NARMS

National Antimicrobial Resistance Monitoring System

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

FDA CDC USDA

2008

Animal Arm Annual Report

BEAR
Bacterial Epidemiology and Antimicrobial Resistance

USDA ARS

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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 2008 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. Other analyses are available upon request.

The 2007 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 (chicken), carcass swabs (turkey, cattle, and swine), and ground products (chicken, turkey, and beef).

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 at establishments randomly selected from the population of eligible 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 non-targeted 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].

B. Isolation and Identification

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. Serotype results were subsequently sent to the BEAR unit as they became available.

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 which involved concentrating spent carcass rinsate and decanting the supernatant prior to culture of the pellet. 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 no longer temperature controlled during shipment; this may affect recovery of *Campylobacter*. 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.

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[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.

BEAR started isolating generic *E. coli* from these same rinsates in 2000. For *E. coli*, a sample of the rinsate was pre-enriched overnight before streaking onto a CHROMAgar™ ECC plate (DRG International; Mountainside, NJ). Plates were incubated at ±36° 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 2008, *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 reporting years 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 as established by the NARMS working group were used.

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 for *Campylobacter* susceptibility testing.

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[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.

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]	≤ 8	16 - 32	≥ 64
	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 (2005-2008)		
		Susceptible	Intermediate	Resistant	Susceptible	Intermediate	Resistant
Aminoglycosides	Gentamicin	≤ 4	8	≥ 16	≤ 2	4	≥ 8
Lincosamides	Clindamycin	≤ 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 2008 for *Salmonella*, from 1998 through 2008 for *Campylobacter*, and from 2000 through 2008 for *E. coli*. Additionally, MIC distributions are presented for 2008. For *Salmonella*, MIC distributions were tabulated both on 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 chicken, cattle, swine and turkey. 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].

Previously, multiple drug resistance (MDR) was defined as resistance to more than one antimicrobial subclass (i.e. individual antimicrobials regardless of class). 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 of 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 2005-2008), lincosamides (clindamycin), macrolides (azithromycin and erythromycin), phenicols (chloramphenicol 1998-2004 and florfenicol 2005-2008), 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 2008 are shown in Table 2A. Overall, Kentucky, Hadar, Montevideo and Derby ranked as the most prevalent serotype for chicken, turkey, cattle and swine, respectively. Using 2008 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 chicken, the upward trend observed beginning in 1997 halted in 2006 at 48.8%, declined in 2007 to 44.6% and again in 2008 to 35.1% of isolates. Slight fluctuations were observed for Heidelberg from 1997 to 2002. After a decline from 2002 (26.9%) to 2004 (13.0%), recovery has remained relatively constant through 2008. For Enteritidis, an overall increase in recovery has been observed since 2002. Conversely, recovery of Typhimurium and Typhimurium variant 5- has remained relatively stable since 1997 (Figure 1A).

Among isolates recovered from turkey (Figure 2A) Hadar increased from 13.1% in 2004 to 43.5% in 2007 but declined to 27.0% in 2008. An overall decline in Heidelberg was observed from 2001 (25.8%) through 2008 (5.7%). From 2004 to 2007, antigenic formula III 18:z4,z23:- declined from 5.9% to 0.4% but increased to 9.5% in 2008.

From 2005 to 2008, recovery of Montevideo and Dublin increased among cattle isolates (from 13.1% to 23.5% and from 3.6% to 12.0%, respectively) while recovery of the other top serotypes remained relatively constant (Figure 3A).

Recovery of Derby decreased among swine from 28.2% in 2005 to 13.7% in 2007, however increased to 22.5% in 2008 (Figure 4A). From 2006 to 2008 recovery of Infantis increased from 5.3% to 13.5%. Only slight changes were noted for recovery of Agona, London, Saintpaul and Typhimurium from 1997-2008.

