NARMS

National Antimicrobial Resistance Monitoring System

Food and Drug Administration • Centers for Disease Control and Prevention • United States Department of Agriculture

2009

Animal Arm Annual Report

BEAR

Bacterial Epidemiology and Antimicrobial Resistance

USDA

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I. Introduction

In an effort to prospectively monitor the emergence of antimicrobial resistance in zoonotic pathogens, the National Antimicrobial Resistance Monitoring System (NARMS) was established in 1996 by the Food and Drug Administration's Center for Veterinary Medicine in collaboration with the Centers for Disease Control and Prevention, and the United States Department of Agriculture (USDA).

The animal component of NARMS is housed within the Bacterial Epidemiology and Antimicrobial Resistance Research Unit (BEAR) of the USDA's Agricultural Research Service in Athens, Georgia. For this report, the animal component of NARMS comprises the testing of isolates obtained from food-producing animals at slaughter through the USDA Food Safety and Inspection Service (FSIS) Pathogen Reduction: Hazard Analysis and Critical Control Point (PR/HACCP) verification testing program.

The antimicrobial agents selected for study are representative of antimicrobials used in both human and veterinary medicine and are selected primarily based on therapeutic value although molecular mechanisms of resistance or treatment patterns may also influence selection. Non-Typhi *Salmonella* was chosen as a sentinel organism of the NARMS program. Testing of *Campylobacter* and *Escherichia coli* isolates from animals began in 1998 and 2000, respectively.

This report summarizes 2009 data for *Salmonella*, *Campylobacter*, and *E. coli* isolates from food-producing animals at slaughter (chicken, turkey, cattle, and swine). Resistance data for previous years is included; however, due to the amount of data and complexity of analyses involved, all permutations are not represented. Additional information on the animal component of NARMS including past annual reports, summary trend tables and graphs, as well as a component for interactive data analysis can be found on the USDA's NARMS web page (http://www.ars.usda.gov/saa/bear/narms). Other analyses are available upon request.

The 2008 NARMS Executive Report contains additional background information on sampling and testing methodology for the human and retail arms of NARMS as well as summary data from all three components.

II. Sampling and Testing Methods

A. Samples

The *Salmonella* isolates included in this report were recovered by FSIS from carcass rinsates (chickens), carcass swabs (turkeys, cattle, and swine), and ground products (chickens, turkeys, and beef). *Campylobacter* and *E. coli* isolates included in this report were recovered by BEAR from FSIS Eastern Lab carcass rinsates (chickens).

Sampling methods used by FSIS for the PR/HACCP *Salmonella* verification testing program have changed since NARMS animal testing began. Before June of 2006, there were two phases of the FSIS regulatory program for *Salmonella* in raw products: non-targeted and targeted testing. Non-targeted samples were collected randomly from eligible federally inspected establishments, with a goal of scheduling every eligible establishment at least once a year. Targeted samples were collected from establishments that had a previously failed sample set. Beginning in June of 2006, sampling was scheduled using risk-based criteria designed to focus FSIS resources on establishments with the most samples positive for *Salmonella* and the greatest number of samples with serotypes most frequently associated with human salmonellosis[1,2]. Once the establishments presenting the greatest risk are sampled, FSIS prioritizes sampling at the establishments that have not been sampled within the last two years.

B. Isolation and Identification

1. *Salmonella*: Isolation from slaughter samples was conducted by FSIS at all three FSIS Regulatory Field Services Laboratories [Eastern (Athens, GA), Midwestern (St. Louis, MO) and Western (Alameda, CA)] following the "Isolation and Identification of *Salmonella* from Meat, Poultry, and Egg" procedures as described in the Microbiology Laboratory Guidebook, section 4[3,4]. Each FSIS laboratory processes samples collected throughout the U.S. Isolates were forwarded by FSIS to the National Veterinary Services Laboratories, Ames, IA (NVSL) for serotyping and a duplicate isolate was sent to BEAR for susceptibility testing and Pulsed Field Gel Electrophoresis (PFGE). Serotype results were subsequently sent to the BEAR unit as they became available.

2. *Campylobacter*: From 1998 to 2000, *Campylobacter* was isolated by all FSIS laboratories as part of the chicken monitoring baseline programs using the method described in the FSIS Microbiology Laboratory Guidebook[5]. Following presumptive identification, isolates were sent to BEAR for final confirmation and susceptibility testing as described below. Upon review of susceptibility data and isolation methods, it was determined that use of nalidixic acid as part of the culture selection criteria may have resulted in recovery of isolates more likely to be resistant to quinolones. A comparative study was initiated by BEAR in 2001.

For the first half of 2001, BEAR pilot tested several isolation methods for *Campylobacter* prior to adopting a new method in July. Since that time, only rinsates from the FSIS Eastern Lab containing $\geq$ 10 ml have been used. Thus, all rinsates tested for *Salmonella* were not processed for *Campylobacter* or *E. coli*. Also important to note is that when the FSIS *Campylobacter* baseline testing ended, rinsates were

[1] USDA/FSIS. 2008. Serotypes Profile of Salmonella Isolates from Meat and Poultry Products. Available at http://www.fsis.usda.gov/Science/Serotypes_Profile_Salmonella_Isolates/index.asp.
[2] USDA/FSIS. FSIS Scheduling Criteria for Salmonella Sets in Raw Classes of Product. Available at http://www.fsis.usda.gov/PDF/Scheduling_Criteria_Salmonella_Sets.pdf.
[3] USDA/FSIS. 2004. Isolation and Identification of *Salmonella* from Meat, Poultry, and Egg Products. Microbiological Lab Guidebook 4.03. Available at http://www.fsis.usda.gov/PDF/MLG_4_03.pdf.
[4] USDA/FSIS. 2010. Laboratories and Procedures. Available a.t http://www.fsis.usda.gov/Science/Laboratories_&_Procedures/index.asp.
[5] USDA/FSIS. 1998. Isolation, Identification, And Enumeration Of Campylobacter jejuni/coli From Meat And Poultry Products. Microbiology Laboratory Guidebook, chapter 6. Available at http://www.fsis.usda.gov/ophs/Microlab/Mlgchp6.pdf.

no longer temperature controlled during shipment which may have affected isolate recovery. For *Campylobacter* isolation, 10 mls of rinsate was enriched in an equal volume of Campylobacter Enrichment Broth without blood under microaerobic conditions for 48 h at 42°C. Aliquots were struck onto Campy Cefex agar and plates were incubated as above. Final confirmation and speciation of *Campylobacter* isolates were obtained using the BAX® System Q7 (DuPont Qualicon; Wilmington, DE). This real-time PCR assay, able to detect *C. coli*, *C. jejuni*, and *C. lari*, was performed according to manufacturer's directions.

3. *Escherichia coli*: BEAR started isolating generic *E. coli* from the same rinsates used for *Campylobacter* isolation in 2000. For *E. coli*, a sample of the rinsate was enriched overnight before streaking onto a CHROMAgar™ ECC plate (DRG International; Mountainside, NJ). Plates were incubated at 36°C ± 1°C for 18-24 h as described by the manufacturer. Blue-green colonies, typical of generic *E. coli,* were selected for susceptibility testing and confirmed as *E. coli* using the Vitek (bioMérieux, Inc; Durham, NC).

C. Antimicrobial Susceptibility

In 2009, *Salmonella*, *Campylobacter*, and *E. coli* were tested using a semi-automated broth micro dilution system (Sensitire®, Trek Diagnostic Systems, Inc., Westlake, Ohio) and a custom made 96-well panel of antimicrobials (catalog no. CMV1AGNF for *Salmonella* and *E. coli;* catalog no. CAMPY for *Campylobacter*) to determine the minimum inhibitory concentration (MIC) of antimicrobials important in both human and veterinary medicine. Tables 1 and 2 list the antimicrobials tested, including the breakpoints for *Salmonella*/*E. coli* and *Campylobacter*, respectively. From 1998-2004, MICs for *Campylobacter* isolates were determined using Etest® (AB Biodisk; Solna, Sweden) as per manufacturer's direction with the exception that MICs were not rounded up prior to categorization. In 2005, the animal arm of NARMS switched to using the Sensititre® broth microdilution system for *Campylobacter* although the antimicrobials tested as described above for *Salmonella* and *E. coli* differed (Table 2). Regardless of the susceptibility testing method used, antimicrobial resistance was determined using Clinical and Laboratory Standards Institute (CLSI) breakpoints, when available[6,7,8].

In January 2010, CLSI published new MIC breakpoints for several cephalosporin antimicrobials for Enterobacteriaceae[9]. In particular, the resistance breakpoint for ceftriaxone changed (decreased) from ≥ 64 µg/ml to ≥ 4 µg/ml. In this report, the revised breakpoints for ceftriaxone are used and have been retrospectively applied to data from previous years; therefore, ceftriaxone resistance in previous reports will differ from what is presented in this report. It is important to note that the actual raw data has not changed over time, only the way that it is interpreted. For antimicrobial agents without CLSI approved breakpoints, interpretive criteria established by the NARMS working group were used.

[6] CLSI. 2006. Methods for Antimicrobial Dilution and Disk Susceptibility Testing of Infrequently Isolated or Fastidious Bacteria; Approved Guideline. CLSI document M45-A. CLSI, Wayne, PA.
[7] CLSI. 2008. Performance Standards for Antimicrobial Disk and Dilution Susceptibility Tests for Bacteria Isolated from Animals; Approved Standard—Third Edition. CLSI document M31-A3. CLSI, Wayne, PA.
[8] CLSI. 2009. Performance Standards for Antimicrobial Susceptibility Testing; Nineteenth Informational Supplement. CLSI document M100-S19. CLSI, Wayne, PA.
[9] CLSI. 2010. Performance Standards for Antimicrobial Susceptibility Testing; Twentieth Informational Supplement. CLSI document M100-S20. CLSI, Wayne, PA.

Quality control strains used for *Salmonella* and *E. coli* susceptibility testing included *E. coli* ATCC 25922, *Enterococcus faecalis* ATCC 29212, *Pseudomonas aeruginosa* ATCC 27853 and *Staphylococcus aureus* ATCC 29213. *Campylobacter jejuni* ATCC 33560 was used as a control for *Campylobacter* susceptibility testing.

Table 1. *Salmonella* and *E. coli* Interpretive Criteria (breakpoints)[10]

CLSI Antimicrobial Class[11]	Antimicrobial Agent	Breakpoints (µg/ml)		
		Susceptible	Intermediate	Resistant
Aminoglycosides	Amikacin	≤ 16	32	≥ 64
	Gentamicin	≤ 4	8	≥ 16
	Kanamycin	≤ 16	32	≥ 64
	Streptomycin[12]	≤ 32	Not Applicable	≥ 64
β-Lactam/β-Lactamase Inhibitor Combinations	Amoxicillin–Clavulanic Acid	≤ 8 / 4	16/8	≥ 32 / 16
Cephems	Cefoxitin	≤ 8	16	≥ 32
	Ceftiofur	≤ 2	4	≥ 8
	Ceftriaxone[13]	≤ 1	2	≥ 4
	Cephalothin	≤ 8	16	≥ 32
Folate Pathway Inhibitors	Sulfonamides[14]	≤ 256	Not Applicable	≥ 512
	Trimethoprim–Sulfamethoxazole	≤ 2 / 38	Not Applicable	≥ 4 / 76
Penicillins	Ampicillin	≤ 8	16	≥ 32
Phenicols	Chloramphenicol	≤ 8	16	≥ 32
Quinolones	Ciprofloxacin	≤ 1	2	≥ 4
	Nalidixic acid	≤ 16	Not Applicable	≥ 32
Tetracyclines	Tetracycline	≤ 4	8	≥ 16

[10] Breakpoints established by CLSI (Clinical and Laboratory Standards Institute) were used when available

[11] According to CLSI M100 document

[12] There are no CLSI breakpoints for streptomycin

[13] In this report, the revised ceftriaxone breakpoints from the CLSI M100-S20 document, published in January 2010, were used (≥ 4 µg/ml). In previous NARMS reports the ceftriaxone breakpoints from the CLSI M100-S19 were used (≥ 64 µg/ml)

[14] From 1997 through 2003, sulfamethoxazole was tested. Sulfisoxazole replaced sulfamethoxazole beginning in 2004

Table 2. *Campylobacter* Interpretive Criteria (breakpoints)[15]

CLSI Antimicrobial Class[16]	Antimicrobial Agent	Breakpoints (µg/ml) Etest (1998-2004)			Breakpoints (µg/ml) Broth Microdilution (2005-2009)		
		Susceptible	Intermediate	Resistant	Susceptible	Intermediate	Resistant
Aminoglycosides	Gentamicin	≤ 4	8	≥ 16	≤ 2	4	≥ 8
Lincosamides	Clindamicin	≤ 0.5	1 - 2	≥ 4	≤ 2	4	≥ 8
Macrolides	Azithromycin	≤ 0.25	0.5 - 1	≥ 2	≤ 2	4	≥ 8
	Erythromycin	≤ 0.5	1 - 4	≥ 8	≤ 8	16	≥ 32
Ketolides	Telithromycin	Not Tested	Not Tested	Not Tested	≤ 4	8	≥ 16
Phenicols	Florfenicol	Not Tested	Not Tested	Not Tested	≤ 4	Not Applicable	Not Applicable
	Chloramphenicol	≤ 8	16	≥ 32	Not Tested	Not Tested	Not Tested
Fluoroquinolones	Ciprofloxacin	≤ 1	2	≥ 4	≤ 1	2	≥ 4
Quinolones	Nalidixic acid	≤ 16	Not Applicable	≥ 32	≤ 16	32	≥ 64
Tetracyclines	Tetracycline	≤ 4	8	≥ 16	≤ 4	8	≥ 16

[15] Breakpoints established by CLSI (Clinical and Laboratory Standards Institute) were used when available. CLSI breakpoints are available only for erythromycin, ciprofloxacin, and tetracycline
[16] According to CLSI M100 document

D. Phage Typing

Salmonella Typhimurium and *S.* Typhimurium variant 5- isolates with resistance to at least ampicillin, chloramphenicol, sulfisoxazole and tetracycline (ACSuT) were submitted to NVSL for phage typing.

III. Reporting Methods

WHONET 5, a free microbiology laboratory database software program, was used to categorize MICs as resistant, intermediate (when applicable), and susceptible according to CLSI established interpretive criteria (when available). The 95% confidence interval was calculated using the Wilson interval with continuity correction method in WHONET 5. Resistance percentages by food animal source and organism are presented from 1997 through 2009 for *Salmonella*, from 1998 through 2009 for *Campylobacter*, and from 2000 through 2009 for *E. coli*. Additionally, MIC distributions are presented for 2009. For *Salmonella*, MIC distributions were tabulated on both macro and micro levels. At the macro level, all *Salmonella* serotypes were combined and analyzed for MIC distributions. At the micro level, isolates were grouped by serotype prior to analysis. Results were tabulated for the top serotypes from chickens, turkeys, cattle, and swine. MIC distributions were tabulated separately for *C. coli* and *C. jejuni*. The change of sample collection methods by FSIS in 2006 limits meaningful trend comparison between pre-2006 results and post-2006 results. Similarly, these changes limit year-to-year comparisons post-2006[17].

In this report, MDR is reported as resistance to more than one antimicrobial class (i.e. multiple antimicrobials may be included in a class and resistance to any one antimicrobial within a class results in the designation of the class being resistant).

The antimicrobial classes used for MDR tabulations for *Salmonella* and *E. coli* were aminoglycosides (amikacin, gentamicin, kanamycin and streptomycin), β-lactam/β-lactamase inhibitor combinations (amoxicillin-clavulanic acid), cephems (cefoxitin, ceftiofur and ceftriaxone), penicillins (ampicillin), folate pathway inhibitors (sulfonamides and trimethoprim/sulfamethoxazole), phenicols (chloramphenicol), quinolones (ciprofloxacin and nalidixic acid), and tetracyclines (tetracycline). The antimicrobial classes used for MDR tabulations for *Campylobacter* were aminoglycosides (gentamicin), ketolides (telithromycin 2005-2009), lincosamides (clindamycin), macrolides (azithromycin and erythromycin), phenicols (chloramphenicol 1998-2004 and florfenicol 2005-2009), quinolones (ciprofloxacin and nalidixic acid) and tetracyclines (tetracycline).

[17] USDA/FSIS. 2008. Serotypes Profile of Salmonella Isolates from Meat and Poultry Products. Available at http://www.fsis.usda.gov/Science/Serotypes_Profile_Salmonella_Isolates/index.asp.

IV. Data Analysis

A. *Salmonella*

1. Recovery of isolates by serotype within commodity

The total number of *Salmonella* isolates tested by year since 1997 is shown in Table 1A.

The top serotypes by commodity for 2009 are shown in Table 2A. Overall, Kentucky, Hadar, Montevideo and Derby ranked as the most prevalent serotype for chickens, turkeys, cattle and swine, respectively. Using 2009 as the baseline, the relative distributions for the top five serotypes per commodity are shown in Figures 1A-4A. While Kentucky was the most frequently recovered serotype for chickens, the upward trend observed beginning in 1997 halted in 2006 at 48.8%, declined in 2007 and 2008, and increased again in 2009 to 38.8% of isolates. From 1997 through 2002 Heidelberg frequency remained between 20.7% and 26.9%; however a decline was observed in 2003 and has remained below 15.1% of isolates since 2004. Since 2002, recovery of Enteritidis has increased to 21.4% of isolates in 2009. Conversely, recovery of Typhimurium variant 5- and I 4,5,12:i:- has remained below 10.0% for all years (Figure 1A).

