Report on the Japanese Veterinary Antimicrobial Resistance Monitoring System
2014–2015

National Veterinary Assay Laboratory

Ministry of Agriculture, Forestry and Fisheries

2018

Contents

Introduction

Antimicrobial agents are essential for maintaining the health and welfare of both animals and humans. However, their use has also been linked to the emergence and increasing prevalence of antimicrobial-resistant bacteria. In 1969, Swann reported on the transmission of antimicrobial-resistant bacteria that emerged from the use of veterinary antimicrobial agents to humans via livestock products, which subsequently reduced the efficacy of antimicrobial drugs in humans[1]. In addition, the development of antimicrobial resistance in these bacteria reduces the efficacy of veterinary antimicrobial drugs.

Antimicrobial agents have been used for the prevention, control, and treatment of infectious diseases in animals worldwide, as well as for non-therapeutic purposes in some countries in food-producing animals in Japan. The Japanese Veterinary Antimicrobial Resistance Monitoring System (JVARM) was established in 1999 in response to international concern over the impact of antimicrobial resistance on public and animal health[2]. Preliminary monitoring for antimicrobial-resistant bacteria was conducted in 1999 and the program has operated continuously since that time. However, although veterinary antimicrobial use is a selective force for the emergence and increasing prevalence of antimicrobial-resistant bacteria in food-producing animals, these bacteria are also found in the absence of antimicrobial selective pressures.

In May 2015, the World Health Assembly endorsed the Global Action Plan on Antimicrobial Resistance[3] and urged all Member States to develop relevant national action plans within 2 years. Japan’s “National Action Plan on Antimicrobial Resistance (AMR) 2016–2020” endorses the current status and monitoring of antimicrobial-resistant bacteria and national antimicrobial use as an important strategy for both evaluating the impact of the action plan on antimicrobial resistance and planning future national policy.

This report outlines the trends in antimicrobial resistance in indicator bacteria from healthy food-producing animals and pathogenic bacteria from diseased animals, as well as antimicrobial sales volumes in 2014–2015, as assessed by the JVARM program.

I. The Japanese Veterinary Antimicrobial Resistance Monitoring System (JVARM)

1. Objectives

JVARM was set up to monitor the occurrence of antimicrobial-resistant bacteria in food-producing animals and the sales of antimicrobials for animal use. These objectives will help determine the efficacy of antimicrobials in food-producing animals, encourage the prudent use of such antimicrobials, and ascertain the effect on public health.

2. Overview

JVARM includes three components (see Fig. 1): 1) monitoring the sales volumes of antimicrobials for animal use, 2) monitoring antimicrobial resistance in zoonotic and indicator bacteria isolated from healthy animals, and 3) monitoring antimicrobial resistance in animal pathogens isolated from diseased animals. Until 2011, all bacteria assessed by this program were isolated from food-producing animals on farms. However, since 2012, samples have also been collected from slaughterhouses to increase the breadth of monitoring.

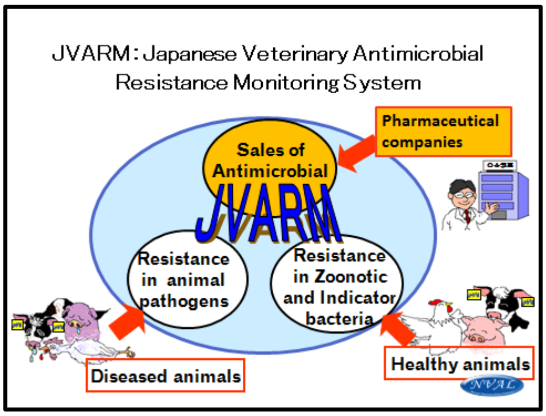

Fig. 1 Overview of JVARM

(1) Monitoring of Antimicrobial Sales

The system that is used to monitor antimicrobial sales volumes is shown in Fig. 2. Marketing authorization holders of veterinary medical products (VMPs) are required to submit the sales data to the National Veterinary Assay Laboratory (NVAL) each year in accordance with “The Act on Securing Quality, Efficacy, and Safety of Pharmaceuticals, Medical Devices, Regenerative and Cellular Therapy Products, Gene Therapy Products, and Cosmetics (Law No.145, Series of 1960)”. NVAL collates, analyzes, and evaluates these data, and then publishes them in an annual report entitled “Amount of medicines and quasi-drugs for animal use” on its website (http://www.maff.go.jp/nval/iyakutou/hanbaidaka/index.html).

The weight in kilograms of the active ingredients in antimicrobial products that are sold for treat animals each year is collected and the data are subdivided by animal species. However, this method of analysis only provides an estimate of the antimicrobial sales volume for each target species, as a single antimicrobial product is frequently used for multiple animal species.

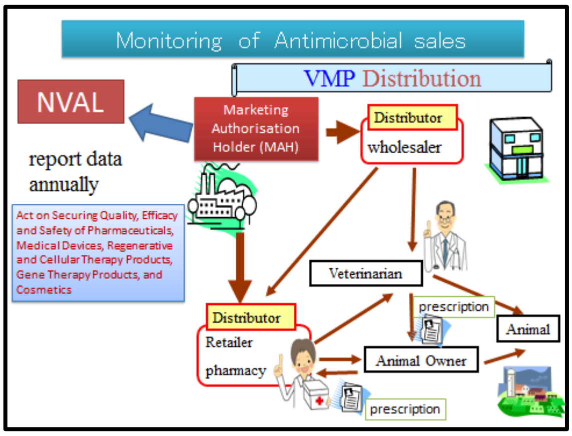

Fig. 2 Monitoring of antimicrobial sales

(2) Monitoring of Antimicrobial-Resistant Bacteria

Zoonotic and indicator bacteria isolated from healthy animals and pathogenic bacteria isolated from diseased animals are continuously collected for antimicrobial susceptibility testing. Zoonotic bacteria include *Salmonella* species, *Campylobacter jejuni*, and *C. coli*; indicator bacteria include *Escherichia coli*, *Enterococcus faecium*, and *E. faecalis*; and animal pathogens include *Salmonella* species, *Staphylococcus* species, *E. coli*, *Mannheimia haemolytica*, and *Klebsiella pneumoniae*. Minimum inhibitory concentrations (MICs) of antimicrobial agents for target bacteria are then determined using the microdilution method, as described by the Clinical and Laboratory Standards Institute (CLSI)[4).

3. Implementation System

(1) Monitoring System in Farms of Healthy Animals

The JVARM monitoring system in farms of healthy animals is shown in Fig. 3. Livestock Hygiene Service Centers (LHSCs), which belong to prefecture offices, function as participating laboratories of JVARM and are responsible for the isolation and identification of target bacteria, as well as MIC measurement. They send the results and tested bacteria to NVAL, which functions as the core laboratory of JVARM and is responsible for preserving the bacteria, collating and analyzing all data, and reporting to the Ministry of Agriculture, Forestry and Fisheries (MAFF) headquarters. MIC measurement, data collation, and the preservation of *E. faecium* and *E. faecalis* are undertaken at the Food and Agricultural Materials Inspection Center (FAMIC).

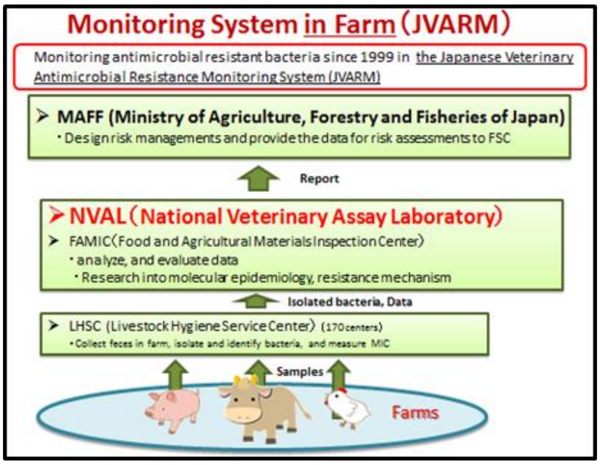

Fig. 3 Monitoring system in farms of healthy animals

(2) Monitoring System in Farms of Diseased Animals

The JVARM monitoring system for isolates from diseased animals in farms is shown in Fig. 4. Animal pathogens that are designated by NVAL as target bacteria for a particular year are collected by LHSCs. The LHSCs isolate and identify some types of pathogenic bacteria as part of their regular work, and send the bacteria to NVAL. NVAL conducts MIC measurement and reports the results on its website (http://www.maff.go.jp/nval/yakuzai/yakuzai_p3.html).

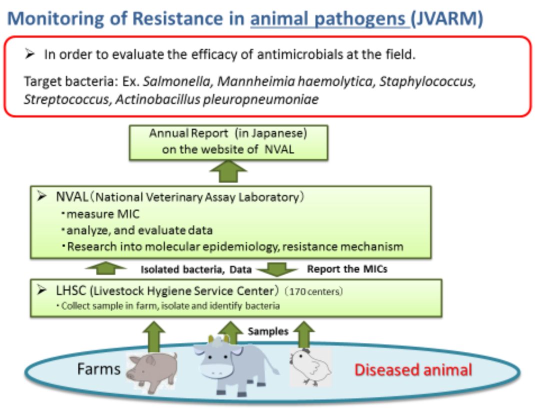

Fig. 4 Monitoring system for diseased animals on farms

(3) Monitoring System in Slaughterhouses

The JVARM monitoring system in slaughterhouses is shown in Fig. 5. MAFF contracts the isolation, identification, and MIC measurement of target bacteria to private research laboratories. These institutions send the results and tested bacteria to NVAL, which is responsible for preserving the bacteria, collating and analyzing all data, and reporting the findings to MAFF headquarters. Data collection and the preservation of *E. faecium* and *E. faecalis* are conducted at FAMIC.

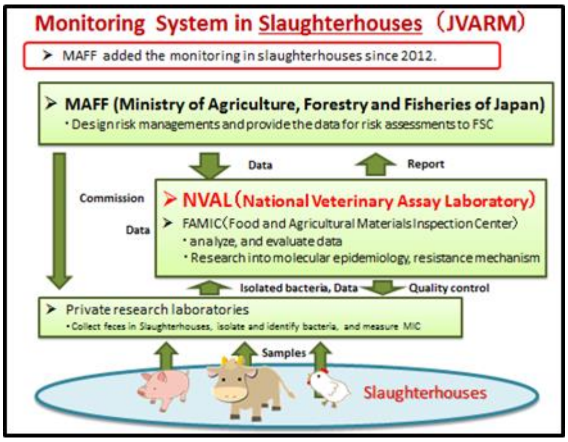

Fig. 5 Monitoring system in slaughterhouses

4. Quality Assurance/Control Systems

Quality control is carried out at the participating laboratories that perform antimicrobial susceptibility testing to help monitor the precision and accuracy of the testing procedures, the performance of the reagents used, and the training of the personnel involved. Strict adherence to standardized techniques is vital to ensure that the data collected are reliable and reproducible. Quality control reference bacteria are also tested in each participating laboratory to ensure standardization. Moreover, NVAL holds a national training course for LHSC staff each year on antimicrobial resistance and standardized laboratory methods for the isolation, identification, and antimicrobial susceptibility testing of target bacteria. NVAL also undertakes inspections of the private research laboratories.

5. Publication of Data

Since antimicrobial resistance affects both animal and human health, it is of paramount importance that information on antimicrobial resistance is distributed as quickly as possible. NVAL officially publishes such information in scientific journals and on its website (http://www.maff.go.jp/nval/yakuzai/yakuzai_p3.html). Furthermore, research conducted by NVAL on the molecular epidemiology and resistance mechanisms of bacteria is published in scientific journals (http://www.maff.go.jp/nval/yakuzai/pdf/jvarm_publications_list_20150916.pdf).

II. An Overview of the Availability of Veterinary Antimicrobial Products for Animal Therapy or Growth Promotion in Japan

The numbers of animals that were slaughtered for meat in slaughterhouses and poultry slaughtering plants between 2013 and 2015 are shown in Table 1.1 There was no remarkable change in the number of meat animals produced between 1999 and 2015 (Fig. 6) despite the scale of pig and poultry farms increasing each year (data not shown), because the number of farmers in Japan has decreased due to a lack of successors.

Table 1.1 Numbers of animals (1,000 heads/birds) slaughtered in slaughterhouses and poultry slaughtering plants in 2013–2015

	Cattle	Calf	Horse	Pig	Broiler	Fowl*
2015	1101.3	5.9	12.5	16104.5	666859	78112
2014	1149.8	6.7	13.5	16202.9	661030	87359
2013	1177.9	7.1	13.7	16940.4	653999	86227

* Most of these fowls were old layer chickens.

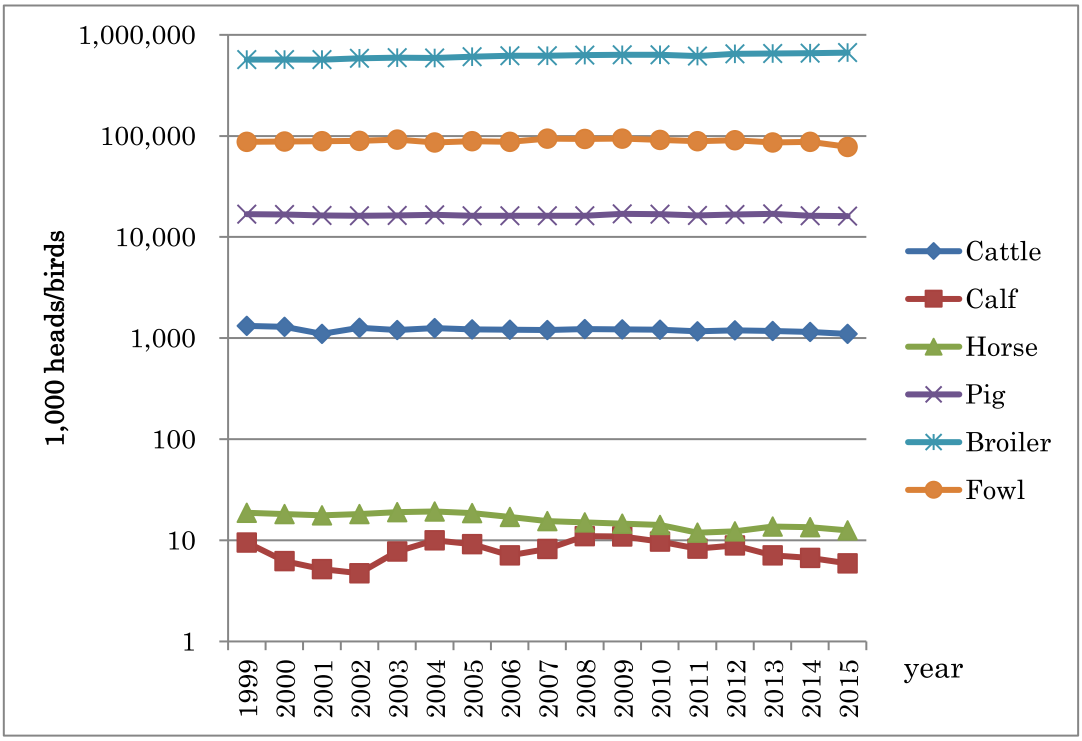

Fig. 6 Trends in the numbers of animals (1000 heads/birds) slaughtered in slaughterhouses and poultry slaughtering plants between 1999 and 2015

The total antimicrobial sales volume for animal use gradually decreased between 2001 and 2015 (Fig. 7). Antimicrobials were used more frequently in pigs than in cattle or poultry (data not shown). In 2015, tetracycline accounted for 45% of the total sales volume of veterinary antimicrobials, whereas fluoroquinolones and cephalosporins were used restrictively (<1% of total sales).

Antimicrobial feed additives were first used in Japan in the 1950s. Trends in the amount of feed additives (converted to bulk products) that were manufactured in Japan between 2003 and 2015 are shown in Fig. 8. A fairly constant volume was manufactured between 2007 and 2009, averaging 171 tons. However, the total volume increased after 2009, primarily due to an increased use of ionophores. Ionophores are widely used in the European Union and USA without prescription and comprised a large proportion of feed additives (142 tons [73.8%]) in 2015. By contrast, polypeptides, tetracyclines, and macrolides comprised 17.6%, 0.8%, and 2.8%, respectively, of the total volume in 2015.

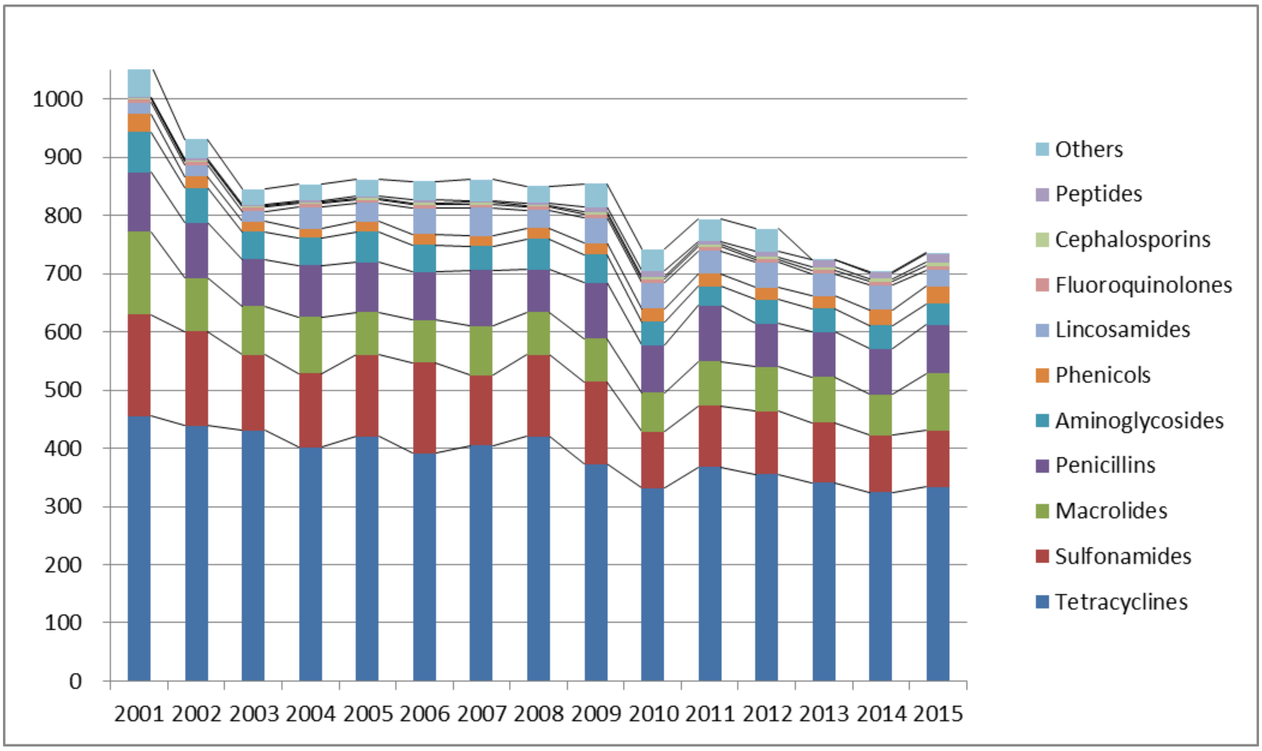

Fig. 7 Volumes of veterinary antimicrobials (in tons of active ingredient) sold by pharmaceutical companies in Japan between 2001 and 2015

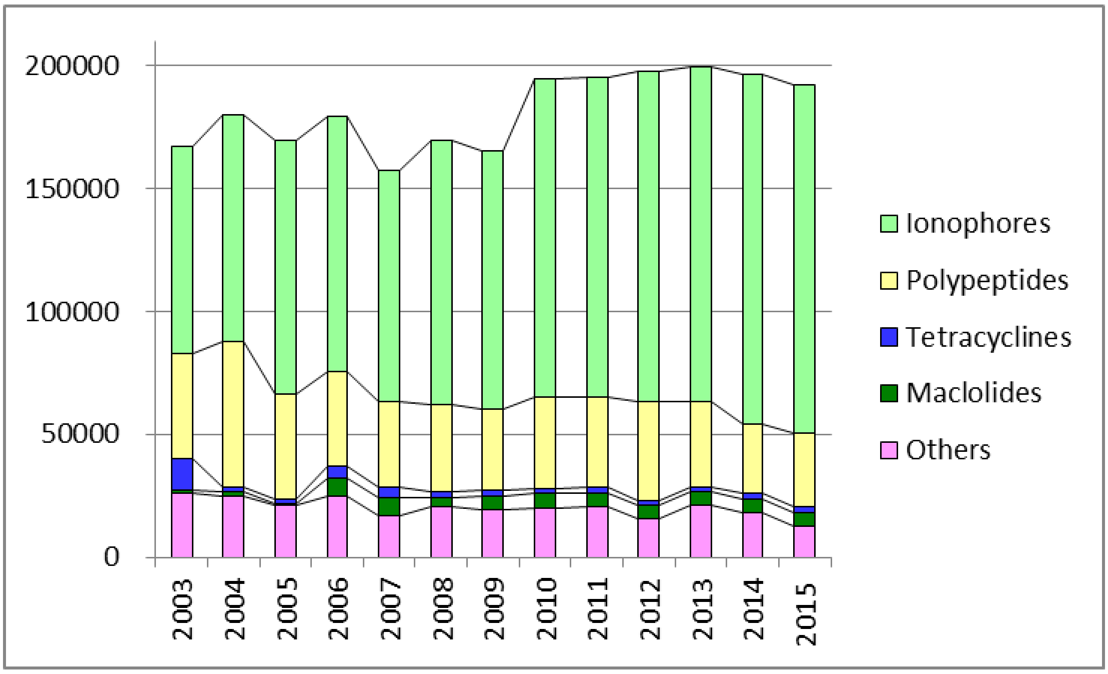

Fig. 8 Amounts of antimicrobial feed additives (in kg of active ingredient) manufactured in Japan between 2003 and 2015

III. Monitoring of Antimicrobial Resistance in 2014-2015

1. Healthy Animals on Farms

The total number of bacteria that were isolated from food-producing animals on farms in 2014–2015 (the 6th stage of the JVARM program) is shown in Table 1.2. All isolates were subjected to antimicrobial susceptibility testing.

(1) *Escherichia coli*

A total of 1,333 isolates of *E. coli* (500 from cattle, 241 from pigs, 292 from broilers, and 300 from layers) collected in 2014–2015 were available for antimicrobial susceptibility testing. Their MIC distributions are shown in Tables 2.1 and 2.2.

Resistance against tetracycline, streptomycin, and ampicillin was frequently detected in *E. coli* isolates from food-producing animals. In general, isolates from pigs or broilers exhibited the highest rates of resistance, which was most commonly against streptomycin (resistance rates in pigs and broilers = 37.4%–47.0% and 33.6%–47.8%, respectively), tetracycline (55.1%–64.2% and 45.5%–51.1%, respectively), ampicillin (24.6%–30.8% and 41.8%–44.5%, respectively), kanamycin (9.7%–11.2% and 29.1%–30.2%, respectively), chloramphenicol (25.2%–25.4% and 14.3%–16.4%, respectively), and trimethoprim (28.0%–34.3% and 30.0%–36.8%, respectively).

The incidence of nalidixic acid resistance was high in *E. coli* isolates from broilers (32.7%–38.5%), intermediate in isolates from pigs (8.2%–9.3%) and layers (10.6%–17.4%), and low in isolates from cattle (0.9%–2.8%). By contrast, the incidence of ciprofloxacin resistance was low (0%–4.5%) in all isolates except those from broilers (9.3%–12.6%), and the incidence of cefazolin and cefotaxime resistance was low in all animal species (0%–3.8% and 0%–3.3%, respectively).

Resistance rates against most antimicrobials remained stable in the 6th stage of the program compared with the 3rd, 4th, and 5th stages (Table 1.3). However, in the 6th stage, there was a significantly higher incidence of kanamycin and enrofloxacin/ciprofloxacin resistance in *E. coli* isolates from broilers compared with the 4th stage, and in enrofloxacin/ciprofloxacin resistance in *E. coli* isolates from layers compared with the 4th and 5th stages ($p < 0.05$).

By contrast, in the 6th stage, there was a significantly lower incidence of cefazolin, ceftiofur/cefotaxime, and oxytetracycline/tetracycline resistance in *E. coli* isolates from broilers compared with the 3rd stage and some other stages, and ceftiofur/cefotaxime and chloramphenicol resistance in *E. coli* isolates from layers compared with the 5th stage ($p < 0.05$).

(2) *Enterococcus*

A total of 278 *Enterococcus faecalis* and 315 *E. faecium* isolates collected in 2014–2015 were subjected to antimicrobial susceptibility testing. Both species of bacteria were isolated from the feces of all four food-producing animal species. Their MIC distributions are shown in Tables 3.1–3.2 and 4.1–4.2.

The level of antimicrobial resistance varied between the bacterial species, with *E. faecalis* isolates more frequently exhibiting resistance than *E. faecium* isolates.

The resistance rates also varied between animal species. Isolates from pigs and broilers frequently exhibited resistance against oxytetracycline (resistance rates in *E. faecalis* and *E. faecium* = 64.5%–100% and 50.0%–61.7%, respectively), dihydrostreptomycin (37.5%–62.7% and 23.1%–40.4%, respectively), erythromycin (44.8%–62.5% and 22.4%–38.5%, respectively), tylosin (44.8%–62.5% and 15.0%–31.3%, respectively), and lincomycin (44.8%–62.5% and 24.3%–40.4%, respectively). The enrofloxacin resistance rate was higher in *E. faecium* isolates (52.0% in 2014, 53.8% in 2015) than in *E. faecalis* isolates (4.0% in 2014, 3.4% in 2015).

Resistance rates against most antimicrobials remained stable in the 6th stage of the program compared with the 3rd, 4th, and 5th stages (Tables 1.4.1 and 1.4.2). However, in the 6th stage, there was a significantly higher incidence of oxytetracycline resistance in *E. faecalis* isolates from cattle compared with the 5th stage, kanamycin resistance in *E. faecium* isolates from cattle, pigs, and broilers compared with the 3rd stage, and chloramphenicol resistance in *E. faecium* isolates from broilers compared with the 3rd, 4th and 5th stages ($p < 0.05$).

By contrast, in the 6th stage, there was a significantly lower incidence of gentamicin resistance in *E. faecalis* isolates from pigs compared with the 3rd stage, dihydrostreptomycin, gentamicin, and erythromycin resistance in *E. faecalis* isolates from layers compared with the 3rd and 4th stages, oxytetracycline resistance in *E. faecalis* isolates from layers compared with the 3rd stage, erythromycin resistance in *E. faecium* isolates from cattle compared with the 4th stage, and gentamicin resistance in *E. faecium* isolates from broilers compared with the 4th stage ($p < 0.05$).

(3) *Campylobacter*

A total of 314 *C. jejuni* and 150 *C. coli* isolates collected in 2014–2015 were subjected to antimicrobial susceptibility testing. *C. jejuni* was isolated mainly from cattle, layer, and broiler feces, whereas *C. coli* was isolated mainly from pig feces. Their MIC distributions are shown in Tables 5.1–5.2 and 6.1–6.2.

Both species of bacteria exhibited antimicrobial resistance against all of the antimicrobials tested except gentamicin.

However, the resistance rates varied between the bacterial species, with *C. coli* isolates exhibiting greater resistance against nearly all of the antimicrobials tested than *C. jejuni* isolates. The resistance rates also varied between animal species, with *C. coli* isolates from pigs generally exhibiting the highest level of resistance.

Tetracycline resistance was more frequently detected in both *C. coli* (63.2%–78.0%) and *C. jejuni* (42.3%–46.8%) than resistance against any other antimicrobial agent tested. In addition, these bacteria exhibited resistance against ampicillin (resistance rates in *C. jejuni* and *C. coli* = 20.9%–26.3% and 7.3%–16.2%, respectively), streptomycin (1.3%–3.2% and 41.5%–44.1%, respectively), erythromycin (0% and 11.8%–35.4%, respectively), chloramphenicol (0%–2.5% and 0%–12.2%, respectively), nalidixic acid (26.3%–38.6% and 43.9%–52.9%, respectively), and ciprofloxacin, (24.4%–38.0% and 43.9%–52.9%, respectively).