2. MIC distributions

The 2008 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. 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 2008. In 2008, resistance to gentamicin appears to remain stable among chicken, cattle and swine (5.6%, 1.6%

and 2.7% respectively). Resistance to cefoxitin, ceftiofur and ceftriaxone declined from 2007 to 2008 for chicken and turkey isolates. In 2008, resistance to the cephems class was highest among cattle isolates (14.7%, 16.3% and 16.0% respectively for cefoxitin, ceftiofur and ceftriaxone). A decline in resistance to ampicillin was observed for chicken (17.0% to 10.6%) and turkey (36.9% to 32.4%) isolates from 2007 to 2008. Resistance to the other antimicrobials varied by commodity.

A micro analysis of the 2008 data is presented in Tables 5A through 8A which shows total percent resistance and MIC distribution by commodity and serotypes. Among serotypes from *Salmonella* isolates recovered from chicken (Table 5A), Enteritidis (n=116) showed no resistance to seven antimicrobials (amikacin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, and trimethoprim/sulfamethoxazole) while exhibiting $\leq$ 2.6% resistance to amoxicillin/clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, streptomycin, sulfonamides and tetracycline. Conversely, Kentucky (n=219) showed no resistance to four antimicrobials (amikacin, ciprofloxacin, nalidixic acid and trimethoprim/sulfamethoxazole) and exhibited varying levels and combinations of resistance to 11 antimicrobials (amoxicillin/clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, chloramphenicol, gentamicin, kanamycin, streptomycin, sulfonamides and tetracycline).

The frequency of isolates exhibiting the ACSSuT (ampicillin, chloramphenicol, streptomycin, sulfisoxazole and tetracycline) penta-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 2008, however, no *S*. Typhimurium exhibited this quad-resistance 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.

The frequency and percentage of confirmed *S.* Typhimurium DT104 isolates is reported separately by food animal source from 1997 through 2008 (Table 12A). Overall, DT104 prevalence was highest in swine followed by cattle, chicken and turkey.

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, ACSSuTAuCf or ceftiofur and nalidixic acid resistance). Overall, pan-susceptible isolates most often originated (in order of decreasing frequency) from cattle, chicken, swine and turkey. Among the clinically important phenotypes reported, resistance was least often observed to ACT/S and to ceftiofur plus nalidixic acid, for all animal sources.

B. *Campylobacter*

The number of *Campylobacter* isolates recovered by species 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 has remained relatively stable since 1998 (Figure 1B).

MIC distributions by antimicrobial and species are shown in Table 2B. No resistance to florfenicol was observed for either species. In 2008, resistance was higher for *C. coli* than *C. jejuni* for all drugs with the exception of the quinolones. *Campylobacter jejuni* exhibited more resistance to ciprofloxacin and nalidixic acid than did *C. coli*.

Percent resistance by year, antimicrobial, and species are shown in Table 3B. In 2008, a decrease in resistance from 2007 was observed in *C. coli* to the lincosamides and macrolides/ketolides. For the second consecutive year, increased resistance was observed in *C. jejuni* to the quinolones. *Campylobacter coli* were more resistant to tetracycline than *C. jejuni* from 1998 to 2004; from 2005 to 2007 *C. jejuni* exhibited more resistance to tetracycline. However, this trend switched again in 2008 as tetracycline resistance increased in *C. coli* to 60.7% which was higher than tetracycline resistance in *C. jejuni* (53.8%).

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 from chicken rinsates tested 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 for any year. An increase in percent resistance was observed to all antimicrobials in 2008 except for sulfonamides and chloramphenicol. Only six isolates were resistant to ciprofloxacin in 2008 (0.6%).

MDR by CLSI class is presented in Table 4C. The percent of isolates that were pan-susceptible decreased in 2008 to 20.9% while resistance to multiple CLSI classes increased.