Among isolates recovered from turkeys (Figure 2A) Hadar remained below 18.5% through 2004, increased in 2007 to 43.5%, and declined in 2009 to 26.4%. The recovery of Saintpaul fluctuated between 0.9% in 1997 and 14.9% in 2009. Both Schwarzengrund and Senftenberg remained at or below 11.4% of isolates since 1997.

From 2005 to 2009, recovery of Montevideo increased among cattle isolates from 13.1% to 29.5%. Dublin also showed an upward trend from 2005 to 2008 (from 3.6% to 12.0%) but decreased in 2009 to 10.5% of isolates. The recovery of the other top serotypes remained below 11.2% (Figure 3A).

Recovery of Derby among swine has fluctuated within the years tested from a high of 34.3% in 2002 to a low of 12.3% in 2007 (Figure 4A). Variations were noted for recovery of Anatum, Infantis, Johannesburg and Typhimurium variant 5- from 1997-2009, but overall remained below 16.2%.

2. MIC distributions

The 2009 MIC distributions by antimicrobial and commodity for all *Salmonella* serotypes combined (macro analysis) are shown in Table 3A. Since it is not unusual for resistance to be driven by only a few serotypes and because the distribution of serotypes between commodities varies greatly, it is important to determine resistance at the serotype and commodity level (micro analysis). However, a macro analysis is often useful to quickly determine any overt change between years prior to conducting a micro analysis of the data.

The overall percent resistance by year, antimicrobial and commodity of all *Salmonella* serotypes combined is shown in Table 4A. Resistance to amikacin has only been observed once in a single isolate from swine in 2007. Similarly, with the exception of one isolate from chicken in 2003, resistance has yet to emerge to ciprofloxacin; resistance to nalidixic acid remained $\leq$ 1.0% for all commodities in 2009. Additionally, resistance to gentamicin appears to remain stable among chickens, cattle and swine. While gentamicin resistance remains higher among turkeys when compared to the other animal sources, a decline was observed in this commodity from 16.9% in 2008 to 14.9% in 2009. In 2009, resistance to the cephems class remained highest among cattle isolates (13.5%, 14.5% and 14.5% for cefoxitin, ceftiofur and ceftriaxone, respectively); however, these numbers show a decline from 2008. Conversely, an increase in resistance to the cephems class was observed in chickens and turkeys from 2008 to 2009 but remained stable in swine. An increase in resistance to ampicillin was observed in all commodities from 2008 to 2009. Ampicillin resistance among turkeys in 2009 (38.8%) has been the highest observed among all commodities and years. In 2009, resistance to trimethoprim/sulfamethoxazole remained below 2.5% among all commodities. An increase was observed in resistance to sulfisoxazole among turkeys from 2008 to 2009 (24.3% to 28.9%) while a decrease was observed among chickens (13.3% to 10.0%, respectively). Resistance to sulfisoxazole remained stable in cattle and swine (24.5% and 30.8%, respectively). Resistance to the other antimicrobials varied by commodity.

A micro analysis of the 2009 data is presented in Tables 5A through 8A which shows total percent resistance and MIC distribution by commodity and serotypes. Data is only presented for those serotypes with greater than ten isolates in a particular commodity. Among serotypes from *Salmonella* isolates recovered from chickens (Table 5A), Enteritidis (n=118) exhibited $\leq$ 2.5% resistance to five antimicrobials (amoxicillin/clavulanic acid, ampicillin, ceftiofur, ceftriaxone, and tetracycline) and was susceptible to the remaining ten antimicrobials. Conversely, Kentucky (n=214) exhibited varying levels and combinations of resistance to 11 antimicrobials (amoxicillin/clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, chloramphenicol, gentamicin, kanamycin, streptomycin, sulfisoxazole and tetracycline) and showed no resistance to four antimicrobials (amikacin, ciprofloxacin, nalidixic acid and trimethoprim/sulfamethoxazole).

The frequency of isolates exhibiting the ACSSuT (ampicillin, chloramphenicol, streptomycin, sulfisoxazole and tetracycline) penta-resistant pattern or the ACSuT quad-resistant pattern is reported separately for *S.* Typhimurium and Typhimurium variant 5- (Table 9A). Although not streptomycin resistant, ACSuT isolates are often confirmed as DT104 and have been included in previous reports (streptomycin is typically intermediate [one dilution from resistant]). In 2009, only one *S*. Typhimurium variant 5- exhibited this quad-resistant pattern.

Table 10A shows the prevalence of confirmed DT104 or DT104 complex (a closely related definitive type) isolates. However, it is important to note that presentation of the ACSSuT pattern does not always result in confirmation of the isolate as DT104 (Table 11A). Therefore, analysis of isolates by phage type enables a more accurate assessment of the prevalence and importance of DT104 or DT104 complex isolates. In 2009, a total of 11 isolates were confirmed as DT104 or DT104 complex which accounted for 14.5% of all *S*. Typhimurium and *S*. Typhimurium variant 5- isolates tested and for 1.1% of all *Salmonella* tested in 2009.

The frequency and percentage of confirmed *S.* Typhimurium DT104 isolates is reported separately by food animal source from 1997 through 2009 (Table 12A). In 2009, DT104 isolates were found in swine (n=7) and cattle (n=4). From 1997 through 2009, DT104 prevalence was highest in swine followed by cattle, chickens and turkeys.

Specific MDR patterns by commodity are presented in Tables 13A through 16A. Data is presented by CLSI class as well as by phenotype(s) thought to be of clinical importance in humans [at least ACSSuT, ACT/S (ampicillin, chloramphenicol, trimethoprim/sulfamethoxazole), ACSSuTAuCx [ACSSuT, amoxicillin/clavulanic acid and ceftriaxone] or ceftriaxone and nalidixic acid resistance]. Overall, pan-susceptible isolates most often originated (in order of decreasing frequency) from cattle, chickens, swine and turkeys as observed in previous years. Among the clinically important phenotypes reported, resistance was least often observed to ACT/S and to ceftriaxone plus nalidixic acid for all animal sources.

B. *Campylobacter*

The number of *Campylobacter* isolates tested from chicken rinsates is shown in Table 1B. *Campylobacter jejuni* were more frequently recovered than *C. coli*. The distribution of *Campylobacter* species recovered from chicken remained stable from 1998 to 2008. In 2009, a decrease was observed in *C. jejuni* (73.6% to 59.1%) while an increase was observed in *C. coli* (26.4% to 40.9%) (Figure 1B).

MIC distributions by antimicrobial and species are shown in Table 2B. No resistance to florfenicol or clindamicin was observed for either species. In 2009, resistance was higher for *C. coli* than *C. jejuni* for all drugs with the exception of tetracycline.

Percent resistance by year, antimicrobial, and species are shown in Table 3B. In 2009, a decrease in resistance from 2008 was observed in both *C. coli* and *C. jejuni* to gentamicin, azithromycin, erythromycin and tetracycline. Following two consecutive years of increased resistance in *C. jejuni* to the quinolones, a decrease was observed in 2009 to 19.7% for both ciprofloxacin and nalidixic acid. However, in *C. coli* an increase in resistance to the quinolones was observed for the first time since 2004. Tetracycline resistance decreased from 2008 to 2009 in both *C. jejuni* and *C. coli;* however, resistance to tetracycline in *C. jejuni* (49.6%) was higher than *C. coli* (44.4%) which is opposite of what was observed in 2008.

MDR by CLSI class is presented in Tables 4B and 5B. Overall, MDR has been more frequently observed in *C. coli* than *C. jejuni.*

C. *Escherichia coli* (generic)

The number of *E. coli* isolates tested from chicken rinsates is shown in Table 1C. MIC distribution by antimicrobial is shown in Table 2C.

Percent resistance by year is shown in Table 3C. No resistance has been observed to amikacin from 1997 through 2009. Resistance to ciprofloxacin has remained below 0.6% since 1997. A decrease in percent resistance was observed to all antimicrobials in 2009 except tetracyline. Resistance in *E. coli* was highest to sulfisoxazole (52.6%), followed by streptomycin (49.8%) and tetracycline (49.1%). MDR by CLSI class is presented in Table 4C. The percent of isolates that were pan-susceptible increased in 2009 to 21.9% while resistance to multiple CLSI classes either decreased or remained stable.

Mention of trade names or commercial products is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the U.S. Department of Agriculture.

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VI. Results

A. *Salmonella*

Table 1A. Number of *Salmonella* Isolates Tested by Year and Animal Source, 1997-2009

Animal Source	Year												
	1997 n=456	1998 n=1878	1999 n=4637	2000 n=3530	2001 n=3168	2002 n=3131	2003 n=2301	2004 n=2431	2005 n=2846	2006 n=2377	2007 n=1915	2008 n=1326	2009 n=992
Chickens	214	561	1438	1173	1307	1500	1158	1280	1989	1380	994	624	551
Turkeys	107	240	713	518	550	244	262	236	227	304	271	148	121
Cattle	24	284	1610	1388	893	1008	670	607	329	389	439	443	200
Swine	111	793	876	451	418	379	211	308	301	304	211	111	120

Table 2A. Most Common Serotypes among *Salmonella* Isolates Tested, 2009

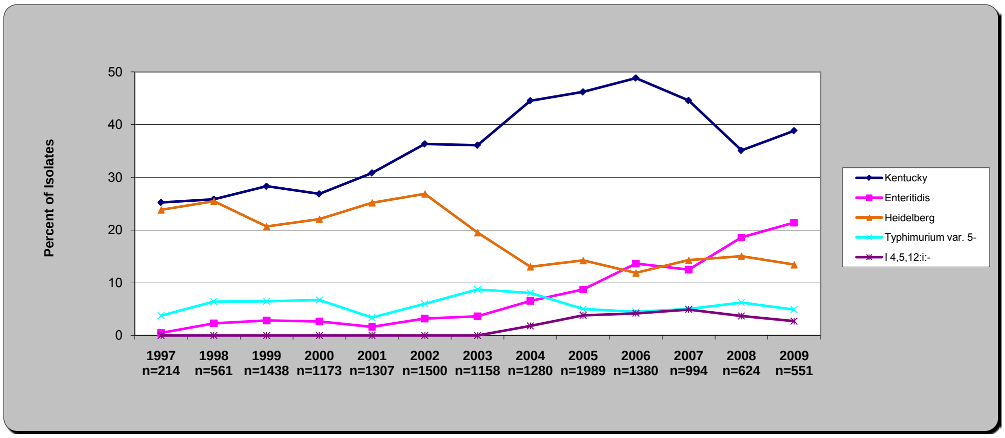
Animal Source	Rank	Serotype	n	%
Chickens (n=551)	1	Kentucky	214	38.8
	2	Enteritidis	118	21.4
	3	Heidelberg	74	13.4
	4	Typhimurium var. 5-	27	4.9
	5	I 4,5,12:i:-	15	2.7
	6	I 8,20:-:z6	13	2.4
	7	Montevideo	10	1.8
	8	Typhimurium	9	1.6
	9	Schwarzengrund	8	1.5
	10	Senftenberg	6	1.1
	10	I 4,12:i:-	6	1.1
	10	Hadar	6	1.1
	10	Worthington	6	1.1
Subtotal			512	92.9
		Others	39	7.1
Total			551	100

Animal Source	Rank	Serotype	n	%
Turkeys (n=121)	1	Hadar	32	26.4
	2	Saintpaul	18	14.9
	3	Agona	15	12.4
	4	Schwarzengrund	7	5.8
	4	Senftenberg	7	5.8
	5	IIIa 18:z4,z23:-	6	5.0
	6	Albany	5	4.1
	7	Derby	4	3.3
	8	Heidelberg	3	2.5
	8	Muenchen	3	2.5
	8	Newport	3	2.5
	9	Kentucky	2	1.7
	9	Anatum	2	1.7
Subtotal			107	88.4
		Others	14	11.6
Total			121	100

Animal Source	Rank	Serotype	n	%
Cattle (n=200)	1	Montevideo	59	29.5
	2	Dublin	21	10.5
	3	Newport	17	8.5
	4	Typhimurium	12	6.0
	5	Kentucky	10	5.0
	6	Cerro	9	4.5
	7	Meleagridis	8	4.0
	8	Muenchen	6	3.0
	8	Typhimurium var. 5-	6	3.0
	9	Agona	5	2.5
	9	Anatum	5	2.5
	10	Muenster	4	2.0
Subtotal			162	81.0
		Others	38	19.0
Total			200	100

Animal Source	Rank	Serotype	n	%
Swine (n=120)	1	Derby	24	20.0
	2	Typhimurium var. 5-	14	11.7
	3	Johannesburg	11	9.2
	3	Anatum	10	8.3
	3	Infantis	10	8.3
	3	Typhimurium	6	5.0
	4	Adelaide	5	4.2
	4	Agona	4	3.3
	5	Saintpaul	4	3.3
	5	Heidelberg	4	3.3
	6	Bredeney	4	3.3
Subtotal			96	80.0
		Others	24	20.0
Total			120	100

Figure 1A. Chickens- Serotype Percent Distribution by Year in Relation to Top Serotypes Identified in 2009[1]



[1] Data are not available for I 4,5,12:i:- prior to 2004

Figure 2A. Turkeys- Serotype Percent Distribution by Year in Relation to Top Serotypes Identified in 2009

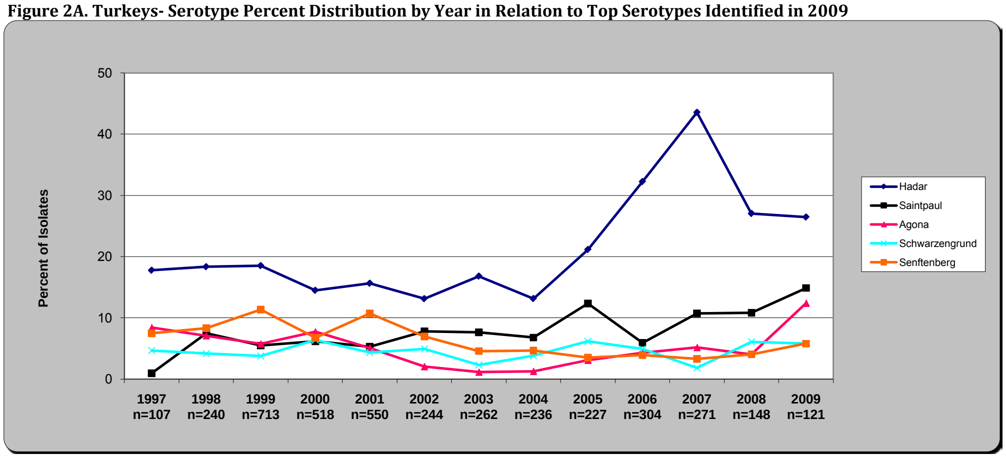


Figure 3A. Cattle- Serotype Percent Distribution by Year in Relation to Top Serotypes Identified in 2009

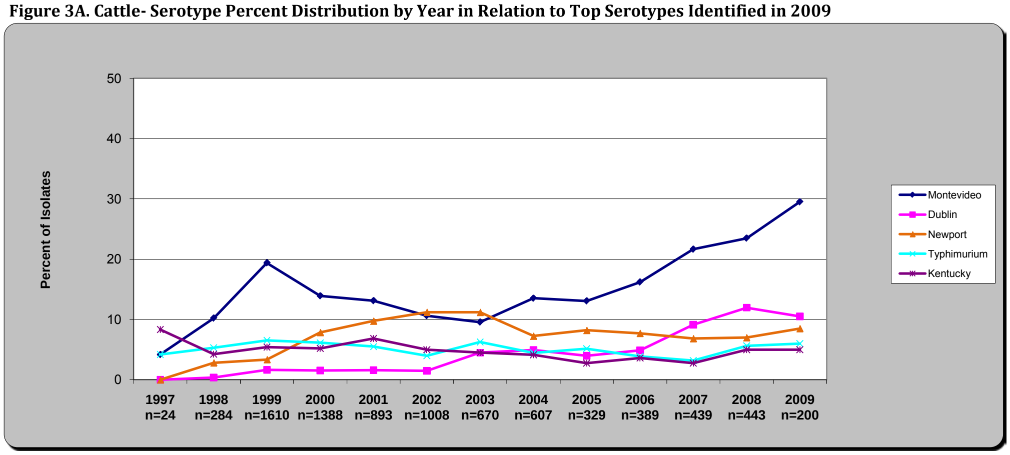


Figure 4A. Swine- Serotype Percent Distribution by Year in Relation to Top Serotypes Identified in 2009

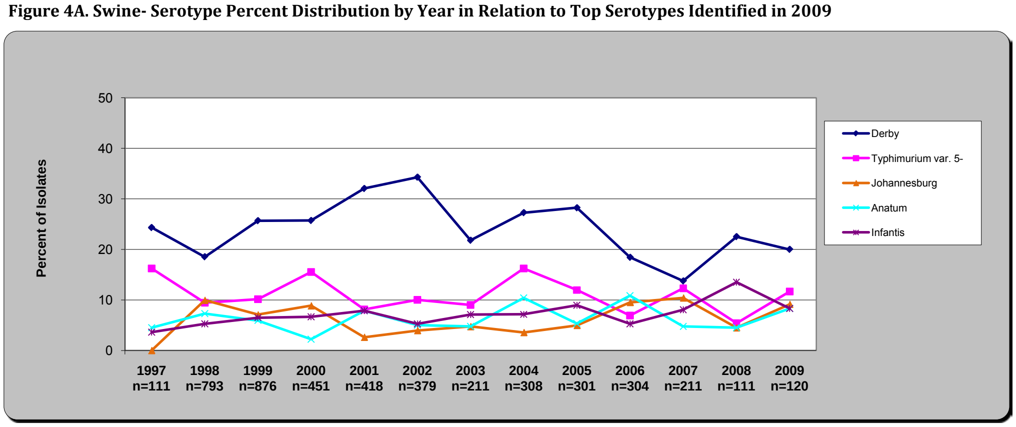


Table 3A. Distribution of MICs and Occurrence of Resistance by Animal Source among *Salmonella* , 2009