The resistance rates of isolates from broilers and layers against most antimicrobials remained stable in the 6th stage of the program compared with the 3rd, 4th, and 5th stages (Table 1.5). However, in the 6th stage, there was a significantly higher incidence of oxytetracycline/tetracycline resistance in *C. jejuni* isolates from cattle and ampicillin resistance in *C. jejuni* isolates from layers compared with the 3rd and 4th stages, and ampicillin resistance in *C. jejuni* isolates from cattle and fluoroquinolone resistance in *C. coli* isolates from pigs compared with the 4th and 5th stages, respectively ($p < 0.05$).

By contrast, the incidence of erythoromycin and chloramphenicol resistance in *C. coli* isolates from pigs was significantly lower in the 6th stage compared with the 4th and 5th stages, respectively ($p < 0.05$).

Erythromycin resistance was not detected in *C. jejuni* isolates from any animal species but was frequently found in *C. coli* isolates from pigs (18.4%–44.1%).

2. Diseased Animals on Farms

(1) *Salmonella*

A total of 304 *Salmonella* isolates (139 from cattle, 107 from pigs, and 58 from chickens) collected in 2014–2015 were available for antimicrobial susceptibility testing. Their MIC distributions are shown in Tables 7.1–7.2.

The predominant serovars were *S.* Typhimurium (85 isolates, 28.0%), which was predominant in cattle isolates (50/139, 36.0%), O4:i:- (68 isolates, 22.4%), which was predominant in pig isolates (43/107, 40.2%), *S.* Choleraesuis (14 isolates, 4.6%), and *S.* Schwarzengrund (14 isolates, 4.6%), which was predominant in chicken isolates (14/58, 24.1%) (Table 8).

The *Salmonella* isolates exhibited antimicrobial resistance against most of the antimicrobials that were tested, with the exception of ciprofloxacin and colistin.

In general, *Salmonella* isolates from cattle and pigs had the highest rates of resistance, which was most commonly against streptomycin (resistance rates in cattle and pigs = 60.3%–67.1% and 67.3%–82.7%, respectively), tetracycline (50.8%–55.3% and 60.3%–61.2%, respectively), and ampicillin (56.6%–61.9% and 41.4%–46.9%, respectively). In addition, isolates from cattle and pigs exhibited resistance against cefazolin and cefotaxime, albeit at a low frequency (0%–7.9%).

The resistance rates of *Salmonella* isolates from chickens remained stable in the 6th stage of the program compared with the 3rd, 4th, and 5th stages (Table 1.6). However, in the 6th stage, there was a significantly higher incidence of ampicillin, cefazolin, oxytetracycline/tetracycline, and nalidixic acid resistance in *Salmonella* from cattle compared with the 3rd stage ($p < 0.05$). By contrast, the incidence of kanamycin and oxytetracycline/tetracycline resistance in *Salmonella* isolates from pigs was significantly lower in the 6th stage compared with the 3rd stage ($p < 0.05$).

(2) *Staphylococcus aureus*

In total, 0%–21.3% of *S. aureus* isolates from cattle and 0%–50.0% of isolates from chickens exhibited resistance against the seven microbial agents tested (Table 1.7).

(3) *Escherichia coli*

In total, 0%–78.7% of *E. coli* isolates from cattle, 0%–75.9% of isolates from pigs, and 0%–70.8% of isolates from chickens exhibited resistance against the 12 antimicrobial agents tested (Table 1.8).

Table 1.2.1 Total numbers of bacteria isolated from livestock on farms since the inception of the Japanese Veterinary Antimicrobial Resistance Monitoring System (JVARM)

	year	*E.coli*	*Enterococcus*	*Campylobacter*
Trial Stage	1999	1,018	1,024	166
1st stage	2000~2003	2,206	1,401	956
2nd stage	2004~2007	1,979	1,920	679
3rd stage	2008~2009	1,295	1,273	390
4th stage	2010~2011	1,567	1,432	540
5th stage	2012~2013	1,481	1,468	464
6th stage	2014~2015	1,333	1,400	464
TOTAL		**10,879**	**9,918**	**3,659**

Table 1.3 Antimicrobial resistance rates (%) of *Escherichia coli* in the 3rd to 6th stages of the Japanese Veterinary Antimicrobial Resistance Monitoring System (JVARM) program

Antimicrobials	Cattle				Pig				Broiler				Layer			
	3rd stage	4th stage	5th stage	6th stage	3rd stage	4th stage	5th stage	6th stage	3rd stage	4th stage	5th stage	6th stage	3rd stage	4th stage	5th stage	6th stage
Ampicillin	8.5	6.5	6.7	5.0	29.8	27.4	29.5	27.4	46.5	42.4	45.8	43.5	19.7	13.6	14.2	19.0
Cefazolin	0	0.4	0.9	0.6	0.0	2.5	1.4	0	19.9	20.2	8.0	3.7ab	1.3	1.9	3.0	0.3
Ceftiofur-Cefotaxime	0	0.4	1.1	0.6	0.0	1.4	1.8	0	17.3	18.3	7.1	3.1abc	1.7	0.6	3.3[b]	0c
Dihydrostreptomycin-Streptomycin	18.1	-	17.3	14.8	50.7	-	41.8	42.7	38.1	-	38.3	42.5	13.7	-	17.2	13.0
Gentamicin	0	0	0.2	0.6	2.1	2.1	2.2	2.9	4.0	3.7	2.4	1.3	0.4	0.3	0.6	0.7
Kanamycin	2.5	3.2	2.4	1.6	15.6	9.5	7.3	10.4	20.4	13.2	26.4	29.8b	2.6	3.6	4.3	4.0
Oxytetracycline-Tetracycline	24.7	19.3	22.4	19.8	63.8	59.3	57.1	60.2	63.7	52.2	59.4	49.0ac	27.9	25.8	32.7	23.7
Nalidixic acid	3.1	1.9	2.6	2.0	8.5	8.4	9.8	8.7	34.1	32.6	32.0	36.3	6.4	11.4	13.6[a]	13.3
Enrofloxacin-Ciprofloxacin	0.2	0.4	0.6	0.2	1.8	2.1	0.7	1.7	9.7	5.1	7.7	11.3b	2.1	0.8	0.6	4.3bc
Colistin	1.4	0.5	0.0	0	1.8	1.1	0.0	0	0.4	0.8	0.3	0.0	2.6	1.1	0.6	0a
Chloramphenicol	3.8	3.2	3.9	3.0	24.8	21.8	24.4	25.3	13.7	10.1	18.7[b]	15.1	5.2	2.2	8.4	3.3c

a: Significantly different compared with the third stage
b: Significantly different compared with the forth stage
c: Significantly different compared with the fifth stage
: Significantly increased
: Significantly decreased

Table 1.4.1 Antimicrobial resistance rates (%) of *Enterococcus faecalis* in the 3rd to 6th stages of the Japanese Veterinary Antimicrobial Resistance Monitoring System (JVARM) program

	Antimicrobials	Cattle				Pig				Broiler				Layer			
		3rd stage	4th stage	5th stage	6th stage	3rd stage	4th stage	5th stage	6th stage	3rd stage	4th stage	5th stage	6th stage	3rd stage	4th stage	5th stage	6th stage
E. faecalis	Ampicillin	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Dihydrostreptomycin	50.0	35.7	47.1	27.3	84.6	76.7	57.4	54.2	69.7	58.4	55.2	61.2	54.5	53.2	47.6	38.6ab
	Gentamicin	22.2	7.1	0.0	0.0	33.3	16.3	13.1	0a	16.9	9.6	16.6	11.2	15.9	14.9	9.8	3.4ab
	Kanamycin	11.1	7.1	5.9	9.1	51.3	44.2	32.8	25.0	33.7	39.3	42.8	44.9	16.7	28.2	27.3	18.6
	Oxytetracycline	27.8	35.7	5.9	54.5c	89.7	76.7	67.2	79.2	86.5	73.0	75.2	67.3	62.1	52.7	53.8	44.8a
	Chloramphenicol	0.0	0.0	0.0	27.3	30.8	53.5	42.6	50.0	11.2	9.6	14.5	15.3	4.5	5.3	6.3	1.4
	Erythromycin	11.1	0.0	0.0	27.3	66.7	65.1	55.7	58.3	52.8	51.7	51.7	45.9	35.6	29.3	25.9	15.9ab
	Tylosin		0.0	0.0	27.3		62.8	52.5	54.2		51.7	53.1	45.9		29.3	25.2	15.9
	Lincomycin	11.1	0.0	0.0	27.3	76.9	62.8	59.0	62.5	55.1	52.2	53.1	45.9	35.6	29.8	25.2	15.9
	Enrofloxacin	5.6	7.1	0.0	0.0	2.6	11.6	0.0	4.2	2.2	4.5	2.1	3.1	2.3	0.5	2.1	4.1

a: Significantly different compared with the third stage
b: Significantly different compared with the forth stage
c: Significantly different compared with the fifth stage
: Significantly increased
: Significantly decreased

Table 1.4.2 Antimicrobial resistance rates (%) of *Enterococcus faecium* in the 3rd to 6th stages of the Japanese Veterinary Antimicrobial Resistance Monitoring System (JVARM) program

	Antimicrobials	Cattle				Pig				Broiler				Layer			
		3rd stage	4th stage	5th stage	6th stage	3rd stage	4th stage	5th stage	6th stage	3rd stage	4th stage	5th stage	6th stage	3rd stage	4th stage	5th stage	6th stage
E. faecium	Ampicillin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	2.2	2.3	1.7	0.0	0.0	0.0	0.0
	Dihydrostreptomycin	13.0	11.1	22.2	11.5	48.2	31.7	27.5	38.1	35.1	19.1	26.9	23.3	12.5	13.9	4.7	10.0
	Gentamicin	1.3	0.0	1.9	3.8	3.6	3.2	0.0	1.6	1.1	7.9	3.1	0.8b	3.6	5.6	1.2	0.0
	Kanamycin	9.1	27.8	38.9	26.9a	26.8	41.3	41.2	55.6a	18.1	34.8	48.5	42.5a	19.6	36.1	40.7	43.8
	Oxytetracycline	14.3	18.5	7.4	15.4	62.5	54.0	45.1	52.4	71.3	60.7	64.6	61.7	37.5	19.4	11.6	18.8
	Chloramphenicol	0.0	1.9	0.0	0.0	1.8	6.3	5.9	12.7	2.1	1.1	3.8	11.7abc	0.0	0.0	0.0	1.3
	Erythromycin	9.1	33.3	14.8	9.6b	25.0	34.9	27.5	30.2	30.9	28.1	29.2	24.2	12.5	30.6	7.0	8.8
	Tylosin	-	5.6	7.4	3.8	-	25.4	19.6	28.6	-	14.6	22.3	16.7	-	4.2	1.2	5.0
	Lincomycin	5.2	9.3	7.4	7.7	41.1	33.3	39.2	39.7	33.0	21.3	30.0	25.0	10.7	4.2	0.0	10.0
	Enrofloxacin	20.8	37.0	35.2	30.8	51.8	28.6	43.1	44.4	63.8	58.4	73.1	65.0	55.4	47.2	55.8	53.8

a: Significantly different compared with the third stage
b: Significantly different compared with the forth stage
c: Significantly different compared with the fifth stage
: Significantly increased
: Significantly decreased

Table 1.5 Antimicrobial resistance rates (%) of *Campylobacter jejuni* isolated from cattle, broilers, and layers, and *C. coli* isolated from pigs in the 3rd to 6th stages of the Japanese Veterinary Antimicrobial Resistance Monitoring System (JVARM) program

Antimicrobials	Cattle				Pig				Broiler				Layer			
	3rd stage	4th stage	5th stage	6th stage	3rd stage	4th stage	5th stage	6th stage	3rd stage	4th stage	5th stage	6th stage	3rd stage	4th stage	5th stage	6th stage
Ampicillin	5.1	1.0	3.4	9.5b	8.7	0.9	4.1	6.2	17.4	25.2	19.3	23.7	18.3	22.5	26.7	36.9ab
Dihydrostreptomycin-Streptomycin	0	-	5.1	6.6	61.5	-	60.6	60.8	0	-	0	0	4.9	-	0.0	0.0
Erythromycin	0	0	0	0	53.8	53.3	42.4	34.0b	0	0	0	0	0	0	0	0
Oxytetracycline-Tetracycline	28.2	43.1	53.4	64.7ab	88.5	76.6	74.7[a]	83.5	40.2	49.5	36.4	40.2	32.9	41.7	37.1	29.7
Nalidixic acid	33.3	34.3	44.1	40.9	48.1	56.1	37.4	52.6	22.8	34.2	22.7	36.1	13.4	14.6	14.7	21.7
Enrofloxacin-Ciprofloxacin	26.9	33.3	42.4	40.0	45.2	55.1	33.3	52.6c	22.8	32.4	18.2	35.0	13.4	11.9	13.0	19.8
Chloramphenicol	0.0	0.0	1.7	3.8	28.8	19.6	25.2	10.3c	1.1	0.0	0.0	0.0	0.0	1.3	0.9	0.0

a: Significantly different compared with the third stage
b: Significantly different compared with the forth stage
c: Significantly different compared with the fifth stage
: Significantly increased
: Significantly decreased

Table 1.6 Antimicrobial resistance rates (%) of *Salmonella* isolates in the 3rd to 6th stages of the Japanese Veterinary Antimicrobial Resistance Monitoring System (JVARM) program

Antimicrobials	Cattle				Pig				Chicken			
	3rd stage	4th stage	5th stage	6th stage	3rd stage	4th stage	5th stage	6th stage	3rd stage	4th stage	5th stage	6th stage
Ampicillin	34.4	45.1	45.0	59.0a	46.5	31.1	33.6	43.9	7.5	6.9	6.1	5.2
Cefazolin	0.6	4.2	4.3	7.9a	0.0	0.8	0.0	2.8	4.3	1.7	3.6	0.0
Cefotaxime	-	3.5	4.3	7.9	-	0.8	0.0	1.9	-	1.7	2.4	0.0
Gentamicin	0.0	0.0	0.0	5.8	15.8	13.1	8.4	12.2	0.0	0.0	1.2	0.0
Kanamycin	20	19	12.2	18.0	21.9	15.6	9.8	7.5a	22.6	13.8	19.5	31.0
Oxytetracycline-Tetracycline	37.6	45.1	47.1	53.3a	79.8	66.4	58.7	60.7a	40.9	22.4	31.7	39.6
Chloramphenicol	11.5	21.5	11.4	20.2	26.3	9.8	12.6	19.6	1.1	0.0	6.1	5.2
Colistin	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	1.1	0.0	2.4	0.0
Nalidixic acid	0.6	5.5	5.0	7.9a	19.3	9.8	14.7	11.2	7.5	6.9	7.3	6.9
Enrofloxacin-Ciprofloxacin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

a: Significantly different compared with the third stage
b: Significantly different compared with the forth stage
c: Significantly different compared with the fifth stage
: Significantly increased
: Significantly decreased

Table 1.7. Proportion (%) of antimicrobial-resistant *Staphylococcus aureus* isolated from diseased animals in 2014 and 2015

Antimicrobials	BP	2014		2015	
		cattle n=91	chicken n=12	cattle n=75	chicken n=6
Ciprofloxacin	4	0	15.4	1.3	33.3
Streptomycin	64	1.1	7.7	2.7	16.7
Erythromycin	8	0	15.4	6.7	16.7
Tetracycline	16	5.6	15.4	6.7	16.7
Ampicillin	0.5	11.1	15.4	21.3	50
Gentamicin	16	0	0	1.3	0
Chloramphenicol	32	0	15.4	1.3	33.3

Table 1.8 Proportion (%) of antimicrobial-resistant *Escherichia coli* isolated from diseased animals in 2014 and 2015

Antimicrobials	BP	2014			2015			
		cattle n=45	pig n=115	total n=160	cattle n=47	pig n=108	chicken n=48	total n=203
Ampicillin	32	57.8	50.4	52.5	63.8	57.4	60.4	59.6
Cefazolin	32	6.7	6.1	6.3	14.9	9.3	14.6	11.8
Cefotaxime	4	6.7	0	1.9	8.5	3.7	10.4	6.4
Streptomycin	32	68.9	64.3	65.6	78.7	66.7	60.4	68
Gentamicin	16	6.7	8.7	8.1	12.8	19.4	2.1	13.8
Kanamycin	64	26.7	33.9	31.9	29.8	31.5	39.6	33
Tetracycline	16	66.7	75.7	73.1	66	75.9	70.8	72.4
Nalidixic acid	32	33.3	52.2	46.9	36.2	50	52.1	47.3
Ciprofloxacin	4	24.4	23.5	23.8	34	32.4	8.3	27.1
Colistin	16	6.7	0	1.9	0	2.8	0	1.5
Chloramphenicol	32	28.9	64.3	54.4	46.8	61.1	16.7	47.3
Trimethoprim	16	33.3	59.1	51.9	44.7	64.8	33.3	52.7

3. Healthy Animals in Slaughterhouses

The total numbers of bacteria isolated from food-producing animals in slaughterhouses are shown in Table 1.9. All isolates were subjected to antimicrobial susceptibility testing.

(1) *Escherichia coli*

A total of 1082 isolates of *E. coli* (537 from cattle, 189 from pigs, and 356 from broilers) collected in 2014–2015 were available for antimicrobial susceptibility testing. Their MIC distributions are shown in Tables 2.3–2.4.

These isolates exhibited antimicrobial resistance against all of the antimicrobials tested, but tetracycline, streptomycin, and ampicillin resistance were most frequently observed.

In general, *E. coli* isolates from pigs and broilers exhibited the highest rates of resistance, which was most commonly against streptomycin (resistance rates in pigs and broilers = 39.6%–52.7% and 41.8%–44.8%, respectively), tetracycline (45.8%–59.1% and 43.6%–54.9%, respectively), ampicillin (34.4%–43.0% and 40.1%–43.5%, respectively), kanamycin (8.3%–9.7% and 33.1%–37.5%, respectively), chloramphenicol (25.0%–34.4% and 9.8%–15.1%, respectively), and sulfamethoxazol/trimethoprim (30.2%–34.4% and 28.3%–30.2 %, respectively).

The incidence of nalidixic acid resistance was high in *E. coli* isolates from broilers (35.9%–45.3 %), intermediate in isolates from pigs (5.2%–9.7%), and low in isolates from cattle (2.3%–2.6 %). By contrast, the incidence of ciprofloxacin and cefazolin/cefotaxime resistance was low (0.0%–3.1% and ≤1.1%, respectively) in all isolates except those from chickens (4.9%–9.9% and 2.2–5.8%, respectively).The resistance rates against all of the antimicrobials tested remained stable between 2012 and 2015 (Table 1.10).

(2) *Enterococcus*

A total of 235 *E. faecalis* and 102 *E. faecium* isolates from cattle, pigs, and chickens collected in 2014–2015 were subjected to antimicrobial susceptibility testing. Their MIC distributions are shown in Tables 3.3–3.4 and 4.3–4.4.

Neither bacterial species exhibited antimicrobial resistance against ampicillin (Tables 3.3–3.4 and 4.3–4.4). However, they did have resistance to each of the other antimicrobials tested. The resistance rates varied according to both the bacterial and animal species, with isolates from pigs and chickens tending to have higher resistance rates than those from cattle.

Isolates from pigs and chickens frequently exhibited resistance against oxytetracycline (resistance rates in *E. faecalis* and *E. faecium* = 67.0%–92.3% and 9.1%–64.5%, respectively), kanamycin (12.5%–69.2% and 25.0%–72.7%, respectively), erythromycin (60.2%–69.2% and 30.6%–58.3%, respectively), Tylosin (53.1%–69.2% and 0.0%–22.6%), and lincomycin (45.1%–92.3% and 9.1%–50.0%, respectively).

The enrofloxacin resistance rate was higher in *E. faecium* isolates (14.8% in 2014, 47.9% in 2015) than in *E. faecalis* isolates (0.9% in 2014, 0.8% in 2015).

The incidence of dihydrostreptomycin and kanamycin resistance in *E. faecalis* isolates from pigs and chickens was significantly higher in 2015 than in 2014 ($p < 0.05$) (Tables 1.11.1 and 1.11.2). By contrast, the incidence of gentamicin resistance in *E. faecalis* isolates from cattle, pigs, and chickens, and the incidence of dihydrostreptomycin, kanamycin, and lincomycin resistance in *E. faecalis* isolates from cattle was significantly lower in 2015 than in 2012 ($p < 0.05$).

The incidence of kanamycin resistance in *E. faecium* isolates from pigs and enrofloxacin resistance in *E. faecium* isolates from chickens was significantly higher in 2015 than in 2014 ($p < 0.05$). By contrast, in 2015, there was a significantly lower incidence of dihydrostreptomycin resistance in *E. faecium* isolates from pigs compared with 2012 and 2014, gentamicin and enrofloxacin resistance in *E. faecium* isolates from pigs compared with 2012, and dihydrostreptomycin and kanamycin resistance in *E. faecium* isolates from chickens compared with 2012 ($p < 0.05$).

(3) *Campylobacter*

A total of 440 *C. jejuni* and 314 *C. coli* isolates collected in 2014–2015 were subjected to antimicrobial susceptibility testing. *C. jejuni* was isolated mainly from cattle and chickens, whereas *C. coli* was isolated mainly from pigs. Their MIC distributions are shown in Tables 5.3–5.4 and 6.3–6.4.

Both bacterial species exhibited resistance against all of the antimicrobials tested, with the exception of gentamicin. However, the resistance rates varied between bacterial species, with *C. coli* isolates exhibiting greater resistance to nearly all of the antimicrobials studied than *C. jejuni* isolates. The resistance rates also varied between animal species, with the highest levels generally being found in *C. coli* isolates from pigs.

Tetracycline resistance was more frequently observed in both *C. coli* (70.0%–72.0%) and *C. jejuni* (43.4%–46.0%) than resistance against any other antimicrobial agent tested. However, isolates of both species also exhibited resistance against ampicillin (resistance rates in *C. jejuni* and *C. coli* = 12.7%–14.3% and 10.4%–30.7%, respectively), streptomycin (2.8%–3.7% and 33.5%–46.7%, respectively), erythromycin (0%–0.8% and 12.2%–29.3%, respectively), chloramphenicol (0.5%–0.8% and 5.5%–6.7%, respectively), nalidixic acid (37.1%–44.4% and 61.0%–62.7%, respectively), and ciprofloxacin, (35.5%–43.4% and 60.4%–60.7%, respectively).

The incidence of ciprofloxacin resistance was high in *C. coli* isolates from cattle (72.8%–78.7%) and intermediate in *C. coli* isolates from pigs (47.7%–50.5%) and *C. jejuni* isolates from chickens (26.6%–29.8%) and cattle (40.8%–49.2%). In addition, erythromycin resistance was frequently detected in *C. coli* isolates from pigs (26.2%–43.0%) but was only detected in isolates from cattle for *C. jejuni* (1.3%).

The incidence of ampicillin resistance in *C. jejuni* isolates from cattle was significantly higher in 2015 than in 2012 ($p < 0.05$) (Table 1.12). By contrast, the incidence of tetracycline and nalidixic acid resistance in *C. jejuni* isolates from broilers was significantly lower in 2015 than in 2012 and 2013, respectively ($p < 0.05$).

(4) *Salmonella*

A total of 251 *Salmonella* isolates collected from broilers in 2014–2015 were available for antimicrobial susceptibility testing. Their MIC distributions are shown in Tables 7.3–7.4.

The predominant serovars that were isolated from broilers were *S.* Schwarzengrund (115 isolates, 45.8%), *S.* Infantis (66 isolates, 26.3%), *S.* Manhattan (24 isolates, 9.6%), and *S.* Typhimurium (23 isolates, 9.2%) (Table 8).

Salmonella isolates exhibited antimicrobial resistance against all of the antimicrobials tested except gentamicin, ciprofloxacin, and colistin, with the highest rates of resistance being observed for tetracycline (83.7%–85.2%), streptomycin (76.4%–85.9%), kanamycin (57.8%–69.1%), trimethoprim/sulfamethoxazole (51.6%–57.7%), nalidixic acid (15.4%–17.2%), and ampicillin (13.0%–17.2%). By contrast, <5% of isolates exhibited resistance against cefazolin, cefotaxime, and chloramphenicol.

In 2015, *Salmonella* isolates exhibited a significantly higher incidence of kanamycin resistance compared with 2012 and 2013, and trimethoprim/sulfamethoxazole resistance compared with 2012 ($p < 0.05$) (Table 1.13). By contrast, the incidence of ampicillin resistance in *Salmonella* isolates was significantly lower in 2015 than in 2012 ($p < 0.05$).

