47.5)	79/158 (50.0)	-	-	3/8 (37.5)	1/10 (10.0)	0/5 (0)	1/7 (14.3)

- No isolates tested

Table S4.8.4: Resistance (interpreted using breakpoints) in all *Salmonella* from sheep (all ages) in England and Wales, Northern Ireland and Scotland, 2015–2017

	No. resistant/No. tested (% resistant)								
	England & Wales			Northern Ireland			Scotland		
Antibiotic	2015	2016	2017	2015	2016	2017	2015	2016	2017
Amoxicillin/clavulanate	0/57 (0)	0/91 (0)	0/104 (0)	0/17 (0)	1/15 (6.7)	0/3 (0)	0/24 (0)	1/38 (2.6)	0/43 (0)
Ampicillin	4/57 (7.0)	11/91 (12.1)	17/104 (16.3)	0/17 (0)	2/15 (13.3)	0/3 (0)	1/24 (4.2)	1/38 (2.6)	0/43 (0)
Apramycin	0/57 (0)	0/91 (0)	0/104 (0)	0/17 (0)	0/15 (0)	0/3 (0)	0/22 (0)	1/36 (2.6)	-
Cefotaxime	0/57 (0)	0/91 (0)	0/104 (0)	0/17 (0)	0/15 (0)	0/3 (0)	-	-	-
Ceftazidime	0/57 (0)	0/91 (0)	0/104 (0)	0/17 (0)	0/15 (0)	0/3 (0)	-	-	-
Ciprofloxacin	0/57 (0)	0/91 (0)	0/104 (0)	0/17 (0)	0/15 (0)	0/3 (0)	-	-	-
Chloramphenicol	0/57 (0)	11/91 (12.1)	17/104 (16.3)	0/17 (0)	1/15 (6.7)	0/3 (0)	-	-	-
Gentamicin	0/57 (0)	0/91 (0)	0/104 (0)	0/17 (0)	0/15 (0)	0/3 (0)	-	-	-
Furazolidone	0/57 (0)	0/91 (0)	0/104 (0)	0/17 (0)	0/15 (0)	0/3 (0)	-	-	-
Nalidixic acid	0/57 (0)	0/91 (0)	0/104 (0)	1/17 (5.9)	1/15 (6.7)	0/3 (0)	0/22 (0)	0/36 (0)	0/43 (0)
Neomycin	0/57 (0)	0/91 (0)	0/104 (0)	-	-	-	0/24 (0)	1/38 (2.6)	0/43 (0)
Streptomycin	5/57 (8.8)	14/91 (15.4)	17/104 (16.3)	2/17 (11.8)	2/15 (13.3)	0/3 (0)	-	-	-
Sulphonamide compounds	4/57 (7.0)	12/91 (13.2)	17/104 (16.3)	2/17 (11.8)	2/15 (13.3)	0/3 (0)	-	-	-
Tetracycline	4/57 (7.0)	13/91 (14.3)	17/104 (16.3)	1/17 (5.9)	2/15 (13.3)	0/3 (0)	3/24 (12.5)	1/38 (2.6)	3/43 (7.0)
Trimethoprim/sulphonamide	1/57 (1.8)	0/91 (0)	0/104 (0)	-	-	0/3 (0)	0/24 (0)	0/38 (0)	-

- No isolates tested

Table S4.8.5: Resistance (interpreted using breakpoints) in all *Salmonella* from chickens (all ages) in England and Wales, Northern Ireland and Scotland, 2015–2017*

	No. resistant/No. tested (% resistant)				
	England & Wales			Northern Ireland	
Antibiotic	2015	2016	2017	2015	2016
Amoxicillin/clavulanate	0/768 (0)	0/696 (0)	1/873 (0.1)	0/104 (0)	1/110 (0.9)
Ampicillin	73/768 (9.5)	21/696 (3.0)	25/873 (2.9)	5/104 (4.8)	5/110 (4.5)
Apramycin	14/768 (1.8)	3/696 (0.4)	1/873 (0.1)	0/104 (0)	2/110 (1.8)
Cefotaxime	0/768 (0)	1/696 (0.1)	0/873 (0)	0/104 (0)	1/110 (0.9)
Ceftazidime	0/768 (0)	1/696 (0.1)	0/873 (0)	0/104 (0)	0/110 (0)
Ciprofloxacin	5/768 (0.7)	6/696 (0.9)	4/873 (0.5)	0/104 (0)	0/110 (0)
Chloramphenicol	8/768 (1.0)	10/696 (1.4)	6/873 (0.7)	1/104 (1.0)	1/110 (0.9)
Gentamicin	18/768 (2.3)	7/696 (1.0)	1/873 (0.1)	0/104 (0)	2/110 (1.8)
Furazolidone	11/768 (1.4)	9/696 (1.3)	14/873 (1.6)	0/104 (0)	1/110 (0.9)
Nalidixic acid	51/768 (6.6)	18/696 (2.6)	25/873 (2.9)	5/104 (4.8)	5/110 (4.5)
Neomycin	28/768 (3.6)	4/696 (0.6)	2/873 (0.2)	-	-
Streptomycin	117/768 (15.2)	67/696 (9.6)	74/873 (8.5)	16/104 (15.4)	16/110 (14.5)
Sulphonamide compounds	158/768 (20.6)	155/696 (22.3)	130/873 (14.9)	10/104 (9.6)	14/110 (12.7)
Tetracycline	123/768 (16.0)	116/696 (16.7)	94/873 (10.8)	4/104 (3.8)	9/110 (8.2)
Trimethoprim/sulphonamide	100/768 (13.0)	93/696 (13.4)	79/873 (9.0)	-	-