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VI. Results

A. *Salmonella*

Table 1A. Number of *Salmonella* Isolates Tested by Year and Animal Source, 1997-2008

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
Chicken	214	561	1438	1173	1307	1500	1158	1280	1989	1380	994	624
Turkey	107	240	713	518	550	244	262	236	227	304	271	148
Cattle	24	284	1610	1388	893	1008	670	607	329	389	439	443
Swine	111	793	876	451	418	379	211	308	301	304	211	111

Table 2A. Most Common Serotypes among *Salmonella* Isolates Tested, 2008

Animal Source	Rank	Serotype	n	%
Chicken (n=624)	1	Kentucky	219	35.1
	2	Enteritidis	116	18.6
	3	Heidelberg	94	15.1
	4	Typhimurium var. 5-	39	6.3
	5	Typhimurium	31	5.0
	6	I 4,[5],12:i:-	23	3.7
	7	Infantis	14	2.2
	8	Montevideo	13	2.1
	9	Schwarzengrund	7	1.1
	10	I 4,12:i:-	6	1.0
	10	Senftenberg	6	1.0
Subtotal			568	91.0
		Others	56	9.0
Total			624	100

Animal Source	Rank	Serotype	n	%
Turkey (n=148)	1	Hadar	40	14.8
	2	Saintpaul	16	5.9
	3	III 18:z4,z23:-	14	5.2
	4	Schwarzengrund	9	3.3
	5	Heidelberg	8	3.0
	5	Newport	8	3.0
	6	Agona	6	2.2
	6	Senftenberg	6	2.2
	6	Worthington	6	2.2
	7	Albany	4	1.5
	7	Berta	4	1.5
	7	Muenchen	4	1.5
	7	Muenster	4	1.5
Subtotal			129	87.2
		Others	19	12.8
Total			148	100

Animal Source	Rank	Serotype	n	%
Cattle (n=443)	1	Montevideo	104	23.5
	2	Dublin	53	12.0
	3	Newport	31	7.0
	4	Anatum	27	6.1
	4	Cerro	27	6.1
	5	Typhimurium	25	5.6
	6	Kentucky	22	5.0
	7	Muenster	18	4.1
	8	Agona	17	3.8
	8	Mbandaka	17	3.8
	8	Meleagridis	17	3.8
	9	Oranienburg	7	1.6
	9	Anatum var. 15+	7	1.6
Subtotal			372	84.0
		Others	71	16.0
Total			443	100

Animal Source	Rank	Serotype	n	%
Swine (n=111)	1	Derby	25	22.5
	2	Infantis	15	13.5
	3	Agona	6	5.4
	3	London	6	5.4
	3	Saintpaul	6	5.4
	3	Typhimurium var. 5-	6	5.4
	4	Anatum	5	4.5
	4	Johannesburg	5	4.5
	5	Ohio	4	3.6
	5	Typhimurium	4	3.6
	6	Hadar	3	2.7
Subtotal			85	76.6
		Others	26	23.4
Total			111	100

Figure 1A. Chicken- Serotype Percent Distribution by Year in Relation to Top Serotypes Identified in 2008

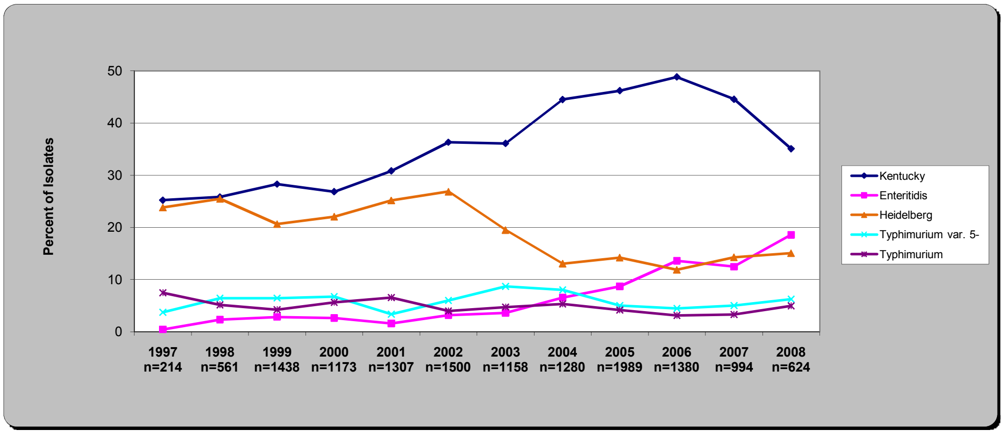

Figure 2A. Turkey- Serotype Percent Distribution by Year in Relation to Top Serotypes Identified in 2008