Table 1.9 Total numbers of bacteria isolated from livestock in slaughterhouses between 2012 and 2015

year	*E.coli*	*Enterococcus*	*Campylobacter*	*Salmonella*
2012	576	528	282	94
2013	634	ND	330	118
2014	528	529	339	128
2015	554	546	415	123
TOTAL	**2,292**	**1,603**	**1,366**	**463**

Table 1.10 Antimicrobial resistance rates of *Escherichia coli* isolated from livestock in slaughterhouses between 2012 and 2015

Antimicrobials	Cattle				Pig				Broiler			
	2012	2013	2014	2015	2012	2013	2014	2015	2012	2013	2014	2015
Ampicillin	2.4	6.5	3	5.5	32.3	26	43	34.4	30.8	35.5	40.1	43.5
Cefazolin	0.4	0.3	0	0	1.0	0.8	1.1	1.0	3	7.8	5.8	3.8
Cefotaxime	0	0	0	0	0	0	1.1	0	1.5	4.8	4.1	2.2
Streptomycin	14.9	12.3	17.1	12.4	44.1	44.9	52.7	39.6	39.1	38.6	44.8	41.8
Gentamicin	0	0.3	0	0	0.5	2.4	6.5	2.1	1.5	1.8	2.9	2.2
Kanamycin	1.2	1.5	0.4	0.7	9.7	7.9	9.7	8.3	24.1	24.1	33.1	37.5
Tetracycline	19	16.4	19.8	18.6	58.5	62.2	59.1	45.8	49.6	44	43.6	54.9
Nalidixic acid	2.4	1.8	2.3	2.6	4.1	11	9.7	5.2	39.8	36.1	45.3	35.9
Ciprofloxacin	0	0.6	0.8	0	1.5	0.8	2.2	3.1	6	5.4	9.9	4.9
Colistin	0	0	0.8	0	0	0	0	0	0.8	0.6	0	0.5
Chloramphenicol	5.2	2.3	3.8	2.9	23.6	23.6	34.4	25.0	11.3	11.4	15.1	9.8
Trimethoprim-sulfamethoxazole	2.0	2.9	5.3	2.9	23.6	26.8	34.4	30.2	24.8	31.9	30.2	28.3

a: Significantly different compared with 2012
b: Significantly different compared with 2013
c: Significantly different compared with 2014
: Significantly increased
: Significantly decreased

Table 1.11.1 Antimicrobial resistance rates of *Enterococcus faecalis* isolated from livestock in slaughterhouses between 2012 and 2015

Antimicrobials	Cattle				Pig				Broiler			
	2012	2013	2014	2015	2012	2013	2014	2015	2012	2013	2014	2015
Ampicillin	0	-	0	0	0	-	0	0	0	-	0	0.0
Dihydrostreptomycin	90.6	-	36.4	35.7a	88.2	-	62.5	100c	76.9	-	53.8	72.4c
Gentamicin	68.8	-	27.3	0a	76.5	-	12.5	15.4a	35.6	-	9.9	14.3a
Kanamycin	71.9	-	9.1	14.3a	72.9	-	12.5	69.2c	71.2	-	57.1	66.3c
Oxytetracycline	31.3	-	27.3	28.6	64.7	-	87.5	92.3	75	-	67.0	70.4
Chloramphenicol	9.4	-	0	0	30.6	-	62.5	53.8	17.3	-	13.2	9.2
Erythromycin	21.9	-	9.1	0	51.8	-	62.5	69.2	58.7	-	64.8	60.2
Tylosin	6.3	-	0	0	50.6	-	62.5	69.2	57.7	-	65.9	53.1
Lincomycin	34.4	-	9.1	0a	76.5	-	75.0	92.3	57.7	-	45.1	54.1
Enrofloxacin	3.1	-	0	0	5.9	-	0	7.7	2.9	-	1.1	0

a: Significantly different compared with 2012
b: Significantly different compared with 2013
c: Significantly different compared with 2014
: Significantly increased
: Significantly decreased

Table 1.11.2 Antimicrobial resistance rates of *Enterococcus faecium* isolated from livestock in slaughterhouses between 2012 and 2015

Antimicrobials	Cattle				Pig				Broiler			
	2012	2013	2014	2015	2012	2013	2014	2015	2012	2013	2014	2015
Ampicillin	0	-	0	0	0	-	0	0	0	-	0	0
Dihydrostreptomycin	33.3	-	33.3	0	75.0	-	58.3	0ac	50	-	13.9	16.1a
Gentamicin	33.3	-	0	0	40.0	-	0	0a	8.3	-	2.8	3.2
Kanamycin	83.3	-	33.3	16.7	90.0	-	25	72.7c	100	-	33.3	35.5a
Oxytetracycline	0	-	0	16.7	35.0	-	41.7	9.1	83.3	-	58.3	64.5
Chloramphenicol	0	-	0	0	15.0	-	25	0	0	-	8.3	6.5
Erythromycin	16.7	-	0	33.3	60.0	-	58.3	54.5	25	-	30.6	35.5
Tylosin	0	-	0	0	20.0	-	16.7	0	25	-	19.4	22.6
Lincomycin	0	-	0	0	30.0	-	50	9.1	50	-	19.4	29
Enrofloxacin	83.3	-	0	16.7	65.0	-	25	0a	66.7	-	13.9	71.0c

a: Significantly different compared with 2012
b: Significantly different compared with 2013
c: Significantly different compared with 2014
: Significantly increased
: Significantly decreased

Table 1.12 Antimicrobial resistance rates of *Campylobacter* species isolated from livestock in slaughterhouses between 2012 and 2015

Antimicrobials	Cattle				Pig				Broiler			
	2012	2013	2014	2015	2012	2013	2014	2015	2012	2013	2014	2015
Ampicillin	0	19.7	12.9	8.9a	23.3	25.5	36.6	24.6	9.1	19.8	17.5	19.1
Streptomycin	2.4	1.4	3.8	3.2	67.4	58.2	69.9	72.3	3.5	0	3.5	2.1
Erythromycin	0	0	0	1.3	32.6	44.3	43	26.2	0.7	0	0	0
Tetracycline	45.1	38.0	49.2	52.2	84.5	93.4	80.6	87.7	52.4	44.4	38.6	28.7a
Nalidixic acid	34.1	39.4	50.8	42.7	46.5	53.8	52.7	47.7	33.6	48.1	29.8	27.7b
Ciprofloxacin	34.1	39.4	49.2	40.8	46.5	46.2	50.5	47.7	29.4	39.5	29.8	26.6
Chloramphenicol	0	0	0	1.3	10.9	3.8	7.5	9.2	6.3	0	1.8	0

a: Significantly different compared with 2012
b: Significantly different compared with 2013
c: Significantly different compared with 2014
: Significantly increased
: Significantly decreased

Table 1.13 Antimicrobial resistance rates of *Salmonella* species isolated from livestock in slaughterhouses between 2012 and 2015

Antimicrobials	Broiler			
	2012	2013	2014	2015
Ampicillin	31.9	22.9	17.2	13.0a
Cefazolin	7.4	5.9	3.1	1.6
Cefotaxime	7.4	5.1	2.3	1.6
Streptomycin	77.7	84.7	85.9	76.4
Gentamicin	0	0	0	0
Kanamycin	31.9	42.4	57.8	69.1ab
Tetracycline	74.5	82.2	85.2	83.7
Nalidixic acid	29.8	19.5	17.2	15.4
Ciprofloxacin	0	0	0	0
Colistin	0	0	0	0
Chloramphenicol	0	0.8	1.6	1.6
Trimethoprim -sulfamethoxazole	31.9	48.3	51.6	57.7a

a: Significantly different compared with 2012
b: Significantly different compared with 2013
c: Significantly different compared with 2014
: Significantly increased
: Significantly decreased

IV. JVARM Topics

Prevalence of the Colistin Resistance Genes *mcr-1* and *mcr-2* in *Escherichia coli* Isolated from Healthy Food-Producing Animals in Japan

Colistin is currently considered the last-resort antibiotic for the treatment of infections caused by multidrug-resistant Gram-negative bacteria in humans worldwide. In addition, this antibiotic has been used as a veterinary drug for the treatment of Gram-negative gastrointestinal infections and as a feed additive to promote healthy development in food-producing animals for more than 50 years. Up until recently, the mechanism for colistin resistance in bacteria was thought to involve only chromosomal mutations. However, in 2015, Liu *et al.*[5] reported on a plasmid-mediated colistin resistance gene, *mcr-1*, in *Enterobacteriaceae* isolated from food-producing animals, retail meat, and humans in China.

A total of 9860 *E. coli* isolates from healthy animals (3350 from cattle, 2159 from swine, 2127 from broilers, and 2224 from layers) were screened for colistin resistance between 2000 and 2015 as part of the JVARM program. Colistin MICs were determined using the agar dilution method in isolates obtained between 2000 and 2009 and the broth dilution method in isolates obtained between 2010 and 2015, according to the recommendations of CLSI. In total, 753 (7.6%) of the isolates had colistin MICs of ≥2 mg/L and so were examined for the presence of the two colistin resistance genes *mcr-1* and *mcr-2* by polymerase chain reaction (PCR), as described by Liu *et al.*[5] and Xavier *et al.*[6], respectively.

Very few colistin-resistant isolates were detected between 2000 and 2015 (MIC > 2 mg/L following the criteria of the European Committee of Antimicrobial Resistance Testing [EUCAST]) (Fig. 9), and even when isolates in which MIC = 2 mg/L were included, there was no increase in the proportion of colistin-resistant and reduced-susceptibility isolates of *E. coli* since 2008, when *mcr-1* was first detected.

mcr-1 was detected in 50 strains (5, 28, and 17 strains isolated from cattle, swine, and broilers, respectively), while *mcr-2* was not detected in any isolates. The prevalence of *mcr-1* in *E. coli* isolates from healthy animals slightly increased over the years but remained very low.

In Japan, risk management measures are implemented according to the extent of risk as determined by risk assessment with regard to the impact of antimicrobial-resistant bacteria on human health through food. Risk management options for colistin in livestock animals are currently being promoted in Japan and include enhanced monitoring of antimicrobial-resistant bacteria, the restriction of colistin to second-choice drug status, and the revocation of its designation as a feed additive. Continuous surveillance and monitoring and ensuring the prudent use of antibiotics in veterinary medicine are essential to preventing or reducing the transfer of resistant bacteria or resistance determinants to humans, animals, food, and the environment.

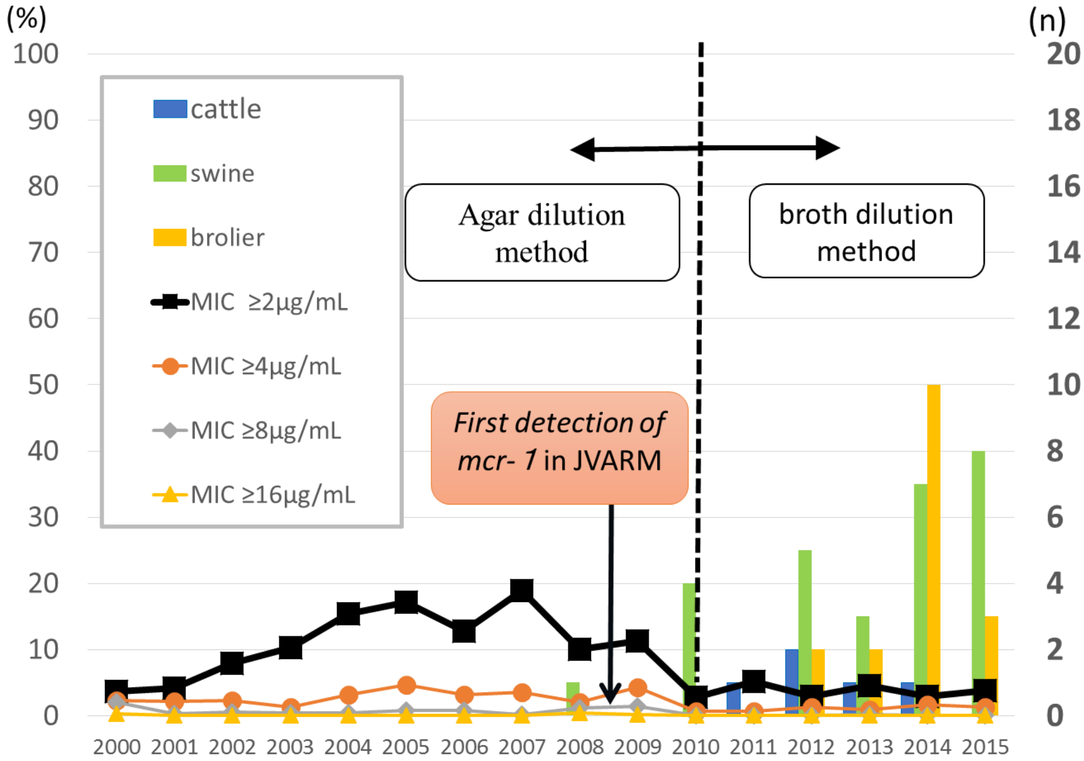

Fig. 9 Proportions of *Escheriachia coli* isolates with different susceptibilities to colistin and the number of *mcr-1* positive isolates from healthy food-producing animals between 2000 and 2015, as assessed by the Japanese Veterinary Antimicrobial Resistance Monitoring System (JVARM) program. MIC, minimum inhibitory concentration.

V. Current Risk Management of Antimicrobial Resistance Linked to Antimicrobial Products

Veterinary medical products (VMPs), including antimicrobial products, used for therapeutic purposes are regulated by "The Act on Securing Quality, Efficacy, and Safety of Pharmaceuticals, Medical Devices, Regenerative and Cellular Therapy Products, Gene Therapy Products, and Cosmetics (Law No.145, Series of 1960)". The purpose of the law is to regulate matters pertaining to drugs, quasi-drugs, medical devices, and regenerative and cellular therapy products to ensure their quality, efficacy, and safety at each stage of development, manufacturing (importing), marketing, retailing, and usage. In addition to therapeutic use, growth promotion is another important use of antimicrobials and has significant economic consequences on the livestock industry. Feed additives, which include antimicrobial products used for growth promotion, are regulated by the Law Concerning Safety Assurance and Quality Improvement of Feed (Law No.35 of 1953). Compared to antimicrobial VMPs, FAs are used at lower concentrations and for longer periods. Antimicrobial growth promoters in the animals cannot be used for 7 days preceding slaughter for human consumption.

There are specific requirements for marketing approval of antimicrobial VMPs in Japan. For the approval of antimicrobial VMPs, data concerning the antimicrobial spectrum; the antimicrobial susceptibility tests of recent field isolates of targeted bacteria, indicator bacteria, and zoonotic bacteria; and the resistance acquisition test are attached to the application for consideration of public and animal health issues. For the approval of VMPs for food-producing animals, data concerning the stability of the antimicrobial substances under natural circumstances is also attached. The antimicrobial substance in the VMP is thoroughly described in the dossier, and the period of administration is limited to 1 week, where possible.

General and specific data are evaluated at an expert meeting conducted by MAFF. The data of VMPs used in food-producing animals are also evaluated by the Food Safety Commission. The Pharmaceutical Affairs and Food Sanitation Council, which is an advisory organization to the Minister, evaluates the quality, efficacy, and safety of the VMP. If the VMP satisfies all requirements, the Minister of MAFF approves the VMP. In Japan, the post-marketing surveillance of VMPs occurs at two stages: during reexamination of new VMPs and during reevaluation of all VMPs. After the reexamination period has ended for the new VMP, the field investigation data about efficacy, safety, and public and livestock health is attached to the application. For new VMPs, results of monitoring for antimicrobial resistance are submitted according to the requirements of the re-examination system. For all approved drugs, MAFF conducts literature reviews about efficacy, safety, residues, and resistant bacteria as per the requirements of the re-evaluation system.

Because most of the antimicrobial VMPs have been approved as drugs requiring directions or prescriptions from a veterinarian, these VMPs cannot be used without the diagnosis and instruction of a veterinarian. The distribution and use of VMPs, including veterinary antimicrobial products, is routinely inspected by the regulatory authority (MAFF).

For marketing and use of VMPs, veterinarians prescribe the drug and place restrictions on its use so that the drug does not remain beyond MRLs in livestock products. As for the label, there are restrictions relating to the description on the ‘direct container’ and on the ‘package insert’. The description on the label must include all of the following: (1) the prescribed drug; (2) disease and bacterial species indicated; (3) the route, dose, and period of administration; (4) prohibition/withdrawal periods; (5) precautions for use, such as side effects and handling; and (6) in the case of specific antimicrobial drugs (fluoroquinolones and 3rd generation cephalosporins), the description includes an explanation that the drug is not considered the first-choice drug. For the specific antimicrobial drugs fluoroquinolone and 3rd generation cephalosporins, which are particularly important for public health, the application for approval of the drug for use in animals is not accepted until the end of the period of re-examination of the corresponding drug for use in humans. After marketing, monitoring data on the amount sold and the appearance of antimicrobial resistance in target pathogens and foodborne pathogens must be submitted to MAFF.

The risk assessment for antimicrobial resistance in bacteria arising from the use of antimicrobials in animals, especially in those bacteria that are common to human medicine, is provided to MAFF by the Food Safety Commission (FSC), which was established in 2003. FSC is an organization responsible for risk assessment based on the Food Safety Basic Law (Law No. 48 of 2003) and is independent of risk management organizations such as MAFF and the Ministry of Health, Labour, and Welfare (MHLW). The risk assessment for antimicrobial resistance in bacteria from the use of antimicrobials in animals is undertaken on the basis of their new guidelines that are based on the OIE guidelines of antimicrobial resistance, Codex, and FDA guidelines (Food Safety Commission 2004).

To implement the risk management strategy developed based on the risk assessment by FSC, the management guidelines for reducing the risk of antimicrobial resistance arising from antimicrobial use in food-producing animals and aquatic animals have been defined (http://www.maff.go.jp/nval/tyosa_kenkyu/taiseiki/pdf/240411.pdf). The purpose of the guidelines is to reduce the adverse effects for human health. However, the significance of antimicrobial VMPs in veterinary medicine should be considered in order to ensure food safety and stability. The guidelines cover the entire process, from development to implementation of risk management options in on-farm animal practices, referring to the standard guidelines for risk management adopted by the MAFF and MHLW (http://www.maff.go.jp/j/syouan/seisaku/risk_analysis/sop/pdf/sop_241016.pdf).

Establishment of risk management strategy should be undertaken according to a stepwise approach. Firstly, available and feasible risk management options are considered based on the results of risk assessment by FSC ('high', 'medium', 'low', or 'negligible'), as shown in Table 9. Extended results of release assessments should especially be considered to determine risk management options; a high-risk estimation-of-release assessment should be carefully estimated. Secondly, to determine risk management options, the factors in Table 10 are fully considered based on target animals and approved administration routes. As necessary, risk communication, including public comment procedures, should be implemented.

The present status of risk analysis of antimicrobial resistance in food-producing animals in Japan is shown in Table11.

Antimicrobial VMPs are essential in animal husbandry in Japan. Growth promotion is another important use of antimicrobials in the livestock industry. In the present conditions, with the increased risk of outbreak due to emerging bacterial diseases as well as viral diseases such as foot-and-mouth disease and avian influenza, clinical veterinarians need various classes of antimicrobials to treat endemic and unexpected disease in domestic animals. The risk assessments of antimicrobial resistance in food-producing animals have been performed by FSC. Risk management strategies for Antimicrobial VMPs are established according to predetermined guidelines in order to perform appropriate risk-management implementation on antimicrobial resistance, taking into consideration the benefits/risks of antimicrobial use in animal husbandry.

Table 9. Selected examples and expected effects of risk management options for antimicrobial drugs depending on their risk assessment result

Assessment result	Examples of risk management options	Expected effects
High	Withdrawal Temporary ban on use	Distribution of the drug in the country is discontinued. Distribution of the drug in the country is discontinued (temporarily).
High/ medium	Withdrawal of the antimicrobial:	

	against specific animal species	When the drug is approved for use in multiple animal species, it will be banned in some target animals. The use of the drug for the target animal should be considered for each administration route of the drug.
	against target disease/bacteria	When the drug is approved for multiple target diseases/bacteria species, it will be banned in some target diseases/bacteria. The use of the drug for the target animal should be considered for each target disease/bacteria.
	Limitation of antimicrobial use near the time of slaughter	Use volume of the drug is decreased by setting limits on its use during the final stage of a rearing period; otherwise, a high amount of the drug would be administered per animal. This will prevent increases in resistant bacteria due to selective pressures during the final stage of a rearing period.
	Shortening duration of antimicrobial administration	A course dose per animal is decreased by shortening a dosage period of AVMPs based on veterinary diagnosis.
Medium	Strict use as secondary line of AVMPs	The drug is strictly used only when treatment with the first-line drug is ineffective, as stated on the label of the specific AVMPs such as new quinolone drugs or 3rd-generation cephalosporin antibiotics available in Japan.
	Intensified monitoring of antimicrobial resistance	Changes in the resistance of bacteria are detected immediately by increasing the monitoring frequency and area.
Low/ negligible	Continued monitoring of antimicrobial resistance	-

AVMPs, antimicrobial veterinary medicinal products.

Table 10. Basic components required to set criteria for risk management options

Decision factors	Comments
Significance of antimicrobial veterinary medicinal products in veterinary medicine	Severity (e.g., organs affected, potential systemic involvement, and pathology) of the target disease

	Significance in the clinical settings (e.g., facility, efficacy, and economy)
The presence of alternates for the target disease	Availability of alternates including different classes of antimicrobials and vaccines used for the same purposes
Secondary risk	Possible harmful consequences entailed in implementing each risk-management option
Estimated efficacy of risk-management option	Extent of efficacy imposed by implementing each risk-management option
Feasibility of risk-management option	Feasibility in terms of technical, administrative, and financial issues involved in implementing each risk-management option
Other concerns	Decision factors depending on antimicrobial characteristics whenever necessary

Table 11. The present situation of risk assessment and risk management of antimicrobial resistance in food-producing animals in Japan (as of April, 2018)

	URL of Japanese documents*	
Antimicrobials	Risk assessment	Risk management
Fluoroquinolones used in cattle and swine (2nd edition)	http://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20071024051 (Risk estimation: Medium)	http://www.maff.go.jp/j/syouan/tikusui/yakuzi/pdf/fluoro.pdf
Tulathromycin used in swine	http://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20091124004 (Risk estimation: Medium)	http://www.maff.go.jp/j/syouan/tikusui/yakuzi/pdf/draxxin_kanrisochi.pdf
Pirlimycin used in dairy cows	http://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20080212002 (Risk estimation: Low)	http://www.maff.go.jp/j/syouan/tikusui/yakuzi/pdf/pirlimy.pdf
Fluoroquinolones used in poultry	https://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20071024051 **https://www.jstage.jst.go.jp/article/foodsafetyfscj/2/4/2_2014035s/_article (Risk estimation: Medium)	http://www.maff.go.jp/j/syouan/tikusui/yakuzi/pdf/risk_mana_torifq.pdf
Gamithromycin used in cattle	https://www.fsc.go.jp/fsciis/evaluationDocument/show/kya2013111337z **http://www.fsc.go.jp/english/evaluationreports/vetmedicine/July_22_2014_Gamithromycin.pdf (Risk estimation: Low)	http://www.maff.go.jp/j/syouan/tikusui/yakuzi/attach/pdf/koukinzai-26.pdf
Ceftiofur used in cattle and swine	https://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20100201004 (Risk estimation: Medium)	http://www.maff.go.jp/j/syouan/tikusui/yakuzi/attach/pdf/koukinzai-12.pdf
Tulathromycin used in cattle	https://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20150310290 (Risk estimation: Low)	http://www.maff.go.jp/j/syouan/tikusui/yakuzi/attach/pdf/koukinzai-16.pdf
Cefquinome sulfate in cattle	http://www.fsc.go.jp/fsciis/evaluationDocument/show/kya20080115000 (Risk estimation: Medium)	http://www.maff.go.jp/j/syouan/tikusui/yakuzi/attach/pdf/koukinzai-17.pdf

**Colistin sulfate in livestock	http://www.fsc.go.jp/fsciis/evaluationDocument/show/kya03120816918 **http://www.fsc.go.jp/english/evaluationreports/others_e1.data/kya03120816918_202.pdf (Risk estimation: Medium)	http://www.maff.go.jp/nval/hourei_tuuti/pdf/29_shoan_3385.pdf

* English versions are not available.

** Summary available in English.

VI. JVARM Publications

2014

Asai T, Hiki M, Ozawa M, Koike R, Eguchi K, Kawanishi M, Kojima A, Endoh YS, Hamamoto S, Sakai M, Sekiya T. Control of the development and prevalence of antimicrobial resistance in bacteria of food animal origin in Japan: a new approach for risk management of antimicrobial veterinary medicinal products in Japan.Foodborne Pathog Dis. 2014 Mar;11(3):171-6. 2014 Jan 4.

Hiki M, Usui M, Akiyama T, Kawanishi M, Tsuyuki M, Imamura S, Sekiguchi H, Kojima A, Asai T. Phylogenetic grouping, epidemiological typing, analysis of virulence genes, and antimicrobial susceptibility of *Escherichia coli* isolated from healthy broilers in Japan. Ir Vet J. 67(1): 14, 2014.

2015

Hiki M, Kawanishi M, Abo H, Kojima A, Koike R, Hamamoto S, Asai T. Decreased Resistance to Broad-Spectrum Cephalosporin in *Escherichia coli* from Healthy Broilers at Farms in Japan After Voluntary Withdrawal of Ceftiofur. Foodborne Pathog Dis. 2015;12: 639-43.

VII. Acknowledgments

The JVARM members would like to thank the staff of the Livestock Hygiene Service Centres for collecting samples and isolates from animals. Gratitude is also extended to the farmers for providing faecal samples and valuable information concerning antimicrobial use.

The JVARM members are grateful to the following people for helpful support and encouragement:

Haruo Watanabe (International University of Health and Welfare),
Keigo Shibayama, Satowa Suzuki, Makoto Kuroda, Hidemasa Izumiya, Makoto Onishi,
(National Institute of Infectious Disease)
Shizunobu Igimi (Tokyo University of Agriculture)
Masato Akiba (National Institute of Animal Health)
Yutaka Tamura, Kohei Makita, Masaru Usui (Rakuno Gakuen University)
Tetsuo Asai (Gifu University)
Yoshikazu Ishii (Toho University)
Akemi Kai (Tokyo Metropolitan Institute of Public Health)
Takayuki Kurazono (Saitama Institute of Public Health)
Masumi Taguchi (Osaka Prefectural Institute of Public Health)

VIII. Participants in the JVARM Program

1. Data from the National Veterinary Assay Laboratory were provided by the following people:

2014

Shuichi Hamamoto (Head of Assay Division II)

Akemi Kojima, Michiko Kawanishi, Mototaka Hiki

2015

Shuichi Hamamoto (Head of Assay Division II)

Ryoji Koike, Manao Ozawa, Michiko Kawanishi, Mototaka Hiki

2. Data from the Food and Agricultural Materials Inspection Centre were provided by the following people:

2014

Norio Aita (Director, Feed Analysis II Division)

Hiroshi Hibino, Toshiaki Yamata, Yoshiyasu Hashimoto, Masaki Kasahara, Miyuki Asao, Chisa Shimamura, Madoka Kato, Mayu Enomoto, Yumiko Shitara

2015

Tetsuo Chihara (Director, Feed Analysis II Division)

Hiroshi Hibino, Yoshihiro Sekiguchi, Yoshiyasu Hashimoto, Toshiaki Okumura, Chisa Shimamura, Madoka Kato, Mayu Enomoto, Naoko Saegursa, Yumiko Shitara

3. Data from the Livestock Hygiene Services Centers were kindly provided by the following people:

2014

Chieko Ohta (Aomori), Yasuo Sato(Iwate), Risa Yajima (Miyagi), Natsumi Haruta (Akita), Toru Ojima (Yamagata), Hidetaka Oonishi (Fukushima), Hitomi Tanabe (Ibaraki), Shunsuke Akama (Tochigi), Rie Arai (Saitama), Takahiro Sato (Chiba), Hiroshi Yoshizaki (Tokyo), Tomomi Ikeda (Kanagawa), Kensuke Tanaka (Niigata), Maiko Mie (Toyama), Hisahiro Ide (Ishikawa), Shinako Takeno (Fukui), Haruna Odagiri(Yamanashi), Aya Osawa (Nagano), Kyoko Saito (Gifu), Toshiyuki Ohtani (Shizuoka), Ryoko Tsuji (Mie), Michiko Mitsumatsu (Shiga), Akane Kato (Kyoto), Eiichi Tsuyama (Osaka), Atsuko

Kojima (Hyogo), Minako Moriyama (Nara), Kumi Toyoshi (Wakayama), Kotaro Nakamura (Tottori), Yoichi Sakamoto (Shimane), Reiko Tahara (Okayama), Megumi Kanehiro (Hiroshima), Daiki Ooishi (Yamaguchi), Kanichirou Suzuki (Tokushima), Naohito Okazaki (Ehime), Yuka Chikami (Kochi), Yuiko Morinaga (Fukuoka), Kengo Shimojo (Nagasaki), Yuka Uchiyama (Kumamoto), Ryou Takizawa (Oita), Fumiko Yoshida (Oita), Hiroko Matsukawa (Miyazaki), Shun Iwao (Kagoshima), Satoko Nakao (Okinawa)

2015

Yasuo Sato (Iwate), Hiroyuki Egashira (Miyagi), Ryo Sato (Akita), Toru Ojima (Yamagata), Youtarou Soga (Fukushima), Yuki Fujii (Ibaraki), Shunsuke Akama (Tochigi), Yuka Nakai (Saitama), Takahiro Sato (Chiba), Hiroshi Yoshizaki (Tokyo), Tomomi Ikeda (Kanagawa), Kensuke Tanaka (Niigata), Kozue Masunaga (Toyama), Masashi Nagato (Ishikawa), Shinako Takeno (Fukui), Haruna Shimizu (Yamanashi), Aya Osawa (Nagano), Keiko Otsu (Gifu), Toshiyuki Ohtani (Shizuoka), Akihisa Ito (Mie), Michiko Mitsumatsu (Shiga), Akane Kato (Kyoto), Hiromi Otsuka (Osaka), Jun Ishii, Mikoto Nabe (Hyogo), Minako Moriyama (Nara), Kumi Toyoshi (Wakayama), Kotaro Nakamura (Tottori), Yoichi Sakamoto (Shimane), Setsuko Izushi (Okayama), Megumi Kanehiro (Hiroshima), Daiki Ooishi (Yamaguchi), Naohito Okazaki (Ehime), Kanichirou Suzuki (Tokushima), Yuka Chikami (Kochi), Yuiko Morinaga (Fukuoka), Misato Murata (Kumamoto), Ryou Takizawa (Oita), Yuya Tanigakubo (Miyazaki), Shunsuke Kamimura (Kagoshima)

IX. Appendix (Materials and Methods)

1. Sampling

(1) Monitoring System in Farms

Sampling was carried out in farms across Japan by the prefectural LHSCs. In brief, the 47 prefectures of Japan were divided into two groups (23 and 24 prefectures per year), which were selected to give an equal representation of geographical differences between northern and southern areas. Freshly voided fecal samples were collected from approximately six healthy cattle, two healthy pigs, two healthy broiler chickens, and two healthy layer chickens on each farm in each prefecture. *Escherichia coli*, *Enterococcus* species, and *Campylobacter* species were isolated from these fecal samples, while *Salmonella* species were isolated from diagnostic submissions of clinical cases.

(2) Monitoring System in Slaughterhouses

Sampling in slaughterhouses was carried out by private research laboratories. Fresh fecal samples were collected from the cecum of healthy broiler chickens and from the rectum of healthy cattle and healthy pigs at each slaughterhouse.

E. coli, *Enterococcus* species, and *Campylobacter* species were isolated from the cecal and rectal fecal samples from healthy cattle, pigs, and broilers, while *Salmonella* species were isolated from only the cecal fecal samples of healthy broilers.

2. Isolation and Identification

(1) *Escherichia coli*

E. coli isolates from each sample were maintained on desoxycholate-hydrogen sulfate-lactose (DHL) agar (Eiken, Japan). Candidate colonies were identified biochemically using a commercially available kit (API20E; bioMérieux, Marcy l'Etoile, France) and stored at −80°C until testing.