* Insufficient data from Scotland (2015–2017) and Northern Ireland (2017)

- No isolates tested

Table S4.8.6: Resistance (interpreted using breakpoints) in all *Salmonella* from turkeys (all ages) in England and Wales, Northern Ireland and Scotland, 2015–2017*

	No. resistant/No. tested (% resistant) England & Wales		
Antibiotic	**2015**	**2016**	**2017**
Amoxicillin/clavulanate	0/251 (0)	0/111 (0)	0/180 (0)
Ampicillin	35/251 (13.9)	8/111 (7.2)	11/180 (6.1)
Apramycin	1/251 (0.4)	0/111 (0)	0/180 (0)
Cefotaxime	0/251 (0)	0/111 (0)	0/180 (0)
Ceftazidime	0/251 (0)	0/111 (0)	0/180 (0)
Ciprofloxacin	14/251 (5.6)	2/111 (1.8)	1/180 (0.6)
Chloramphenicol	4/251 (1.6)	0/111 (0)	0/180 (0)
Gentamicin	1/251 (0.4)	0/111 (0)	1/180 (0.6)
Furazolidone	0/251 (0)	0/111 (0)	0/180 (0)
Nalidixic acid	40/251 (15.9)	7/111 (6.3)	33/180 (18.3)
Neomycin	7/251 (2.8)	0/111 (0)	1/180 (0.6)
Streptomycin	178/251 (70.9)	59/111 (53.2)	81/180 (45.0)
Sulphonamide compounds	189/251 (75.3)	80/111 (72.1)	103/180 (57.2)
Tetracycline	184/251 (73.3)	78/111 (70.3)	103/180 (57.2)
Trimethoprim/sulphonamide	15/251 (6.0)	6/111 (5.4)	4/180 (2.2)

* Insufficient data from Scotland and Northern Ireland

Table S4.8.7: Resistance (interpreted using breakpoints) in all *Salmonella* Dublin from cattle, pigs, sheep, chickens and turkeys (combined) in England and Wales, Northern Ireland and Scotland, 2015–2017*

	No. resistant/No. tested (% resistant)								
	England & Wales			Northern Ireland			Scotland		
Antibiotic	2015	2016	2017	2015	2016	2017	2015	2016	2017
Ampicillin	4/226 (1.8)	1/245 (0.4)	0/272 (0)	6/79 (7.6)	0/81 (0)	0/72 (0)	0/56 (0)	0/56 (0)	0/68 (0)
Chloramphenicol	1/226 (0.4)	1/245 (0.4)	0/272 (0)	0/79 (0)	0/81 (0)	0/72 (0)	-	-	-
Furazolidone	0/226 (0)	0/245 (0)	0/272 (0)	0/79 (0)	0/81 (0)	0/72 (0)	-	-	-
Nalidixic acid	5/226 (2.2)	3/245 (1.2)	0/272 (0)	0/79 (0)	4/81 (4.9)	8/72 (11.1)	1/56 (1.8)	0/55 (0)	2/68 (0)
Neomycin	5/226 (2.2)	0/245 (0)	0/272 (0)	-	-	-	0/56 (0)	0/56 (0)	0/68 (0)
Streptomycin	9/226 (4.0)	4/245 (1.6)	0/272 (0)	0/79 (0)	7/81 (8.6)	3/72 (4.2)	0/56 (0)	-	-
Sulphonamide compounds	0/226 (0)	0/245 (0)	0/272 (0)	-	-	0/72 (0)	0/56 (0)	-	-
Tetracycline	1/226 (0.4)	1/245 (0.4)	0/272 (0)	5/79 (6.3)	0/81 (0)	0/72 (0)	0/56 (0)	3/56 (5.4)	2/68 (2.9)
Trimethoprim/sulphonamide	0/226 (0)	0/245 (0)	0/272 (0)	0/79 (0)	0/81 (0)	-	0/56 (0)	0/56 (0)	0/68 (0)