Antimicrobial	Isolate Source (# of Isolates)	%I[1]	%R[2]	95% CI[3]	Distribution (%) of MICs (µg/ml)[4] 0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
Aminoglycosides																					
Amikacin	Chickens (551)	0.0	**0.0**	0.0-0.9						9.6	71.3	18.3	0.5	0.2							
	Turkeys (121)	0.0	**0.0**	0.0-3.8						5.8	58.7	31.4	4.1								
	Cattle (200)	0.0	**0.0**	0.0-2.3						2.0	47.0	48.5	2.5								
	Swine (120)	0.0	**0.0**	0.0-3.9						3.3	83.3	12.5	0.8								
Gentamicin	Chickens (551)	0.9	**5.6**	3.9-7.9					70.4	22.1	0.7		0.2	0.9	**2.5**	**3.1**					
	Turkeys (121)	0.8	**14.9**	9.3-22.8					40.5	43.0			0.8	0.8	**4.1**	**10.7**					
	Cattle (200)	0.0	**2.0**	0.6-5.4					39.0	55.5	3.0	0.5				**2.0**					
	Swine (120)	0.8	**0.0**	0.0-3.9					66.7	30.8	0.8		0.8	0.8							
Kanamycin	Chickens (551)	0.2	**3.1**	1.9-5.0										96.4	0.4	0.2	**0.7**	**2.4**			
	Turkeys (121)	0.0	**10.7**	6.0-18.0										89.3				**10.7**			
	Cattle (200)	0.0	**9.0**	5.6-14.1										91.0				**9.0**			
	Swine (120)	0.0	**4.2**	1.6-10.0										95.0	0.8			**4.2**			
Streptomycin	Chickens (551)	N/A	**30.5**	26.7-34.6												69.5	**20.9**	**9.6**			
	Turkeys (121)	N/A	**38.8**	30.2-48.1												61.2	**23.1**	**15.7**			
	Cattle (200)	N/A	**22.0**	16.6-28.5												78.0	**5.5**	**16.5**			
	Swine (120)	N/A	**29.2**	21.4-38.3												70.8	**10.8**	**18.3**			
β-Lactam/β-Lactamase Inhibitor Combinations																					
Amoxicillin-Clavulanic Acid	Chickens (551)	0.0	**12.9**	10.3-16.1							84.0	2.0	0.2	0.9		**3.8**	**9.1**				
	Turkeys (121)	18.2	**13.2**	8.0-20.9							60.3	0.8		7.4	18.2	**3.3**	**9.9**				
	Cattle (200)	2.5	**15.0**	10.5-20.9							74.5	3.0	1.0	4.0	2.5	**6.5**	**8.5**				
	Swine (120)	10.8	**4.2**	1.6-10.0							78.3	2.5	2.5	1.7	10.8		**4.2**				
Cephems																					
Cefoxitin	Chickens (551)	1.3	**11.4**	8.9-14.4							25.2	50.8	10.7	0.5	1.3	**9.3**	**2.2**				
	Turkeys (121)	0.0	**12.4**	7.3-19.9							15.7	51.2	19.0	1.7		**1.7**	**10.7**				
	Cattle (200)	2.0	**13.5**	9.2-19.2							18.5	36.0	27.0	3.0	2.0	**5.5**	**8.0**				
	Swine (120)	0.0	**4.2**	1.6-10.0							10.8	39.2	42.5	3.3		**0.8**	**3.3**				
Ceftiofur	Chickens (551)	0.2	**12.7**	10.1-15.8				0.2		47.5	39.0	0.4	0.2	**0.7**	**12.0**						
	Turkeys (121)	0.0	**12.4**	7.3-19.9						29.8	57.9			**0.8**	**11.6**						
	Cattle (200)	0.5	**14.5**	10.1-20.3					2.0	37.5	43.5	2.0	0.5	**1.0**	**13.5**						
	Swine (120)	0.0	**4.2**	1.6-10.0					0.8	29.2	63.3	2.5			**4.2**						
Ceftriaxone	Chickens (551)	0.0	**12.9**	10.3-16.1					86.9	0.2			**0.9**	**3.4**	**6.5**	**1.5**	**0.4**	**0.2**			
	Turkeys (121)	0.0	**12.4**	7.3-19.9					87.6					**0.8**	**4.1**	**6.6**	**0.8**				
	Cattle (200)	0.5	**14.5**	10.1-20.3					85.0			0.5	**1.0**	**1.0**	**9.0**	**3.5**					
	Swine (120)	0.0	**4.2**	1.6-10.0					95.8					**0.8**	**1.7**	**1.7**					

[1] Percent of isolates with intermediate susceptibility

[2] Percent of isolates that were resistant

[3] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity method

[4] The unshaded areas indicate the range of dilutions tested for each antimicrobial. Single vertical bars indicate the breakpoints for susceptibility, while double vertical bars indicate the breakpoints for resistance. Numbers in the shaded area indicate the percentages of isolates with MICs greater than the highest tested concentrations. Numbers listed for the lowest tested concentrations represent the percentages of isolates with MICs equal to or less than the lowest tested concentration. CLSI breakpoints were used when available. There are no CLSI breakpoints for streptomycin.

Table 3A (continued). Distribution of MICs and Occurrence of Resistance by Animal Source among *Salmonella* , 2009

Antimicrobial	Isolate Source (# of Isolates)	%I[1]	%R[2]	[95% CI][3]	Distribution (%) of MICs (µg/ml)[4] 0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
Folate Pathway Inhibitors																					
Sulfisoxazole	Chickens (551)	N/A	10.0	7.7-12.9											27.2	50.8	11.6	0.4		10.0	
	Turkeys (121)	N/A	28.9	21.2-38.0											14.9	41.3	13.2	1.7		28.9	
	Cattle (200)	N/A	24.5	18.8-31.2											21.0	43.5	10.0	1.0		24.5	
	Swine (120)	N/A	30.8	22.9-40.0											26.7	30.8	10.8		0.8	30.8	
Trimethoprim-Sulfamethoxazole	Chickens (551)	N/A	0.2	0-1.2				94.0	5.8					0.2							
	Turkeys (121)	N/A	1.7	0.3-6.5				89.3	9.1					1.7							
	Cattle (200)	N/A	1.5	0.4-4.7				80.5	15.0	2.0	1.0			1.5							
	Swine (120)	N/A	2.5	0.6-7.7				73.3	23.3	0.8				2.5							
Penicillins																					
Ampicillin	Chickens (551)	0.0	13.8	11.1-17.0							81.5	4.4	0.4				13.8				
	Turkeys (121)	0.0	38.8	30.2-48.1							57.9	2.5	0.8				38.8				
	Cattle (200)	0.0	22.5	17.0-29.0							74.0	2.5	0.5	0.5			22.5				
	Swine (120)	0.0	19.2	12.8-27.6							74.2	6.7					19.2				
Phenicols																					
Chloramphenicol	Chickens (551)	0.2	1.6	0.8-3.1								15.1	61.7	21.4	0.2	0.2	1.5				
	Turkeys (121)	0.8	3.3	1.1-8.7								14.9	57.0	24.0	0.8		3.3				
	Cattle (200)	1.0	21.0	15.7-27.4								3.0	49.0	26.0	1.0	0.5	20.5				
	Swine (120)	1.7	15.0	9.4-22.9									20.8	62.5	1.7		15.0				
Quinolones																					
Ciprofloxacin	Chickens (551)	0.0	0.0	0.0-0.9	90.4	9.6															
	Turkeys (121)	0.0	0.0	0.0-3.8	97.5	1.7			0.8												
	Cattle (200)	0.0	0.0	0.0-2.3	95.5	3.0	0.5		0.5	0.5											
	Swine (120)	0.0	0.0	0.0-3.9	92.5	7.5															
Nalidixic Acid	Chickens (551)	N/A	0.0	0.0-0.9						0.2	2.2	62.8	34.3	0.5							
	Turkeys (121)	N/A	0.8	0-5.2							0.8	70.2	27.3	0.8			0.8				
	Cattle (200)	N/A	1.0	0.2-3.9							0.5	64.0	33.5	1.0			1.0				
	Swine (120)	N/A	0.0	0.0-3.9								45.0	53.3	1.7							
Tetracyclines																					
Tetracycline	Chickens (551)	1.1	33.9	30.0-38.0									65.0	1.1		0.5	33.4				
	Turkeys (121)	0.0	63.6	54.3-72.0									36.4			8.3	55.4				
	Cattle (200)	0.0	29.0	22.9-35.9									71.0		0.5	5.5	23.0				
	Swine (120)	0.0	53.3	44.0-62.4									46.7			14.2	39.2				

[1] Percent of isolates with intermediate susceptibility

[2] Percent of isolates that were resistant

[3] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

[4] The unshaded areas indicate the range of dilutions tested for each antimicrobial. Single vertical bars indicate the breakpoints for susceptibility, while double vertical bars indicate the breakpoints for resistance. Numbers in the shaded area indicate the percentages of isolates with MICs greater than the highest tested concentrations. Numbers listed for the lowest tested concentrations represent the percentages of isolates with MICs equal to or less than the lowest tested concentration. CLSI breakpoints were used when available. There are no CLSI breakpoints for streptomycin.

Table 4A. Antimicrobial Resistance among *Salmonella* by Animal Source, 1997-2009

Year			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of Isolates Tested		Chickens	214	561	1438	1173	1307	1500	1158	1280	1989	1380	994	624	551
		Turkeys	107	240	713	518	550	244	262	236	227	304	271	148	121
		Cattle	24	284	1610	1388	893	1008	670	607	329	389	439	443	200
		Swine	111	793	876	451	418	379	211	308	301	304	211	111	120
Antimicrobial Class	**Antimicrobial**	**Isolate Source**													
Aminoglycosides	Amikacin	Chickens	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0
		Turkeys	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0
		Cattle	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0
		Swine	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.5% 1	0.0% 0	0.0% 0
	Gentamicin	Chickens	17.8% 38	15.3% 86	10.4% 150	14.9% 175	7.9% 103	5.5% 83	6.3% 73	4.9% 63	4.3% 85	5.7% 79	4.5% 45	5.6% 35	5.6% 31
		Turkeys	20.6% 22	18.3% 44	17.5% 125	16.2% 84	20.9% 115	19.3% 47	21.0% 55	25.4% 60	22.9% 52	16.4% 50	12.9% 35	16.9% 25	14.9% 18
		Cattle	0.0% 0	1.8% 5	1.6% 25	2.1% 29	2.1% 19	2.6% 26	2.7% 18	1.8% 11	2.4% 8	3.9% 15	1.6% 7	1.6% 7	2.0% 4
		Swine	0.9% 1	0.8% 6	1.1% 10	1.3% 6	1.4% 6	0.8% 3	0.5% 1	1.3% 4	2.7% 8	2.0% 6	0.9% 2	2.7% 3	0.0% 0
	Kanamycin	Chickens	2.3% 5	3.2% 18	1.2% 17	4.1% 48	2.4% 31	2.0% 30	2.8% 32	2.7% 34	2.5% 49	3.6% 49	3.4% 34	3.4% 21	3.1% 17
		Turkeys	24.3% 26	17.1% 41	21.5% 153	21.4% 111	22.9% 126	24.2% 59	16.0% 42	14.4% 34	19.8% 45	10.5% 32	16.2% 44	14.2% 21	10.7% 13
		Cattle	8.3% 2	9.5% 27	7.1% 115	6.6% 92	6.9% 62	10.1% 102	13.7% 92	8.9% 54	13.1% 43	9.5% 37	7.7% 34	9.9% 44	9.0% 18
		Swine	11.7% 13	7.2% 57	6.7% 59	9.3% 42	6.9% 29	4.2% 16	5.7% 12	3.9% 12	5.0% 15	8.6% 26	7.1% 15	3.6% 4	4.2% 5
	Streptomycin	Chickens	24.3% 52	27.8% 156	27.5% 396	28.6% 335	21.0% 275	22.9% 343	19.6% 227	22.2% 284	23.3% 464	21.2% 293	19.3% 192	25.2% 157	30.5% 168
		Turkeys	34.6% 37	40.8% 98	43.6% 311	41.9% 217	46.7% 257	37.7% 92	29.4% 77	33.9% 80	40.1% 91	28.9% 88	34.7% 94	32.4% 48	38.8% 47
		Cattle	12.5% 3	16.2% 46	15.4% 248	21.3% 296	20.3% 181	25.9% 261	28.7% 192	20.9% 127	24.3% 80	23.7% 92	19.8% 87	23.0% 102	22.0% 44
		Swine	27.9% 31	29.4% 233	29.3% 257	39.2% 177	35.6% 149	40.1% 152	30.8% 65	36.4% 112	36.5% 110	26.3% 80	27.0% 57	29.7% 33	29.2% 35
β-Lactam/β-Lactamase Inhibitor Combinations	Amoxicillin-Clavulanic Acid	Chickens	0.5% 1	2.0% 11	4.9% 70	7.3% 86	4.5% 59	10.2% 153	9.7% 112	12.4% 159	12.1% 241	12.9% 178	15.6% 155	8.7% 54	12.9% 71
		Turkeys	4.7% 5	0.4% 1	4.3% 31	3.5% 18	6.9% 38	3.7% 9	1.5% 4	4.7% 11	3.5% 8	5.6% 17	11.1% 30	5.4% 8	13.2% 16
		Cattle	8.3% 2	2.5% 7	3.9% 62	9.9% 138	11.8% 105	17.7% 178	21.0% 141	13.5% 82	21.0% 69	18.5% 72	15.5% 68	16.5% 73	15.0% 30
		Swine	0.0% 0	0.4% 3	1.0% 9	1.8% 8	2.6% 11	3.7% 14	3.8% 8	1.9% 6	4.3% 13	2.3% 7	3.3% 7	4.5% 5	4.2% 5

Table 4A (continued). Resistance among *Salmonella* by Animal Source, 1997-2009

Year			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of Isolates Tested		Chickens	214	561	1438	1173	1307	1500	1158	1280	1989	1380	994	624	551
		Turkeys	107	240	713	518	550	244	262	236	227	304	271	148	121
		Cattle	24	284	1610	1388	893	1008	670	607	329	389	439	443	200
		Swine	111	793	876	451	418	379	211	308	301	304	211	111	120
Antimicrobial Class	**Antimicrobial**	**Isolate Source**													
Cephems	Cefoxitin	Chickens	Not Tested	Not Tested	Not Tested	7.2% 85	4.1% 53	8.7% 130	8.2% 95	12.4% 159	12.0% 238	12.8% 176	13.0% 129	8.0% 50	11.4% 63
		Turkeys	Not Tested	Not Tested	Not Tested	3.3% 17	4.5% 25	2.5% 6	1.1% 3	5.1% 12	3.5% 8	5.3% 16	9.2% 25	5.4% 8	12.4% 15
		Cattle	Not Tested	Not Tested	Not Tested	9.1% 126	11.1% 99	15.9% 160	17.8% 119	13.2% 80	19.8% 65	17.7% 69	15.0% 66	14.7% 65	13.5% 27
		Swine	Not Tested	Not Tested	Not Tested	1.3% 6	2.2% 9	2.9% 11	4.3% 9	1.9% 6	3.7% 11	2.0% 6	2.8% 6	4.5% 5	4.2% 5
	Ceftiofur	Chickens	0.5% 1	2.0% 11	5.2% 75	7.6% 89	4.1% 54	10.2% 153	9.8% 113	12.4% 159	12.2% 242	12.8% 177	15.4% 153	8.7% 54	12.7% 70
		Turkeys	3.7% 4	0.4% 1	4.6% 33	3.3% 17	5.1% 28	3.3% 8	1.5% 4	4.7% 11	3.5% 8	5.3% 16	11.1% 30	5.4% 8	12.4% 15
		Cattle	0.0% 0	2.1% 6	4.2% 67	9.8% 136	11.4% 102	17.4% 175	21.0% 141	13.3% 81	21.6% 71	18.8% 73	15.5% 68	16.3% 72	14.5% 29
		Swine	0.0% 0	0.1% 1	1.9% 17	1.3% 6	2.2% 9	3.2% 12	4.3% 9	1.9% 6	3.7% 11	2.0% 6	2.8% 6	4.5% 5	4.2% 5
	Ceftriaxone	Chickens	0.5% 1	1.8% 10	4.6% 66	7.4% 87	4.1% 54	9.9% 149	9.7% 112	12.3% 158	12.2% 242	12.8% 177	15.6% 155	8.7% 54	12.9% 71
		Turkeys	3.7% 4	0.4% 1	4.2% 30	3.1% 16	4.7% 26	3.3% 8	1.1% 3	4.7% 11	3.5% 8	5.3% 16	11.1% 30	5.4% 8	12.4% 15
		Cattle	0.0% 0	2.1% 6	3.9% 63	9.9% 137	11.3% 101	17.3% 174	21.0% 141	13.5% 82	20.7% 68	18.5% 72	15.9% 70	16.0% 71	14.5% 29
		Swine	0.0% 0	0.1% 1	1.3% 11	1.3% 6	2.2% 9	2.9% 11	4.3% 9	1.6% 5	3.7% 11	1.6% 5	2.4% 5	4.5% 5	4.2% 5
	Cephalothin	Chickens	1.4% 3	4.5% 25	5.8% 83	7.8% 91	4.7% 62	10.5% 158	10.4% 121	10.4% 121	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested
		Turkeys	5.6% 6	5.0% 12	10.5% 75	8.3% 43	13.1% 72	9.8% 24	11.1% 29	11.1% 29	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested
		Cattle	0.0% 0	2.1% 6	4.7% 76	9.9% 137	11.6% 104	17.7% 178	21.2% 142	21.2% 142	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested
		Swine	0.0% 0	0.1% 1	0.8% 7	2.4% 11	2.2% 9	3.2% 12	3.8% 8	3.8% 8	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested
Folate Pathway Inhibitors	Sulfonamides[1]	Chickens	24.8% 53	23.7% 133	15.9% 229	18.4% 216	11.8% 154	8.9% 133	10.3% 119	11.9% 152	8.5% 169	10.7% 148	10.4% 103	13.3% 83	10.0% 55
		Turkeys	37.4% 40	32.1% 77	36.0% 257	25.1% 130	38.0% 209	30.3% 74	28.2% 74	36.4% 86	37.0% 84	27.3% 83	25.5% 69	24.3% 36	28.9% 35
		Cattle	20.8% 5	15.5% 44	15.0% 242	19.9% 276	19.7% 176	22.3% 225	25.1% 168	22.7% 138	27.4% 90	24.2% 94	21.6% 95	24.8% 110	24.5% 49
		Swine	34.2% 38	29.0% 230	30.7% 269	35.7% 161	34.9% 146	34.6% 131	25.1% 53	37.0% 114	32.9% 99	26.6% 81	30.8% 65	31.5% 35	30.8% 37
	Trimethoprim-Sulfamethoxazole	Chickens	0.5% 1	1.2% 7	1.1% 16	0.4% 5	0.5% 6	0.8% 12	0.3% 4	0.2% 3	0.2% 4	0.1% 1	0.0% 0	0.3% 2	0.2% 1
		Turkeys	3.7% 4	2.5% 6	4.2% 30	1.5% 8	2.5% 14	2.5% 6	2.3% 6	0.8% 2	1.8% 4	1.0% 3	1.1% 3	1.4% 2	1.7% 2
		Cattle	4.2% 1	2.5% 7	2.4% 39	2.2% 30	2.6% 23	2.5% 25	3.3% 22	1.5% 9	4.9% 16	4.6% 18	3.0% 13	4.5% 20	1.5% 3
		Swine	1.8% 2	0.3% 2	1.1% 10	0.9% 4	0.0% 0	1.6% 6	2.4% 5	1.6% 5	2.3% 7	2.0% 6	1.9% 4	2.7% 3	2.5% 3