(2) *Enterococcus*

Fecal samples were cultured by direct culturing using bile esculin azide agar (BEA; Difco Laboratories, Detroit, MI, USA) or using the enrichment procedure with Buffered Peptone Water (Oxoid, Basingstoke, Hampshire, England). In the former procedure, plates were incubated at 37°C for 48–72 h, while in the latter, tubes were incubated at 37°C for 18–24 h and subsequently passaged onto the same plates as were used for the direct culturing method.

Isolates were presumptively identified as enterococci based on colony morphology. These isolates were subcultured onto heart infusion agar (Difco) supplemented with 5% (v/v) sheep blood, following which hemolysis was observed and Gram staining was performed. Isolates were tested for catalase production, growth in heart infusion broth supplemented with 6.5% NaCl, and growth at 45°C. In addition, the hydrolysis of L-pyrrolidonyl-β-naphthylamide and their pigmentation and motility were evaluated, and the API 20 STREP system (bioMérieux) was used. Further identification was achieved using D-xylose and sucrose fermentation tests where required [7]. All isolates were stored at −80°C until testing.

(3) *Campylobacter*

Campylobacter species were isolated by the direct inoculation method onto *Campylobacter* blood-free selective agar (mCCDA; Oxoid, UK). Isolates were identified biochemically and molecularly using PCR[8]. Two isolates per sample were then selected for antimicrobial susceptibility testing and suspended in 15% glycerin to which Buffered Peptone Water (Oxoid) had been added. They were then stored at −80°C until testing.

(4) *Salmonella*

Salmonella isolates from farms were provided by the Livestock Hygiene Service Centers from diagnostic submissions of clinical cases, while samples from slaughterhouses were obtained from cecal fecal samples collected from healthy broilers. The fecal samples were cultured using the enrichment procedure with Buffered Peptone Water (Oxoid, Basingstoke, Hampshire, England). Tubes containing the samples were incubated at 37°C for 18–24 h and subsequently passaged onto Rappaport–Vassiliadis broth and incubated at 42°C for a further 18–24 h. They were then passaged onto CHROMagar™ *Salmonella* plates and incubated at 37°C for 18–24 h, following which they were presumptively identified as *Salmonella* based on colony morphology.

After biochemical identification, the serotype of the isolates was determined using slide and tube agglutination, according to the latest versions of the Kauffmann–White scheme [9]. All isolates were stored at −80°C until testing.

3. Antimicrobial Susceptibility Testing

The MICs of *E. coli*, *Enterococcus*, *Campylobacter*, and *Salmonella* isolates were determined using the broth microdilution method according to the CLSI guidelines. *Staphylococcus aureus* ATCC 29213 and *E. coli* ATCC 25922 were used as quality control strains, while *C. jejuni* ATCC33560 was used for the quality control of MIC measurements in *Campylobacter* species.

4. Resistance Breakpoints

Resistance breakpoints were defined microbiologically in serial studies. Where the MICs for the isolates were bimodally distributed, the intermediate MIC of the two peaks was defined as the breakpoint

The MIC of each antimicrobial established by CLSI was interpreted using the CLSI criteria. The breakpoints of the other antimicrobial agents were determined microbiologically.

5. Statistical Analysis

The resistance rates of the 6th stage (2014–2015) were compared with those of the 3rd, 4th, and 5th stages of the JVARM program using the chi-square test followed by Ryan's multiple comparison method[10]. Where the expected frequency was less than 5, Fisher's exact test was used. Differences were considered significant at $p < 0.05$.

X. References

1) Swann, M.M. 1969. Report of the joint committee on the use of antibiotics in animal husbandry and veterinary medicine. HM Stationary Office. London.

2) Tamura, Y. 2003. The Japanese veterinary antimicrobial resistance monitoring system (JVARM) In: Bernard, V. editor. OIE International Standards on Antimicrobial Resistance. Paris, France: OIE (World Organisation for Animal Health); 2003: 206-210.

3) World Health Organization. 2015. Global action plan on antimicrobial resistance, Geneva, Switzerland.

4) Clinical and Laboratory Standards Institute. 2014. Performance standards for antimicrobial susceptibility testing; twenty-fourth information supplement. CLSI document M100-S24. Clinical and Laboratory Standards Institute, Wayne, PA.

5) Liu YY, Wang Y, Walsh TR, Yi LX, Zhang R, Spencer J, Doi Y, Tian G, Dong B, Huang X, Yu LF, Gu D, Ren H, Chen X, Lv L, He D, Zhou H, Liang Z, Liu JH, Shen J. 2016. Emergence of plasmid-mediated colistin resistance mechanism MCR-1 in animals and human beings in China microbiological and molecular biological study. *Lancet Infect Dis* 16:161–168.

6) Xavier BB, Lammens C, Ruhal R, Kumar-Singh S, Butaye P, Goossens H, Malhotra-Kumar S. 2016. Identification of a novel plasmid-mediated colistin-resistance gene, *mcr-2*, in *Escherichia coli*, Belgium, *Euro Surveill* 21: 30280.

7) Teixeira, L. M., M. G. S. Carvalho, and R. R. Facklam, 2007. *Enterococcus*. In: Murray, P. R., E. J. Baron, J. H. Jorgensen, M. L. Landry, and M. A. Pfaller (eds), Manual of Clinical Microbiology, 9th edn. 430–442. American Society for Microbiology, Washington, DC.

8) Liton, D., Lawson, A. J., Owen, R. J and Stanley, J. 1997. PCR detection, identification to species level, and fingerprinting of *Campylobacter jejuni* and *Campylobacter coli* direct from diarrheic samples. *J. clin. Microbiol.* 35:2568-2572.

9) Grimont PAD, Weill FX. 2007. Antigenic formulae of the *Salmonella* serovars, 9th edn. World Health Organization Collaborating Center for Reference and Research on *Salmonella,* Pasteur Institute, Paris, France

10) T. A. Ryan. 1960. Significance tests for multiple comparison of proportions, variances and order statistics, *Psychol. Bull.*, 57:3

Table2.1. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=284), pigs(n=134), broilers(n=182) and layers(n=179) in 2014_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	8.0	5.6	3.25-8.99						2.5	17.3	66.9	7.7					5.6	
	Pigs	4.0	>128	24.6	17.59-32.82						0.7	23.1	47.8	1.5	2.2				24.6	
	Broilers	4.0	>128	44.5	37.15-52.04						1.1	18.1	34.1	1.6	0.5			0.5	44.0	
	Layers	4.0	>128	18.4	13.04-24.91						1.1	28.5	45.3	6.7					18.4	
	Total	4.0	>128	20.9	18.11-23.96						1.5	21.1	51.0	5.0	0.5			0.1	20.8	
Cefazolin	Cattle	≦1	2.0	1.1	0.21-3.06						58.5	36.3	4.2						1.1	
	Pigs	≦1	2.0	0.0	0-2.72						53.7	41.0	3.7	0.7	0.7					
	Broilers	2.0	8.0	3.8	1.56-7.77						41.2	34.6	11.0	7.7	1.6	0.5	1.1	0.5	1.6	
	Layers	≦1	4.0	0.0	0-2.04						55.3	33.0	8.4	1.7	1.7					
	Total	≦1	4.0	1.3	0.61-2.35						52.9	35.9	6.7	2.3	0.9	0.1	0.3	0.1	0.8	
Cefotaxime	Cattle	≦0.5	≦0.5	1.1	0.21-3.06					98.6	0.4			0.4	0.4	0.4				
	Pigs	≦0.5	≦0.5	0.0	0-2.72					100.0										
	Broilers	≦0.5	≦0.5	3.3	1.21-7.04					96.2		0.5	2.2	1.1						
	Layers	≦0.5	≦0.5	0.0	0-2.04					100.0										
	Total	≦0.5	≦0.5	1.2	0.52-2.19					98.6	0.1	0.1	0.5	0.4	0.1	0.1				
Streptomycin	Cattle	8.0	64.0	13.4	9.64-17.91							0.4	21.5	61.6	3.2	1.1	2.8	2.5	7.0	
	Pigs	16.0	>128	47.0	38.34-55.83							0.7	10.4	35.1	6.7	7.5	7.5	11.2	20.9	
	Broilers	16.0	>128	47.8	40.35-55.33								8.2	35.2	8.8	6.6	3.8	6.0	31.3	
	Layers	8.0	16.0	9.5	5.63-14.78								10.6	64.2	15.6	2.8		1.1	5.6	
	Total	8.0	>128	26.3	23.25-29.56							0.3	14.0	51.5	8.0	3.9	3.2	4.5	14.8	
Gentamicin	Cattle	≦0.5	1.0	0.0	0-1.3					81.0	16.9	2.1								
	Pigs	≦0.5	1.0	3.7	1.22-8.5					70.9	21.6	2.2	0.7	0.7	0.7	1.5		1.5		
	Broilers	≦0.5	1.0	1.6	0.34-4.75					73.1	19.8	5.5					0.5	1.1		
	Layers	≦0.5	1.0	1.1	0.13-3.98					74.3	20.1	4.5					0.6	0.6		
	Total	≦0.5	1.0	1.3	0.61-2.35					75.9	19.1	3.5	0.1	0.1	0.1	0.3	0.3	0.6		
Kanamycin	Cattle	4.0	8.0	1.8	0.57-4.07							27.8	58.8	10.9	0.7				1.8	
	Pigs	4.0	32.0	9.7	5.26-16.02						1.5	23.9	45.5	14.9	3.7	0.7		0.7	9.0	
	Broilers	4.0	>128	30.2	23.64-37.46						0.5	13.2	42.3	11.5	2.2				30.2	
	Layers	4.0	8.0	1.7	0.34-4.82						1.1	15.1	61.5	17.3	2.8	0.6			1.7	
	Total	4.0	32.0	9.8	7.76-12.06						0.6	20.8	53.3	13.2	2.1	0.3		0.1	9.6	

Table2.1. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=284), pigs(n=134), broilers(n=182) and layers(n=179) in 2014_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Tetracycline	Cattle	2.0	64.0	20.4	15.88-25.59						21.5	38.0	16.9	3.2	1.8	2.5	10.2	6.0		
	Pigs	64.0	>64	64.2	55.44-72.28					0.7	11.2	23.1	0.7		3.0	2.2	27.6	31.3		
	Broilers	32.0	>64	51.1	43.59-58.57						15.4	23.6	7.1	2.7		2.7	25.3	23.1		
	Layers	2.0	64.0	24.6	18.46-31.56						21.8	38.5	14.5	0.6	0.6	1.1	14.5	8.4		
	Total	2.0	>64	36.1	32.69-39.56					0.1	18.4	32.2	11.3	1.9	1.3	2.2	17.7	14.9		
Nalidixic acid	Cattle	4.0	4.0	2.8	1.22-5.48						1.1	27.8	62.0	6.3					2.8	
	Pigs	4.0	16.0	8.2	4.16-14.22							24.6	53.7	7.5	6.0	1.5	0.7	2.2	3.7	
	Broilers	4.0	>128	38.5	31.35-45.95							18.7	38.5	3.3	1.1			2.2	36.3	
	Layers	4.0	>128	10.6	6.51-16.08						0.6	29.1	53.1	5.0	1.7			0.6	10.1	
	Total	4.0	>128	13.9	11.51-16.5						0.5	25.4	53.0	5.5	1.7	0.3	0.1	1.0	12.5	
Ciprofloxacin	Cattle	≦0.03	≦0.03	0.0	0-1.3	96.8	0.4	0.4	1.1	0.7	0.7									
	Pigs	≦0.03	0.25	1.5	0.18-5.29	82.8	0.7	5.2	6.0	3.7				1.5						
	Broilers	≦0.03	4.0	12.6	8.18-18.36	57.1	0.5	7.7	13.2	2.7	3.8	2.2	5.5	7.1						
	Layers	≦0.03	0.25	4.5	1.94-8.62	85.5	0.6	2.8	6.1	0.6			2.8	1.7						
	Total	≦0.03	0.25	4.2	2.93-5.9	82.5	0.5	3.5	5.9	1.7	1.2	0.5	1.9	2.3						
Colistin	Cattle	0.25	0.5	0.0	0-1.3			31.7	47.5	14.1	4.2	1.1	1.4							
	Pigs	0.25	0.5	0.0	0-2.72			26.1	48.5	17.2	3.0	2.2	3.0							
	Broilers	0.25	0.5	0.0	0-2.01			26.9	41.8	21.4	3.3	2.2	4.4							
	Layers	0.25	0.5	0.0	0-2.04			21.2	50.3	22.9	5.6									
	Total	0.25	0.5	0.0	0-0.48			27.2	47.0	18.4	4.1	1.3	2.1							
Chloramphenicol	Cattle	8.0	8.0	2.5	0.99-5.02							1.1	43.7	52.1	0.7			1.8	0.7	
	Pigs	8.0	128.0	25.4	18.25-33.62							2.2	34.3	36.6	1.5	4.5	3.0	10.4	7.5	
	Broilers	8.0	64.0	14.3	9.54-20.23							0.5	41.8	40.7	2.7	1.6	2.7	3.8	6.0	
	Layers	8.0	8.0	2.8	0.91-6.4							1.1	37.4	58.1	0.6	0.6	1.7		0.6	
	Total	8.0	16.0	9.2	7.3-11.5							1.2	40.2	48.1	1.3	1.3	1.5	3.3	3.1	
Trimethoprim	Cattle	0.5	2.0	3.2	1.45-5.94				21.1	41.2	25.7	6.7	1.8	0.4		3.2				
	Pigs	0.5	>16	34.3	26.34-43.02				12.7	37.3	12.7	3.0				34.3				
	Broilers	1.0	>16	36.8	29.79-44.27				13.7	27.5	17.0	4.4	0.5			36.8				
	Layers	0.5	>16	17.9	12.56-24.29				21.2	43.0	12.8	2.8	2.2			17.9				
	Total	0.5	>16	19.8	17.02-22.75				18.0	37.7	18.5	4.6	1.3	0.1		19.8				

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table2.2. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=216), pigs(n=107), broilers(n=110) and layers(n=121) in 2015_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	8.0	4.2	1.92-7.77						2.3	25.0	58.3	9.7	0.5				4.2	
	Pigs	4.0	>128	30.8	22.27-40.51						3.7	23.4	36.4	5.6			0.9	0.9	29.0	
	Broilers	4.0	>128	41.8	32.48-51.61						2.7	14.5	35.5	5.5				1.8	40.0	
	Layers	4.0	>128	19.8	13.14-28.06						2.5	21.5	47.1	9.1			0.8		19.0	
	Total	4.0	>128	20.2	16.94-23.81						2.7	21.8	47.1	7.9	0.2		0.4	0.5	19.3	
Cefazolin	Cattle	≦1	2.0	0.0	0-1.7						64.4	31.9	1.4	1.9	0.5					
	Pigs	2.0	4.0	0.0	0-3.39						44.9	43.9	7.5	3.7						
	Broilers	2.0	4.0	3.6	0.99-9.05						43.6	37.3	13.6	1.8		0.9			2.7	
	Layers	2.0	4.0	0.8	0.02-4.52						48.8	38.0	10.7	1.7					0.8	
	Total	≦1	4.0	0.9	0.29-2.1						53.1	36.6	7.0	2.2	0.2	0.2			0.7	
Cefotaxime	Cattle	≦0.5	≦0.5	0.0	0-1.7					99.5	0.5									
	Pigs	≦0.5	≦0.5	0.0	0-3.39					100.0										
	Broilers	≦0.5	≦0.5	2.7	0.56-7.77					96.4		0.9			1.8		0.9			
	Layers	≦0.5	≦0.5	0.0	0-3.01					100.0										
	Total	≦0.5	≦0.5	0.5	0.11-1.58					99.1	0.2	0.2			0.4		0.2			
Streptomycin	Cattle	8.0	64.0	16.7	11.95-22.32								8.8	60.6	13.9	2.8	4.6	5.1	4.2	
	Pigs	16.0	>128	37.4	28.21-47.27								7.5	38.3	16.8	2.8	8.4	9.3	16.8	
	Broilers	8.0	>128	33.6	24.9-43.28							0.9	4.5	45.5	15.5	2.7	5.5	5.5	20.0	
	Layers	8.0	128.0	18.2	11.75-26.23							0.8	5.8	57.0	18.2	1.7	4.1	5.0	7.4	
	Total	8.0	>128	24.4	20.84-28.17							0.4	7.0	52.5	15.7	2.5	5.4	6.0	10.5	
Gentamicin	Cattle	≦0.5	1.0	1.4	0.28-4.01					77.3	17.6	3.7			0.5	0.5	0.5			
	Pigs	≦0.5	1.0	1.9	0.22-6.59					67.3	24.3	6.5				0.9	0.9			
	Broilers	≦0.5	1.0	0.9	0.02-4.97					68.2	24.5	1.8	0.9	3.6			0.9			
	Layers	≦0.5	1.0	0.0	0-3.01					69.4	24.0	6.6								
	Total	≦0.5	1.0	1.1	0.39-2.35					71.8	21.7	4.5	0.2	0.7	0.2	0.4	0.5			
Kanamycin	Cattle	4.0	8.0	1.4	0.28-4.01						0.5	6.9	67.1	21.8	2.3				1.4	
	Pigs	4.0	>128	11.2	5.93-18.78							9.3	55.1	19.6	3.7	0.9			11.2	
	Broilers	8.0	>128	29.1	20.82-38.52							3.6	44.5	20.0	2.7				29.1	
	Layers	4.0	16.0	7.4	3.45-13.66							5.8	49.6	33.1	4.1				7.4	
	Total	4.0	>128	10.1	7.72-12.93						0.2	6.5	56.5	23.5	3.1	0.2			10.1	

Table2.2. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=216), pigs(n=107), broilers(n=110) and layers(n=121) in 2015_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Tetracycline	Cattle	2.0	64.0	19.0	13.97-24.86					0.5	23.1	28.2	25.0	4.2	3.2	1.4	9.7	4.6		
	Pigs	64.0	>64	55.1	45.22-64.77						13.1	19.6	11.2	0.9		3.7	17.8	33.6		
	Broilers	4.0	>64	45.5	35.92-55.25						17.3	25.5	8.2	3.6	0.9	0.9	27.3	16.4		
	Layers	2.0	64.0	22.3	15.24-30.79						26.4	39.7	9.9	1.7			18.2	4.1		
	Total	4.0	>64	31.9	28.08-36.02					0.2	20.8	28.5	15.7	2.9	1.4	1.4	16.6	12.5		
Nalidixic acid	Cattle	4.0	4.0	0.9	0.11-3.31						2.3	25.9	66.2	3.7	0.9		0.5		0.5	
	Pigs	4.0	16.0	9.3	4.57-16.52							22.4	61.7	2.8	3.7	0.9	1.9	2.8	3.7	
	Broilers	4.0	>128	32.7	24.08-42.33						0.9	16.4	44.5	5.5		1.8	1.8	1.8	27.3	
	Layers	4.0	>128	17.4	11.07-25.3							26.4	49.6	6.6					17.4	
	Total	4.0	>128	12.5	9.82-15.5						1.1	23.5	57.4	4.5	1.1	0.5	0.9	0.9	10.1	
Ciprofloxacin	Cattle	≦0.03	≦0.03	0.5	0.01-2.56	94.0	4.2	0.5		0.9				0.5						
	Pigs	≦0.03	0.25	1.9	0.22-6.59	84.1	1.9	0.9	8.4	2.8				1.9						
	Broilers	≦0.03	0.50	9.1	4.44-16.09	64.5	1.8	2.7	16.4	4.5	0.9		5.5	3.6						
	Layers	≦0.03	0.25	4.1	1.35-9.38	76.9	4.1	3.3	9.1		2.5		0.8	3.3						
	Total	≦0.03	0.25	3.2	1.93-5.09	82.5	3.2	1.6	6.9	1.8	0.7		1.3	2.0						
Colistin	Cattle	0.25	0.5	0.0	0-1.7			25.9	44.0	20.8	6.5	1.9	0.9							
	Pigs	0.25	2.0	0.0	0-3.39			20.6	43.9	20.6	4.7	1.9	8.4							
	Broilers	0.25	0.5	0.0	0-3.3			23.6	42.7	24.5	6.4	0.9	1.8							
	Layers	0.25	0.5	0.0	0-3.01			27.3	35.5	31.4	5.0		0.8							
	Total	0.25	0.5	0.0	0-0.67			24.7	41.9	23.8	5.8	1.3	2.5							
Chloramphenicol	Cattle	8.0	8.0	3.7	1.61-7.17							2.3	31.5	59.3	3.2	0.9	1.4	0.9	0.5	
	Pigs	8.0	128.0	25.2	17.33-34.56							4.7	15.0	49.5	5.6	4.7	7.5	3.7	9.3	
	Broilers	8.0	128.0	16.4	9.99-24.63							0.9	25.5	51.8	5.5		1.8	5.5	9.1	
	Layers	8.0	8.0	4.1	1.35-9.38							6.6	33.1	55.4	0.8			0.8	3.3	
	Total	8.0	32.0	10.5	8.04-13.33							3.4	27.4	55.1	3.6	1.3	2.3	2.3	4.5	
Trimethoprim	Cattle	0.5	2.0	3.2	1.31-6.57				20.4	38.4	29.2	7.4	0.9	0.5		3.2				
	Pigs	1.0	>16	28.0	19.78-37.55				17.8	29.9	19.6	2.8		1.9	0.9	27.1				
	Broilers	1.0	>16	30.0	21.63-39.48				12.7	31.8	20.0	3.6	1.8			30.0				
	Layers	0.5	>16	18.2	11.75-26.23				22.3	43.0	13.2	3.3				18.2				
	Total	0.5	>16	16.6	13.6-19.98				18.8	36.5	22.0	4.9	0.7	0.5	0.2	16.4				

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table2.3. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=263), pigs(n=93) and broilers(n=172) in 2014_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	8.0	3.0	1.32-5.91						0.8	17.5	66.2	11.8	0.8	0.4	0.8		1.9	
	Pigs	8.0	>128	43.0	32.77-53.73						1.1	14.0	29.0	10.8	2.2	1.1			41.9	
	Broilers	8.0	>128	40.1	32.72-47.86							14.5	30.8	11.6	2.9			1.7	38.4	
	Layers				-															
	Total	4.0	>128	22.2	18.68-25.95						0.6	15.9	48.1	11.6	1.7	0.4	0.4	0.6	20.8	
Cefazolin	Cattle	≦1	2.0	0.0	0-1.4						53.2	38.0	8.0	0.8						
	Pigs	2.0	8.0	1.1	0.02-5.85						33.3	45.2	8.6	10.8	1.1		1.1			
	Broilers	2.0	8.0	5.8	2.82-10.44						41.9	36.0	11.0	4.7	0.6	1.2		0.6	4.1	
	Layers				-															
	Total	2.0	4.0	2.1	1.04-3.7						46.0	38.6	9.1	3.8	0.4	0.4	0.2	0.2	1.3	
Cefotaxime	Cattle	≦0.5	≦0.5	0.0	0-1.4					98.9	0.8	0.4								
	Pigs	≦0.5	≦0.5	1.1	0.02-5.85					96.8	1.1	1.1		1.1						
	Broilers	≦0.5	≦0.5	4.1	1.65-8.21					94.8	0.6	0.6		1.7	1.2		0.6	0.6		
	Layers				-															
	Total	≦0.5	≦0.5	1.5	0.65-2.97					97.2	0.8	0.6		0.8	0.4		0.2	0.2		
Streptomycin	Cattle	8.0	>64	17.1	12.76-22.22						0.8	1.1	13.3	52.1	15.6	2.3	3.4	11.4		
	Pigs	32.0	>64	52.7	42.06-63.14								6.5	30.1	10.8	3.2	6.5	43.0		
	Broilers	16.0	>64	44.8	37.19-52.53							1.7	8.7	33.7	11.0	4.1	6.4	34.3		
	Layers				-															
	Total	8.0	>64	32.4	28.4-36.57						0.4	1.1	10.6	42.2	13.3	3.0	4.9	24.4		
Gentamicin	Cattle	≦0.5	1.0	0.0	0-1.4					62.4	31.9	5.7								
	Pigs	≦0.5	2.0	6.5	2.4-13.52					63.4	20.4	8.6	1.1		1.1	1.1	3.2	1.1		
	Broilers	≦0.5	2.0	2.9	0.95-6.66					50.6	23.3	18.6	4.7			1.7	1.2			
	Layers				-															
	Total	≦0.5	2.0	2.1	1.04-3.7					58.7	27.1	10.4	1.7		0.2	0.8	0.9	0.2		
Kanamycin	Cattle	4.0	8.0	0.4	0-2.11							19.8	51.3	25.1	3.4				0.4	
	Pigs	4.0	16.0	9.7	4.52-17.58							9.7	55.9	17.2	7.5				9.7	
	Broilers	8.0	>128	33.1	26.16-40.72						1.2	11.6	30.8	19.2	3.5	0.6			33.1	
	Layers				-															
	Total	4.0	>128	12.7	9.97-15.84						0.4	15.3	45.5	21.8	4.2	0.2			12.7	

Table2.3. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=263), pigs(n=93) and broilers(n=172) in 2014_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Tetracycline	Cattle	2.0	64.0	19.8	15.13-25.11					0.8	16.7	45.6	14.1	3.0	4.2	1.5	4.6	9.5		
	Pigs	64.0	>64	59.1	48.45-69.23						15.1	20.4	3.2	2.2	1.1	3.2	19.4	35.5		
	Broilers	4.0	>64	43.6	36.07-51.37					0.6	9.3	25.0	17.4	4.1		0.6	17.4	25.6		
	Layers				-															
	Total	4.0	>64	34.5	30.41-38.7					0.6	14.0	34.5	13.3	3.2	2.3	1.5	11.4	19.3		
Nalidixic acid	Cattle	4.0	8.0	2.3	0.84-4.9						0.4	19.8	64.3	10.3	3.0	1.5		0.4	0.4	
	Pigs	4.0	16.0	9.7	4.52-17.58						1.1	19.4	58.1	6.5	5.4	2.2			7.5	
	Broilers	8.0	>128	45.3	37.75-53.11							11.6	34.3	7.6	1.2	1.2	1.2	4.1	39.0	
	Layers				-															
	Total	4.0	>128	17.6	14.45-21.14						0.4	17.0	53.4	8.7	2.8	1.5	0.4	1.5	14.2	
Ciprofloxacin	Cattle	≦0.03	≦0.03	0.8	0.09-2.72	92.0	4.2	1.1	0.8	0.4		0.8	0.4	0.4						
	Pigs	≦0.03	0.25	2.2	0.26-7.56	82.8	1.1		8.6	3.2	2.2			2.2						
	Broilers	≦0.03	2.0	9.9	5.86-15.36	50.6	1.7	4.7	22.1	5.8	4.7	0.6	4.1	5.8						
	Layers				-															
	Total	≦0.03	0.3	4.0	2.47-6.02	76.9	2.8	2.1	9.1	2.7	1.9	0.6	1.5	2.5						
Colistin	Cattle	0.25	1.0	0.8	0.09-2.72			17.1	51.3	18.6	10.3	1.5	0.4			0.8				
	Pigs	0.25	0.5	0.0	0-3.89			14.0	71.0	9.7	3.2	1.1		1.1						
	Broilers	0.25	0.5	0.0	0-2.13			14.5	66.9	15.1	1.7	0.6	0.6	0.6						
	Layers				-															
	Total	0.3	0.5	0.4	0.04-1.37			15.7	59.8	15.9	6.3	1.1	0.4	0.4		0.4				
Chloramphenicol	Cattle	8.0	16.0	3.8	1.83-6.89							3.0	44.5	39.9	8.7	1.1	0.8	0.8	1.1	
	Pigs	8.0	>128	34.4	24.86-44.98						1.1	4.3	37.6	19.4	3.2	3.2	8.6	7.5	15.1	
	Broilers	8.0	64.0	15.1	10.11-21.36							1.2	29.7	46.5	7.6	3.5	4.7	4.1	2.9	
	Layers				-															
	Total	8.0	64.0	12.9	10.14-16.04						0.2	2.7	38.4	38.4	7.4	2.3	3.4	3.0	4.2	