- No isolates tested

* Minor amendments have been made to the historical data published in past UK-VARSS reports for this data set

Table S4.8.8: Resistance (interpreted using breakpoints) in all *Salmonella* Typhimurium from cattle, pigs, sheep, chickens and turkeys (combined) in England and Wales, Northern Ireland and Scotland, 2015–2017**

	No. resistant/No. tested (% resistant)								
	England & Wales			Northern Ireland			Scotland		
Antibiotic	2015	2016	2017	2015	2016	2017	2015	2016	2017
Ampicillin	77/165 (46.7)	100/166 (60.2)	109/187 (58.3)	13/24 (54.2)	15/22 (68.2)	9/11 (81.8)	17/22 (77.3)	3/3 (100)	20/27 (74.1)
Apramycin	0/165 (0)	4/166 (2.4)	0/187 (0)	*	*	3/11 (27.3)	*	*	*
Chloramphenicol	75.9/165 (46.1)	96/166 (57.8)	100/187 (53.5)	6/24 (25.0)	14/22 (63.6)	3/11 (27.3)	-	-	-
Furazolidone	0/165 (0)	1/166 (0.6)	0/187 (0)	14/24 (58.3)	0/22 (0)	0/11 (0)	-	-	-
Nalidixic acid	2/165 (1.2)	0/166 (0)	3/187 (1.6)	12/24 (50.0)	4/22 (18.2)	1/11 (9.1)	4/22 (18.2)	0/3 (0)	0/27 (0)
Neomycin	4/165 (2.4)	1/166 (0.6)	0/187 (0)	-	-	-	1/22 (4.5)	0/3 (0)	0/27 (0)
Streptomycin	85/165 (51.5)	106/166 (63.9)	107/187 (57.1)	13/24 (54.2)	19/22 (86.4)	10/11 (90.9)	-	-	-
Sulphonamide compounds	80/165 (48.5)	110/166 (66.3)	117/187 (62.6)	-	19/22 (86.4)	9/11 (81.8)	-	-	-
Tetracycline	77/165 (46.7)	102/166 (61.4)	102/187 (54.5)	2/24 (8.3)	18/22 (81.8)	8/11 (72.7)	21/22 (95.5)	3/3 (100)	25/27 (92.6)
Trimethoprim/ sulphonamide	53/165 (32.1)	48/166 (28.9)	37/187 (19.8)	0/24 (0)	-	-	1/22 (4.5)	0/3 (0)	0/27 (0)

- No isolates tested

* Data not available

** Minor amendments have been made to the historical data published in past UK-VARSS reports for this data set

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 England and Wales, Northern Ireland and Scotland, 2015–2017**

	No. resistant/No. tested (% resistant)								
	England & Wales			Northern Ireland			Scotland		
Antibiotic	2015	2016	2017	2015	2016	2017	2015	2016	2017
Ampicillin	292/2198 (13.3)	220/1986 (11.1)	273/2652 (10.3)	13/24 (54.2)	5/125 (4.0)	0/3 (0)	44/89 (49.4)	1/72 (1.4)	2/69 (2.9)
Apramycin	64/2198 (2.9)	40/1986 (2.0)	42/2652 (1.6)	*	*	0/3 (0)	*	*	*
Chloramphenicol	53/2198 (2.4)	52/1986 (2.6)	53/2652 (2.0)	6/24 (25.0)	1/125 (0.8)	0/3 (0)	-	-	-
Furazolidone	42/2198 (1.9)	28/1986 (1.4)	42/2652 (1.6)	14/24 (58.3)	1/125 (0.8)	0/3 (0)	-	-	-
Nalidixic acid	121/2198 (5.5)	52/1986 (2.6)	154/2652 (5.8)	12/24 (50.0)	5/125 (4.0)	0/3 (0)	0/89 (0)	0/72 (0)	0/69 (0)
Neomycin	70/2198 (3.2)	44/1986 (2.2)	53/2652 (2.0)	-	-	-	0/89 (0)	1/72 (1.4)	0/69 (0)
Streptomycin	497/2198 (22.6)	318/1986 (16.0)	347/2652 (13.1)	13/24 (54.2)	18/125 (14.4)	0/3 (0)	-	-	-
Sulphonamide compounds	580/2198 (26.4)	471/1986 (23.7)	504/2652 (19.0)	-	17/125 (13.6)	0/3 (0)	-	-	-
Tetracycline	560/2198 (25.5)	455/1986 (22.9)	520/2652 (19.6)	2/24 (8.3)	13/125 (10.4)	1/3 (33.3)	55/89 (61.8)	1/72 (1.4)	4/69 (5.8)
Trimethoprim/ sulphonamides	229/2198 (10.4)	207/1986 (10.4)	164/2652 (6.2)	0/24 (0)	-	-	25/89 (28.1)	0/72 (0)	0/69 (0)