[1] Sulfamethoxazole was tested from 1997-2003 and was replaced by sulfisoxazole in 2004

Table 4A (continued). Resistance among *Salmonella* by Animal Source, 1997-2009

Year			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of Isolates Tested		Chickens	214	561	1438	1173	1307	1500	1158	1280	1989	1380	994	624	551
		Turkeys	107	240	713	518	550	244	262	236	227	304	271	148	121
		Cattle	24	284	1610	1388	893	1008	670	607	329	389	439	443	200
		Swine	111	793	876	451	418	379	211	308	301	304	211	111	120
Penicillins	Ampicillin	Chickens	11.7% 25	12.8% 72	12.4% 179	13.0% 152	9.4% 123	14.3% 215	13.7% 159	14.5% 185	14.0% 279	14.9% 205	17.0% 169	10.6% 66	13.8% 76
		Turkeys	12.1% 13	10.4% 25	17.7% 126	16.2% 84	19.5% 107	18.0% 44	18.7% 49	22.0% 52	22.9% 52	25.3% 77	36.9% 100	32.4% 48	38.8% 47
		Cattle	12.5% 3	9.2% 26	12.5% 202	18.7% 259	17.9% 160	23.9% 241	28.1% 188	19.3% 117	26.7% 88	22.4% 87	20.0% 88	21.7% 96	22.5% 45
		Swine	16.2% 18	12.9% 102	10.8% 95	18.8% 85	11.7% 49	13.7% 52	12.8% 27	16.2% 50	13.6% 41	11.5% 35	18.0% 38	14.4% 16	19.2% 23
Phenicols	Chloramphenicol	Chickens	2.3% 5	2.9% 16	1.8% 26	4.6% 54	2.5% 33	2.4% 36	2.1% 24	1.3% 16	1.8% 36	1.7% 24	1.8% 18	1.8% 11	1.6% 9
		Turkeys	3.7% 4	0.8% 2	4.1% 29	4.1% 21	3.8% 21	5.3% 13	4.2% 11	4.7% 11	4.8% 11	3.9% 12	5.5% 15	2.7% 4	3.3% 4
		Cattle	4.2% 1	5.6% 16	8.5% 137	15.1% 209	16.5% 147	20.6% 208	25.1% 168	17.6% 107	21.9% 72	19.8% 77	20.0% 88	19.6% 87	21.0% 42
		Swine	11.7% 13	8.4% 67	8.0% 70	12.4% 56	7.7% 32	10.0% 38	8.5% 18	12.7% 39	10.6% 32	7.9% 24	15.2% 32	9.9% 11	15.0% 18
Quinolones	Ciprofloxacin	Chickens	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.1% 1	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0
		Turkeys	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0
		Cattle	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0
		Swine	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0
	Nalidixic Acid	Chickens	0.0% 0	0.2% 1	0.2% 3	0.5% 6	0.0% 0	0.8% 12	0.4% 5	0.5% 6	0.3% 6	0.1% 2	0.1% 1	0.0% 0	0.0% 0
		Turkeys	4.7% 5	2.1% 5	5.3% 38	5.4% 28	5.1% 28	5.3% 13	3.8% 10	2.1% 5	2.2% 5	0.7% 2	1.1% 3	0.7% 1	0.8% 1
		Cattle	0.0% 0	0.4% 1	0.1% 1	0.4% 6	0.4% 4	0.4% 4	0.4% 3	2.0% 12	1.5% 5	0.5% 2	0.7% 3	0.7% 3	1.0% 2
		Swine	0.0% 0	0.0% 0	0.0% 0	0.2% 1	0.0% 0	0.3% 1	0.0% 0	0.0% 0	0.3% 1	0.0% 0	0.0% 0	0.0% 0	0.0% 0
Tetracyclines	Tetracycline	Chickens	20.6% 44	20.5% 115	25.0% 359	26.3% 308	21.9% 286	24.9% 374	26.2% 303	27.4% 351	28.3% 563	31.8% 439	35.5% 353	30.4% 190	33.9% 187
		Turkeys	52.3% 56	45.8% 110	52.9% 377	56.2% 291	54.9% 302	54.5% 133	58.8% 154	48.3% 114	54.6% 124	61.8% 188	73.8% 200	64.2% 95	63.6% 77
		Cattle	25.0% 6	24.3% 69	20.9% 336	25.8% 358	26.3% 235	32.0% 323	36.9% 247	31.8% 193	34.0% 112	30.3% 118	27.3% 120	29.3% 130	29.0% 58
		Swine	52.3% 58	47.5% 377	48.4% 424	54.3% 245	53.1% 222	57.8% 219	43.1% 91	58.8% 181	54.8% 165	62.8% 191	54.5% 115	51.4% 57	53.3% 64

Table 5A. Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Chickens, 2009[1]

Antimicrobial	Serotype (# of Isolates)	%I[2]	%R[3]	95% CI[4]	0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
					Distribution (%) of MICs (µg/ml)[5]																
Aminoglycosides																					
Amikacin	Kentucky (214)	0.0	**0.0**	0.0-2.2						5.1	77.6	16.8	0.5								
	Enteritidis (118)	0.0	**0.0**	0.0-3.9						18.6	77.1	3.4	0.8								
	Heidelberg (74)	0.0	**0.0**	0.0-6.1						4.1	68.9	27.0									
	Typhimurium var. 5- (27)	0.0	**0.0**	0.0-15.5						37.0	48.1	14.8									
	I 4,5,12:i:- (15)	0.0	**0.0**	0.0-25.3							53.3	40.0		6.7							
	I 8,20:-:z6 (13)	0.0	**0.0**	0.0-28.3						7.7	69.2	23.1									
	Montevideo (10)	0.0	**0.0**	0.0-34.5							30.0	70.0									
Gentamicin	Kentucky (214)	0.0	**2.3**	0.8-5.6					74.3	22.9	0.5				**0.5**	**1.9**					
	Enteritidis (118)	0.0	**0.0**	0.0-3.9					91.5	8.5											
	Heidelberg (74)	0.0	**23.0**	14.3-34.5					52.7	24.3					**13.5**	**9.5**					
	Typhimurium var. 5- (27)	0.0	**0.0**	0.0-15.5					77.8	22.2											
	I 4,5,12:i:- (15)	0.0	**6.7**	0.4-34.0					53.3	40.0					**6.7**						
	I 8,20:-:z6 (13)	30.8	**0.0**	0.0-28.3					53.8	7.7			7.7	30.8							
	Montevideo (10)	0.0	**10.0**	0.5-45.9					20.0	70.0						**10.0**					
Kanamycin	Kentucky (214)	0.0	**2.3**	0.8-5.6										97.7				**2.3**			
	Enteritidis (118)	0.0	**0.0**	0.0-3.9										100.0							
	Heidelberg (74)	0.0	**12.2**	6.1-22.4										85.1	2.7		**5.4**	**6.8**			
	Typhimurium var. 5- (27)	0.0	**11.1**	2.9-30.3										88.9				**11.1**			
	I 4,5,12:i:- (15)	0.0	**0.0**	0.0-25.3										100.0							
	I 8,20:-:z6 (13)	0.0	**0.0**	0.0-28.3										100.0							
	Montevideo (10)	0.0	**0.0**	0.0-34.5										100.0							
Streptomycin	Kentucky (214)	N/A	**54.7**	47.8-61.5												45.3	**39.7**	**15.0**			
	Enteritidis (118)	N/A	**0.0**	0.0-3.9												100.0					
	Heidelberg (74)	N/A	**27.0**	17.6-38.8												73.0	**9.5**	**17.6**			
	Typhimurium var. 5- (27)	N/A	**7.4**	1.3-25.7												92.6	**7.4**				
	I 4,5,12:i:- (15)	N/A	**13.3**	2.3-41.6												86.7	**6.7**	**6.7**			
	I 8,20:-:z6 (13)	N/A	**76.9**	46.0-93.8												23.1	**69.2**	**7.7**			
	Montevideo (10)	N/A	**10.0**	0.5-45.9												90.0	**10.0**				

[1] Data is only presented for serotypes with at least 10 or more isolates

[2] Percent of isolates with intermediate susceptibility

[3] Percent of isolates that were resistant

[4] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

[5] The unshaded areas indicate the range of dilutions tested for each antimicrobial. Single vertical bars indicate the breakpoints for susceptibility, while double vertical bars indicate the breakpoints for resistance. Numbers in the shaded area indicate the percentages of isolates with MICs greater than the highest tested concentrations. Numbers listed for the lowest tested concentrations represent the percentages of isolates with MICs equal to or less than the lowest tested concentration. CLSI breakpoints were used when available. There are no CLSI breakpoints for streptomycin.

Table 5A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Chickens, 2009[1]

Antimicrobial	Serotype (# of Isolates)	%I[2]	%R[3]	95% CI[4]	Distribution (%) of MICs (µg/ml)[5] 0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
β-Lactam/β-Lactamase Inhibitor Combinations																					
Amoxicillin-Clavulanic Acid	Kentucky (214)	0.0	**19.2**	14.3-25.3							78.5	1.4	0.5	0.5		**6.5**	**12.6**				
	Enteritidis (118)	0.0	**0.8**	0-5.2							92.4	5.1		1.7		**0.8**					
	Heidelberg (74)	0.0	**17.6**	10.1-28.6							79.7			2.7		**2.7**	**14.9**				
	Typhimurium var. 5- (27)	0.0	**40.7**	23.0-61.0							59.3					**11.1**	**29.6**				
	I 4,5,12:i:- (15)	0.0	**6.7**	0.4-34.0							86.7	6.7					**6.7**				
	I 8,20:-:z6 (13)	0.0	**0.0**	0.0-28.3							100.0										
	Montevideo (10)	0.0	**0.0**	0.0-34.5							90.0	10.0									
Cephems																					
Cefoxitin	Kentucky (214)	1.9	**17.3**	12.6-23.2							32.7	39.7	7.5	0.9	1.9	**16.4**	**0.9**				
	Enteritidis (118)	0.0	**0.0**	0.0-3.9							5.9	82.2	11.9								
	Heidelberg (74)	0.0	**17.6**	10.1-28.6							48.6	33.8				**9.5**	**8.1**				
	Typhimurium var. 5- (27)	7.4	**33.3**	17.2-54.0							14.8	40.7	3.7		7.4	**25.9**	**7.4**				
	I 4,5,12:i:- (15)	0.0	**6.7**	0.4-34.0							26.7	66.7				**6.7**					
	I 8,20:-:z6 (13)	0.0	**0.0**	0.0-28.3							23.1	76.9									
	Montevideo (10)	0.0	**0.0**	0.0-34.5							10.0	80.0	10.0								
Ceftiofur	Kentucky (214)	0.5	**18.7**	13.8-24.7				0.5		67.8	12.1	0.5	0.5		**18.7**						
	Enteritidis (118)	0.0	**0.8**	0-5.2						1.7	97.5				**0.8**						
	Heidelberg (74)	0.0	**17.6**	10.1-28.6						67.6	14.9				**17.6**						
	Typhimurium var. 5- (27)	0.0	**40.7**	23.0-61.0						44.4	14.8			**11.1**	**29.6**						
	I 4,5,12:i:- (15)	0.0	**6.7**	0.4-34.0						46.7	46.7				**6.7**						
	I 8,20:-:z6 (13)	0.0	**0.0**	0.0-28.3						76.9	23.1										
	Montevideo (10)	0.0	**0.0**	0.0-34.5						70.0	30.0										
Ceftriaxone	Kentucky (214)	0.0	**19.2**	14.3-25.3					80.8				**0.5**	**7.5**	**8.9**	**2.3**					
	Enteritidis (118)	0.0	**0.8**	0-5.2					99.2					**0.8**							
	Heidelberg (74)	0.0	**17.6**	10.1-28.6					81.1	1.4				**1.4**	**8.1**	**4.1**	**2.7**	**1.4**			
	Typhimurium var. 5- (27)	0.0	**40.7**	23.0-61.0					59.3				**11.1**	**3.7**	**25.9**						
	I 4,5,12:i:- (15)	0.0	**6.7**	0.4-34.0					93.3						**6.7**						
	I 8,20:-:z6 (13)	0.0	**0.0**	0.0-28.3					100.0												
	Montevideo (10)	0.0	**0.0**	0.0-34.5					100.0												

[1] Data is only presented for serotypes with at least 10 or more isolates

[2] Percent of isolates with intermediate susceptibility

[3] Percent of isolates that were resistant

[4] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

[5] The unshaded areas indicate the range of dilutions tested for each antimicrobial. Single vertical bars indicate the breakpoints for susceptibility, while double vertical bars indicate the breakpoints for resistance. Numbers in the shaded area indicate the percentages of isolates with MICs greater than the highest tested concentrations. Numbers listed for the lowest tested concentrations represent the percentages of isolates with MICs equal to or less than the lowest tested concentration. CLSI breakpoints were used when available. There are no CLSI breakpoints for streptomycin.

Table 5A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Chickens, 2009[1]

Antimicrobial	Serotype (# of Isolates)	%I[2]	%R[3]	95% CI[4]	Distribution (%) of MICs (µg/ml)[5] 0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
Folate Pathway Inhibitors																					
Sulfisoxazole	Kentucky (214)	N/A	**2.3**	0.8-5.6											38.8	50.5	8.4			**2.3**	
	Enteritidis (118)	N/A	**0.0**	0.0-3.9											3.4	68.6	27.1	0.8			
	Heidelberg (74)	N/A	**21.6**	13.2-33.0											51.4	24.3	2.7			**21.6**	
	Typhimurium var. 5- (27)	N/A	**59.3**	39.0-77.0											22.2	18.5				**59.3**	
	I 4,5,12:i:- (15)	N/A	**6.7**	0.4-34.0												93.3				**6.7**	
	I 8,20:-:z6 (13)	N/A	**38.5**	15.2-67.8											7.7	38.5	15.4			**38.5**	
	Montevideo (10)	N/A	**10.0**	0.5-45.9											20.0	70.0				**10.0**	
Trimethoprim-Sulfamethoxazole	Kentucky (214)	N/A	**0.0**	0.0-2.2				94.9	5.1												
	Enteritidis (118)	N/A	**0.0**	0.0-3.9				94.9	5.1												
	Heidelberg (74)	N/A	**0.0**	0.0-6.1				91.9	8.1												
	Typhimurium var. 5- (27)	N/A	**0.0**	0.0-15.5				92.6	7.4												
	I 4,5,12:i:- (15)	N/A	**0.0**	0.0-25.3				100.0													
	I 8,20:-:z6 (13)	N/A	**0.0**	0.0-28.3				92.3	7.7												
	Montevideo (10)	N/A	**0.0**	0.0-34.5				100.0													
Penicillins																					
Ampicillin	Kentucky (214)	0.0	**19.6**	14.6-25.7							78.0	2.3					**19.6**				
	Enteritidis (118)	0.0	**2.5**	0.6-7.7							83.1	12.7	1.7				**2.5**				
	Heidelberg (74)	0.0	**20.3**	12.2-31.6							78.4	1.4					**20.3**				
	Typhimurium var. 5- (27)	0.0	**40.7**	23.0-61.0							59.3						**40.7**				
	I 4,5,12:i:- (15)	0.0	**6.7**	0.4-34.0							93.3						**6.7**				
	I 8,20:-:z6 (13)	0.0	**0.0**	0.0-28.3							100.0										
	Montevideo (10)	0.0	**0.0**	0.0-34.5							90.0	10.0									

[1] Data is only presented for serotypes with at least 10 or more isolates

[2] Percent of isolates with intermediate susceptibility

[3] Percent of isolates that were resistant

[4] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

[5] The unshaded areas indicate the range of dilutions tested for each antimicrobial. Single vertical bars indicate the breakpoints for susceptibility, while double vertical bars indicate the breakpoints for resistance. Numbers in the shaded area indicate the percentages of isolates with MICs greater than the highest tested concentrations. Numbers listed for the lowest tested concentrations represent the percentages of isolates with MICs equal to or less than the lowest tested concentration. CLSI breakpoints were used when available. There are no CLSI breakpoints for streptomycin.