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs							
						2.38/0.12	4.75/0.25	9.5/0.5	19/1	38/2	76/4	152/8	>152/8
Sulfamethoxazole /Trimethoprim	Cattle	≦2.38/0.12	19/1	5.3	2.94-8.78	62.4	15.2	8.7	5.7	2.7	1.1	0.4	3.8
	Pigs	4.75/0.25	>152/8	34.4	24.86-44.98	40.9	15.1	3.2	5.4	1.1	1.1		33.3
	Broilers	4.75/0.25	>152/8	30.2	23.47-37.69	47.7	8.1	8.1	3.5	2.3	0.6		29.7
	Layers				-								
	Total	≦2.38/0.12	>152/8	18.6	15.33-22.15	53.8	12.9	7.6	4.9	2.3	0.9	0.2	17.4

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table2.4. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=274), pigs(n=96) and broilers(n=184) in 2015_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	4.0	5.5	3.09-8.87						2.9	24.1	63.5	3.6	0.4		0.4	0.7	4.4	
	Pigs	4.0	>128	34.4	24.97-44.77						2.1	18.8	42.7	2.1					34.4	
	Broilers	4.0	>128	43.5	36.2-50.97							13.6	38.6	4.3			0.5	0.5	42.4	
	Layers				-															
	Total	4.0	>128	23.1	19.65-26.85						1.8	19.7	51.6	3.6	0.2		0.4	0.5	22.2	
Cefazolin	Cattle	≦1	2.0	0.0	0-1.34						75.9	21.9	2.2							
	Pigs	≦1	2.0	1.0	0.02-5.67						56.3	34.4	8.3					1.0		
	Broilers	2.0	4.0	3.8	1.54-7.69						47.8	33.2	13.6	1.6		1.1		0.5	2.2	
	Layers				-															
	Total	≦1	2.0	1.4	0.62-2.83						63.2	27.8	7.0	0.5		0.4		0.4	0.7	
Cefotaxime	Cattle	≦0.12	≦0.12	0.0	0-1.34			99.3	0.7											
	Pigs	≦0.12	≦0.12	0.0	0-3.77			99.0			1.0									
	Broilers	≦0.12	≦0.12	2.2	0.59-5.48			95.7	1.1			1.1		0.5	1.1	0.5				
	Layers				-															
	Total	0.1	0.1	0.7	0.19-1.84			98.0	0.7		0.2	0.4		0.2	0.4	0.2				
Streptomycin	Cattle	4.0	32.0	12.4	8.74-16.91							2.2	68.6	14.6	2.2	2.9	4.7	2.9	1.8	
	Pigs	8.0	>128	39.6	29.74-50.09							2.1	28.1	24.0	6.3	5.2	3.1	8.3	22.9	
	Broilers	8.0	>128	41.8	34.63-49.34							0.5	38.6	14.7	4.3	3.3	9.8	7.6	21.2	
	Layers				-															
	Total	4.0	>128	26.9	23.24-30.8							1.6	51.6	16.2	3.6	3.4	6.1	5.4	11.9	
Gentamicin	Cattle	≦0.5	≦0.5	0.0	0-1.34					97.1	2.6	0.4								
	Pigs	≦0.5	≦0.5	2.1	0.25-7.33					94.8	3.1					2.1				
	Broilers	≦0.5	≦0.5	2.2	0.59-5.48					91.8	2.7	1.6		1.6		1.6		0.5		
	Layers				-															
	Total	≦0.5	≦0.5	1.1	0.39-2.35					94.9	2.7	0.7		0.5		0.9		0.2		
Kanamycin	Cattle	2.0	4.0	0.7	0.08-2.62						4.7	73.7	20.8						0.7	
	Pigs	2.0	8.0	8.3	3.66-15.77						4.2	52.1	30.2	4.2	1.0				8.3	
	Broilers	4.0	>128	37.5	30.48-44.93						3.3	40.8	15.2	3.3				0.5	37.0	
	Layers				-															
	Total	2.0	>128	14.3	11.45-17.46						4.2	59.0	20.6	1.8	0.2			0.2	14.1	

Table2.4. Distribution of MICs and resistance(%) in *Escherichia coli* from cattle(n=274), pigs(n=96) and broilers(n=184) in 2015_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Tetracycline	Cattle	2.0	>64	18.6	14.18-23.74					0.4	25.5	50.7	2.9	1.8	1.1	0.4	6.9	10.2		
	Pigs	4.0	>64	45.8	35.61-56.32						9.4	39.6	4.2	1.0	1.0	1.0	16.7	27.1		
	Broilers	64.0	>64	54.9	47.4-62.23						12.0	16.8	12.0	4.3	0.5	2.7	27.2	24.5		
	Layers				-															
	Total	2.0	>64	35.4	31.39-39.53					0.2	18.2	37.5	6.1	2.5	0.9	1.3	15.3	17.9		
Nalidixic acid	Cattle	4.0	4.0	2.6	1.03-5.2							37.2	59.1	0.4	0.7			0.4	2.2	
	Pigs	4.0	8.0	5.2	1.71-11.74							25.0	62.5	5.2	2.1				5.2	
	Broilers	4.0	>128	35.9	28.94-43.26							19.6	39.1	2.7	2.7	1.1	3.3	6.0	25.5	
	Layers				-															
	Total	4.0	>128	14.1	11.29-17.26							29.2	53.1	2.0	1.6	0.4	1.1	2.2	10.5	
Ciprofloxacin	Cattle	≦0.03	≦0.03	0.0	0-1.34	96.4	0.4	0.4	2.2	0.4	0.4									
	Pigs	≦0.03	≦0.03	3.1	0.64-8.87	91.7			5.2				3.1							
	Broilers	≦0.03	0.5	4.9	2.26-9.09	59.8	1.1	10.3	13.0	7.6	2.7	0.5	1.1	3.8						
	Layers				-															
	Total	≦0.03	0.3	2.2	1.12-3.76	83.4	0.5	3.6	6.3	2.7	1.1	0.2	0.9	1.3						
Colistin	Cattle	0.25	1.0	0.0	0-1.34			15.3	37.2	27.4	19.0	0.7	0.4							
	Pigs	0.25	1.0	0.0	0-3.77			6.3	45.8	32.3	13.5	2.1								
	Broilers	0.25	1.0	0.5	0.01-3			13.0	42.9	27.2	10.9	3.8	1.6			0.5				
	Layers				-															
	Total	0.3	1.0	0.2	0-1.01			13.0	40.6	28.2	15.3	2.0	0.7			0.2				
Chloramphenicol	Cattle	8.0	8.0	2.9	1.26-5.68							0.4	23.7	73.0		0.4	0.7	0.7	1.1	
	Pigs	8.0	128.0	25.0	16.72-34.88							1.0	27.1	46.9		4.2	5.2	7.3	8.3	
	Broilers	8.0	16.0	9.8	5.9-15.02							0.5	16.3	63.0	10.3	3.8	1.6	1.1	3.3	
	Layers				-															
	Total	8.0	16.0	9.0	6.77-11.73							0.5	21.8	65.2	3.4	2.2	1.8	2.0	3.1	

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs							
						2.38/0.12	4.75/0.25	9.5/0.5	19/1	38/2	76/4	152/8	>152/8
Sulfamethoxazole /Trimethoprim	Cattle	≦2.38/0.12	4.75/0.25	2.9	1.26-5.68	88.0	4.4	4.0	0.7				2.9
	Pigs	≦2.38/0.12	>152/8	30.2	21.25-40.43	61.5	1.0	5.2	2.1				30.2
	Broilers	≦2.38/0.12	>152/8	28.3	21.88-35.36	51.1	6.0	8.7	4.9	1.1	0.5	0.5	27.2
	Layers				-								
	Total	≦2.38/0.12	>152/8	16.1	13.1-19.4	71.1	4.3	5.8	2.3	0.4	0.2	0.2	15.7

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table3.1. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=6), pigs(n=8), broilers(n=31) and layers(n=56) in 2014_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	0.5	1.0	0.0	0-45.93				50.0	50.0										
	Pigs	0.5	1.0	0.0	0-36.95				50.0	50.0										
	Broilers	1.0	1.0	0.0	0-11.22			3.2	6.5	80.6	6.5		3.2							
	Layers	1.0	1.0	0.0	0-6.38			1.8	3.6	89.3	3.6		1.8							
	Total	1.0	1.0	0.0	0-3.59			2.0	10.9	81.2	4.0		2.0							
Dihydrostreptomycin	Cattle	64.0	>512	33.3	4.32-77.73										16.7	50.0	16.7			16.7
	Pigs	64.0	>512	37.5	8.52-75.52											62.5	25.0			12.5
	Broilers	128.0	>512	58.1	39.07-75.46						3.2				9.7	29.0	22.6			35.5
	Layers	64.0	128.0	42.9	29.71-56.79										3.6	53.6	35.7			7.1
	Total	64.0	>512	46.5	36.54-56.74						1.0				5.9	46.5	29.7			16.8
Gentamicin	Cattle	8.0	16.0	0.0	0-45.93							33.3	16.7	50.0						
	Pigs	16.0	16.0	0.0	0-36.95								25.0	75.0						
	Broilers	16.0	16.0	9.7	2.04-25.76					3.2	3.2	6.5	19.4	58.1	9.7					
	Layers	16.0	16.0	3.6	0.43-12.32								17.9	78.6	1.8				1.8	
	Total	16.0	16.0	5.0	1.62-11.18					1.0	1.0	4.0	18.8	70.3	4.0				1.0	
Kanamycin	Cattle	32.0	>512	16.7	0.42-64.13										50.0	33.3				16.7
	Pigs	64.0	>512	12.5	0.31-52.66											87.5				12.5
	Broilers	64.0	>512	41.9	24.54-60.93							3.2		3.2	16.1	35.5	9.7			32.3
	Layers	64.0	128.0	14.3	6.37-26.23										3.6	82.1	5.4			8.9
	Total	64.0	>512	22.8	15.01-32.19							1.0		1.0	9.9	65.3	5.9			16.8
Oxytetracycline	Cattle	64.0	>64	83.3	35.87-99.58					16.7						33.3	50.0			
	Pigs	>64	>64	100.0	63.05-100												####			
	Broilers	16.0	>64	64.5	45.36-80.78			3.2	6.5	22.6			3.2	19.4	3.2	12.9	29.0			
	Layers	1.0	>64	39.3	26.49-53.25			1.8	14.3	42.9			1.8	3.6	8.9	7.1	19.6			
	Total	16.0	>64	54.5	44.24-64.4			2.0	9.9	31.7			2.0	7.9	5.9	9.9	30.7			
Chloramphenicol	Cattle	8.0	128.0	33.3	4.32-77.73								50.0	16.7			33.3			
	Pigs	128.0	128.0	87.5	47.34-99.69									12.5			87.5			
	Broilers	16.0	16.0	6.5	0.79-21.43							12.9	29.0	51.6	3.2		3.2			
	Layers	8.0	16.0	1.8	0.04-9.56							3.6	50.0	44.6	1.8					
	Total	16.0	32.0	11.9	6.29-19.84							5.9	39.6	42.6	2.0		9.9			
Bacitracin	Cattle	256.0	512.0	-	-												16.7	50.0	33.3	
	Pigs	256.0	256.0	-	-												12.5	87.5		
	Broilers	256.0	512.0	-	-								3.2				29.0	54.8	3.2	9.7
	Layers	256.0	512.0	-	-											1.8	10.7	76.8	5.4	5.4
	Total	256.0	512.0	-	-								1.0			1.0	16.8	69.3	5.9	5.9

Table3.1. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=6), pigs(n=8), broilers(n=31) and layers(n=56) in 2014_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	2.0	8.0	-	-					33.3	16.7	16.7	33.3							
	Pigs	8.0	8.0	-	-							37.5	62.5							
	Broilers	4.0	8.0	-	-			6.5	3.2	3.2	3.2	71.0	9.7	3.2						
	Layers	4.0	8.0	-	-			1.8		3.6	1.8	60.7	32.1							
	Total	4.0	8.0	-	-			3.0	1.0	5.0	3.0	59.4	27.7	1.0						
Erythromycin	Cattle	4.0	>128	50.0	11.81-88.19					16.7		33.3						50.0		
	Pigs	>128	>128	62.5	24.48-91.48							37.5						62.5		
	Broilers	2.0	>128	48.4	30.15-66.94		3.2	3.2	6.5	22.6	16.1			3.2	6.5			38.7		
	Layers	2.0	>128	17.9	8.91-30.4		5.4	5.4	8.9	23.2	28.6	10.7						17.9		
	Total	2.0	>128	32.7	23.66-42.73		4.0	4.0	6.9	20.8	20.8	10.9		1.0	2.0			29.7		
Tylosin	Cattle	4.0	>256	50.0	11.81-88.19							50.0							50.0	
	Pigs	>256	>256	62.5	24.48-91.48						37.5								62.5	
	Broilers	4.0	>256	48.4	30.15-66.94						38.7	12.9						3.2	45.2	
	Layers	2.0	>256	17.9	8.91-30.4					1.8	73.2	7.1							17.9	
	Total	2.0	>256	32.7	23.66-42.73					1.0	55.4	10.9						1.0	31.7	
Lincomycin	Cattle	32.0	>256	50.0	11.81-88.19										50.0				50.0	
	Pigs	>256	>256	62.5	24.48-91.48										37.5				62.5	
	Broilers	32.0	>256	48.4	30.15-66.94				3.2	6.5				3.2	38.7		3.2	3.2	41.9	
	Layers	32.0	>256	17.9	8.91-30.4					1.8			1.8	7.1	69.6	1.8			17.9	
	Total	32.0	>256	32.7	23.66-42.73				1.0	3.0			1.0	5.0	56.4	1.0	1.0	1.0	30.7	
Enrofloxacin	Cattle	1.0	2.0	0.0	0-45.93				16.7	50.0	33.3									
	Pigs	1.0	1.0	0.0	0-36.95				37.5	62.5										
	Broilers	1.0	1.0	6.5	0.79-21.43			3.2	45.2	41.9	3.2	3.2		3.2						
	Layers	1.0	1.0	3.6	0.43-12.32				30.4	64.3	1.8	1.8		1.8						
	Total	1.0	1.0	4.0	1.08-9.84			1.0	34.7	56.4	4.0	2.0		2.0						
Salinomycin	Cattle	1.0	2.0	-	-					50.0	50.0									
	Pigs	1.0	8.0	-	-					62.5	25.0		12.5							
	Broilers	2.0	8.0	-	-				9.7	22.6	25.8	6.5	29.0	6.5						
	Layers	2.0	2.0	-	-					25.0	66.1	3.6	3.6	1.8						
	Total	2.0	8.0	-	-				3.0	28.7	49.5	4.0	11.9	3.0						

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table3.2. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=5), pigs(n=16), broilers(n=67) and layers(n=89) in 2015_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	1.0	1.0	0.0	0-52.19				20.0	80.0										
	Pigs	1.0	1.0	0.0	0-20.6				12.5	81.3	6.3									
	Broilers	1.0	1.0	0.0	0-5.36				4.5	95.5										
	Layers	1.0	1.0	0.0	0-4.07			2.2	11.2	86.5										
	Total	1.0	1.0	0.0	0-2.07			1.1	9.0	89.3	0.6									
Dihydrostreptomycin	Cattle	64.0	128.0	20.0	0.5-71.65										20.0	60.0	20.0			
	Pigs	128.0	>512	62.5	35.43-84.81										6.3	31.3	18.8			43.8
	Broilers	128.0	>512	62.7	50.01-74.21										3.0	34.3	22.4		1.5	38.8
	Layers	64.0	>512	36.0	26.05-46.83									1.1	9.0	53.9	16.9	3.4	2.2	13.5
	Total	64.0	>512	48.0	40.46-55.65									0.6	6.8	44.6	19.2	1.7	1.7	25.4
Gentamicin	Cattle	8.0	16.0	0.0	0-52.19							20.0	60.0	20.0						
	Pigs	8.0	16.0	0.0	0-20.6						6.3	12.5	56.3	25.0						
	Broilers	8.0	>256	11.9	5.29-22.18						3.0	9.0	55.2	20.9					11.9	
	Layers	8.0	16.0	3.4	0.7-9.54						4.5	22.5	44.9	24.7	1.1	1.1			1.1	
	Total	8.0	16.0	6.2	3.14-10.85						4.0	16.4	50.3	23.2	0.6	0.6			5.1	
Kanamycin	Cattle	64.0	64.0	0.0	0-52.19									20.0		80.0				
	Pigs	64.0	>512	31.3	11.01-58.67									6.3	12.5	50.0				31.3
	Broilers	64.0	>512	46.3	33.99-58.89										16.4	37.3	4.5			41.8
	Layers	64.0	>512	21.3	13.36-31.32									7.9	30.3	40.4	7.9			13.5
	Total	64.0	>512	31.1	24.34-38.46									5.1	22.6	41.2	5.6			25.4
Oxytetracycline	Cattle	1.0	32.0	20.0	0.5-71.65					80.0					20.0					
	Pigs	64.0	>64	68.8	41.33-88.99				18.8	12.5				6.3		12.5	50.0			
	Broilers	32.0	>64	68.7	56.16-79.45			1.5	7.5	19.4		1.5	1.5	17.9	1.5	3.0	46.3			
	Layers	2.0	>64	48.3	37.58-59.16			2.2	10.1	37.1	1.1		1.1	4.5	18.0	5.6	20.2			
	Total	16.0	>64	57.1	49.42-64.47			1.7	9.6	29.4	0.6	0.6	1.1	9.6	10.2	5.1	32.2			
Chloramphenicol	Cattle	8.0	32.0	20.0	0.5-71.65								80.0		20.0					
	Pigs	8.0	128.0	31.3	11.01-58.67							6.3	62.5			12.5	18.8			
	Broilers	8.0	64.0	19.4	10.75-30.9							10.4	55.2	14.9		11.9	7.5			
	Layers	8.0	16.0	1.1	0.02-6.11							20.2	66.3	12.4		1.1				
	Total	8.0	64.0	11.3	7.04-16.92							14.7	62.1	11.9	0.6	6.2	4.5			
Bacitracin	Cattle	256.0	512.0	-	-												40.0	40.0	20.0	
	Pigs	256.0	>512	-	-												6.3	75.0		18.8
	Broilers	256.0	>512	-	-											3.0	17.9	59.7	7.5	11.9
	Layers	256.0	>512	-	-												16.9	61.8	11.2	10.1
	Total	256.0	>512	-	-											1.1	16.9	61.6	9.0	11.3

Table3.2. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=5), pigs(n=16), broilers(n=67) and layers(n=89) in 2015_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	8.0	8.0	-	-						20.0		80.0							
	Pigs	4.0	8.0	-	-						12.5	62.5	25.0							
	Broilers	8.0	8.0	-	-							49.3	50.7							
	Layers	8.0	8.0	-	-						12.4	37.1	49.4	1.1						
	Total	4.0	8.0	-	-						7.9	42.9	48.6	0.6						
Erythromycin	Cattle	2.0	2.0	0.0	0-52.19				20.0		80.0									
	Pigs	8.0	>128	56.3	29.87-80.25		6.3			12.5	25.0		12.5					43.8		
	Broilers	4.0	>128	44.8	32.6-57.43			3.0	1.5	6.0	35.8	9.0	3.0		3.0			38.8		
	Layers	2.0	>128	14.6	8.01-23.69			6.7	21.3	20.2	23.6	13.5						14.6		
	Total	2.0	>128	29.4	22.78-36.68		0.6	4.5	11.9	13.6	29.9	10.2	2.3		1.1			26.0		
Tylosin	Cattle	4.0	8.0	0.0	0-52.19						40.0	40.0	20.0							
	Pigs	8.0	>256	50.0	24.65-75.35						37.5	6.3	6.3			6.3			43.8	
	Broilers	4.0	>256	44.8	32.6-57.43					1.5	34.3	19.4					1.5	3.0	40.3	
	Layers	4.0	>256	14.6	8.01-23.69						42.7	38.2	4.5						14.6	
	Total	4.0	>256	28.8	22.26-36.09					0.6	39.0	28.2	3.4			0.6	0.6	1.1	26.6	
Lincomycin	Cattle	32.0	64.0	0.0	0-52.19										60.0	40.0				
	Pigs	256.0	>256	62.5	35.43-84.81									6.3	31.3			12.5	50.0	
	Broilers	64.0	>256	44.8	32.6-57.43									4.5	44.8	6.0	1.5	4.5	38.8	
	Layers	32.0	>256	14.6	8.01-23.69									12.4	66.3	6.7			14.6	
	Total	32.0	>256	29.9	23.3-37.28									8.5	54.8	6.8	0.6	2.8	26.6	
Enrofloxacin	Cattle	1.0	1.0	0.0	0-52.19				20.0	80.0										
	Pigs	1.0	1.0	6.3	0.15-30.24				37.5	56.3				6.3						
	Broilers	1.0	1.0	1.5	0.03-8.04				40.3	55.2	3.0		1.5							
	Layers	1.0	1.0	4.5	1.23-11.11				21.3	69.7	4.5	2.2			2.2					
	Total	1.0	1.0	3.4	1.25-7.24				29.9	63.3	3.4	1.1	0.6	0.6	1.1					
Salinomycin	Cattle	2.0	2.0	-	-						100									
	Pigs	2.0	2.0	-	-					18.8	75.0			6.3						
	Broilers	2.0	8.0	-	-					17.9	43.3	11.9	23.9	3.0						
	Layers	2.0	2.0	-	-					25.8	68.5	1.1	4.5							
	Total	2.0	8.0	-	-					21.5	60.5	5.1	11.3	1.7						

White fields represent the range of dilutions tested.

MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.

MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table3.3. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=11), pigs(n=8) and broilers(n=91) in 2014_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	1.0	1.0	0.0	0-28.5				9.1	90.9										
	Pigs	0.5	1.0	0.0	0-36.95			12.5	37.5	50.0										
	Broilers	0.5	1.0	0.0	0-3.98		1.1	2.2	72.5	24.2										
	Layers				-															
	Total	0.5	1.0	0.0	0-3.3		0.9	2.7	63.6	32.7										
Dihydrostreptomycin	Cattle	64.0	128.0	36.4	10.92-69.21									18.2	27.3	18.2	27.3	9.1		
	Pigs	512.0	>512	62.5	24.48-91.48										12.5	25.0			12.5	50.0
	Broilers	128.0	>512	53.8	43.07-64.36							3.3	2.2	16.5	17.6	6.6	8.8	1.1	17.6	26.4
	Layers				-															
	Total	128.0	>512	52.7	42.98-62.33							2.7	1.8	15.5	18.2	9.1	10.0	1.8	15.5	25.5
Gentamicin	Cattle	8.0	32.0	27.3	6.02-60.98						18.2	9.1	27.3	18.2	18.2	9.1				
	Pigs	8.0	64.0	12.5	0.31-52.66							12.5	37.5	37.5		12.5				
	Broilers	4.0	16.0	9.9	4.62-17.95				2.2	2.2	12.1	47.3	15.4	11.0	3.3	4.4		1.1	1.1	
	Layers				-															
	Total	4.0	32.0	11.8	6.44-19.37				1.8	1.8	11.8	40.9	18.2	13.6	4.5	5.5		0.9	0.9	
Kanamycin	Cattle	32.0	64.0	9.1	0.22-41.28								9.1		54.5	27.3		9.1		
	Pigs	32.0	>512	12.5	0.31-52.66									12.5	37.5	37.5				12.5
	Broilers	>512	>512	57.1	46.33-67.48						1.1	1.1	8.8	20.9	6.6	4.4	3.3		1.1	52.7
	Layers				-															
	Total	64.0	>512	49.1	39.43-58.8						0.9	0.9	8.2	18.2	13.6	9.1	2.7	0.9	0.9	44.5
Oxytetracycline	Cattle	1.0	32.0	27.3	6.02-60.98				36.4	36.4					18.2		9.1			
	Pigs	>64	>64	87.5	47.34-99.69					12.5							87.5			
	Broilers	16.0	>64	67.0	56.38-76.54			5.5	11.0	6.6	3.3		6.6	22.0	4.4	3.3	37.4			
	Layers				-															
	Total	16.0	>64	64.5	54.85-73.44			4.5	12.7	10.0	2.7		5.5	18.2	5.5	2.7	38.2			
Chloramphenicol	Cattle	8.0	8.0	0.0	0-28.5							18.2	81.8							
	Pigs	64.0	128.0	62.5	24.48-91.48								25.0	12.5		25.0	37.5			
	Broilers	8.0	32.0	13.2	7-21.91						2.2	20.9	44.0	19.8	4.4	5.5	3.3			
	Layers				-															
	Total	8.0	64.0	15.5	9.26-23.59						1.8	19.1	46.4	17.3	3.6	6.4	5.5			
Bacitracin	Cattle	256.0	256.0	-	-								9.1	9.1			27.3	54.5		
	Pigs	128.0	>512	-	-									12.5			37.5	37.5		12.5
	Broilers	128.0	256.0	-	-							1.1		1.1		17.6	52.7	19.8	2.2	5.5
	Layers				-															
	Total	128.0	256.0	-	-							0.9	0.9	2.7		14.5	49.1	24.5	1.8	5.5

Table3.3. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=11), pigs(n=8) and broilers(n=91) in 2014_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	8.0	8.0	-	-						27.3	18.2	54.5							
	Pigs	8.0	32.0	-	-						12.5		37.5	25.0	25.0					
	Broilers	8.0	8.0	-	-			2.2		1.1	3.3	42.9	40.7	7.7	2.2					
	Layers				-															
	Total	8.0	16.0	-	-			1.8		0.9	6.4	37.3	41.8	8.2	3.6					
Erythromycin	Cattle	4.0	4.0	9.1	0.22-41.28		9.1	18.2	9.1		9.1	45.5	9.1							
	Pigs	>128	>128	62.5	24.48-91.48			12.5				25.0						62.5		
	Broilers	>128	>128	64.8	54.11-74.56		1.1		8.8	6.6	9.9	8.8	2.2	3.3	2.2	4.4	1.1	51.6		
	Layers				-															
	Total	64.0	>128	59.1	49.3-68.38		1.8	2.7	8.2	5.5	9.1	13.6	2.7	2.7	1.8	3.6	0.9	47.3		
Tylosin	Cattle	4.0	4.0	0.0	0-28.5						18.2	72.7	9.1							
	Pigs	>256	>256	62.5	24.48-91.48							25.0	12.5						62.5	
	Broilers	>256	>256	65.9	55.25-75.55						15.4	16.5	2.2				1.1	1.1	63.7	
	Layers				-															
	Total	>256	>256	59.1	49.3-68.38						14.5	22.7	3.6				0.9	0.9	57.3	
Lincomycin	Cattle	32.0	64.0	9.1	0.22-41.28								9.1	18.2	54.5	9.1			9.1	
	Pigs	>256	>256	75.0	34.91-96.82											25.0			75.0	
	Broilers	32.0	>256	45.1	34.59-55.85				1.1	2.2	2.2	8.8	17.6	6.6	14.3	2.2		2.2	42.9	
	Layers				-															
	Total	32.0	>256	43.6	34.2-53.43				0.9	1.8	1.8	7.3	15.5	7.3	17.3	4.5		1.8	41.8	
Enrofloxacin	Cattle	0.5	0.5	0.0	0-28.5			9.1	90.9											
	Pigs	0.5	1.0	0.0	0-36.95				50.0	50.0										
	Broilers	0.25	0.5	1.1	0.02-5.98		6.6	51.6	36.3	4.4				1.1						
	Layers				-															
	Total	0.5	0.5	0.9	0.02-4.97		5.5	43.6	42.7	7.3				0.9						
Salinomycin	Cattle	2.0	2.0	-	-					45.5	54.5									
	Pigs	2.0	2.0	-	-					25.0	75.0									
	Broilers	8.0	8.0	-	-			1.1	2.2	25.3	15.4	5.5	40.7	9.9						
	Layers				-															
	Total	2.0	8.0	-	-			0.9	1.8	27.3	23.6	4.5	33.6	8.2						