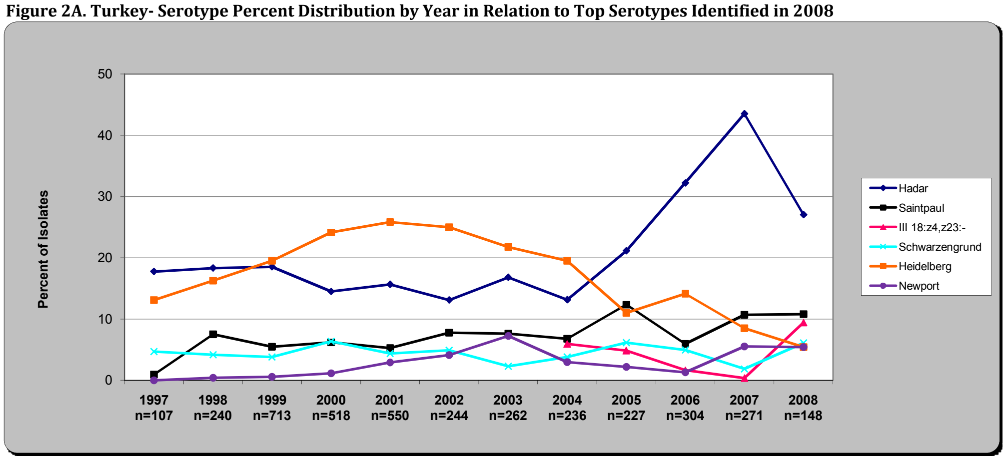

Figure 3A. Cattle- Serotype Percent Distribution by Year in Relation to Top Serotypes Identified in 2008

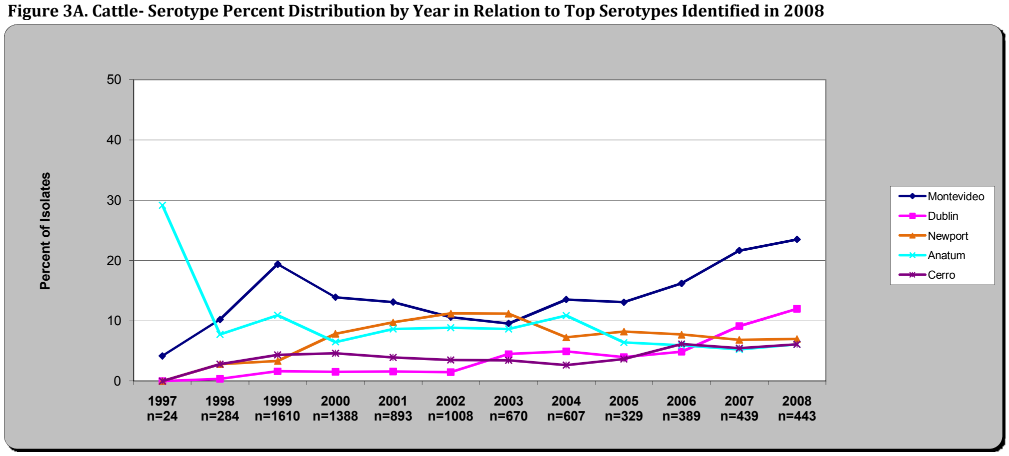

Figure 4A. Swine- Serotype Percent Distribution by Year in Relation to Top Serotypes Identified in 2008