Table 5A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Chickens, 2009[1]

Antimicrobial	Serotype (# of Isolates)	%I[2]	%R[3]	95% CI[4]	0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
					Distribution (%) of MICs (µg/ml)[5]																
Phenicols																					
Chloramphenicol	Kentucky (214)	0.0	**1.9**	0.6-5.1								31.8	60.3	6.1			**1.9**				
	Enteritidis (118)	0.0	**0.0**	0.0-3.9								6.8	67.8	25.4							
	Heidelberg (74)	0.0	**5.4**	1.7-14.0									48.6	45.9		**1.4**	**4.1**				
	Typhimurium var. 5- (27)	0.0	**0.0**	0.0-15.5								7.4	74.1	18.5							
	I 4,5,12:i:- (15)	0.0	**0.0**	0.0-25.3									86.7	13.3							
	I 8,20:-:z6 (13)	0.0	**0.0**	0.0-28.3								23.1	76.9								
	Montevideo (10)	0.0	**0.0**	0.0-34.5									60.0	40.0							
Quinolones																					
Ciprofloxacin	Kentucky (214)	0.0	**0.0**	0.0-2.2	98.6	1.4															
	Enteritidis (118)	0.0	**0.0**	0.0-3.9	63.6	36.4															
	Heidelberg (74)	0.0	**0.0**	0.0-6.1	94.6	5.4															
	Typhimurium var. 5- (27)	0.0	**0.0**	0.0-15.5	100.0																
	I 4,5,12:i:- (15)	0.0	**0.0**	0.0-25.3	93.3	6.7															
	I 8,20:-:z6 (13)	0.0	**0.0**	0.0-28.3	100.0																
	Montevideo (10)	0.0	**0.0**	0.0-34.5	100.0																
Nalidixic Acid	Kentucky (214)	N/A	**0.0**	0.0-2.2						0.5	5.1	85.5	8.4	0.5							
	Enteritidis (118)	N/A	**0.0**	0.0-3.9								17.8	80.5	1.7							
	Heidelberg (74)	N/A	**0.0**	0.0-6.1								54.1	45.9								
	Typhimurium var. 5- (27)	N/A	**0.0**	0.0-15.5								85.2	14.8								
	I 4,5,12:i:- (15)	N/A	**0.0**	0.0-25.3								66.7	33.3								
	I 8,20:-:z6 (13)	N/A	**0.0**	0.0-28.3								100.0									
	Montevideo (10)	N/A	**0.0**	0.0-34.5								40.0	60.0								
Tetracyclines																					
Tetracycline	Kentucky (214)	2.3	**57.5**	50.6-64.2									40.2	2.3			**57.5**				
	Enteritidis (118)	0.0	**2.5**	0.6-7.7									97.5			**1.7**	**0.8**				
	Heidelberg (74)	0.0	**14.9**	8.0-25.5									85.1				**14.9**				
	Typhimurium var. 5- (27)	0.0	**63.0**	42.5-80.0									37.0				**63.0**				
	I 4,5,12:i:- (15)	0.0	**6.7**	0.4-34.0									93.3				**6.7**				
	I 8,20:-:z6 (13)	0.0	**100.0**	71.7-100													**100.0**				
	Montevideo (10)	0.0	**0.0**	0.0-34.5									100.0								

[1] Data is only presented for serotypes with at least 10 or more isolates

[2] Percent of isolates with intermediate susceptibility

[3] Percent of isolates that were resistant

[4] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

Table 6A. Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Turkeys, 2009[1]

Antimicrobial	Serotype (# of Isolates)	%I[2]	%R[3]	95% CI[4]	0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
					Distribution (%) of MICs (µg/ml)[5]																
Aminoglycosides																					
Amikacin	Hadar (32)	0.0	**0.0**	0.0-13.3							46.9	43.8	9.4								
	Saintpaul (18)	0.0	**0.0**	0.0-21.9						5.6	66.7	27.8									
	Agona (15)	0.0	**0.0**	0.0-25.3						6.7	86.7	6.7									
Gentamicin	Hadar (32)	0.0	**3.1**	0.2-18.0					25.0	71.9						**3.1**					
	Saintpaul (18)	0.0	**11.1**	1.9-36.1					44.4	44.4					**5.6**	**5.6**					
	Agona (15)	0.0	**13.3**	2.3-41.6					46.7	40.0					**6.7**	**6.7**					
Kanamycin	Hadar (32)	0.0	**12.5**	4.1-29.9										87.5				**12.5**			
	Saintpaul (18)	0.0	**22.2**	7.4-48.1										77.8				**22.2**			
	Agona (15)	0.0	**0.0**	0.0-25.3										100.0							
Streptomycin	Hadar (32)	N/A	**68.8**	49.9-83.3												31.2	**46.9**	**21.9**			
	Saintpaul (18)	N/A	**0.0**	0.0-21.9												100.0					
	Agona (15)	N/A	**33.3**	13.0-61.3												66.7	**13.3**	**20.0**			
β-Lactam/β-Lactamase Inhibitor Combinations																					
Amoxicillin-Clavulanic Acid	Hadar (32)	50.0	**0.0**	0.0-13.3							46.9			3.1	50.0						
	Saintpaul (18)	27.8	**0.0**	0.0-21.9							55.6			16.7	27.8						
	Agona (15)	0.0	**46.7**	22.3-72.6							46.7			6.7			**46.7**				
Cephems																					
Cefoxitin	Hadar (32)	0.0	**0.0**	0.0-13.3							31.2	68.8									
	Saintpaul (18)	0.0	**0.0**	0.0-21.9							27.8	50.0	11.1	11.1							
	Agona (15)	0.0	**46.7**	22.3-72.6								13.3	40.0				**46.7**				
Ceftiofur	Hadar (32)	0.0	**0.0**	0.0-13.3						28.1	71.9										
	Saintpaul (18)	0.0	**0.0**	0.0-21.9						33.3	66.7										
	Agona (15)	0.0	**46.7**	22.3-72.6						13.3	40.0				**46.7**						
Ceftriaxone	Hadar (32)	0.0	**0.0**	0.0-13.3					100.0												
	Saintpaul (18)	0.0	**0.0**	0.0-21.9					100.0												
	Agona (15)	0.0	**46.7**	22.3-72.6					53.3						**20.0**	**26.7**					

[1] Data is only presented for serotypes with at least 10 or more isolates

[2] Percent of isolates with intermediate susceptibility

[3] Percent of isolates that were resistant

[4] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

[5] The unshaded areas indicate the range of dilutions tested for each antimicrobial. Single vertical bars indicate the breakpoints for susceptibility, while double vertical bars indicate the breakpoints for resistance. Numbers in the shaded area indicate the percentages of isolates with MICs greater than the highest tested concentrations. Numbers listed for the lowest tested concentrations represent the percentages of isolates with MICs equal to or less than the lowest tested concentration. CLSI breakpoints were used when available. There are no CLSI breakpoints for streptomycin.

Table 6A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Turkeys, 2009[1]

Antimicrobial	Serotype (# of Isolates)	%I[2]	%R[3]	95% CI[4]	Distribution (%) of MICs (µg/ml)[5] 0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
Folate Pathway Inhibitors																					
Sulfonamides	Hadar (32)	N/A	**3.1**	0.2-18.0											18.8	65.6	9.4	3.1		**3.1**	
	Saintpaul (18)	N/A	**22.2**	7.4-48.1												44.4	33.3			**22.2**	
	Agona (15)	N/A	**73.3**	44.8-91.1												20.0		6.7		**73.3**	
Trimethoprim-Sulfamethoxazole	Hadar (32)	N/A	**0.0**	0.0-13.3				96.9	3.1												
	Saintpaul (18)	N/A	**5.6**	0.3-29.4				88.9	5.6					**5.6**							
	Agona (15)	N/A	**6.7**	0.4-34.0				80.0	13.3					**6.7**							
Penicillins																					
Ampicillin	Hadar (32)	0.0	**53.1**	35.0-70.5							46.9						**53.1**				
	Saintpaul (18)	0.0	**44.4**	22.4-68.6							50.0	5.6					**44.4**				
	Agona (15)	0.0	**53.3**	27.4-77.7							46.7						**53.3**				
Phenicols																					
Chloramphenicol	Hadar (32)	0.0	**0.0**	0.0-13.3								46.9	53.1								
	Saintpaul (18)	0.0	**0.0**	0.0-21.9									66.7	33.3							
	Agona (15)	0.0	**20.0**	5.3-48.6								6.7	20.0	53.3			**20.0**				
Quinolones																					
Ciprofloxacin	Hadar (32)	0.0	**0.0**	0.0-13.3	100.0																
	Saintpaul (18)	0.0	**0.0**	0.0-21.9	100.0																
	Agona (15)	0.0	**0.0**	0.0-25.3	100.0																
Nalidixic Acid	Hadar (32)	0.0	**0.0**	0.0-13.3								78.1	21.9								
	Saintpaul (18)	0.0	**0.0**	0.0-21.9								83.3	16.7								
	Agona (15)	0.0	**0.0**	0.0-25.3							6.7	33.3	53.3	6.7							
Tetracyclines																					
Tetracycline	Hadar (32)	0.0	**100.0**	86.7-100												**31.2**	**68.8**				
	Saintpaul (18)	0.0	**66.7**	41.2-85.7									33.3				**66.7**				
	Agona (15)	0.0	**60.0**	32.9-82.5									40.0				**60.0**				

[1] Data is only presented for serotypes with at least 10 or more isolates

[2] Percent of isolates with intermediate susceptibility

[3] Percent of isolates that were resistant

[4] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

[5] The unshaded areas indicate the range of dilutions tested for each antimicrobial. Single vertical bars indicate the breakpoints for susceptibility, while double vertical bars indicate the breakpoints for resistance. Numbers in the shaded area indicate the percentages of isolates with MICs greater than the highest tested concentrations. Numbers listed for the lowest tested concentrations represent the percentages of isolates with MICs equal to or less than the lowest tested concentration. CLSI breakpoints were used when available. There are no CLSI breakpoints for streptomycin.

Table 7A. Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Cattle, 2009[1]

Antimicrobial	Serotype (# of Isolates)	%I[2]	%R[3]	95% CI[4]	0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
					Distribution (%) of MICs (µg/ml)[5]																
Aminoglycosides																					
Amikacin	Montevideo (59)	0.0	**0.0**	0.0-7.6							20.3	74.6	5.1								
	Dublin (21)	0.0	**0.0**	0.0-19.2							23.8	71.4	4.8								
	Newport (17)	0.0	**0.0**	0.0-22.9						5.9	88.2	5.9									
	Typhimurium (12)	0.0	**0.0**	0.0-30.1							50.0	50.0									
	Kentucky (10)	0.0	**0.0**	0.0-34.5						10.0	40.0	50.0									
Gentamicin	Montevideo (59)	0.0	**0.0**	0.0-7.6					8.5	89.8	1.7										
	Dublin (21)	0.0	**9.5**	1.7-31.8					19.0	66.7	4.8					**9.5**					
	Newport (17)	0.0	**0.0**	0.0-22.9					70.6	29.4											
	Typhimurium (12)	0.0	**0.0**	0.0-30.1					41.7	33.3	25.0										
	Kentucky (10)	0.0	**0.0**	0.0-34.5					50.0	50.0											
Kanamycin	Montevideo (59)	0.0	**0.0**	0.0-7.6										100.0							
	Dublin (21)	0.0	**33.3**	15.5-56.9										66.7				**33.3**			
	Newport (17)	0.0	**5.9**	0.3-30.8										94.1				**5.9**			
	Typhimurium (12)	0.0	**33.3**	11.3-64.5										66.7				**33.3**			
	Kentucky (10)	0.0	**0.0**	0.0-34.5										100.0							
Streptomycin	Montevideo (59)	N/A	**1.7**	0.1-10.3												98.3		**1.7**			
	Dublin (21)	N/A	**52.4**	30.4-73.6												47.6		**52.4**			
	Newport (17)	N/A	**70.6**	44.1-88.6												29.4	**5.9**	**64.7**			
	Typhimurium (12)	N/A	**75.0**	42.8-93.3												25.0	**33.3**	**41.7**			
	Kentucky (10)	N/A	**0.0**	0.0-34.5												100.0					
β-Lactam/β-Lactamase Inhibitor Combinations																					
Amoxicillin-Clavulanic Acid	Montevideo (59)	0.0	**1.7**	0.1-10.3							96.6	1.7					**1.7**				
	Dublin (21)	0.0	**42.9**	22.6-65.6							38.1	9.5	4.8	4.8		**9.5**	**33.3**				
	Newport (17)	0.0	**58.8**	33.4-80.6							35.3			5.9		**41.2**	**17.6**				
	Typhimurium (12)	25.0	**25.0**	6.7-57.2							16.7			33.3	25.0		**25.0**				
	Kentucky (10)	0.0	**0.0**	0.0-34.5							100.0										

[1] Data is only presented for serotypes with at least 10 or more isolates

[2] Percent of isolates with intermediate susceptibility

[3] Percent of isolates that were resistant

[4] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

[5] The unshaded areas indicate the range of dilutions tested for each antimicrobial. Single vertical bars indicate the breakpoints for susceptibility, while double vertical bars indicate the breakpoints for resistance. Numbers in the shaded area indicate the percentages of isolates with MICs greater than the highest tested concentrations. Numbers listed for the lowest tested concentrations represent the percentages of isolates with MICs equal to or less than the lowest tested concentration. CLSI breakpoints were used when available. There are no CLSI breakpoints for streptomycin.

Table 7A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Cattle, 2009[1]

Antimicrobial	Serotype (# of Isolates)	%I[2]	%R[3]	95% CI[4]	Distribution (%) of MICs (µg/ml)[5]																
					0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
Cephems																					
Cefoxitin	Montevideo (59)	0.0	**1.7**	0.1-10.3							39.0	47.5	10.2	1.7		**1.7**					
	Dublin (21)	9.5	**38.1**	19.0-61.3							4.8	9.5	33.3	4.8	9.5	**9.5**	**28.6**				
	Newport (17)	5.9	**52.9**	28.5-76.1							17.6	23.5			5.9	**35.3**	**17.6**				
	Typhimurium (12)	0.0	**25.0**	6.7-57.2							8.3	58.3	8.3			**8.3**	**16.7**				
	Kentucky (10)	0.0	**0.0**	0.0-34.5								60.0	40.0								
Ceftiofur	Montevideo (59)	0.0	**1.7**	0.1-10.3						62.7	35.6				**1.7**						
	Dublin (21)	4.8	**38.1**	19.0-61.3					14.3	28.6	9.5	4.8	4.8	**4.8**	**33.3**						
	Newport (17)	0.0	**58.8**	33.4-80.6						17.6	23.5				**58.8**						
	Typhimurium (12)	0.0	**25.0**	6.7-57.2						25.0	50.0				**25.0**						
	Kentucky (10)	0.0	**0.0**	0.0-34.5						10.0	90.0										
Ceftriaxone	Montevideo (59)	0.0	**1.7**	0.1-10.3					98.3						1.7						
	Dublin (21)	4.8	**38.1**	19.0-61.3					57.1			4.8	**4.8**		**19.0**	**14.3**					
	Newport (17)	0.0	**58.8**	33.4-80.6					41.2					**5.9**	**41.2**	**11.8**					
	Typhimurium (12)	0.0	**25.0**	6.7-57.2					75.0					**8.3**	**16.7**						
	Kentucky (10)	0.0	**0.0**	0.0-34.5					100.0												
Folate Pathway Inhibitors																					
Sulfonamides	Montevideo (59)	N/A	**1.7**	0.1-10.3											35.6	57.6	5.1			**1.7**	
	Dublin (21)	N/A	**71.4**	47.7-87.8											23.8	4.8				**71.4**	
	Newport (17)	N/A	**70.6**	44.1-88.6											5.9	17.6	5.9			**70.6**	
	Typhimurium (12)	N/A	**75.0**	42.8-93.3											8.3	16.7				**75.0**	
	Kentucky (10)	N/A	**0.0**	0.0-34.5											40.0	50.0	10.0				
Trimethoprim-Sulfamethoxazole	Montevideo (59)	N/A	**0.0**	0.0-7.6				94.9	5.1												
	Dublin (21)	N/A	**0.0**	0.0-19.2				19.0	66.7	9.5	4.8										
	Newport (17)	N/A	**0.0**	0.0-22.9				88.2	11.8												
	Typhimurium (12)	N/A	**8.3**	0.4-40.2				58.3	33.3					**8.3**							
	Kentucky (10)	N/A	**0.0**	0.0-34.5				90.0	10.0												

[1] Data is only presented for serotypes with at least 10 or more isolates

[2] Percent of isolates with intermediate susceptibility

[3] Percent of isolates that were resistant

[4] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

[5] The unshaded areas indicate the range of dilutions tested for each antimicrobial. Single vertical bars indicate the breakpoints for susceptibility, while double vertical bars indicate the breakpoints for resistance. Numbers in the shaded area indicate the percentages of isolates with MICs greater than the highest tested concentrations. Numbers listed for the lowest tested concentrations represent the percentages of isolates with MICs equal to or less than the lowest tested concentration. CLSI breakpoints were used when available. There are no CLSI breakpoints for streptomycin.