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table3.4. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=14), pigs(n=13) and broilers(n=98) in 2015_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	1.0	1.0	0.0	0-23.17			7.1	14.3	78.6										
	Pigs	1.0	1.0	0.0	0-24.71				38.5	61.5										
	Broilers	1.0	1.0	0.0	0-3.7				48.0	51.0	1.0									
	Layers				-															
	Total	1.0	1.0	0.0	0-2.91			0.8	43.2	55.2	0.8									
Dihydrostreptomycin	Cattle	64.0	128.0	35.7	12.75-64.87										21.4	42.9	35.7			
	Pigs	>512	>512	100.0	75.29-100												15.4			84.6
	Broilers	128.0	>512	72.4	62.5-81									1.0	7.1	19.4	24.5	2.0		45.9
	Layers				-															
	Total	128.0	>512	71.2	62.42-78.95									0.8	8.0	20.0	24.8	1.6		44.8
Gentamicin	Cattle	16.0	16.0	0.0	0-23.17						7.1	14.3	7.1	71.4						
	Pigs	16.0	64.0	15.4	1.92-45.45								7.7	76.9		7.7			7.7	
	Broilers	16.0	>256	14.3	8.03-22.81						2.0		33.7	50.0	3.1				11.2	
	Layers				-															
	Total	16.0	64.0	12.8	7.49-19.96						2.4	1.6	28.0	55.2	2.4	0.8			9.6	
Kanamycin	Cattle	64.0	128.0	14.3	1.77-42.82									21.4	7.1	57.1	14.3			
	Pigs	>512	>512	69.2	38.57-90.91											30.8	7.7			61.5
	Broilers	>512	>512	66.3	56.07-75.57										11.2	22.4	7.1		2.0	57.1
	Layers				-															
	Total	>512	>512	60.8	51.66-69.41									2.4	9.6	27.2	8.0		1.6	51.2
Oxytetracycline	Cattle	1.0	32.0	28.6	8.38-58.11				35.7	35.7				7.1	14.3	7.1				
	Pigs	>64	>64	92.3	63.97-99.81				7.7						15.4		76.9			
	Broilers	32.0	>64	70.4	60.33-79.21			1.0	17.3	7.1			4.1	12.2	10.2	3.1	44.9			
	Layers				-															
	Total	32.0	>64	68.0	59.06-76.06			0.8	18.4	9.6			3.2	10.4	11.2	3.2	43.2			
Chloramphenicol	Cattle	8.0	8.0	0.0	0-23.17							42.9	57.1							
	Pigs	32.0	128.0	53.8	25.13-80.78								38.5	7.7	7.7	7.7	38.5			
	Broilers	8.0	16.0	9.2	4.28-16.72							16.3	71.4	3.1		4.1	5.1			
	Layers				-															
	Total	8.0	64.0	12.8	7.49-19.96							17.6	66.4	3.2	0.8	4.0	8.0			
Bacitracin	Cattle	256.0	512.0	-	-													85.7	14.3	
	Pigs	256.0	256.0	-	-													100.0		
	Broilers	256.0	512.0	-	-										3.1	4.1	24.5	39.8	19.4	9.2
	Layers				-															
	Total	256.0	512.0	-	-										2.4	3.2	19.2	51.2	16.8	7.2

Table3.4. Distribution of MICs and resistance(%) in *Enterococcus faecalis* from cattle(n=14), pigs(n=13) and broilers(n=98) in 2015_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	8.0	16.0	-	-						21.4		28.6	50.0						
	Pigs	16.0	16.0	-	-						7.7		23.1	69.2						
	Broilers	8.0	16.0	-	-						3.1	7.1	57.1	24.5	8.2					
	Layers				-															
	Total	8.0	16.0	-	-						5.6	5.6	50.4	32.0	6.4					
Erythromycin	Cattle	4.0	4.0	0.0	0-23.17		7.1		7.1	14.3	14.3	57.1								
	Pigs	>128	>128	69.2	38.57-90.91					7.7	7.7	15.4						69.2		
	Broilers	32.0	>128	60.2	49.81-69.96		1.0	3.1	4.1	6.1	6.1	19.4	7.1	2.0	2.0	1.0	1.0	46.9		
	Layers				-															
	Total	8.0	>128	54.4	45.25-63.34		1.6	2.4	4.0	7.2	7.2	23.2	5.6	1.6	1.6	0.8	0.8	44.0		
Tylosin	Cattle	4.0	8.0	0.0	0-23.17						35.7	50.0	14.3							
	Pigs	>256	>256	69.2	38.57-90.91						15.4	15.4							69.2	
	Broilers	>256	>256	53.1	42.71-63.23						37.8	6.1	3.1				1.0		52.0	
	Layers				-															
	Total	8.0	>256	48.8	39.75-57.9						35.2	12.0	4.0				0.8		48.0	
Lincomycin	Cattle	32.0	64.0	0.0	0-23.17										50.0	50.0				
	Pigs	>256	>256	92.3	63.97-99.81											7.7		15.4	76.9	
	Broilers	>256	>256	54.1	43.71-64.2										32.7	13.3	1.0	2.0	51.0	
	Layers				-															
	Total	256.0	>256	52.0	42.88-61.02										31.2	16.8	0.8	3.2	48.0	
Enrofloxacin	Cattle	1.0	1.0	0.0	0-23.17				7.1	92.9										
	Pigs	1.0	1.0	7.7	0.19-36.03			7.7	15.4	69.2					7.7					
	Broilers	1.0	1.0	0.0	0-3.7			6.1	33.7	58.2	2.0									
	Layers				-															
	Total	1.0	1.0	0.8	0.02-4.38			5.6	28.8	63.2	1.6				0.8					
Salinomycin	Cattle	1.0	2.0	-	-					78.6	21.4									
	Pigs	2.0	2.0	-	-					46.2	53.8									
	Broilers	1.0	8.0	-	-			1.0	5.1	48.0	11.2	13.3	21.4							
	Layers				-															
	Total	1.0	8.0	-	-			0.8	4.0	51.2	16.8	10.4	16.8							

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table4.1. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=27), pigs(n=47), broilers(n=107) and layers(n=69) in 2014_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	2.0	4.0	0.0	0-12.78			3.7	11.1	29.6	44.4	11.1								
	Pigs	2.0	4.0	0.0	0-7.55		4.3	2.1	4.3	6.4	66.0	8.5	8.5							
	Broilers	2.0	8.0	1.9	0.22-6.59		4.7	12.1	9.3	8.4	23.4	15.9	24.3		0.9		0.9			
	Layers	2.0	4.0	0.0	0-5.21		1.4	11.6	18.8	11.6	42.0	5.8	8.7							
	Total	2.0	8.0	0.8	0.09-2.86		3.2	9.2	11.2	11.2	38.8	11.2	14.4		0.4		0.4			
Dihydrostreptomycin	Cattle	64.0	64.0	7.4	0.91-24.29										29.6	63.0				7.4
	Pigs	64.0	>512	40.4	26.36-55.74										21.3	38.3			2.1	38.3
	Broilers	64.0	>512	23.4	15.72-32.53										20.6	56.1	4.7	0.9	2.8	15.0
	Layers	64.0	128.0	10.1	4.17-19.8									5.8	24.6	59.4	2.9			7.2
	Total	64.0	>512	21.2	16.3-26.8									1.6	22.8	54.4	2.8	0.4	1.6	16.4
Gentamicin	Cattle	8.0	16.0	7.4	0.91-24.29						7.4	29.6	48.1	7.4					7.4	
	Pigs	4.0	16.0	0.0	0-7.55						2.1	48.9	34.0	14.9						
	Broilers	8.0	8.0	0.9	0.02-5.1						3.7	22.4	64.5	8.4					0.9	
	Layers	8.0	16.0	0.0	0-5.21						7.2	24.6	56.5	11.6						
	Total	8.0	16.0	1.2	0.24-3.47						4.8	28.8	54.8	10.4					1.2	
Kanamycin	Cattle	64.0	256.0	29.6	13.75-50.19										33.3	37.0	18.5	3.7		7.4
	Pigs	128.0	>512	59.6	44.26-73.64									4.3	10.6	25.5	25.5	10.6	2.1	21.3
	Broilers	64.0	>512	45.8	36.12-55.71									0.9	8.4	44.9	27.1	2.8		15.9
	Layers	64.0	256.0	43.5	31.57-55.96									4.3	10.1	42.0	30.4	7.2	1.4	4.3
	Total	64.0	>512	46.0	39.7-52.4									2.4	12.0	39.6	26.8	5.6	0.8	12.8
Oxytetracycline	Cattle	0.5	>64	14.8	4.18-33.74		3.7	14.8	59.3	7.4							14.8			
	Pigs	32.0	>64	53.2	38.07-67.89			6.4	36.2	4.3				2.1	10.6	12.8	27.7			
	Broilers	64.0	>64	61.7	51.78-70.92		1.9	20.6	10.3	2.8		0.9	1.9	2.8	4.7	12.1	42.1			
	Layers	0.5	64.0	20.3	11.56-31.7		2.9	23.2	49.3	4.3					7.2	5.8	7.2			
	Total	0.5	>64	43.6	37.36-50		2.0	18.0	31.2	4.0		0.4	0.8	1.6	6.0	9.2	26.8			
Chloramphenicol	Cattle	8.0	8.0	0.0	0-12.78							22.2	77.8							
	Pigs	8.0	32.0	12.8	4.83-25.75						2.1	6.4	72.3	6.4	10.6	2.1				
	Broilers	8.0	32.0	12.1	6.63-19.88						0.9	41.1	43.0	2.8	11.2		0.9			
	Layers	8.0	8.0	1.4	0.03-7.82							14.5	84.1			1.4				
	Total	8.0	16.0	8.0	4.95-12.09						0.8	25.2	63.6	2.4	6.8	0.8	0.4			
Bacitracin	Cattle	256.0	512.0	-	-									7.4	3.7		3.7	44.4	37.0	3.7
	Pigs	512.0	>512	-	-								4.3	2.1	2.1		4.3	27.7	40.4	19.1
	Broilers	256.0	>512	-	-			1.9			1.9	2.8	5.6	15.9	0.9	2.8	6.5	31.8	9.3	20.6
	Layers	256.0	>512	-	-							2.9		7.2	2.9	1.4	7.2	34.8	33.3	10.1
	Total	256.0	>512	-	-			0.8			0.8	2.0	3.2	10.0	2.0	1.6	6.0	33.2	24.8	15.6

Table4.1. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=27), pigs(n=47), broilers(n=107) and layers(n=69) in 2014_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	1.0	2.0	-	-			3.7	18.5	48.1	29.6									
	Pigs	2.0	2.0	-	-				4.3	17.0	72.3	6.4								
	Broilers	1.0	2.0	-	-			13.1	29.0	44.9	9.3	0.9	1.9		0.9					
	Layers	1.0	2.0	-	-			8.7	33.3	34.8	23.2									
	Total	1.0	2.0	-	-			8.4	24.4	37.2	27.2	1.6	0.8		0.4					
Erythromycin	Cattle	2.0	8.0	11.1	2.35-29.16		11.1		14.8	18.5	18.5	25.9	3.7					7.4		
	Pigs	2.0	>128	27.7	15.62-42.64		17.0	12.8	2.1	10.6	8.5	21.3		4.3				23.4		
	Broilers	0.5	>128	22.4	14.93-31.52		42.1	3.7	5.6	11.2	1.9	13.1	9.3	0.9	0.9			11.2		
	Layers	1.0	4.0	8.7	3.25-17.98		20.3	7.2	14.5	18.8	15.9	14.5	2.9	2.9				2.9		
	Total	1.0	>128	18.4	13.79-23.77		28.0	6.0	8.4	14.0	8.8	16.4	5.2	2.0	0.4			10.8		
Tylosin	Cattle	4.0	8.0	7.4	0.91-24.29					3.7	18.5	55.6	14.8						7.4	
	Pigs	8.0	>256	27.7	15.62-42.64						10.6	19.1	42.6				4.3	2.1	21.3	
	Broilers	2.0	>256	15.0	8.79-23.15			1.9	0.9	13.1	38.3	29.0	1.9			0.9	0.9		13.1	
	Layers	2.0	8.0	5.8	1.6-14.19					4.3	53.6	21.7	14.5					1.4	4.3	
	Total	4.0	>256	14.0	9.94-18.93			0.8	0.4	7.2	35.2	28.0	14.4			0.4	1.2	0.8	11.6	
Lincomycin	Cattle	16.0	256.0	11.1	2.35-29.16			3.7	14.8			11.1	3.7	48.1	7.4			3.7	7.4	
	Pigs	32.0	>256	40.4	26.36-55.74				4.3			4.3	4.3	36.2	10.6			4.3	36.2	
	Broilers	16.0	>256	24.3	16.52-33.55			3.7	23.4	6.5		0.9	12.1	24.3	2.8	1.9	5.6	7.5	11.2	
	Layers	16.0	128.0	11.6	5.14-21.58		1.4	2.9	24.6	11.6	1.4	1.4	5.8	27.5	11.6		5.8		5.8	
	Total	16.0	>256	22.4	17.38-28.09		0.4	2.8	19.2	6.0	0.4	2.8	8.0	30.0	7.2	0.8	4.0	4.4	14.0	
Enrofloxacin	Cattle	2.0	16.0	33.3	16.51-53.97				18.5	22.2	25.9	11.1	11.1	11.1						
	Pigs	2.0	8.0	40.4	26.36-55.74			4.3	4.3	21.3	29.8	19.1	21.3							
	Broilers	4.0	8.0	61.7	51.78-70.92		1.9	0.9	4.7	15.0	15.9	43.0	17.8	0.9						
	Layers	4.0	8.0	52.2	39.8-64.36				5.8	11.6	30.4	27.5	20.3	4.3						
	Total	4.0	8.0	52.0	45.61-58.34		0.8	1.2	6.4	16.0	23.6	30.8	18.4	2.8						
Salinomycin	Cattle	2.0	4.0	-	-					37.0	40.7	22.2								
	Pigs	2.0	2.0	-	-				2.1	10.6	78.7	8.5								
	Broilers	2.0	8.0	-	-		1.9			11.2	41.1	30.8	13.1	1.9						
	Layers	2.0	2.0	-	-				1.4	24.6	65.2	5.8	2.9							
	Total	2.0	4.0	-	-		0.8		0.8	17.6	54.8	18.8	6.4	0.8						

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table4.2. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=25),pigs(n=16), broilers(n=13) and layers(n=11) in 2015_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	2.0	2.0	0.0	0-13.72			8.0	8.0	12.0	72.0									
	Pigs	2.0	4.0	0.0	0-20.6					6.3	81.3	12.5								
	Broilers	4.0	8.0	0.0	0-24.71			7.7		7.7	30.8	23.1	30.8							
	Layers	2.0	4.0	0.0	0-28.5				9.1	18.2	54.5	18.2								
	Total	2.0	4.0	0.0	0-5.52			4.6	4.6	10.8	63.1	10.8	6.2							
Dihydrostreptomycin	Cattle	64.0	512.0	16.0	4.53-36.09										40.0	44.0		4.0	4.0	8.0
	Pigs	64.0	>512	31.3	11.01-58.67										18.8	50.0			6.3	25.0
	Broilers	64.0	>512	23.1	5.03-53.82									7.7	38.5	30.8			7.7	15.4
	Layers	64.0	64.0	9.1	0.22-41.28										18.2	72.7				9.1
	Total	64.0	>512	20.0	11.1-31.77									1.5	30.8	47.7		1.5	4.6	13.8
Gentamicin	Cattle	4.0	8.0	0.0	0-13.72							68.0	32.0							
	Pigs	4.0	16.0	6.3	0.15-30.24							50.0	37.5	6.3			6.3			
	Broilers	4.0	8.0	0.0	0-24.71					7.7		61.5	30.8							
	Layers	8.0	8.0	0.0	0-28.5							27.3	63.6	9.1						
	Total	4.0	8.0	1.5	0.03-8.28					1.5		55.4	38.5	3.1			1.5			
Kanamycin	Cattle	64.0	128.0	24.0	9.35-45.13									8.0	16.0	52.0	20.0	4.0		
	Pigs	64.0	>512	43.8	19.75-70.13										12.5	43.8	25.0			18.8
	Broilers	64.0	128.0	15.4	1.92-45.45								7.7		15.4	61.5	7.7			7.7
	Layers	64.0	256.0	45.5	16.74-76.63										18.2	36.4	27.3	18.2		
	Total	64.0	256.0	30.8	19.91-43.45								1.5	3.1	15.4	49.2	20.0	4.6		6.2
Oxytetracycline	Cattle	0.5	>64	16.0	4.53-36.09			24.0	60.0								16.0			
	Pigs	0.5	>64	50.0	24.65-75.35			25.0	25.0					6.3	6.3		37.5			
	Broilers	32.0	>64	61.5	31.57-86.15			15.4	23.1					7.7	7.7	7.7	38.5			
	Layers	0.25	2.0	9.1	0.22-41.28			54.5	27.3		9.1						9.1			
	Total	0.5	>64	32.3	21.23-45.06			27.7	38.5		1.5			3.1	3.1	1.5	24.6			
Chloramphenicol	Cattle	4.0	4.0	0.0	0-13.72							92.0	8.0							
	Pigs	4.0	32.0	12.5	1.55-38.35							81.3	6.3		12.5					
	Broilers	4.0	8.0	7.7	0.19-36.03						7.7	61.5	23.1		7.7					
	Layers	4.0	4.0	0.0	0-28.5							90.9	9.1							
	Total	4.0	8.0	4.6	0.96-12.91						1.5	83.1	10.8		4.6					
Bacitracin	Cattle	256.0	>512	-	-											4.0	8.0	64.0	4.0	20.0
	Pigs	256.0	>512	-	-												18.8	43.8	18.8	18.8
	Broilers	256.0	>512	-	-								7.7	15.4		15.4		30.8		30.8
	Layers	256.0	>512	-	-												9.1	45.5	27.3	18.2
	Total	256.0	>512	-	-								1.5	3.1		4.6	9.2	49.2	10.8	21.5

Table4.2. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=25),pigs(n=16), broilers(n=13) and layers(n=11) in 2015_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	2.0	2.0	-	-				20.0	4.0	76.0									
	Pigs	2.0	2.0	-	-				12.5	18.8	68.8									
	Broilers	2.0	16.0	-	-				7.7	30.8	46.2			7.7		7.7				
	Layers	2.0	2.0	-	-				36.4	9.1	54.5									
	Total	2.0	2.0	-	-				18.5	13.8	64.6			1.5		1.5				
Erythromycin	Cattle	4.0	4.0	8.0	0.98-26.04		16.0				20.0	56.0	8.0							
	Pigs	4.0	>128	37.5	15.19-64.57		6.3	6.3			31.3	18.8	6.3				6.3	25.0		
	Broilers	4.0	>128	38.5	13.85-68.43		30.8		15.4			15.4	7.7					30.8		
	Layers	1.0	4.0	9.1	0.22-41.28			18.2		45.5	9.1	18.2	9.1							
	Total	4.0	>128	21.5	12.3-33.49		13.8	4.6	3.1	7.7	16.9	32.3	7.7				1.5	12.3		
Tylosin	Cattle	4.0	8.0	0.0	0-13.72						28.0	32.0	40.0							
	Pigs	8.0	>256	31.3	11.01-58.67						12.5	25.0	31.3						31.3	
	Broilers	4.0	>256	30.8	9.09-61.43				7.7		23.1	23.1	15.4						30.8	
	Layers	4.0	8.0	0.0	0-28.5						36.4	27.3	36.4							
	Total	4.0	>256	13.8	6.53-24.67				1.5		24.6	27.7	32.3						13.8	
Lincomycin	Cattle	16.0	32.0	4.0	0.1-20.36				20.0		4.0		20.0	44.0	8.0				4.0	
	Pigs	16.0	>256	37.5	15.19-64.57				12.5				18.8	31.3					37.5	
	Broilers	16.0	>256	30.8	9.09-61.43						7.7	7.7	15.4	23.1		15.4			30.8	
	Layers	16.0	16.0	0.0	0-28.5			9.1	27.3			9.1		45.5	9.1					
	Total	16.0	>256	16.9	8.76-28.27			1.5	15.4		3.1	3.1	15.4	36.9	4.6	3.1			16.9	
Enrofloxacin	Cattle	2.0	8.0	28.0	12.07-49.39				4.0	24.0	44.0	8.0	16.0	4.0						
	Pigs	4.0	16.0	56.3	29.87-80.25				6.3	12.5	25.0	31.3	12.5	12.5						
	Broilers	8.0	16.0	92.3	63.97-99.81					7.7		30.8	46.2	15.4						
	Layers	4.0	8.0	63.6	30.79-89.08				9.1	18.2	9.1	45.5	18.2							
	Total	4.0	8.0	53.8	41.03-66.3				4.6	16.9	24.6	24.6	21.5	7.7						
Salinomycin	Cattle	2.0	2.0	-	-					4.0	96.0									
	Pigs	2.0	4.0	-	-						87.5	12.5								
	Broilers	4.0	8.0	-	-						46.2	38.5	15.4							
	Layers	2.0	2.0	-	-					18.2	72.7	9.1								
	Total	2.0	4.0	-	-					4.6	80.0	12.3	3.1							

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table4.3. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=6), pigs(n=12) and broilers(n=36) in 2014_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	1.0	2.0	0.0	0-45.93		16.7		16.7	33.3	33.3									
	Pigs	1.0	2.0	0.0	0-26.47		8.3	16.7	16.7	33.3	25.0									
	Broilers	0.5	2.0	0.0	0-9.74		22.2	8.3	38.9	11.1	11.1	8.3								
	Layers				-															
	Total	0.5	2.0	0.0	0-6.61		18.5	9.3	31.5	18.5	16.7	5.6								
Dihydrostreptomycin	Cattle	64.0	128.0	33.3	4.32-77.73											66.7	33.3			
	Pigs	128.0	>512	58.3	27.66-84.84									8.3	8.3	25.0	16.7			41.7
	Broilers	32.0	128.0	13.9	4.66-29.5						11.1		2.8	33.3	27.8	11.1	8.3	2.8		2.8
	Layers				-															
	Total	32.0	>512	25.9	14.95-39.66						7.4		1.9	24.1	20.4	20.4	13.0	1.9		11.1
Gentamicin	Cattle	8.0	8.0	0.0	0-45.93							16.7	83.3							
	Pigs	4.0	8.0	0.0	0-26.47							50.0	41.7	8.3						
	Broilers	2.0	8.0	2.8	0.07-14.53				5.6	5.6	38.9	22.2	19.4	5.6	2.8					
	Layers				-															
	Total	4.0	8.0	1.9	0.04-9.9				3.7	3.7	25.9	27.8	31.5	5.6	1.9					
Kanamycin	Cattle	64.0	128.0	33.3	4.32-77.73										33.3	33.3	33.3			
	Pigs	64.0	>512	25.0	5.48-57.19									8.3	33.3	33.3	8.3			16.7
	Broilers	32.0	>512	33.3	18.55-50.98							5.6	11.1	25.0	22.2	2.8	5.6	2.8	5.6	19.4
	Layers				-															
	Total	32.0	>512	31.5	19.52-45.56							3.7	7.4	18.5	25.9	13.0	9.3	1.9	3.7	16.7
Oxytetracycline	Cattle	0.5	1.0	0.0	0-45.93				66.7	33.3										
	Pigs	0.5	>64	41.7	15.16-72.34			16.7	33.3	8.3						8.3	33.3			
	Broilers	16.0	>64	58.3	40.75-74.49		13.9	8.3	8.3	5.6	2.8		2.8	11.1	5.6	5.6	36.1			
	Layers				-															
	Total	2.0	>64	48.1	34.34-62.17		9.3	9.3	20.4	9.3	1.9		1.9	7.4	3.7	5.6	31.5			
Chloramphenicol	Cattle	8.0	16.0	0.0	0-45.93							33.3	50.0	16.7						
	Pigs	8.0	32.0	25.0	5.48-57.19							33.3	33.3	8.3	25.0					
	Broilers	4.0	16.0	8.3	1.75-22.47					13.9	27.8	19.4	22.2	8.3	2.8	2.8	2.8			
	Layers				-															
	Total	4.0	32.0	11.1	4.18-22.64					9.3	18.5	24.1	27.8	9.3	7.4	1.9	1.9			
Bacitracin	Cattle	256.0	512.0	-	-												33.3	50.0	16.7	
	Pigs	256.0	256.0	-	-									25.0			16.7	58.3		
	Broilers	64.0	>512	-	-						5.6	11.1	8.3	13.9	8.3	11.1	13.9	5.6	11.1	11.1
	Layers				-															
	Total	128.0	512.0	-	-						3.7	7.4	5.6	14.8	5.6	7.4	16.7	22.2	9.3	7.4

Table4.3. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=6), pigs(n=12) and broilers(n=36) in 2014_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	1.0	2.0	-	-					50.0	50.0									
	Pigs	2.0	8.0	-	-					25.0	41.7	16.7	16.7							
	Broilers	0.5	4.0	-	-		11.1	27.8	30.6	19.4		5.6	5.6							
	Layers				-															
	Total	1.0	4.0	-	-		7.4	18.5	20.4	24.1	14.8	7.4	7.4							
Erythromycin	Cattle	0.25	1.0	0.0	0-45.93			50.0	16.7	33.3										
	Pigs	8.0	>128	58.3	27.66-84.84		8.3	25.0				8.3	25.0	16.7				16.7		
	Broilers	1.0	>128	30.6	16.34-48.11		25.0	8.3	5.6	16.7	8.3	5.6	5.6	5.6			2.8	16.7		
	Layers				-															
	Total	1.0	>128	33.3	21.09-47.48		18.5	16.7	5.6	14.8	5.6	5.6	9.3	7.4			1.9	14.8		
Tylosin	Cattle	8.0	8.0	0.0	0-45.93								100							
	Pigs	8.0	>256	16.7	2.08-48.42						8.3	33.3	25.0	16.7					16.7	
	Broilers	2.0	>256	19.4	8.19-36.03			2.8	8.3	16.7	30.6	11.1	5.6	5.6		5.6			13.9	
	Layers				-															
	Total	4.0	>256	16.7	7.91-29.3			1.9	5.6	11.1	22.2	14.8	20.4	7.4		3.7			13.0	
Lincomycin	Cattle	32.0	64.0	0.0	0-45.93										83.3	16.7				
	Pigs	64.0	>256	50.0	21.09-78.91					8.3			8.3		25.0	8.3			50.0	
	Broilers	8.0	>256	19.4	8.19-36.03		11.1	13.9	8.3	2.8		11.1	5.6	25.0	2.8			8.3	11.1	
	Layers				-															
	Total	16.0	>256	24.1	13.48-37.65		7.4	9.3	5.6	3.7		7.4	5.6	16.7	16.7	3.7		5.6	18.5	
Enrofloxacin	Cattle	0.5	1.0	0.0	0-45.93				83.3	16.7										
	Pigs	1.0	4.0	25.0	5.48-57.19			25.0	16.7	33.3		25.0								
	Broilers	1.0	4.0	13.9	4.66-29.5		2.8	13.9	13.9	19.4	36.1	11.1	2.8							
	Layers				-															
	Total	1.0	4.0	14.8	6.61-27.12		1.9	14.8	22.2	22.2	24.1	13.0	1.9							
Salinomycin	Cattle	1.0	2.0	-	-					50.0	50.0									
	Pigs	2.0	2.0	-	-					25.0	75.0									
	Broilers	2.0	8.0	-	-					22.2	30.6	19.4	27.8							
	Layers				-															
	Total	2.0	8.0	-	-					25.9	42.6	13.0	18.5							