- No isolates tested

* Data not available

** Minor amendments have been made to the historical data published in past UK-VARSS reports for this data set

Table S4.8.10: Top ten *Salmonella* serovars isolated in Northern Ireland, 2015–2017

Rank	2015	2016	2017
1	Derby (437 isolations)	Dublin (81 isolations)	Dublin (173 isolations)
2	Mbandaka (335 isolations)	Mbandaka (46 isolations)	(Monophasic) Typhimurium (26 isolations)
3	Dublin (247 isolations)	Muenster (37 isolations)	*Salmonella* sp. (8 isolations)
4	Kedougou (230 isolations)	Typhimurium (22 isolations)	Derby (3 isolations)
5	13,23:i:- (189 isolations)	Senftenberg (11 isolations)	Newport (2 isolations)
6	Senftenberg (90 isolations)	Derby (5 isolations)	*
7	Enteritidis (87 isolations)	Tennessee (4 isolations)	
8	Typhimurium (67 isolations)	Diarizonae 61:-:1,5,7 (4 isolations)	
9	4,12:i:- (58 isolations)	Brandenburg (2 isolations)	
10	4,5,12:i:- (54 isolations)	Choleraesuis (2 isolations)	

* No other serovars detected in 2017

Table S4.8.11: Top ten *Salmonella* serovars isolated in Scotland, 2015–2017

Rank	2015	2016	2017
1	Dublin (64 isolations)	Dublin (68 isolations)	Dublin (74 isolations)
2	Typhimurium (49 isolations)	Typhimurium (25 isolations)	Typhimurium (30 isolations)
3	Arizonae (17 isolations)	Montevideo (17 isolations)	Arizonae (28 isolations)
4	Montevideo (9 isolations)	Bovismorbificans (14 isolations)	Bovismorbificans (19 isolations)
5	Salmonella sp. (7 isolations)	Minnesota (17 isolations)	Montevideo (16 isolations)
6	Salmonella sp. (6 isolations)	Arizonae (13 isolations)	Mbandaka (9 isolations)
7	Derby (2 isolations)	Mbandaka (9 isolations)	Urbana (7 isolations)
8	Enteritidis (2 isolations)	Panama (6 isolations)	Derby (2 isolations)
9	Mbandaka (2 isolations)	4,5,12:i:- (3 isolations)	Enteritidis/Minnesota/ Reading/Agama (1 isolation each)
10	Senftenberg (2 isolations)	Binza (2 isolations)	

Table S4.8.10: Top ten *Salmonella* serovars isolated in Northern Ireland, 2015–2017

Rank	2015	2016	2017
1	Derby (437 isolations)	Dublin (81 isolations)	Dublin (173 isolations)
2	Mbandaka (335 isolations)	Mbandaka (46 isolations)	(Monophasic) Typhimurium (26 isolations)
3	Dublin (247 isolations)	Muenster (37 isolations)	*Salmonella* sp. (8 isolations)
4	Kedougou (230 isolations)	Typhimurium (22 isolations)	Derby (3 isolations)
5	13,23:i:- (189 isolations)	Senftenberg (11 isolations)	Newport (2 isolations)
6	Senftenberg (90 isolations)	Derby (5 isolations)	*
7	Enteritidis (87 isolations)	Tennessee (4 isolations)	
8	Typhimurium (67 isolations)	Diarizonae 61:-:1,5,7 (4 isolations)	
9	4,12:i:- (58 isolations)	Brandenburg (2 isolations)	
10	4,5,12:i:- (54 isolations)	Choleraesuis (2 isolations)	

* No other serovars detected in 2017

Table S4.8.11: Top ten *Salmonella* serovars isolated in Scotland, 2015–2017

Rank	2015	2016	2017
1	Dublin (64 isolations)	Dublin (68 isolations)	Dublin (74 isolations)
2	Typhimurium (49 isolations)	Typhimurium (25 isolations)	Typhimurium (30 isolations)
3	Arizonae (17 isolations)	Montevideo (17 isolations)	Arizonae (28 isolations)
4	Montevideo (9 isolations)	Bovismorbificans (14 isolations)	Bovismorbificans (19 isolations)
5	Salmonella sp. (7 isolations)	Minnesota (17 isolations)	Montevideo (16 isolations)
6	Salmonella sp. (6 isolations)	Arizonae (13 isolations)	Mbandaka (9 isolations)
7	Derby (2 isolations)	Mbandaka (9 isolations)	Urbana (7 isolations)
8	Enteritidis (2 isolations)	Panama (6 isolations)	Derby (2 isolations)
9	Mbandaka (2 isolations)	4,5,12:i:- (3 isolations)	Enteritidis/Minnesota/ Reading/Agama (1 isolation each)
10	Senftenberg (2 isolations)	Binza (2 isolations)	