Table 7A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Cattle, 2009[1]

Antimicrobial	Serotype (# of Isolates)	%I[2]	%R[3]	95% CI[4]	Distribution (%) of MICs (µg/ml)[5] 0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
Penicillins																					
Ampicillin	Montevideo (59)	0.0	**1.7**	0.1-10.3							98.3						**1.7**				
	Dublin (21)	0.0	**52.4**	30.4-73.6							38.1	4.8		4.8			**52.4**				
	Newport (17)	0.0	**64.7**	38.6-84.7							35.3						**64.7**				
	Typhimurium (12)	0.0	**83.3**	50.8-97.0							16.7						**83.3**				
	Kentucky (10)	0.0	**0.0**	0.0-34.5							100.0										
Phenicols																					
Chloramphenicol	Montevideo (59)	0.0	**1.7**	0.1-10.3									52.5	45.8			**1.7**				
	Dublin (21)	4.8	**71.4**	47.7-87.8								4.8	14.3	4.8	4.8		**71.4**				
	Newport (17)	0.0	**52.9**	28.5-76.1									47.1				**52.9**				
	Typhimurium (12)	0.0	**75.0**	42.8-93.3									25.0				**75.0**				
	Kentucky (10)	0.0	**0.0**	0.0-34.5									70.0	30.0							
Quinolones																					
Ciprofloxacin	Montevideo (59)	0.0	**0.0**	0.0-7.6	100.0																
	Dublin (21)	0.0	**0.0**	0.0-19.2	61.9	23.8	4.8		4.8	4.8											
	Newport (17)	0.0	**0.0**	0.0-22.9	100.0																
	Typhimurium (12)	0.0	**0.0**	0.0-30.1	100.0																
	Kentucky (10)	0.0	**0.0**	0.0-34.5	100.0																
Nalidixic Acid	Montevideo (59)	N/A	**0.0**	0.0-7.6								79.7	20.3								
	Dublin (21)	N/A	**9.5**	1.7-31.8								28.6	57.1	4.8			**9.5**				
	Newport (17)	N/A	**0.0**	0.0-22.9								94.1	5.9								
	Typhimurium (12)	N/A	**0.0**	0.0-30.1								58.3	41.7								
	Kentucky (10)	N/A	**0.0**	0.0-34.5								70.0	30.0								
Tetracyclines																					
Tetracycline	Montevideo (59)	0.0	**6.8**	2.2-17.3									93.2				**6.8**				
	Dublin (21)	0.0	**71.4**	47.7-87.8									28.6				**71.4**				
	Newport (17)	0.0	**70.6**	44.1-88.6									29.4				**70.6**				
	Typhimurium (12)	0.0	**83.3**	50.8-97.0									16.7		**8.3**	**50.0**	**25.0**				
	Kentucky (10)	0.0	**0.0**	0.0-34.5									100.0								

[1] Data is only presented for serotypes with at least 10 or more isolates

[2] Percent of isolates with intermediate susceptibility

[3] Percent of isolates that were resistant

[4] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

[5] The unshaded areas indicate the range of dilutions tested for each antimicrobial. Single vertical bars indicate the breakpoints for susceptibility, while double vertical bars indicate the breakpoints for resistance. Numbers in the shaded area indicate the percentages of isolates with MICs greater than the highest tested concentrations. Numbers listed for the lowest tested concentrations represent the percentages of isolates with MICs equal to or less than the lowest tested concentration. CLSI breakpoints were used when available. There are no CLSI breakpoints for streptomycin.

Table 8A. Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Swine, 2009[1]

Antimicrobial	Serotype (# of Isolates)	%I[2]	%R[3]	95% CI[4]	Distribution (%) of MICs (µg/ml)[5] 0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
Aminoglycosides																					
Amikacin	Derby (24)	0.0	**0.0**	0.0-17.2						4.2	75.0	16.7	4.2								
	Typhimurium var. 5- (14)	0.0	**0.0**	0.0-26.8							92.9	7.1									
	Johannesburg (11)	0.0	**0.0**	0.0-32.1							90.9	9.1									
	Anatum (10)	0.0	**0.0**	0.0-34.5							100.0										
	Infantis (10)	0.0	**0.0**	0.0-34.5						20.0	80.0										
Gentamicin	Derby (24)	0.0	**0.0**	0.0-17.2					66.7	29.2	4.2										
	Typhimurium var. 5- (14)	0.0	**0.0**	0.0-26.8					57.1	42.9											
	Johannesburg (11)	0.0	**0.0**	0.0-32.1					54.5	45.5											
	Anatum (10)	0.0	**0.0**	0.0-34.5					90.0	10.0											
	Infantis (10)	0.0	**0.0**	0.0-34.5					90.0				10.0								
Kanamycin	Derby (24)	0.0	**0.0**	0.0-17.2										100.0							
	Typhimurium var. 5- (14)	0.0	**0.0**	0.0-26.8										100.0							
	Johannesburg (11)	0.0	**0.0**	0.0-32.1										100.0							
	Anatum (10)	0.0	**0.0**	0.0-34.5										100.0							
	Infantis (10)	0.0	**0.0**	0.0-34.5										100.0							
Streptomycin	Derby (24)	N/A	**58.3**	36.9-77.2												41.7	**4.2**	**54.2**			
	Typhimurium var. 5- (14)	N/A	**71.4**	42.0-90.4												28.6	**42.9**	**28.6**			
	Johannesburg (11)	N/A	**0.0**	0.0-32.1												100.0					
	Anatum (10)	N/A	**0.0**	0.0-34.5												100.0					
	Infantis (10)	N/A	**0.0**	0.0-34.5												100.0					
β-Lactam/β-Lactamase Inhibitor Combinations																					
Amoxicillin-Clavulanic Acid	Derby (24)	0.0	**4.2**	0.2-23.2							87.5	8.3					**4.2**				
	Typhimurium var. 5- (14)	57.1	**0.0**	0.0-26.8							28.6		7.1	7.1	57.1						
	Johannesburg (11)	0.0	**9.1**	0.5-42.9							90.9						**9.1**				
	Anatum (10)	0.0	**0.0**	0.0-34.5							100.0										
	Infantis (10)	0.0	**0.0**	0.0-34.5							90.0		10.0								

[1] Data is only presented for serotypes with at least 10 or more isolates

[2] Percent of isolates with intermediate susceptibility

[3] Percent of isolates that were resistant

[4] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

[5] The unshaded areas indicate the range of dilutions tested for each antimicrobial. Single vertical bars indicate the breakpoints for susceptibility, while double vertical bars indicate the breakpoints for resistance. Numbers in the shaded area indicate the percentages of isolates with MICs greater than the highest tested concentrations. Numbers listed for the lowest tested concentrations represent the percentages of isolates with MICs equal to or less than the lowest tested concentration. CLSI breakpoints were used when available. There are no CLSI breakpoints for streptomycin.

Table 8A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Swine, 2009[1]

Antimicrobial	Serotype (# of Isolates)	%I[2]	%R[3]	95% CI[4]	0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
													Distribution (%) of MICs (µg/ml)[5]								
Cephems																					
Cefoxitin	Derby (24)	0.0	**4.2**	0.2-23.2								16.7	70.8	8.3			**4.2**				
	Typhimurium var. 5- (14)	0.0	**0.0**	0.0-26.8							14.3	71.4	7.1	7.1							
	Johannesburg (11)	0.0	**9.1**	0.5-42.9								90.9				**9.1**					
	Anatum (10)	0.0	**0.0**	0.0-34.5								10.0	90.0								
	Infantis (10)	0.0	**0.0**	0.0-34.5								10.0	90.0								
Ceftiofur	Derby (24)	0.0	**4.2**	0.2-23.2						4.2	87.5	4.2			**4.2**						
	Typhimurium var. 5- (14)	0.0	**0.0**	0.0-26.8						14.3	85.7										
	Johannesburg (11)	0.0	**9.1**	0.5-42.9						81.8	9.1				**9.1**						
	Anatum (10)	0.0	**0.0**	0.0-34.5						10.0	90.0										
	Infantis (10)	0.0	**0.0**	0.0-34.5							100.0										
Ceftriaxone	Derby (24)	0.0	**4.2**	0.2-23.2					95.8							**4.2**					
	Typhimurium var. 5- (14)	0.0	**0.0**	0.0-26.8					100.0												
	Johannesburg (11)	0.0	**9.1**	0.5-42.9					90.9					**9.1**							
	Anatum (10)	0.0	**0.0**	0.0-34.5					100.0												
	Infantis (10)	0.0	**0.0**	0.0-34.5					100.0												
Folate Pathway Inhibitors																					
Sulfonamides	Derby (24)	N/A	**62.5**	40.8-80.5												29.2	8.3			**62.5**	
	Typhimurium var. 5- (14)	N/A	**85.7**	56.1-97.5												7.1	7.1			**85.7**	
	Johannesburg (11)	N/A	**0.0**	0.0-32.1											90.9	9.1					
	Anatum (10)	N/A	**0.0**	0.0-34.5											50.0	40.0	10.0				
	Infantis (10)	N/A	**10.0**	0.5-45.9											10.0	60.0	20.0			**10.0**	
Trimethoprim-Sulfamethoxazole	Derby (24)	N/A	**4.2**	0.2-23.2				45.8	50.0					**4.2**							
	Typhimurium var. 5- (14)	N/A	**7.1**	0.4-35.8				35.7	57.1					**7.1**							
	Johannesburg (11)	N/A	**0.0**	0.0-32.1				100.0													
	Anatum (10)	N/A	**0.0**	0.0-34.5				90.0	10.0												
	Infantis (10)	N/A	**0.0**	0.0-34.5				90.0	10.0												

[1] Data is only presented for serotypes with at least 10 or more isolates

[2] Percent of isolates with intermediate susceptibility

[3] Percent of isolates that were resistant

[4] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

[5] The unshaded areas indicate the range of dilutions tested for each antimicrobial. Single vertical bars indicate the breakpoints for susceptibility, while double vertical bars indicate the breakpoints for resistance. Numbers in the shaded area indicate the percentages of isolates with MICs greater than the highest tested concentrations. Numbers listed for the lowest tested concentrations represent the percentages of isolates with MICs equal to or less than the lowest tested concentration. CLSI breakpoints were used when available. There are no CLSI breakpoints for streptomycin.

Table 8A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Swine, 2009[1]

Antimicrobial	Serotype (# of Isolates)	%I[2]	%R[3]	95% CI[4]	Distribution (%) of MICs (µg/ml)[5] 0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
Penicillins																					
Ampicillin	Derby (24)	0.0	**4.2**	0.2-23.2							87.5	8.3					**4.2**				
	Typhimurium var. 5- (14)	0.0	**71.4**	42.0-90.4							21.4	7.1					**71.4**				
	Johannesburg (11)	0.0	**9.1**	0.5-42.9							90.9						**9.1**				
	Anatum (10)	0.0	**0.0**	0.0-34.5							90.0	10.0									
	Infantis (10)	0.0	**10.0**	0.5-45.9							80.0	10.0					**10.0**				
Phenicols																					
Chloramphenicol	Derby (24)	4.2	**4.2**	0.2-23.2									8.3	83.3	4.2		**4.2**				
	Typhimurium var. 5- (14)	0.0	**64.3**	35.6-86.0									14.3	21.4			**64.3**				
	Johannesburg (11)	0.0	**0.0**	0.0-32.1									27.3	72.7							
	Anatum (10)	0.0	**0.0**	0.0-34.5										100.0							
	Infantis (10)	0.0	**0.0**	0.0-34.5									20.0	80.0							
Quinolones																					
Ciprofloxacin	Derby (24)	0.0	**0.0**	0.0-17.2	91.7	8.3															
	Typhimurium var. 5- (14)	0.0	**0.0**	0.0-26.8	100.0																
	Johannesburg (11)	0.0	**0.0**	0.0-32.1	81.8	18.2															
	Anatum (10)	0.0	**0.0**	0.0-34.5	90.0	10.0															
	Infantis (10)	0.0	**0.0**	0.0-34.5	100.0																
Nalidixic Acid	Derby (24)	N/A	**0.0**	0.0-17.2								62.5	37.5								
	Typhimurium var. 5- (14)	N/A	**0.0**	0.0-26.8								35.7	64.3								
	Johannesburg (11)	N/A	**0.0**	0.0-32.1								36.4	63.6								
	Anatum (10)	N/A	**0.0**	0.0-34.5								10.0	90.0								
	Infantis (10)	N/A	**0.0**	0.0-34.5								70.0	30.0								
Tetracyclines																					
Tetracycline	Derby (24)	0.0	**83.3**	61.8-94.5									16.7				**83.3**				
	Typhimurium var. 5- (14)	0.0	**100.0**	73.2-100												**57.1**	**42.9**				
	Johannesburg (11)	0.0	**54.5**	24.5-81.8									45.5				**54.5**				
	Anatum (10)	0.0	**50.0**	20.1-79.9									50.0			**20.0**	**30.0**				
	Infantis (10)	0.0	**10.0**	0.5-45.9									90.0				**10.0**				

[1] Data is only presented for serotypes with at least 10 or more isolates

[2] Percent of isolates with intermediate susceptibility

[3] Percent of isolates that were resistant

[4] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

Table 9A. *Salmonella* Typhimurium with ACSSuT or ACSuT Resistance Pattern, 2009[1,2]

	Typhimurium	Percent of		Typhimurium variant 5-	Percent of		Grand Total	Percent of	
		Typhimurium n=28	Total n=992		Typhimurium variant 5- n=48	Total n=992		All Typhimurium n=76	Total n=992
Resistance Pattern									
ACSSuT[1] (penta-resistant)	15	53.6	1.5	11	22.9	1.1	26	34.2	2.6
ACSuT[2] (quad-resistant)	0	0.0	0.0	1	2.1	0.1	1	1.3	0.1
Total	**15**	**53.6**	**1.5**	**12**	**25.0**	**1.2**	**27**	**35.5**	**2.7**

[1] ACSSuT: resistance to at least ampicillin, chloramphenicol, streptomycin, sulfisoxazole, and tetracycline

[2] ACSuT: resistance to at least ampicillin, chloramphenicol, streptomycin, and tetracycline and categorized as non-resistant to sulfizoxazole

Table 10A. *Salmonella* Typhimurium that were DT104 or DT104 Complex Isolates, 2009

	Typhimurium	Percent of		Typhimurium variant 5-	Percent of		Grand Total	Percent of	
		Typhimurium n=28	Total n=992		Typhimurium variant 5- n=48	Total n=992		All Typhimurium n=76	Total n=992
ACSSuT (penta-resistant)									
DT104	3	10.7	0.3	1	2.1	0.1	4	5.3	0.4
DT104B	1	3.6	0.1	5	10.4	0.5	6	7.9	0.6
ACSuT (quad-resistant)									
DT104	0	0.0	0.0	1	2.1	0.1	1	1.3	0.1
Total	**4**	**14.3**	**0.4**	**7**	**14.6**	**0.7**	**11**	**14.5**	**1.1**

[1] The single *S*. Typhimurium var. 5- isolate exhibiting the ACSuT resistant pattern was confirmed as phagetype DT104

Table 11A. Phage Types other than DT104 for *S.* Typhimurium with ACSSuT Resistance Pattern, 2009

	Typhimurium	Percent of		Typhimurium variant 5-	Percent of		Grand Total	Percent of	
		Typhimurium n=28	Total n=992		Typhimurium variant 5- n=48	Total n=992		All Typhimurium n=76	Total n=992
ACSSuT (penta-resistant)									
DT120	1	3.6	0.1	1	2.1	0.1	2	2.6	0.2
DT193	1	3.6	0.1	0	0.0	0.0	1	1.3	0.1
DT208	0	0.0	0.0	1	2.1	0.1	1	1.3	0.1
U302	6	21.4	0.6	3	6.3	0.3	9	11.8	0.9
Untypable	3	10.7	0.3	0	0.0	0.0	3	3.9	0.3
Total	**11**	**39.3**	**1.1**	**5**	**10.4**	**0.5**	**16**	**21.1**	**1.6**

Table 12A. Confirmed *S*. Typhimurium DT104[1,2] Isolates, 1997-2009

Year	Chickens			Turkeys			Cattle			Swine		
	n (DT104)	% (All *S*.Typhimurium)	% (Chickens)	n (DT104)	% (All *S*.Typhimurium)	% (Turkeys)	n (DT104)	% (All *S*.Typhimurium)	% (Cattle)	n (DT104)	% (All *S*.Typhimurium)	% (Swine)
1997	4	16.7	1.9	0	0.0	0.0	1	50.0	4.2	11	44.0	9.9
1998	11	16.7	2.0	0	0.0	0.0	2	6.1	0.7	48	45.7	6.1
1999	12	7.8	0.8	2	5.4	0.3	37	19.6	2.3	34	29.8	3.9
2000	18	12.4	1.5	3	16.7	0.6	46	24.6	3.3	25	30.9	5.5
2001	14	10.8	1.1	2	13.3	0.4	20	23.0	2.2	15	34.1	3.6
2002	16	10.7	1.1	1	11.1	0.4	21	21.4	2.1	13	27.1	3.4
2003	4	2.6	0.3	1	16.7	0.4	10	12.8	1.5	8	29.6	3.8
2004	3	1.8	0.2	0	0.0	0.0	14	29.2	2.3	11	20.8	3.6
2005	9	4.9	0.5	2	28.6	0.9	7	20.6	2.1	12	28.6	4.0
2006	8	7.6	0.6	3	60.0	1.0	5	22.7	1.3	8	32.0	2.6
2007	1	1.2	0.1	3	50.0	1.1	7	26.9	1.6	13	29.5	6.2
2008	0	0.0	0.0	0	0.0	0.0	4	14.3	0.9	3	30.0	2.7
2009	0	0.0	0.0	0	0.0	0.0	4	22.2	2.0	7	35.0	5.8