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table4.4. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=6), pigs(n=11) and broilers(n=31) in 2015_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Ampicillin	Cattle	1.0	2.0	0.0	0-45.93			16.7	16.7	33.3	33.3									
	Pigs	2.0	2.0	0.0	0-28.5				18.2	18.2	63.6									
	Broilers	2.0	4.0	0.0	0-11.22			3.2	6.5	25.8	35.5	25.8	3.2							
	Layers				-															
	Total	2.0	4.0	0.0	0-7.4			4.2	10.4	25.0	41.7	16.7	2.1							
Dihydrostreptomycin	Cattle	32.0	64.0	0.0	0-45.93										83.3	16.7				
	Pigs	32.0	64.0	0.0	0-28.5										81.8	18.2				
	Broilers	32.0	128.0	16.1	5.45-33.73										58.1	25.8	6.5		3.2	6.5
	Layers				-															
	Total	32.0	128.0	10.4	3.46-22.66										66.7	22.9	4.2		2.1	4.2
Gentamicin	Cattle	4.0	16.0	0.0	0-45.93							50.0	33.3	16.7						
	Pigs	8.0	16.0	0.0	0-28.5							36.4	45.5	18.2						
	Broilers	8.0	16.0	3.2	0.08-16.71							25.8	54.8	16.1	3.2					
	Layers				-															
	Total	8.0	16.0	2.1	0.05-11.07							31.3	50.0	16.7	2.1					
Kanamycin	Cattle	64.0	128.0	16.7	0.42-64.13									33.3		50.0	16.7			
	Pigs	128.0	256.0	72.7	39.02-93.98									9.1	9.1	9.1	36.4	36.4		
	Broilers	64.0	512.0	35.5	19.22-54.64										25.8	38.7	22.6		3.2	9.7
	Layers				-															
	Total	64.0	256.0	41.7	27.61-56.79									6.3	18.8	33.3	25.0	8.3	2.1	6.3
Oxytetracycline	Cattle	0.5	32.0	16.7	0.42-64.13			16.7	66.7						16.7					
	Pigs	0.5	0.5	9.1	0.22-41.28			45.5	45.5							9.1				
	Broilers	64.0	>64	64.5	45.36-80.78		3.2	16.1	12.9				3.2	3.2	6.5	12.9	41.9			
	Layers				-															
	Total	0.5	>64	45.8	31.37-60.83		2.1	22.9	27.1				2.1	2.1	6.3	10.4	27.1			
Chloramphenicol	Cattle	4.0	8.0	0.0	0-45.93							66.7	33.3							
	Pigs	4.0	4.0	0.0	0-28.5							100								
	Broilers	4.0	8.0	6.5	0.79-21.43						16.1	64.5	12.9		3.2		3.2			
	Layers				-															
	Total	4.0	8.0	4.2	0.5-14.26						10.4	72.9	12.5		2.1		2.1			
Bacitracin	Cattle	512.0	>512	-	-													16.7	66.7	16.7
	Pigs	256.0	>512	-	-												9.1	45.5	27.3	18.2
	Broilers	256.0	>512	-	-							6.5	3.2	3.2	3.2		6.5	29.0	19.4	29.0
	Layers				-															
	Total	512.0	>512	-	-							4.2	2.1	2.1	2.1		6.3	31.3	27.1	25.0

Table4.4. Distribution of MICs and resistance(%) in *Enterococcus faecium* from cattle(n=6), pigs(n=11) and broilers(n=31) in 2015_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.06	0.13	0.25	0.5	1	2	4	8	16	32	64	128	256	512	>512
Virginiamycin	Cattle	2.0	2.0	-	-						100									
	Pigs	2.0	2.0	-	-					9.1	90.9									
	Broilers	1.0	2.0	-	-			3.2	16.1	38.7	35.5		3.2	3.2						
	Layers				-															
	Total	2.0	2.0	-	-			2.1	10.4	27.1	56.3		2.1	2.1						
Erythromycin	Cattle	2.0	16.0	33.3	4.32-77.73			16.7			33.3	16.7	16.7	16.7						
	Pigs	8.0	8.0	54.5	23.37-83.26			18.2			9.1	18.2	45.5	9.1						
	Broilers	2.0	>128	35.5	19.22-54.64		29.0	6.5	3.2	3.2	9.7	12.9	3.2	3.2		3.2		25.8		
	Layers				-															
	Total	4.0	>128	39.6	25.76-54.74		18.8	10.4	2.1	2.1	12.5	14.6	14.6	6.3		2.1		16.7		
Tylosin	Cattle	8.0	16.0	0.0	0-45.93								66.7	33.3						
	Pigs	8.0	16.0	0.0	0-28.5						9.1	27.3	36.4	27.3						
	Broilers	4.0	>256	22.6	9.59-41.1					9.7	22.6	22.6	16.1	6.5					22.6	
	Layers				-															
	Total	8.0	>256	14.6	6.07-27.77					6.3	16.7	20.8	27.1	14.6					14.6	
Lincomycin	Cattle	32.0	32.0	0.0	0-45.93									16.7	83.3					
	Pigs	32.0	64.0	9.1	0.22-41.28								18.2	18.2	45.5	9.1			9.1	
	Broilers	32.0	>256	29.0	14.22-48.04				12.9	6.5	9.7			19.4	16.1	6.5	6.5	6.5	16.1	
	Layers				-															
	Total	32.0	>256	20.8	10.46-35				8.3	4.2	6.3		4.2	18.8	31.3	6.3	4.2	4.2	12.5	
Enrofloxacin	Cattle	1.0	8.0	16.7	0.42-64.13					50.0	33.3		16.7							
	Pigs	1.0	2.0	0.0	0-28.5			9.1	27.3	45.5	18.2									
	Broilers	4.0	8.0	71.0	51.96-85.78					19.4	9.7	54.8	16.1							
	Layers				-															
	Total	2.0	8.0	47.9	33.28-62.82			2.1	6.3	29.2	14.6	35.4	12.5							
Salinomycin	Cattle	2.0	2.0	-	-						100									
	Pigs	2.0	2.0	-	-					18.2	81.8									
	Broilers	4.0	8.0	-	-			3.2		12.9	32.3	29.0	22.6							
	Layers				-															
	Total	2.0	8.0	-	-			2.1		12.5	52.1	18.8	14.6							

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table5.1. Distribution of MICs and resistance(%) in *Campylobacter jejuni* from cattle(n=60), pigs(n=1), broilers(n=48) and layers(n=49) in 2014_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	32.0	13.3	5.93-24.6			1.7	3.3	8.3	11.7	11.7	30.0	16.7	3.3	13.3				
	Broilers	8.0	64.0	20.8	10.46-35						14.6	6.3	20.8	29.2	8.3	8.3	12.5			
	Layers	4.0	64.0	30.6	18.25-45.42					2.0		28.6	24.5	14.3		8.2	18.4	4.1		
	Total	4.0	64.0	20.9	14.83-28.07			0.6	1.9	3.8	8.9	15.2	25.3	19.6	3.8	10.1	9.5	1.3		
Gentamicin	Cattle	1.0	1.0	-	-			1.7	3.3	26.7	60.0	6.7	1.7							
	Pigs	2.0	2.0	-	-							100.0								
	Broilers	1.0	1.0	-	-				2.1	37.5	60.4									
	Layers	1.0	1.0	-	-				4.1	34.7	61.2									
	Total	1.0	1.0	-	-			0.6	3.2	32.3	60.1	3.2	0.6							
Streptomycin	Cattle	1.0	2.0	8.3	2.76-18.39					16.7	63.3	11.7					5.0		3.3	
	Pigs	1.0	1.0	0.0	0-97.5						100									
	Broilers	1.0	1.0	0.0	0-7.4				2.1	16.7	77.1	2.1		2.1						
	Layers	1.0	1.0	0.0	0-7.26					38.8	55.1	6.1								
	Total	1.0	2.0	3.2	1.03-7.24				0.6	23.4	65.2	7.0		0.6			1.9		1.3	
Erythromycin	Cattle	0.25	1.0	0.0	-			3.3	48.3	26.7	20.0	1.7								
	Pigs	0.25	0.3	0.0	-				100											
	Broilers	0.25	1.0	0.0	-			18.8	33.3	33.3	14.6									
	Layers	0.25	0.5	0.0	-			18.4	44.9	30.6	6.1									
	Total	0.25	1.0	0.0	-			12.7	43.0	29.7	13.9	0.6								
Tetracycline	Cattle	64.0	>128	68.3	55.04-79.75			26.7	5.0							11.7	26.7	16.7	13.3	
	Pigs	8.0	8.0	0.0	0-97.5									100.0						
	Broilers	≦0.12	128.0	27.1	15.27-41.85			56.3	4.2	12.5					2.1	4.2	8.3	10.4	2.1	
	Layers	≦0.12	>128	40.8	26.99-55.79			51.0	4.1	4.1					2.0	6.1	16.3	6.1	10.2	
	Total	0.5	128.0	46.8	38.85-54.95			43.0	4.4	5.1				0.6	1.3	7.6	17.7	11.4	8.9	
Nalidixic acid	Cattle	8.0	128.0	43.3	30.58-56.76							15.0	31.7	10.0		8.3	8.3	16.7	10.0	
	Pigs	4.0	4.0	0.0	0-97.5								100							
	Broilers	8.0	>128	47.9	33.24-62.9							8.3	37.5	6.3		6.3	8.3	18.8	14.6	
	Layers	4.0	128.0	24.5	13.34-38.87							24.5	40.8	10.2			4.1	12.2	8.2	
	Total	4.0	>128	38.6	30.97-46.69							15.8	36.7	8.9		5.1	7.0	15.8	10.8	
Ciprofloxacin	Cattle	0.12	16.0	43.3	30.58-56.76		13.3	36.7	3.3			3.3	5.0	18.3	16.7	3.3				
	Pigs	0.12	0.1	0.0	0-97.5			100												
	Broilers	0.5	32.0	45.8	31.37-60.83		6.3	35.4	4.2	8.3				22.9	10.4	12.5				
	Layers	0.12	16.0	24.5	13.34-38.87		6.1	51.0	12.2	6.1				8.2	12.2	4.1				
	Total	0.12	16.0	38.0	30.38-46.03		8.9	41.1	6.3	4.4		1.3	1.9	16.5	13.3	6.3				
Chloramphenicol	Cattle	1.0	4.0	6.7	1.84-16.2			1.7		6.7	61.7	16.7	5.0	1.7		5.0	1.7			
	Pigs	1.0	1.0	0.0	0-97.5						100									
	Broilers	2.0	4.0	0.0	0-7.4					4.2	43.8	37.5	14.6							
	Layers	1.0	2.0	0.0	0-7.26					2.0	67.3	30.6								
	Total	1.0	2.0	2.5	0.69-6.36			0.6		4.4	58.2	27.2	6.3	0.6		1.9	0.6			

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table5.2. Distribution of MICs and resistance(%) in *Campylobacter jejuni* from cattle(n=45), pigs(n=0), broilers(n=49) and layers(n=62) in 2015_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	2.0	8.0	4.4	0.54-15.15				6.7	4.4	15.6	31.1	22.2	15.6		4.4				
	Pigs				-															
	Broilers	4.0	64.0	26.5	14.94-41.09					8.2	6.1	6.1	32.7	16.3	4.1	14.3	12.2			
	Layers	8.0	64.0	41.9	29.49-55.21					1.6	6.5	19.4	19.4	11.3		11.3	25.8	1.6		3.2
	Total	4.0	64.0	26.3	19.56-33.93				1.9	4.5	9.0	18.6	24.4	14.1	1.3	10.3	14.1	0.6		1.3
Gentamicin	Cattle	0.5	1.0	-	-				28.9	33.3	37.8									
	Pigs				-															
	Broilers	0.5	0.5	-	-			6.1	18.4	69.4	2.0		4.1							
	Layers	0.5	0.5	-	-			3.2	14.5	72.6	9.7									
	Total	0.5	1.0	-	-			3.2	19.9	60.3	15.4		1.3							
Streptomycin	Cattle	1.0	2.0	4.4	0.54-15.15				2.2	33.3	35.6	24.4					4.4			
	Pigs				-															
	Broilers	1.0	2.0	0.0	0-7.26				6.1	36.7	46.9	6.1	4.1							
	Layers	1.0	2.0	0.0	0-5.78				4.8	32.3	50.0	11.3	1.6							
	Total	1.0	2.0	1.3	0.15-4.56				4.5	34.0	44.9	13.5	1.9				1.3			
Erythromycin	Cattle	0.5	1.0	0.0	-			2.2	35.6	40.0	13.3	8.9								
	Pigs				-															
	Broilers	0.25	0.5	0.0	-			8.2	55.1	28.6	4.1	4.1								
	Layers	0.5	2.0	0.0	-			4.8	32.3	33.9	16.1	12.9								
	Total	0.5	1.0	0.0	-			5.1	40.4	34.0	11.5	9.0								
Tetracycline	Cattle	32.0	>128	60.0	44.33-74.31			33.3	4.4	2.2					4.4	8.9	13.3	11.1	22.2	
	Pigs				-															
	Broilers	16.0	128.0	53.1	38.27-67.47			22.4	12.2	2.0			4.1	6.1	6.1	12.2	18.4	8.2	8.2	
	Layers	0.25	64.0	21.0	11.66-33.19			48.4	12.9	11.3	4.8		1.6			6.5	6.5	4.8	3.2	
	Total	0.5	>128	42.3	34.44-50.48			35.9	10.3	5.8	1.9		1.9	1.9	3.2	9.0	12.2	7.7	10.3	
Nalidixic acid	Cattle	8.0	>128	37.8	23.76-53.46						2.2	22.2	24.4	13.3			15.6	4.4	17.8	
	Pigs				-															
	Broilers	4.0	>128	24.5	13.34-38.87						4.1	10.2	49.0	12.2				6.1	18.4	
	Layers	4.0	128.0	19.4	10.42-31.37							6.5	53.2	19.4	1.6	4.8	3.2	6.5	4.8	
	Total	4.0	>128	26.3	19.56-33.93						1.9	12.2	43.6	15.4	0.6	1.9	5.8	5.8	12.8	
Ciprofloxacin	Cattle	0.25	16.0	35.6	21.84-51.29		24.4	24.4	15.6					20.0	6.7	8.9				
	Pigs				-															
	Broilers	0.12	16.0	24.5	13.34-38.87		8.2	44.9	22.4					6.1	12.2	2.0		4.1		
	Layers	0.25	16.0	16.1	8.01-27.67		1.6	41.9	30.6	6.5	3.2			4.8	8.1		3.2			
	Total	0.25	16.0	24.4	17.85-31.87		10.3	37.8	23.7	2.6	1.3			9.6	9.0	3.2	1.3	1.3		
Chloramphenicol	Cattle	1.0	2.0	0.0	0-7.88					11.1	40.0	42.2	6.7							
	Pigs				-															
	Broilers	2.0	4.0	0.0	0-7.26				2.0	6.1	38.8	42.9	8.2	2.0						
	Layers	2.0	2.0	0.0	0-5.78			3.2			35.5	51.6	9.7							
	Total	2.0	2.0	0.0	0-2.34			1.3	0.6	5.1	37.8	46.2	8.3	0.6						

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table5.3. Distribution of MICs and resistance(%) in *Campylobacter jejuni* from cattle(n=132) and broilers(n=57) in 2014_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	32.0	12.9	7.68-19.82					3.0	5.3	21.2	28.0	15.2	14.4	9.1	2.3		1.5	
	Broilers	4.0	32.0	17.5	8.74-29.91					3.5	21.1	12.3	21.1	17.5	7.0	10.5	1.8	1.8	1.8	1.8
	Total	4.0	32.0	14.3	9.63-20.11					3.2	10.1	18.5	25.9	15.9	12.2	9.5	2.1	0.5	1.6	0.5
Gentamicin	Cattle	1.0	1.0	-	-				0.8	28.8	65.9	4.5								
	Broilers	0.5	1.0	-	-			3.5	19.3	35.1	33.3	8.8								
	Total	1.0	1.0	-	-			1.1	6.3	30.7	56.1	5.8								
Streptomycin	Cattle	1.0	4.0	3.8	1.24-8.62					5.3	44.7	20.5	20.5	5.3				0.8	3.0	
	Broilers	1.0	2.0	3.5	0.42-12.11			3.5	8.8	28.1	43.9	8.8	1.8	1.8				1.8	1.8	
	Total	1.0	4.0	3.7	1.5-7.49			1.1	2.6	12.2	44.4	16.9	14.8	4.2				1.1	2.6	
Erythromycin	Cattle	0.5	1.0	0.0	-				36.4	46.2	13.6	3.0	0.8							
	Broilers	0.25	1.0	0.0	-			7.0	47.4	35.1	7.0	1.8	1.8							
	Total	0.5	1.0	0.0	-			2.1	39.7	42.9	11.6	2.6	1.1							
Tetracycline	Cattle	8.0	>64	49.2	40.43-58.09		7.6	21.2	6.8	6.1	6.8		0.8	1.5		3.8	7.6	37.9		
	Broilers	1.0	>64	38.6	25.99-52.43		12.3	10.5	12.3	14.0	5.3	3.5	3.5		1.8	3.5	8.8	24.6		
	Total	1.0	>64	46.0	38.77-53.42		9.0	18.0	8.5	8.5	6.3	1.1	1.6	1.1	0.5	3.7	7.9	33.9		
Nalidixic acid	Cattle	32.0	>128	50.8	41.91-59.57							1.5	19.7	12.1	15.9	2.3	3.8	25.0	19.7	
	Broilers	8.0	>128	29.8	18.42-43.41				3.5		1.8	1.8	36.8	19.3	7.0		8.8	10.5	10.5	
	Total	16.0	>128	44.4	37.23-51.84				1.1		0.5	1.6	24.9	14.3	13.2	1.6	5.3	20.6	16.9	
Ciprofloxacin	Cattle	0.5	32.0	49.2	40.43-58.09		0.8	21.2	25.8	2.3	0.8			8.3	30.3	7.6	1.5	1.5		
	Broilers	0.25	32.0	29.8	18.42-43.41		3.5	28.1	24.6	10.5	1.8	1.8	1.8	7.0	7.0	10.5	3.5			
	Total	0.25	32.0	43.4	36.21-50.78		1.6	23.3	25.4	4.8	1.1	0.5	0.5	7.9	23.3	8.5	2.1	1.1		
Chloramphenicol	Cattle	2.0	2.0	0.0	0-2.76					0.8	34.1	59.1	6.1							
	Broilers	2.0	4.0	1.8	0.04-9.4					8.8	33.3	47.4	8.8			1.8				
	Total	2.0	2.0	0.5	0.01-2.92					3.2	33.9	55.6	6.9			0.5				

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table5.4. Distribution of MICs and resistance(%) in *Campylobacter jejuni* from cattle(n=157) and broilers(n=94) in 2015_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	4.0	16.0	8.9	4.96-14.51				3.2	4.5	10.2	29.9	33.8	8.3	1.3	5.1	1.9	1.9		
	Broilers	4.0	32.0	19.1	11.76-28.57					2.1	6.4	23.4	33.0	13.8	2.1	12.8	6.4			
	Total	4.0	32.0	12.7	8.88-17.52				2.0	3.6	8.8	27.5	33.5	10.4	1.6	8.0	3.6	1.2		
Gentamicin	Cattle	0.5	1.0	-	-				7.6	63.7	26.8	1.9								
	Broilers	0.5	1.0	-	-				6.4	68.1	25.5									
	Total	0.5	1.0	-	-				7.2	65.3	26.3	1.2								
Streptomycin	Cattle	1.0	2.0	3.2	1.04-7.28				0.6	17.8	68.2	7.6	2.5						3.2	
	Broilers	1.0	1.0	2.1	0.25-7.48					36.2	58.5	3.2							2.1	
	Total	1.0	2.0	2.8	1.12-5.67				0.4	24.7	64.5	6.0	1.6						2.8	
Erythromycin	Cattle	0.5	1.0	1.3	-			1.3	21.7	58.0	13.4	3.2	1.3					1.3		
	Broilers	0.5	1.0	0.0	-			8.5	33.0	34.0	18.1	5.3	1.1							
	Total	0.5	1.0	0.8	-			4.0	25.9	49.0	15.1	4.0	1.2					0.8		
Tetracycline	Cattle	32.0	>64	52.2	44.12-60.26		19.7	24.2	3.2		0.6				1.3	5.7	12.1	33.1		
	Broilers	0.12	64.0	28.7	19.85-38.98		16.0	38.3	16.0	1.1					1.1	4.3	17.0	6.4		
	Total	0.3	>64	43.4	37.2-49.81		18.3	29.5	8.0	0.4	0.4				1.2	5.2	13.9	23.1		
Nalidixic acid	Cattle	4.0	128.0	42.7	34.82-50.81						0.6	20.4	30.6	5.7		1.3	14.0	19.7	7.6	
	Broilers	4.0	128.0	27.7	18.92-37.85							20.2	37.2	13.8	1.1	2.1	6.4	12.8	6.4	
	Total	4.0	128.0	37.1	31.06-43.36						0.4	20.3	33.1	8.8	0.4	1.6	11.2	17.1	7.2	
Ciprofloxacin	Cattle	0.25	16.0	40.8	33-48.89	1.9	5.1	38.2	10.8	1.3	1.3	0.6	1.3	19.1	17.2	2.5	0.6			
	Broilers	0.25	16.0	26.6	18-36.71		3.2	39.4	17.0	13.8				7.4	16.0	2.1	1.1			
	Total	0.25	16.0	35.5	29.54-41.73	1.2	4.4	38.6	13.1	6.0	0.8	0.4	0.8	14.7	16.7	2.4	0.8			
Chloramphenicol	Cattle	1.0	2.0	1.3	0.15-4.53					0.6	57.3	36.9	3.2	0.6		0.6	0.6			
	Broilers	1.0	2.0	0.0	0-3.85					3.2	52.1	35.1	9.6							
	Total	1.0	2.0	0.8	0.09-2.85					1.6	55.4	36.3	5.6	0.4		0.4	0.4			

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table6.1. Distribution of MICs and resistance(%) in *Campylobacter coli* from cattle(n=6), pigs(n=59), broilers(n=8) and layers(n=9) in 2014_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	8.0	16.0	0.0	0-45.93					33.3				33.3	33.3					
	Pigs	8.0	16.0	5.1	1.06-14.15						6.8	25.4	11.9	35.6	15.3		3.4	1.7		
	Broilers	16.0	256.0	37.5	8.52-75.52						12.5	12.5			37.5	12.5			25.0	
	Layers	8.0	16.0	0.0	0-33.63								33.3	55.6	11.1					
	Total	8.0	16.0	7.3	2.73-15.25					2.4	6.1	19.5	12.2	34.1	18.3	1.2	2.4	1.2	2.4	
Gentamicin	Cattle	2.0	2.0	-	-						16.7	83.3								
	Pigs	2.0	4.0	-	-						10.2	74.6	15.3							
	Broilers	1.0	1.0	-	-					25.0	75.0									
	Layers	1.0	1.0	-	-						100									
	Total	2.0	4.0	-	-					2.4	26.8	59.8	11.0							
Streptomycin	Cattle	2.0	8.0	0.0	0-45.93							50.0	33.3	16.7						
	Pigs	128.0	>128	54.2	40.75-67.29							5.1	20.3	20.3			3.4	23.7	27.1	
	Broilers	1.0	>128	25.0	3.18-65.09						50.0	25.0							25.0	
	Layers	1.0	2.0	0.0	0-33.63					11.1	66.7	22.2								
	Total	8.0	>128	41.5	30.68-52.88					1.2	12.2	12.2	17.1	15.9			2.4	17.1	22.0	
Erythromycin	Cattle	2.0	>128	33.3	-						16.7	50.0							33.3	
	Pigs	2.0	>128	44.1	-				1.7	8.5	20.3	25.4						5.1	39.0	
	Broilers	0.3	32.0	12.5	-			37.5	12.5		25.0		12.5			12.5				
	Layers	0.5	1.0	0.0	-			11.1	11.1	55.6	22.2									
	Total	2.0	>128	35.4	-			4.9	3.7	12.2	20.7	22.0	1.2			1.2		3.7	30.5	
Tetracycline	Cattle	>128	>128	100.0	54.07-100												33.3		66.7	
	Pigs	64.0	>128	86.4	74.78-94.14				3.4	6.8				3.4	5.1	11.9	32.2	25.4	11.9	
	Broilers	32.0	>128	62.5	24.48-91.48			37.5								12.5	12.5	12.5	25.0	
	Layers	≦0.12	64.0	22.2	2.81-60.01			66.7	11.1								22.2			
	Total	64.0	>128	78.0	67.45-86.54			11.0	3.7	4.9				2.4	3.7	9.8	29.3	19.5	15.9	
Nalidixic acid	Cattle	64.0	>128	66.7	22.27-95.68									16.7	16.7		33.3	16.7	16.7	
	Pigs	16.0	128.0	49.2	35.89-62.51								16.9	32.2	1.7	5.1	15.3	25.4	3.4	
	Broilers	4.0	64.0	25.0	3.18-65.09							25.0	25.0	25.0			25.0			
	Layers	4.0	>128	11.1	0.28-48.25							11.1	66.7	11.1					11.1	
	Total	8.0	128.0	43.9	32.95-55.31							3.7	22.0	28.0	2.4	3.7	15.9	19.5	4.9	
Ciprofloxacin	Cattle	8.0	16.0	66.7	22.27-95.68				33.3					33.3	33.3					
	Pigs	0.5	16.0	49.2	35.89-62.51			18.6	27.1	5.1			3.4	11.9	25.4	8.5				
	Broilers	0.3	8.0	25.0	3.18-65.09			25.0	37.5		12.5			25.0						
	Layers	0.3	32.0	11.1	0.28-48.25			33.3	44.4	11.1						11.1				
	Total	0.3	16.0	43.9	32.95-55.31			19.5	30.5	4.9	1.2		2.4	13.4	20.7	7.3				
Chloramphenicol	Cattle	4.0	4.0	0.0	0-45.93							33.3	66.7							
	Pigs	2.0	32.0	16.9	8.43-28.97						11.9	52.5	13.6	5.1	3.4	11.9	1.7			
	Broilers	2.0	2.0	0.0	0-36.95						12.5	87.5								
	Layers	2.0	2.0	0.0	0-33.63						33.3	66.7								
	Total	2.0	16.0	12.2	6-21.29						13.4	56.1	14.6	3.7	2.4	8.5	1.2			

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table6.2. Distribution of MICs and resistance(%) in *Campylobacter coli* from cattle(n=6), pigs(n=38), broilers(n=12) and layers(n=12) in 2015_Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	16.0	64.0	16.7	0.42-64.13									16.7	66.7		16.7			
	Pigs	4.0	16.0	7.9	1.65-21.38						18.4	26.3	21.1	13.2	13.2	2.6		5.3		
	Broilers	16.0	64.0	41.7	15.07-73							16.7	25.0		16.7	25.0	8.3	8.3		
	Layers	16.0	64.0	16.7	2.08-48.42						8.3			16.7	58.3		8.3	8.3		
	Total	8.0	64.0	16.2	8.36-27.11						11.8	17.6	16.2	11.8	26.5	5.9	4.4	5.9		
Gentamicin	Cattle	1.0	1.0	-	-						100									
	Pigs	1.0	2.0	-	-					10.5	50.0	39.5								
	Broilers	0.5	1.0	-	-				8.3	50.0	41.7									
	Layers	1.0	1.0	-	-					41.7	50.0	8.3								
	Total	1.0	2.0	-	-				1.5	22.1	52.9	23.5								
Streptomycin	Cattle	2.0	>128	50.0	11.81-88.19						16.7	33.3						33.3	16.7	
	Pigs	128.0	>128	71.1	54.09-84.58							7.9	18.4	2.6		2.6	5.3	42.1	21.1	
	Broilers	1.0	2.0	0.0	0-26.47					33.3	16.7	50.0								
	Layers	2.0	4.0	0.0	0-26.47					16.7	25.0	41.7	16.7							
	Total	4.0	>128	44.1	32.08-56.69					8.8	8.8	23.5	13.2	1.5		1.5	2.9	26.5	13.2	
Erythromycin	Cattle	2.0	>128	16.7	-							66.7	16.7						16.7	
	Pigs	2.0	>128	18.4	-				7.9	7.9	28.9	31.6	2.6	2.6					18.4	
	Broilers	0.5	1.0	0.0	-				25.0	41.7	33.3									
	Layers	1.0	2.0	0.0	-			8.3	16.7	8.3	50.0	16.7								
	Total	1.0	>128	11.8	-			1.5	11.8	13.2	30.9	26.5	2.9	1.5					11.8	
Tetracycline	Cattle	2.0	>128	50.0	11.81-88.19				33.3			16.7					33.3		16.7	
	Pigs	64.0	128.0	78.9	62.68-90.45			5.3	5.3	5.3		2.6	2.6		7.9	13.2	34.2	15.8	7.9	
	Broilers	64.0	128.0	58.3	27.66-84.84			25.0	16.7								25.0	33.3		
	Layers	0.3	>128	25.0	5.48-57.19			33.3	25.0		16.7				8.3				16.7	
	Total	32.0	128.0	63.2	50.66-74.62			13.2	13.2	2.9	2.9	2.9	1.5		5.9	7.4	26.5	14.7	8.8	
Nalidixic acid	Cattle	128.0	128.0	100.0	54.07-100												33.3	66.7		
	Pigs	64.0	>128	57.9	40.82-73.7								10.5	26.3	5.3		13.2	34.2	10.5	
	Broilers	4.0	128.0	50.0	21.09-78.91							16.7	33.3				25.0	16.7	8.3	
	Layers	4.0	32.0	16.7	2.08-48.42							8.3	41.7	33.3		16.7				
	Total	32.0	128.0	52.9	40.44-65.17							4.4	19.1	20.6	2.9	2.9	14.7	27.9	7.4	
Ciprofloxacin	Cattle	32.0	32.0	100.0	54.07-100										16.7	83.3				
	Pigs	8.0	32.0	57.9	40.82-73.7		5.3	15.8	7.9	13.2				10.5	21.1	18.4	5.3	2.6		
	Broilers	0.3	32.0	50.0	21.09-78.91			33.3	16.7					16.7	16.7	16.7				
	Layers	0.3	64.0	16.7	2.08-48.42				50.0	25.0	8.3						16.7			
	Total	8.0	32.0	52.9	40.44-65.17		2.9	14.7	16.2	11.8	1.5			8.8	16.2	20.6	5.9	1.5		
Chloramphenicol	Cattle	4.0	4.0	0.0	0-45.93								100							
	Pigs	2.0	4.0	0.0	0-9.26						7.9	57.9	26.3	7.9						
	Broilers	2.0	2.0	0.0	0-26.47						25.0	66.7	8.3							
	Layers	2.0	4.0	0.0	0-26.47						8.3	66.7	25.0							
	Total	2.0	4.0	0.0	0-5.29						10.3	55.9	29.4	4.4						