[1] Includes isolates that are DT104 complex

[2] Includes *S.* Typhimurium and *S*.Typhimurium variant 5-

Table 13A. MDR *Salmonella* from Chickens, 1997-2009

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of Isolates Tested	214	561	1438	1173	1307	1500	1158	1280	1989	1380	994	624	551
Resistance Pattern													
No Resistance Detected	52.8%	58.6%	58.8%	56.9%	66.6%	62.0%	61.1%	62.7%	61.2%	57.2%	53.9%	60.4%	56.1%
(Pan-susceptible)	113	329	846	668	871	930	708	803	1217	790	536	377	309
Resistance ≥1 CLSI Class[1]	47.2%	41.4%	41.2%	43.1%	33.4%	38.0%	39.2%	37.3%	38.8%	42.8%	46.1%	39.6%	43.9%
	101	232	592	505	436	570	454	477	772	590	458	247	242
Resistance ≥ 2 CLSI Classes[1]	28.0%	30.7%	31.9%	32.2%	25.2%	28.3%	27.2%	31.2%	31.3%	31.4%	30.2%	33.3%	35.8%
	60	172	459	378	330	424	315	399	622	434	300	208	197
Resistance ≥ 3 CLSI Classes[1]	9.8%	13.4%	12.3%	15.1%	10.2%	14.2%	13.5%	15.8%	15.1%	16.4%	17.8%	11.4%	15.6%
	21	75	177	177	133	213	156	202	301	226	177	71	86
Resistance ≥ 4 CLSI Classes[1]	3.3%	3.9%	4.9%	6.7%	3.6%	7.7%	6.8%	9.8%	8.7%	10.3%	12.3%	7.5%	11.1%
	7	22	71	79	47	115	79	126	174	142	122	47	61
Resistance ≥ 5 CLSI Classes[1]	1.4%	2.7%	3.0%	5.5%	3.1%	5.7%	4.9%	8.0%	5.9%	6.6%	7.4%	6.1%	7.8%
	3	15	43	64	41	85	57	103	117	91	74	38	43
At Least ACSSuT[2]	1.4%	2.7%	1.7%	4.3%	2.4%	1.9%	1.5%	0.9%	1.6%	1.6%	1.5%	1.4%	1.3%
	3	15	24	50	32	29	17	12	31	22	15	9	7
At Least ACT/S[3]	0.0%	0.2%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
	0	1	2	0	1	0	0	1	2	0	0	0	0
At Least ACSSuTAuCx[4]	0.0%	0.5%	0.3%	2.7%	1.1%	0.9%	1.0%	0.4%	0.9%	1.1%	1.4%	1.1%	1.3%
	0	3	4	32	14	13	12	5	18	15	14	7	7
At Least Ceftriaxone and Nalidixic	0.0%	0.0%	0.1%	0.1%	0.0%	0.5%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%
Acid Resistant	0	0	1	1	0	8	0	2	1	0	0	0	0

Table 14A. MDR *Salmonella* from Turkeys, 1997-2009

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of Isolates Tested	107	240	713	518	550	244	262	236	227	304	271	148	121
Resistance Pattern													
No Resistance Detected	32.7%	41.3%	32.5%	33.4%	31.6%	29.9%	24.0%	33.5%	27.8%	28.0%	15.5%	21.6%	19.8%
(Pan-susceptible)	35	99	232	173	174	73	63	79	63	85	42	32	24
Resistance ≥1 CLSI Class[1]	67.3%	58.8%	67.5%	66.6%	68.4%	70.1%	76.0%	66.5%	72.2%	71.4%	84.5%	78.4%	80.2%
	72	141	481	345	376	171	199	157	164	219	229	116	97
Resistance ≥ 2 CLSI Classes[1]	48.6%	45.0%	53.3%	51.0%	56.2%	46.3%	42.7%	50.0%	53.3%	37.5%	60.1%	55.4%	67.8%
	52	108	380	264	309	113	112	118	121	141	163	82	82
Resistance ≥ 3 CLSI Classes[1]	25.2%	23.8%	26.2%	21.6%	30.4%	24.2%	21.8%	27.1%	28.2%	27.3%	33.6%	29.7%	33.1%
	27	57	187	112	167	59	57	64	64	83	91	44	40
Resistance ≥ 4 CLSI Classes[1]	5.6%	6.3%	10.8%	10.0%	14.7%	11.1%	9.5%	10.2%	11.5%	12.2%	15.1%	10.1%	11.6%
	6	15	77	52	81	27	25	24	26	37	41	15	14
Resistance ≥ 5 CLSI Classes[1]	4.7%	0.8%	5.0%	4.8%	6.0%	6.6%	3.1%	5.5%	6.2%	5.9%	7.0%	4.1%	9.1%
	5	2	36	25	33	16	8	13	14	18	19	6	11
At Least ACSSuT[2]	3.7%	0.8%	3.8%	3.3%	3.6%	4.5%	2.3%	4.7%	4.0%	3.9%	4.8%	2.0%	3.3%
	4	2	27	17	20	11	6	11	9	12	13	3	4
At Least ACT/S[3]	0.0%	0.4%	0.4%	0.8%	0.7%	0.8%	0.0%	0.4%	0.0%	0.3%	0.0%	0.0%	0.8%
	0	1	3	4	4	2	0	1	0	1	0	0	1
At Least ACSSuTAuCx[4]	3.7%	0.4%	3.4%	1.9%	2.9%	1.6%	0.8%	2.1%	1.8%	2.3%	4.1%	2.0%	3.3%
	4	1	24	10	16	4	2	5	4	7	11	3	4
At Least Ceftriaxone and Nalidixic	1.9%	0.0%	2.7%	1.2%	1.5%	1.2%	0.4%	0.8%	0.9%	0.3%	0.7%	0.0%	0.0%
Acid Resistant	2	0	19	6	8	3	1	2	2	1	2	0	0

[1]CLSI: Clinical and Laboratory Standards Institute M100 Document
[2]ACSSuT: resistance to at least ampicillin, chloramphenicol, streptomycin, sulfamethoxazole/sulfisoxazole, and tetracycline
[3]ACT/S: resistance to at least ampicillin, chloramphenicol, and trimethoprim-sulfamethoxazole
[4]ACSSuTAuCx: resistance to at least ACSSuT, amoxicillin-clavulanic acid, and ceftriaxone

Table 15A. MDR *Salmonella* from Cattle, 1997-2009

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of Isolates Tested	24	284	1610	1388	893	1008	670	607	329	389	439	443	200
Resistance Pattern													
No Resistance Detected	66.7%	73.2%	74.5%	70.0%	69.9%	64.3%	61.0%	65.6%	63.2%	67.6%	72.0%	68.8%	68.5%
(Pan-susceptible)	16	208	1200	972	624	648	409	398	208	263	316	305	137
Resistance ≥1 CLSI Class1	33.3%	26.8%	25.5%	30.0%	30.1%	35.7%	39.0%	34.4%	36.8%	32.4%	28.0%	31.2%	31.5%
	8	76	410	416	269	360	261	209	121	126	123	138	63
Resistance ≥2 CLSI Classes1	20.8%	17.3%	15.8%	21.8%	21.6%	27.9%	31.8%	23.9%	28.6%	26.0%	22.8%	25.7%	26.5%
	5	49	254	303	193	281	213	145	94	101	101	114	53
Resistance ≥3 CLSI Classes1	12.5%	13.7%	13.3%	19.8%	18.9%	24.5%	29.6%	21.1%	27.7%	23.9%	22.1%	23.5%	26.0%
	3	39	214	275	169	247	198	128	91	93	97	104	52
Resistance ≥4 CLSI Classes1	8.3%	9.2%	10.9%	17.4%	16.9%	22.1%	27.5%	18.8%	24.9%	22.1%	21.0%	21.9%	24.5%
	2	26	175	242	151	223	184	114	82	86	92	97	49
Resistance ≥5 CLSI Classes1	8.3%	4.6%	8.0%	14.0%	15.1%	19.3%	23.6%	17.8%	23.1%	20.1%	18.9%	19.0%	20.0%
	2	13	128	195	135	195	158	108	76	78	83	84	40
At Least ACSSuT[2]	4.2%	4.2%	7.6%	13.1%	14.6%	17.1%	18.1%	16.3%	20.4%	18.3%	16.2%	18.1%	15.0%
	1	12	123	182	130	172	121	99	67	71	71	80	30
At Least ACT/S[3]	0.0%	2.1%	2.2%	1.7%	2.4%	2.4%	2.7%	1.2%	4.3%	4.1%	2.5%	0.0%	1.5%
	0	6	35	23	21	24	18	7	14	16	11	0	3
At Least ACSSuTAuCx[4]	0.0%	2.1%	3.7%	8.9%	11.0%	14.6%	15.1%	12.0%	17.3%	16.2%	13.9%	14.7%	9.5%
	0	6	59	124	98	147	101	73	57	63	61	65	19
At Least Ceftriaxone and Nalidixic	0.0%	0.0%	0.1%	0.1%	0.3%	0.2%	0.4%	1.0%	0.9%	0.3%	0.2%	0.7%	0.0%
Acid Resistant	0	0	1	1	3	2	3	6	3	1	1	3	0

Table 16A. MDR *Salmonella* from Swine, 1997-2009

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of Isolates Tested	111	793	876	451	418	379	211	308	301	304	211	111	120
Resistance Pattern													
No Resistance Detected	44.1%	49.2%	48.9%	43.2%	43.5%	40.1%	53.6%	37.3%	44.5%	34.5%	43.1%	47.7%	44.2%
(Pan-susceptible)	49	390	428	195	182	152	113	115	134	105	91	53	53
Resistance ≥1 CLSI Class[1]	55.9%	50.8%	51.1%	56.8%	56.5%	59.9%	46.4%	62.7%	55.5%	65.5%	56.9%	52.3%	55.8%
	62	403	448	256	236	227	98	193	167	199	120	58	67
Resistance ≥2 CLSI Classes[1]	43.2%	34.4%	35.3%	44.6%	40.2%	43.3%	34.1%	41.2%	40.5%	36.2%	38.4%	36.9%	35.8%
	48	273	309	201	168	164	72	127	122	110	81	41	43
Resistance ≥3 CLSI Classes[1]	26.1%	24.0%	26.4%	34.6%	30.6%	34.0%	23.7%	33.4%	31.9%	22.7%	28.0%	29.7%	31.7%
	29	190	231	156	128	129	50	103	96	69	59	33	38
Resistance ≥4 CLSI Classes[1]	15.3%	11.2%	9.8%	17.1%	9.1%	12.7%	10.9%	15.3%	13.3%	9.5%	17.5%	14.4%	15.0%
	17	89	86	77	38	48	23	47	40	29	37	16	18
Resistance ≥5 CLSI Classes[1]	4.5%	8.1%	7.3%	9.3%	7.2%	9.0%	9.5%	12.3%	10.3%	5.9%	11.4%	8.1%	14.2%
	5	64	64	42	30	34	20	38	31	18	24	9	17
At Least ACSSuT[2]	4.5%	7.8%	7.1%	8.6%	7.2%	7.7%	7.6%	12.0%	9.6%	5.3%	10.9%	8.1%	13.3%
	5	62	62	39	30	29	16	37	29	16	23	9	16
At Least ACT/S[3]	0.0%	0.5%	0.5%	0.0%	1.0%	0.5%	0.9%	0.6%	1.7%	0.3%	1.9%	0.0%	1.7%
	0	4	4	0	4	2	2	2	5	1	4	0	2
At Least ACSSuTAuCx[4]	0.0%	0.1%	0.5%	1.3%	2.2%	1.8%	1.9%	1.0%	2.7%	0.7%	0.5%	0.9%	1.7%
	0	1	4	6	9	7	4	3	8	2	1	1	2
At Least Ceftriaxone and Nalidixic	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Acid Resistant	0	0	0	0	0	1	0	0	0	0	0	0	0

[1]CLSI: Clinical and Laboratory Standards Institute M100 Document

[2]ACSSuT: resistance to at least ampicillin, chloramphenicol, streptomycin, sulfamethoxazole/sulfisoxazole, and tetracycline

[3]ACT/S: resistance to at least ampicillin, chloramphenicol, and trimethoprim-sulfamethoxazole

[4]ACSSuTAuCx: resistance to at least ACSSuT, amoxicillin-clavulanic acid, and ceftriaxone

B. *Campylobacter*

Table 1B. *Campylobacter* Species Tested from Chickens, 1998-2009[1]

Campylobacter Species	1998 n=194	1999 n=731	2000 n=765	2001 n=116	2002 n=814	2003 n=621	2004 n=694	2005 n=947	2006 n=351	2007 n=242	2008 n=106	2009 n=198
C. coli	32.5% 63	23.0% 168	22.5% 172	44.8% 52	35.4% 288	39.8% 247	26.8% 186	40.1% 380	35.0% 123	31.4% 76	26.4% 28	40.9% 81
C. jejuni	66.0% 128	77.0% 563	72.1% 590	55.2% 64	64.6% 526	60.2% 374	73.2% 508	59.9% 567	65.0% 228	68.6% 166	73.6% 78	59.1% 117
Other	1.5% 3	0.0% 0	0.4% 3	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0

[1] Differences in isolation methods are described in the section on methods

Figure 1B. *Campylobacter* Species Tested from Chickens, 1998-2009

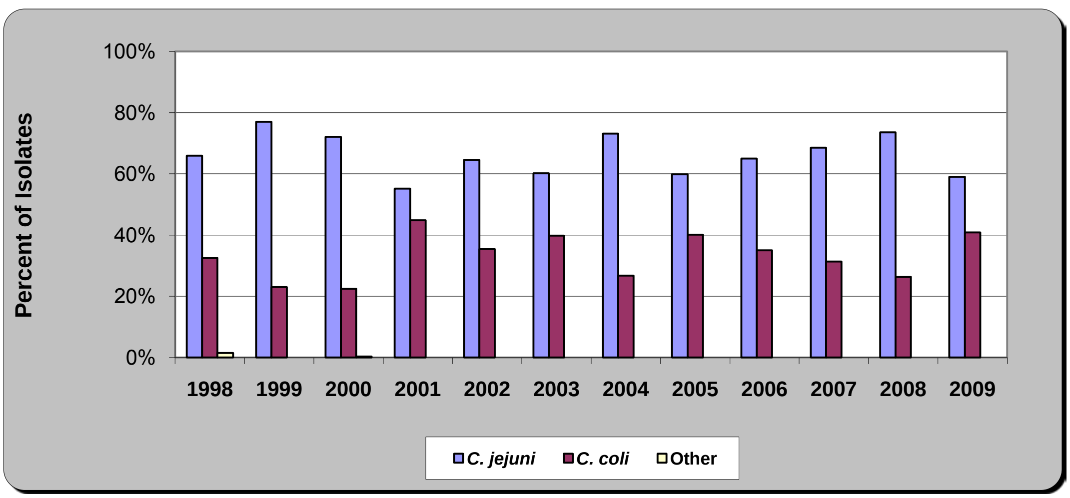


Table 2B. Distribution of MICs and Occurrence of Resistance among *Campylobacter* from Chickens, 2009

Antimicrobial	Isolate Species (# of Isolates) C. coli (81) C. jejuni (117)	%I[1]	%R[2]	95% CI[3]	Distribution (%) of MICs (µg/ml)[4] 0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128
Aminoglycosides																		
Gentamicin	*C. coli*	0.0	**2.5**	0.4-9.5					32.1	65.4							**2.5**	
	C. jejuni	0.0	**0.9**	0.1-5.4				17.9	50.4	30.8							**0.9**	
Lincosamides																		
Clindamicin	*C. coli*	6.2	**0.0**	0.0-5.6			1.2	48.1	37.0	3.7	2.5	1.2	6.2					
	C. jejuni	0.0	**0.0**	0.0-4.0		2.6	42.7	41.0	12.0	1.7								
Macrolides/Ketolides																		
Azithromycin	*C. coli*	0.0	**6.2**	2.3-14.5		9.9	65.4	18.5										**6.2**
	C. jejuni	0.0	**0.0**	0.0-4.0	3.4	57.3	36.8	2.6										
Erythromycin	*C. coli*	0.0	**6.2**	2.3-14.5				1.2	16.0	37.0	33.3	6.2						**6.2**
	C. jejuni	0.0	**0.0**	0.0-4.0				8.5	41.0	41.9	6.8	1.7						
Telithromycin	*C. coli*	0.0	**6.2**	2.3-14.5				4.9	12.3	8.6	40.7	25.9	1.2		**6.2**			
	C. jejuni	0.0	**0.0**	0.0-4.0				1.7	20.5	51.3	22.2	4.3						
Phenicols																		
Florfenicol	*C. coli*	0.0	**0.0**	0.0-5.6						7.4	86.4	6.2						
	C. jejuni	0.0	**0.0**	0.0-4.0					0.9	63.2	35.0	0.9						
Quinolones																		
Ciprofloxacin	*C. coli*	0.0	**22.2**	14.0-33.1			18.5	50.6	8.6					**8.6**	**13.6**			
	C. jejuni	0.0	**19.7**	13.1-28.3		4.3	47.9	26.5	1.7				**1.7**	**12.0**	**5.1**	**0.9**		
Nalidixic acid	*C. coli*	0.0	**22.2**	14.0-33.1									72.8	4.9			**17.3**	**4.9**
	C. jejuni	0.0	**19.7**	13.1-28.3									76.9	3.4			**8.5**	**11.1**
Tetracyclines																		
Tetracycline	*C. coli*	0.0	**44.4**	33.5-55.8				3.7	32.1	9.9	8.6		1.2			**4.9**	**13.6**	**25.9**
	C. jejuni	0.9	**49.6**	40.3-58.9			3.4	23.1	13.7	6.0	2.6		0.9	0.9	**1.7**	**8.5**	**22.2**	**17.1**

[1] Percent of isolates with intermediate susceptibility

[2] Percent of isolates that were resistant

[3] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

[4] Unshaded areas indicate the range of dilutions tested for each antimicrobial. Single vertical bars indicate the breakpoints for susceptibility, while double vertical bars indicate the breakpoints for resistance. Numbers in the shaded areas indicate the percentages of isolates with MICs greater than the highest tested concentrations. Numbers listed for the lowest tested concentrations represent the percentages of isolates with MICs equal to or less than the lowest tested concentration

Table 3B. Antimicrobial Resistance among *Campylobacter* from Chickens, 1998-2009[1,2]

Year			1998	1999	2000	2001[3]	2002	2003	2004	2005	2006	2007	2008	2009
Number of Isolates Tested		*C. coli*	63	168	172	52	288	247	186	380	123	76	28	81
		C. jejuni	128	563	590	64	526	374	508	567	228	166	78	117
Antimicrobial Class	**Antimicrobial**	**Isolate Species**												
Aminoglycosides	Gentamicin	*C. coli*	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.3% 1	0.0% 0	1.3% 1	3.6% 1	2.5% 2
		C. jejuni	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	1.3% 1	0.9% 1
Lincosamides	Clindamicin	*C. coli*	20.6% 13	12.5% 21	12.8% 22	3.8% 2	8.3% 24	8.9% 22	4.8% 9	2.4% 9	1.6% 2	9.2% 7	3.6% 1	0.0% 0
		C. jejuni	3.9% 5	0.5% 3	0.2% 1	0.0% 0	0.8% 4	1.1% 4	0.8% 4	0.4% 2	0.0% 0	0.0% 0	0.0% 0	0.0% 0
Macrolides/ Ketolides	Azithromycin	*C. coli*	25.4% 16	14.9% 25	22.7% 39	11.5% 6	19.4% 56	20.2% 50	9.1% 17	8.4% 32	8.9% 11	14.5% 11	10.7% 3	6.2% 5
		C. jejuni	3.1% 4	0.4% 2	0.7% 4	3.1% 2	1.0% 5	1.3% 5	1.6% 8	1.4% 8	0.4% 1	0.0% 0	1.3% 1	0.0% 0
	Erythromycin	*C. coli*	23.8% 15	14.9% 25	22.7% 39	11.5% 6	18.8% 54	20.2% 50	9.1% 17	8.4% 32	8.9% 11	14.5% 11	10.7% 3	6.2% 5
		C. jejuni	3.1% 4	0.2% 1	0.5% 3	3.1% 2	0.6% 3	1.6% 6	1.6% 8	1.1% 6	0.4% 1	0.0% 0	1.3% 1	0.0% 0
	Telithromycin	*C. coli*	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	5.5% 21	6.5% 8	13.2% 10	3.6% 1	6.2% 5
		C. jejuni	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	0.4% 2	0.0% 0	0.0% 0	0.0% 0	0.0% 0
Phenicols	Chloramphenicol	*C. coli*	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested
		C. jejuni	0.0% 0	0.0% 0[4]	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested
	Florfenicol	*C. coli*	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0
		C. jejuni	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0
Quinolones	Ciprofloxacin	*C. coli*	20.6% 13	13.7% 23	14.5% 25	19.2% 10	16.0% 46	20.2% 50	26.3% 49	22.1% 84	15.4% 19	15.8% 12	14.3% 4	22.2% 18
		C. jejuni	9.4% 12	9.6% 54	10.5% 62	20.3% 13	18.6% 98	14.7% 55	21.3% 108	15.0% 85	8.8% 20	21.7% 36	32.1% 25	19.7% 23
	Nalidixic acid	*C. coli*	31.7% 20	17.3% 29	16.3% 28	21.2% 11	18.1% 52	21.9% 54	28.0% 52	22.1% 84	15.4% 19	15.8% 12	14.3% 4	22.2% 18
		C. jejuni	14.8% 19	11.9% 67	12.2% 72	20.3% 13	22.8% 120	15.5% 58	21.7% 110	15.3% 87	8.8% 20	21.7% 36	33.3% 26	19.7% 23
Tetracyclines	Tetracycline	*C. coli*	61.9% 39	57.7% 97	57.6% 99	57.7% 30	49.0% 141	51.0% 126	48.4% 90	42.1% 160	53.7% 66	42.1% 32	60.7% 17	44.4% 36
		C. jejuni	58.6% 75	53.3% 300	52.9% 312	34.4% 22	44.7% 235	47.1% 176	41.1% 209	44.1% 250	56.1% 128	56.6% 94	53.8% 42	49.6% 58

[1] From 1998 through 2004, the Etest method was used for susceptibility testing while in 2005 testing was conducted using broth microdilution. For

[2] From 1998 through 2000, nalidixic acid susceptibility and cephalothin resistance were used as selection criteria for *Campylobacter*

[3] These isolates were recovered from July through December, 2001, when the new ARS isolation method was used

[4] One isolate originally found to be chloramphenicol resistant was not reproducible upon further testing

Table 4B. MDR *C. coli* from Chickens, 1998-2009

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of Isolates Tested	63	168	172	52	288	247	186	380	123	76	28	81
Resistance Pattern												
No Resistance Detected	19.0% 12	33.3% 56	27.9% 48	30.8% 16	37.5% 108	32.8% 81	37.1% 69	47.6% 181	39.0% 48	43.4% 33	28.6% 8	49.4% 40
Resistance ≥1 CLSI Class[1]	81.0% 51	66.7% 112	72.1% 124	69.2% 36	62.5% 180	67.2% 166	62.9% 117	52.4% 199	61.0% 75	56.6% 43	71.4% 20	50.6% 41
Resistance ≥2 CLSI Classes[1]	47.6% 30	26.2% 44	29.7% 51	26.9% 14	27.4% 79	32.4% 80	32.3% 60	29.2% 111	22.8% 28	26.3% 20	17.9% 5	19.8% 16
Resistance ≥3 CLSI Classes[1]	30.2% 19	17.3% 29	18.6% 32	15.4% 8	13.9% 40	18.6% 46	18.3% 34	17.9% 68	16.3% 20	18.4% 14	17.9% 5	6.2% 5
Resistance ≥4 CLSI Classes[1]	1.6% 1	4.8% 8	3.5% 6	1.9% 1	4.9% 14	3.6% 9	2.7% 5	2.6% 10	1.6% 2	5.3% 4	3.6% 1	4.9% 4
Resistance ≥5 CLSI Classes[1]	0.0% 0	1.8% 3	0.0% 0	0.0% 0	2.1% 6	0.4% 1	0.5% 1	0.3% 1	0.0% 0	3.9% 3	0.0% 0	0.0% 0

[1]CLSI: Clinical and Laboratory Standards Institute M100 Document

Table 5B. MDR *C. jejuni* from Chickens, 1998-2009

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of Isolates Tested	128	563	590	64	526	374	508	567	228	166	78	117
Resistance Pattern												
No Resistance Detected	38.3% 49	42.6% 240	42.2% 249	53.1% 34	44.9% 236	45.5% 170	48.2% 245	46.9% 266	39.9% 91	34.3% 57	33.3% 26	41.9% 49
Resistance ≥1 CLSI Class[1]	61.7% 79	57.4% 323	57.8% 341	46.9% 30	55.1% 290	54.5% 204	51.8% 263	53.1% 301	60.1% 137	65.7% 109	66.7% 52	58.1% 68
Resistance ≥2 CLSI Classes[1]	14.8% 19	11.5% 65	11.9% 70	21.9% 14	21.3% 112	16.0% 60	22.0% 112	16.0% 91	8.8% 20	21.7% 36	33.3% 26	12.0% 14
Resistance ≥3 CLSI Classes[1]	9.4% 12	6.9% 39	6.6% 39	9.4% 6	11.4% 60	8.8% 33	12.2% 62	6.2% 35	5.3% 12	12.7% 21	21.8% 17	0.0% 0
Resistance ≥4 CLSI Classes[1]	2.3% 3	0.0% 0	0.2% 1	0.0% 0	0.0% 0	0.0% 0	0.4% 2	0.2% 1	0.0% 0	0.0% 0	0.0% 0	0.0% 0
Resistance ≥5 CLSI Classes[1]	1.6% 2	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.3% 1	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0	0.0% 0

[1]CLSI: Clinical and Laboratory Standards Institute M100 Document

C. *Escherichia coli*

Table 1C. Number of *E. coli* Tested from Chickens, 2000-2009

Year									
2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
285	1989	2100	1365	1697	2232	1357	1510	986	877

Table 2C. Distribution of MICs and Occurrence of Resistance among *E. coli* from Chickens, 2009

Antimicrobial	%I[1]	%R[2]	95% CI[3]	Distribution (%) of MICs (µg/ml)[4]																
				0.015	0.03	0.06	0.125	0.25	0.50	1	2	4	8	16	32	64	128	256	512	1024
Aminoglycosides																				
Amikacin	0.0	**0.0**	0.0-0.5						0.5	16.8	67.0	15.3	0.5							
Gentamicin	3.6	**43.3**	40.0-46.7					4.4	36.5	11.1	0.3	0.7	3.6	**16.0**	**27.4**					
Kanamycin	1.0	**7.9**	6.2-9.9										87.1	4.0	1.0	**0.6**	**7.3**			
Streptomycin	N/A	**49.8**	46.4-53.2												50.2	**17.1**	**32.6**			
β-Lactam/β-Lactamase Inhibitor Combinations																				
Amoxicillin-Clavulanic Acid	0.5	**12.4**	10.3-14.8							4.7	30.7	43.0	8.8	0.5	**8.9**	**3.5**				
Cephems																				
Cefoxitin	1.1	**11.4**	9.4-13.7						0.1	1.8	28.7	49.0	7.8	1.1	**6.0**	**5.4**				
Ceftiofur	2.1	**9.5**	7.7-11.7				5.0	43.9	37.2	2.3	0.1	2.1	**6.5**	**3.0**						
Ceftriaxone	0.1	**11.5**	9.5-13.8					87.6	0.7	0.1	0.1	**1.4**	**6.4**	**3.5**	**0.2**					
Folate Pathway Inhibitors																				
Sulfonamides	N/A	**52.6**	49.2-55.9											43.8	3.1	0.2	0.1	0.2	**52.6**	
Trimethoprim-Sulfamethoxazole	N/A	**7.0**	5.4-8.9				68.4	14.6	6.2	2.7	1.1	**0.2**	**6.7**							
Penicillins																				
Ampicillin	0.0	**19.8**	17.2-22.6							15.1	46.9	17.8	0.5		**0.2**	**19.6**				
Phenicols																				
Chloramphenicol	0.2	**1.1**	0.6-2.1								15.4	65.1	18.1	0.2	**0.3**	**0.8**				
Quinolones																				
Ciprofloxacin	0.0	**0.5**	0.2-1.3	95.3	1.3	0.5	1.4	0.9	0.2				**0.5**							
Nalidixic Acid	N/A	**3.2**	2.2-4.7						1.7	31.4	60.2	3.0	0.1	0.5	**0.9**	**2.3**				
Tetracyclines																				
Tetracycline	0.8	**49.1**	45.7-52.5									50.1	0.8	**1.5**	**11.3**	**36.4**				

[1] Percent of isolates with intermediate susceptibility

[2] Percent of isolates that were resistant

[3] 95% confidence intervals for percent resistant (%R) were calculated using the Wilson interval with continuity correction method

[4] The unshaded areas indicate the range of dilutions tested for each antimicrobial. Single vertical bars indicate the breakpoints for susceptibility, while double vertical bars indicate the breakpoints for resistance. Numbers in the shaded area indicate the percentages of isolates with MICs greater than the highest tested concentrations. Numbers listed for the lowest tested concentrations represent the percentages of isolates with MICs equal to or less than the lowest tested concentration. CLSI breakpoints were used when available. There are no CLSI breakpoints for streptomycin.

Table 3C. Antimicrobial Resistance among *E. coli* from Chickens, 2000-2009

Year		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of Isolates Tested		285	1989	2100	1365	1697	2232	1357	1510	986	877
Antimicrobial Class	**Antimicrobial (Resistance Breakpoint)**										
Aminoglycosides	Amikacin	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
		0	0	0	0	0	0	0	0	0	0
	Gentamicin	40.0%	33.4%	38.0%	38.8%	39.1%	36.7%	33.1%	38.0%	44.5%	43.3%
		114	664	799	530	663	819	449	574	439	380
	Kanamycin	16.1%	14.5%	11.6%	10.3%	11.5%	10.3%	9.1%	7.7%	10.2%	7.9%
		46	288	243	140	196	231	123	117	101	69
	Streptomycin	77.5%	65.8%	65.1%	64.2%	64.1%	58.0%	49.5%	47.0%	54.6%	49.8%
		221	1308	1368	877	1088	1295	672	710	538	437
β-Lactam/β-Lactamase Inhibitor Combinations	Amoxicillin-Clavulanic Acid	8.1%	10.0%	10.9%	11.1%	8.8%	10.6%	16.0%	11.2%	13.7%	12.4%
		23	199	229	151	149	236	217	169	135	109
Cephems	Cefoxitin	7.4%	8.7%	8.5%	8.3%	8.2%	9.9%	15.0%	10.3%	13.8%	11.4%
		21	173	178	113	139	221	204	155	136	100
	Ceftriaxone	6.3%	7.6%	8.6%	9.4%	7.2%	9.0%	14.7%	10.3%	13.5%	11.5%
		18	152	181	128	122	200	199	155	133	101
	Cephalothin	17.9%	12.9%	15.1%	16.6%	Not	Not	Not	Not	Not	Not
		51	256	317	226	Tested	Tested	Tested	Tested	Tested	Tested
	Ceftiofur	6.3%	4.4%	5.5%	7.1%	4.9%	6.5%	10.2%	7.0%	10.5%	9.5%
		18	88	115	97	83	145	139	106	103	83
Folate Pathway Inhibitors	Sulfonamides[1]	57.9%	58.2%	46.1%	43.9%	53.2%	51.9%	48.6%	53.2%	52.7%	52.6%
		165	1157	969	599	903	1159	660	804	520	461
	Trimethoprim-Sulfamethoxazole	17.2%	12.6%	10.4%	10.5%	10.7%	10.4%	8.4%	7.9%	9.1%	7.0%
		49	251	218	144	181	232	114	120	90	61
Penicillins	Ampicillin	20.0%	19.5%	19.0%	18.6%	17.6%	22.0%	25.6%	18.7%	23.5%	19.8%
		57	388	399	254	298	492	347	282	232	174
Phenicols	Chloramphenicol	4.6%	2.4%	1.8%	1.3%	1.0%	1.0%	1.9%	2.3%	1.0%	1.1%
		13	47	38	18	17	22	26	34	10	10
Quinolones	Ciprofloxacin	0.0%	0.2%	0.0%	0.1%	0.2%	0.4%	0.0%	0.1%	0.6%	0.5%
		0	3	0	1	3	8	0	1	6	4
	Nalidixic Acid	10.2%	8.4%	6.8%	6.2%	6.8%	7.5%	5.4%	4.2%	6.0%	3.2%
		29	168	142	84	115	168	73	64	59	28
Tetracyclines	Tetracycline	68.4%	61.6%	58.6%	52.2%	50.3%	48.9%	49.0%	40.2%	47.4%	49.1%
		195	1226	1231	713	853	1092	665	607	467	431

[1] Sulfamethoxazole was tested from 1997-2003 and was replaced by sulfisoxazole in 2004

Table 4C. MDR *E. coli* from Chickens, 2000-2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number of Isolates Tested	285	1989	2100	1365	1697	2232	1357	1510	986	877
Resistance Pattern										
No Resistance Detected	10.2%	12.9%	15.9%	16.0%	17.0%	17.7%	18.6%	24.4%	20.9%	21.9%
	29	257	333	219	288	395	252	367	206	192
Resistance ≥1 CLSI Class[1]	89.8%	87.1%	84.1%	84.0%	83.0%	82.3%	81.4%	75.6%	79.1%	78.1%
	256	1732	1767	1146	1409	1837	1105	1143	780	685
Resistance ≥2 CLSI Classes[1]	76.8%	71.3%	68.1%	65.0%	66.5%	64.7%	62.9%	60.8%	65.4%	65.2%
	219	1419	1430	887	1129	1444	854	920	645	572
Resistance ≥3 CLSI Classes[1]	55.1%	50.3%	43.9%	39.2%	43.0%	41.5%	43.7%	36.1%	44.1%	41.4%
	157	1000	921	535	729	926	593	554	435	363
Resistance ≥4 CLSI Classes[1]	19.3%	16.1%	14.3%	13.8%	11.8%	14.9%	17.5%	13.6%	16.6%	14.5%
	55	320	300	188	200	333	237	206	164	127
Resistance ≥5 CLSI Classes[1]	8.1%	8.1%	7.4%	7.2%	5.8%	7.6%	8.9%	7.1%	9.0%	7.5%
	23	162	155	98	98	170	121	107	89	66

[1]CLSI: Clinical and Laboratory Standards Institute M100 Document