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table6.3. Distribution of MICs and resistance(%) in *Campylobacter coli* from cattle(n=47), pigs(n=93) and broilers(n=10) in 2014_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	16.0	256.0	25.5	13.94-40.35								6.4	42.6	25.5	4.3	4.3	4.3	8.5	4.3
	Pigs	16.0	128.0	36.6	26.81-47.19						1.1	3.2	14.0	30.1	15.1	2.2	7.5	24.7	2.2	
	Broilers	4.0	4.0	0.0	0-30.85						20.0	10.0	60.0	10.0						
	Total	8.0	128.0	30.7	23.4-38.72						2.0	2.7	14.7	32.7	17.3	2.7	6.0	16.7	4.0	1.3
Gentamicin	Cattle	1.0	2.0	-	-					2.1	68.1	25.5	4.3							
	Pigs	2.0	2.0	-	-						15.1	76.3	8.6							
	Broilers	1.0	2.0	-	-						50.0	40.0	10.0							
	Total	2.0	2.0	-	-					0.7	34.0	58.0	7.3							
Streptomycin	Cattle	4.0	16.0	8.5	2.36-20.38						10.6	31.9	29.8	17.0	2.1			2.1	6.4	
	Pigs	128.0	>128	69.9	59.45-79.04					1.1	2.2	4.3	15.1	7.5		1.1	1.1	22.6	45.2	
	Broilers	2.0	4.0	10.0	0.25-44.51						20.0	50.0	20.0					10.0		
	Total	8.0	>128	46.7	38.48-54.99					0.7	6.0	16.0	20.0	10.0	0.7	0.7	0.7	15.3	30.0	
Erythromycin	Cattle	2.0	4.0	6.4	-					2.1	21.3	55.3	12.8	2.1				6.4		
	Pigs	2.0	>64	43.0	-					5.4	29.0	19.4	3.2					43.0		
	Broilers	0.5	2.0	10.0	-				40.0	40.0		10.0						10.0		
	Total	2.0	>64	29.3	-				2.7	6.7	24.7	30.0	6.0	0.7				29.3		
Tetracycline	Cattle	>64	>64	61.7	46.37-75.5			4.3	6.4	4.3	14.9	2.1	4.3	2.1			4.3	57.4		
	Pigs	>64	>64	80.6	71.14-88.11			1.1	11.8	2.2	2.2	1.1		1.1	1.1	10.8	18.3	50.5		
	Broilers	0.3	0.5	10.0	0.25-44.51		10.0	10.0	60.0	10.0							10.0			
	Total	64.0	>64	70.0	61.98-77.21		0.7	2.7	13.3	3.3	6.0	1.3	1.3	1.3	0.7	6.7	13.3	49.3		
Nalidixic acid	Cattle	128.0	>128	80.9	66.74-90.86								2.1	4.3	12.8	4.3	10.6	31.9	34.0	
	Pigs	64.0	>128	52.7	42.06-63.14								5.4	21.5	20.4	2.2	3.2	20.4	26.9	
	Broilers	64.0	128.0	70.0	34.75-93.33								30.0				30.0	40.0		
	Total	128.0	>128	62.7	54.38-70.45								6.0	14.7	16.7	2.7	7.3	25.3	27.3	
Ciprofloxacin	Cattle	16.0	32.0	78.7	64.13-89.5			6.4	10.6	4.3					51.1	23.4	4.3			
	Pigs	8.0	32.0	50.5	39.96-61.08			5.4	36.6	5.4	2.2			7.5	20.4	18.3	4.3			
	Broilers	8.0	16.0	70.0	34.75-93.33			30.0					10.0	10.0	40.0	10.0				
	Total	16.0	32.0	60.7	52.36-68.54			7.3	26.0	4.7	1.3		0.7	5.3	31.3	19.3	4.0			
Chloramphenicol	Cattle	4.0	8.0	4.3	0.51-14.55							27.7	61.7	6.4			4.3			
	Pigs	4.0	4.0	7.5	3.07-14.9						4.3	38.7	47.3	2.2	1.1	3.2	2.2	1.1		
	Broilers	2.0	8.0	10.0	0.25-44.51							80.0		10.0			10.0			
	Total	4.0	8.0	6.7	3.24-11.92						2.7	38.0	48.7	4.0	0.7	2.0	3.3	0.7		

White fields represent the range of dilutions tested.

MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.

MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table6.4. Distribution of MICs and resistance(%) in *Campylobacter coli* from cattle(n=81), pigs(n=65) and broilers(n=18) in 2015_Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval	Distribution(%) of MICs														
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	256	>256
Ampicillin	Cattle	16.0	16.0	1.2	0.03-6.69								1.2	43.2	54.3			1.2		
	Pigs	8.0	128.0	24.6	14.77-36.88						4.6	9.2	12.3	41.5	7.7		3.1	21.5		
	Broilers	8.0	8.0	0.0	0-18.54					11.1		33.3		50.0	5.6					
	Total	8.0	64.0	10.4	6.15-16.08					1.2	1.8	7.3	5.5	43.3	30.5		1.2	9.1		
Gentamicin	Cattle	1.0	2.0	-	-						71.6	27.2	1.2							
	Pigs	2.0	4.0	-	-						12.3	76.9	10.8							
	Broilers	1.0	2.0	-	-					11.1	72.2	11.1			5.6					
	Total	2.0	2.0	-	-					1.2	48.2	45.1	4.9		0.6					
Streptomycin	Cattle	4.0	8.0	3.7	0.77-10.45						1.2	40.7	33.3	21.0					3.7	
	Pigs	128.0	>128	72.3	59.8-82.69							3.1	9.2	15.4			1.5	23.1	47.7	
	Broilers	1.0	128.0	27.8	9.69-53.49						61.1	11.1				11.1		16.7		
	Total	4.0	>128	33.5	26.36-41.33						7.3	22.6	20.1	16.5		1.2	0.6	11.0	20.7	
Erythromycin	Cattle	2.0	4.0	2.5	-						9.9	55.6	32.1					2.5		
	Pigs	2.0	>64	26.2	-					9.2	30.8	32.3	1.5					26.2		
	Broilers	0.5	4.0	5.6	-				16.7	44.4	11.1	16.7	5.6					5.6		
	Total	2.0	>64	12.2	-				1.8	8.5	18.3	42.1	17.1					12.2		
Tetracycline	Cattle	>64	>64	65.4	54.04-75.66			2.5	22.2	8.6			1.2					65.4		
	Pigs	>64	>64	87.7	77.18-94.54			1.5	6.2	4.6						3.1	10.8	73.8		
	Broilers	0.5	>64	44.4	21.53-69.25		5.6	38.9		5.6	5.6					5.6	11.1	27.8		
	Total	>64	>64	72.0	64.41-78.68		0.6	6.1	13.4	6.7	0.6		0.6			1.8	5.5	64.6		
Nalidixic acid	Cattle	128.0	>128	72.8	61.81-82.14									18.5	8.6		4.9	29.6	38.3	
	Pigs	16.0	>128	47.7	35.11-60.51								6.2	38.5	7.7	1.5	1.5	23.1	21.5	
	Broilers	64.0	128.0	55.6	30.75-78.47								27.8	16.7			38.9	16.7		
	Total	128.0	>128	61.0	53.06-68.49								5.5	26.2	7.3	0.6	7.3	25.6	27.4	
Ciprofloxacin	Cattle	16.0	32.0	72.8	61.81-82.14				25.9	1.2				1.2	40.7	29.6	1.2			
	Pigs	0.5	32.0	47.7	35.11-60.51			7.7	33.8	10.8			1.5	1.5	23.1	20.0	1.5			
	Broilers	1.0	16.0	50.0	26.01-73.99			11.1	27.8		11.1		5.6	22.2	16.7	5.6				
	Total	16.0	32.0	60.4	52.44-67.91			4.3	29.3	4.9	1.2		1.2	3.7	31.1	23.2	1.2			
Chloramphenicol	Cattle	4.0	4.0	3.7	0.77-10.45							14.8	76.5	4.9			1.2	2.5		
	Pigs	4.0	8.0	9.2	3.46-19.02						3.1	36.9	47.7	3.1	4.6	4.6				
	Broilers	2.0	4.0	0.0	0-18.54						5.6	66.7	27.8							
	Total	4.0	4.0	5.5	2.53-10.17						1.8	29.3	59.8	3.7	1.8	1.8	0.6	1.2		

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table7.1. Distribution of MICs and resistance (%) in *Salmonella* from cattle (n=63), pigs (n=58) and chickens (n=51) in 2014 Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	% Resistance	95% Confidence interval of % resistance	Distribution (%) of MICs													
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	>128
Ampicillin	Cattle	>128	>128	61.9	48.79-73.86						31.7	6.3							61.9
	Pigs	2	>128	41.4	28.59-55.08						34.5	15.5	8.6						41.4
	Chickens	≦1	2	3.9	0.47-13.46						80.4	13.7	2.0						3.9
	Total	2	>128	37.8	30.52-45.49						47.1	11.6	3.5						37.8
Cefazolin	Cattle	2	8	7.9	2.62-17.56						31.7	28.6	27.0	4.8					7.9
	Pigs	2	4	0.0	0-6.17						46.6	32.8	13.8	6.9					
	Chickens	≦1	2	0.0	0-6.98						64.7	29.4	5.9						
	Total	2	4	2.9	0.95-6.66						46.5	30.2	16.3	4.1					2.9
Cefotaxime	Cattle	≦0.5	≦0.5	7.9	2.62-17.56					92.1					1.6	3.2	3.2		
	Pigs	≦0.5	≦0.5	0.0	0-6.17					100									
	Chickens	≦0.5	≦0.5	0.0	0-6.98					98.0	2.0								
	Total	≦0.5	≦0.5	2.9	0.95-6.66					96.5	0.6				0.6	1.2	1.2		
Streptomycin	Cattle	>128	>128	60.3	47.2-72.4									9.5	30.2	7.9		1.6	50.8
	Pigs	>128	>128	82.7	70.6-91.4									3.4	13.8	15.5	1.7	8.6	56.9
	Chickens	16	32	39.2	25.8-53.9								7.8	19.6	33.3	33.3	2.0		3.9
	Total	32	>128	61.7	53.9-68.9								2.3	10.5	25.6	18.0	1.2	3.5	39.0
Gentamicin	Cattle	≦0.5	≦0.5	3.2	0.38-11.01					92.1	4.8						1.6	1.6	
	Pigs	≦0.5	64	15.5	7.34-27.43					79.3	3.4	1.7				5.2	3.4	6.9	
	Chickens	≦0.5	≦0.5	0.0	0-6.98					98.0	2.0								
	Total	≦0.5	1	6.4	3.23-11.16					89.5	3.5	0.6				1.7	1.7	2.9	
Kanamycin	Cattle	2	>128	14.3	6.74-25.4						3.2	55.6	22.2	3.2		1.6			14.3
	Pigs	2	16	8.6	2.85-18.99							50.0	31.0	5.2	5.2				8.6
	Chickens	2	>128	29.4	17.48-43.83						5.9	45.1	17.6	2.0					29.4
	Total	2	>128	16.9	11.59-23.31						2.9	50.6	23.8	3.5	1.7	0.6			16.9
Tetracycline	Cattle	32	>64	50.8	37.88-63.63						14.3	31.7	1.6	1.6		1.6	3.2	46.0	
	Pigs	64	>64	60.3	46.64-72.96						8.6	19.0	6.9	5.2		1.7	17.2	41.4	
	Chickens	2	64	39.2	25.84-53.89						9.8	51.0					33.3	5.9	
	Total	32	>64	50.6	42.86-58.28						11.0	33.1	2.9	2.3		1.2	16.9	32.6	
Nalidixic acid	Cattle	4	8	3.2	0.38-11.01								71.4	23.8	1.6	1.6			1.6
	Pigs	4	>128	15.5	7.34-27.43						1.7	1.7	51.7	25.9	3.4				15.5
	Chickens	4	4	3.9	0.47-13.46							2.0	88.2	3.9	2.0				3.9
	Total	4	8	7.6	4.08-12.58						0.6	1.2	69.8	18.6	2.3	0.6			7.0
Ciprofloxacin	Cattle	≦0.03	≦0.03	0.0	0-5.69	96.8	1.6		1.6										
	Pigs	≦0.03	0.25	0.0	0-6.17	75.9	10.3	1.7	8.6	1.7	1.7								
	Chickens	≦0.03	≦0.03	0.0	0-6.98	94.1			3.9	2.0									
	Total	≦0.03	0.06	0.0	0-2.13	89.0	4.1	0.6	4.7	1.2	0.6								
Colistin	Cattle	0.25	1	0.0	0-5.69				60.3	19.0	17.5	3.2							
	Pigs	0.25	1	0.0	0-6.17			1.7	48.3	37.9	6.9	3.4	1.7						
	Chickens	1	1	0.0	0-6.98				25.5	13.7	54.9	2.0	3.9						
	Total	0.5	1	0.0	0-2.13			0.6	45.9	23.8	25.0	2.9	1.7						
Chloramphenicol	Cattle	8	>128	17.5	9.05-29.1									81.0	1.6	1.6		3.2	12.7
	Pigs	8	>128	25.9	15.25-39.05								22.4	41.4	10.3			3.4	22.4
	Chickens	8	8	3.9	0.47-13.46								11.8	80.4	3.9				3.9
	Total	8	>128	16.3	11.09-22.67								11.0	67.4	5.2	0.6		2.3	13.4
Trimethoprim	Cattle	≦0.25	1	6.3	1.75-15.47				61.9	25.4	4.8	1.6				6.3			
	Pigs	0.5	>16	32.8	21-46.35				48.3	15.5	3.4					32.8			
	Chickens	0.5	>16	29.4	17.48-43.83				31.4	31.4	2.0	5.9				29.4			
	Total	0.5	>16	22.1	16.13-29.04				48.3	23.8	3.5	2.3				22.1			

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table7.2 Distribution of MICs and resistance (%) in *Salmonella* from cattle (n=76), pigs (n=49) and chickens (n=7) in 2015 Farm

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	% Resistance	95% Confidence interval of % resistance	Distribution (%) of MICs													
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	>128
Ampicillin	Cattle	>128	>128	56.6	44.71-67.92						10.5	27.6	3.9		1.3	1.3			55.3
	Pigs	4	>128	46.9	32.49-61.81						26.5	22.4	4.1				2.0		44.9
	Chickens	2	>128	14.3	0.36-57.88						14.3	57.1	14.3						14.3
	Total	2	>128	41.4	33.9-49.24						21.9	30.8	4.1	1.2	0.6	1.2	0.6		39.6
Cefazolin	Cattle	2	8	7.9	2.95-16.4						28.9	28.9	27.6	5.3	1.3				7.9
	Pigs	2	16	6.1	1.28-16.87						38.8	28.6	20.4	2.0	4.1	2.0			4.1
	Chickens	2	4	0.0	0-40.97						28.6	57.1	14.3						
	Total	2	8	5.9	2.87-10.62						41.4	29.0	18.9	3.0	1.8	0.6		0.6	4.7
Cefotaxime	Cattle	≦0.5	≦0.5	7.9	2.95-16.4					92.1					1.3		3.9	2.6	
	Pigs	≦0.5	≦0.5	4.1	0.49-13.98					95.9					4.1				
	Chickens	≦0.5	≦0.5	0.0	0-40.97					100									
	Total	≦0.5	≦0.5	4.7	2.06-9.12					95.3					1.8		1.8	1.2	
Streptomycin	Cattle	64	>128	67.1	55.3-77.5								3.9	7.9	21.1	14.5	2.6	3.9	46.1
	Pigs	>128	>128	67.3	52.4-80.1										32.7	8.2	2.0	2.0	55.1
	Chickens	4	>128	42.9	9.9-81.6								57.1			28.6			14.3
	Total	32	>128	58.1	49.4-66.8								6.5	8.9	26.6	14.8	1.8	2.4	39.1
Gentamicin	Cattle	≦0.5	1	7.9	2.95-16.4					86.8	5.3				1.3	3.9		2.6	
	Pigs	≦0.5	1	8.2	2.26-19.61					75.5	16.3				4.1	4.1			
	Chickens	≦0.5	≦0.5	0.0	0-40.97					100									
	Total	≦0.5	1	5.9	2.87-10.62					84.0	10.1				1.8	3.0		1.2	
Kanamycin	Cattle	4	>128	21.1	12.53-31.93							27.6	46.1	3.9		1.3	2.6	1.3	17.1
	Pigs	4	8	6.1	1.28-16.87							22.4	59.2	12.2					6.1
	Chickens	4	>128	42.9	9.89-81.6							42.9	14.3						42.9
	Total	4	>128	13.6	8.82-19.72							27.2	53.3	5.3		0.6	1.2	0.6	11.8
Tetracycline	Cattle	>64	>64	55.3	43.38-66.75						10.5	30.3	1.3	2.6		1.3	2.6	51.3	
	Pigs	64	>64	61.2	46.23-74.81						4.1	32.7	2.0			10.2	6.1	44.9	
	Chickens	2	>64	42.9	9.89-81.6							57.1					28.6	14.3	
	Total	4	>64	46.2	38.46-53.98						7.1	42.6	3.0	1.2		3.6	4.7	37.9	
Nalidixic acid	Cattle	8	64	11.8	5.56-21.3								42.1	44.7	1.3	1.3	1.3		9.2
	Pigs	8	16	6.1	1.28-16.87								46.9	38.8	8.2				6.1
	Chickens	8	>128	28.6	3.66-70.96								28.6	42.9					28.6
	Total	8	16	9.5	5.5-14.92								47.3	39.1	4.1	0.6	0.6	0.6	7.7
Ciprofloxacin	Cattle	≦0.03	0.25	0.0	0-4.74	80.3	5.3	2.6	6.6	3.9	1.3								
	Pigs	≦0.03	0.12	0.0	0-7.26	81.6	8.2	2.0	4.1	4.1									
	Chickens	≦0.03	0.25	0.0	0-40.97	71.4		14.3	14.3										
	Total	≦0.03	0.12	0.0	0.01-3.26	81.7	6.5	3.0	4.7	3.0	0.6								
Colistin	Cattle	0.5	2	0.0	0-4.74				32.9	53.9	2.6	1.3	9.2						
	Pigs	0.5	0.5	0.0	0-7.26			2.0	44.9	44.9	2.0	6.1							
	Chickens	4	4	0.0	0-40.97						14.3	28.6	57.1						
	Total	0.5	2	0.0	0-2.16			0.6	33.7	48.5	3.6	4.7	8.9						
Chloramphenicol	Cattle	8	>128	22.4	13.6-33.39								2.6	69.7	5.3	3.9		2.6	15.8
	Pigs	8	128	12.2	4.62-24.77							2.0	10.2	63.3	12.2	2.0		2.0	8.2
	Chickens	8	>128	14.3	0.36-57.88								28.6	57.1					14.3
	Total	8	>128	16.6	11.3-23.05							1.2	7.1	68.0	7.1	3.6		1.8	11.2
Trimethoprim	Cattle	0.5	>16	13.2	6.49-22.87				47.4	28.9	9.2	1.3			1.3	11.8			
	Pigs	0.5	>16	22.4	11.77-36.63				42.9	32.7	2.0					22.4			
	Chickens	1	>16	42.9	9.89-81.6					28.6	28.6					42.9			
	Total	0.5	>16	14.2	9.31-20.39				38.5	37.3	9.5	0.6			0.6	13.6			

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table 7.3 Distribution of MICs and resistance (%) in *Salmonella* from chickens (n=128) in 2014 Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	% Resistance	95% Confidence interval of % resistance	Distribution (%) of MICs													
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	>128
Ampicillin	Broilers	≦1	>128	17.2	11.09-24.86						59.4	21.9	1.6				0.8	0.8	15.6
Cefazolin		2	8	3.1	0.85-7.81						25.8	53.9	7.0	9.4	0.8				3.1
Cefotaxime		≦0.5	≦0.5	2.3	0.48-6.7					97.7			0.8	1.6					
Streptomycin		32	>64	85.9	78.68-91.45						0.8			9.4	3.9	39.8	33.6	12.5	
Gentamicin		≦0.5	≦0.5	0.0	0-2.85					93.0	7.0								
Kanamycin		>128	>128	57.8	48.76-66.49						9.4	25.0	4.7	2.3	0.8				57.8
Tetracycline		64	>64	85.2	77.79-90.83						1.6	8.6	4.7			0.8	64.1	20.3	
Nalidixic acid		4	>128	17.2	11.09-24.86								60.2	18.8	3.9				17.2
Ciprofloxacin		≦0.03	0.25	0.0	0-2.85	79.7	3.1	5.5	9.4	2.3									
Colistin		2	2	0.0	0-2.85				6.3	18.0	20.3	48.4	7.0						
Chloramphenicol		8	8	1.6	0.18-5.54							5.5	37.5	50.0	5.5				1.6

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	% Resistance	95% Confidence interval of % resistance	Distribution (%) of MICs									
								2.38/0.12	4.75/0.25	9.5/0.5	19/1	38/2	76/4	152/8	>152/8
Sulfamethoxazole/ Trimethoprim	Broilers	>152/8	>152/8	51.6	42.56-60.49			20.3	15.6	9.4	2.3	0.8	0.8		50.8

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table 7.4 Distribution of MICs and resistance (%) in *Salmonella* from broilers (n=123) in 2015 Slaughterhouse

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	% Resistance	95% Confidence interval of % resistance	Distribution (%) of MICs													
						0.03	0.06	0.12	0.25	0.5	1	2	4	8	16	32	64	128	>128
Ampicillin	Broilers	≦1	>128	13.0	7.62-20.27						74.8	10.6	1.6					0.8	12.2
Cefazolin		2	4	1.6	0.19-5.76						34.1	53.7	3.3	5.7	1.6	0.8			0.8
Cefotaxime		0.12	0.12	1.6	0.19-5.76			91.1	7.3					1.6					
Streptomycin		32	64	76.4	67.87-83.66								2.4	8.9	12.2	61.8	9.8		4.9
Gentamicin		≦0.5	≦0.5	0.0	0-2.96					96.7	2.4	0.8							
Kanamycin		>128	>128	69.1	60.14-77.13						18.7	8.1	0.8	0.8	1.6	0.8			69.1
Tetracycline		64	64	83.7	76.01-89.78						8.9	4.9	0.8	1.6		1.6	79.7	2.4	
Nalidixic acid		4	>128	15.4	9.56-23.08							0.8	73.2	8.9	1.6	0.8			14.6
Ciprofloxacin		≦0.03	0.25	0.0	0-2.96	82.9		2.4	10.6	4.1									
Colistin		0.5	1	0.0	0-2.96				24.4	62.6	13.0								
Chloramphenicol		4	8	1.6	0.19-5.76						1.6	11.4	72.4	9.8	3.3				1.6

Antimicrobial agent	Animal species	MIC_{50}	MIC_{90}	%Resistant	95% Confidence interval of % resistance	Distribution (%) of MICs							
						2.38/0.12	4.75/0.25	9.5/0.5	19/1	38/2	76/4	152/8	>152/8
Sulfamethoxazole/ Trimethoprim	Broilers	>152/8	>152/8	57.7	48.47-66.61	13.8	19.5	8.9					57.7

White fields represent the range of dilutions tested.
MIC values equal to or lower than the lowest concentration tested are presented as the lowest concentration.
MIC values greater than the highest concentration in the range are presented as one dilution step above the range

Table 8 *Salmonella* serovars isolated from food-producing animals in fiscal years of 2014 (Apr. 2014-Mar. 2015) and 2015 (Apr. 2015-Mar. 2016)

Serovar	Farm*											Slaughterhouse			
	Cattle			Pigs			Chickens			**Total**	**Rate(%)**	Chickens		**Total**	**Rate(%)**
	2014	2015	Subtotal	2014	2015	Subtotal	2014	2015	Subtotal			2014	2015		
Typhimurium	23	18	41	25	18	43	1		1	85	28.0	11	12	23	9.2
O4:i:-	20	30	50	8	10	18			0	68	22.4			0	0.0
Choleraesuis			0	6	8	14			0	14	4.6			0	0.0
Infantis	1		1		1	1	8		8	10	3.3	38	28	66	26.3
Schwarzengrund			0			0	11	3	14	14	4.6	60	55	115	45.8
Manhattan			0			0			0	0	0.0	7	17	24	9.6
Derby		2	2	5	4	9			0	11	3.6			0	0.0
Give			0			0			0	0	0.0			0	0.0
Mbandaka		3	3			0	5		5	8	2.6			0	0.0
Rissen		2	2	1	1	2			0	4	1.3			0	0.0
Newport	3	2	5		2	2	1		1	8	2.6			0	0.0
Bareilly			0			0	1		1	1	0.3			0	0.0
Braenderup	1		1	3		3	5		5	9	3.0			0	0.0
Livingstone			0			0	1		1	1	0.3			0	0.0
Tennessee			0			0	2		2	2	0.7			0	0.0
Thompson	1	3	4		1	1	2		2	7	2.3		1	1	0.4
Stanley	2		2			0			0	2	0.7			0	0.0
II (Sofia)			0			0			0	0	0.0			0	0.0
Enteritidis			0			0	2	4	6	6	2.0			0	0.0
Blockley			0			0			0	0	0.0			0	0.0
Cerro			0			0			0	0	0.0			0	0.0
Dublin		5	5			0			0	5	1.6			0	0.0
Montevideo			0			0			0	0	0.0			0	0.0
Oranienburg	1		1			0			0	1	0.3			0	0.0
Othmarschen			0			0			0	0	0.0			0	0.0
Senftenberg			0			0			0	0	0.0			0	0.0
Others	11	11	22	10	4	14	12		12	48	15.8	7	15	22	8.8
Total	63	76	139	58	49	107	51	7	58	304	100.0	123	128	251	100.0

* For the farm monitoring, *Salmonella* was collected from diseased animals.

Editors:

Mayumi Kijima (DVM. PhD)
Section Leader
Assay Division II, Safety Assay Section I (JVARM Section)
E-mail; mayumi_kijima420@maff.go.jp

Michiko Kawanishi (DVM. PhD)
Chief Researcher, Chief Editor
Assay Division II, Safety Assay Section I (JVARM Section)
E-mail; michiko_kawanishi700@maff.go.jp
National Veterinary Assay Laboratory
Ministry of Agriculture, Forestry and Fisheries
1-15-1 Tokura Kokubunji, Tokyo 185-8511, Japan

Authors:
- **Mayumi Kijima**
- **Ryoji Koike**
- **Manao Ozawa** (Chief Researcher)
- **Michiko Kawanishi** (Chief Researcher)
- **Mariko Uchiyama** (Chief Researcher)
- **Takahiro Shirakawa**

Contributors:
- **Yuriko Sugawara**
- **Hitoshi Abo**
- **Daisuke Mitsuya**
- **Naoki Hatanaka**
- **Miyuki Asao (FAMIC)**

This report includes data gathered between 2014 and 2015, as well as some data from 1999 onward.
This report is published by JVARM-Japanese Veterinary Antimicrobial Resistance Monitoring System