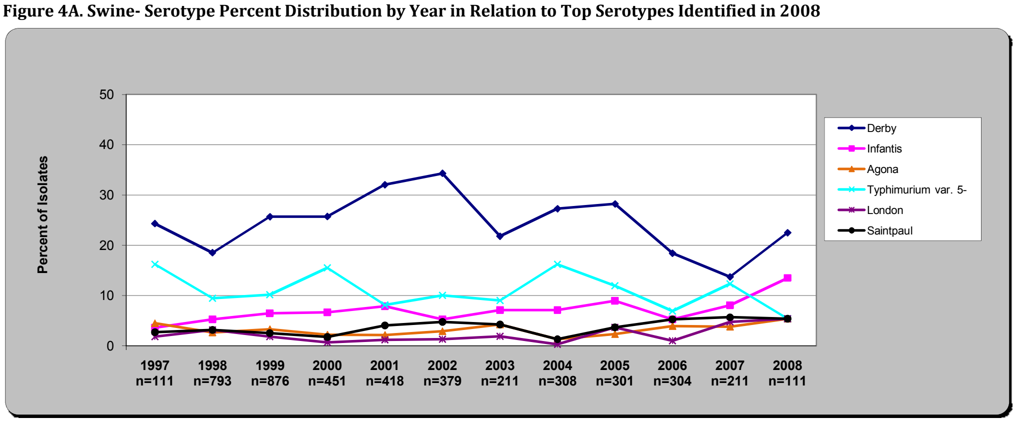

Table 3A. Distribution of MICs and Occurrence of Resistance by Animal Source among *Salmonella* , 2008

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	Chicken (624)	0.0	**0.0**	0.0-0.8						11.7	61.7	25.2	1.4								
	Turkey (148)	0.0	**0.0**	0.0-3.2						4.7	56.8	36.5	2.0								
	Cattle (443)	0.0	**0.0**	0.0-1.1						5.0	43.1	47.9	3.6	0.5							
	Swine (111)	0.0	**0.0**	0.0-4.2						4.5	55.9	37.8	1.8								
Gentamicin	Chicken (624)	0.3	**5.6**	4.0-7.8					50.2	42.6	1.3			0.3	**2.6**	**3.0**					
	Turkey (148)	1.4	**16.9**	11.4-24.1					33.8	43.2	4.1		0.7	1.4	**6.1**	**10.8**					
	Cattle (443)	0.5	**1.6**	0.7-3.4					25.5	63.2	9.0	0.2		0.5	**0.7**	**0.9**					
	Swine (111)	0.0	**2.7**	0.7-8.3					34.2	59.5	3.6				**1.8**	**0.9**					
Kanamycin	Chicken (624)	0.0	**3.4**	2.2-5.2										96.3	0.3		**0.3**	**3.0**			
	Turkey (148)	0.0	**14.2**	9.2-21.1										84.5	1.4		**0.7**	**13.5**			
	Cattle (443)	0.2	**9.9**	7.4-13.2										89.8		0.2	**0.2**	**9.7**			
	Swine (111)	0.0	**3.6**	1.2-9.5										96.4				**3.6**			
Streptomycin	Chicken (624)	N/A	**25.2**	21.9-28.8												74.8	**19.9**	**5.3**			
	Turkey (148)	N/A	**32.4**	25.1-40.7												67.6	**23.0**	**9.5**			
	Cattle (443)	N/A	**23.0**	19.2-27.3												77.0	**2.9**	**20.1**			
	Swine (111)	N/A	**29.7**	21.6-39.2												70.3	**6.3**	**23.4**			
β-Lactam/β-Lactamase Inhibitor Combinations																					
Amoxicillin-Clavulanic Acid	Chicken (624)	0.3	**8.7**	6.7-11.3							88.6	0.8	0.2	1.4	0.3	**3.4**	**5.3**				
	Turkey (148)	14.2	**5.4**	2.5-10.7							66.9	0.7	1.4	11.5	14.2	**2.0**	**3.4**				
	Cattle (443)	1.4	**16.5**	13.2-20.4							77.7	0.7	0.2	3.6	1.4	**5.0**	**11.5**				
	Swine (111)	4.5	**4.5**	1.7-10.7							82.9	1.8	0.9	5.4	4.5		**4.5**				
Cephems																					
Cefoxitin	Chicken (624)	0.6	**8.0**	6.0-10.5						19.9	58.0	13.0	0.5	0.6	6.4	**1.6**					
	Turkey (148)	0.0	**5.4**	2.5-10.7						8.1	61.5	24.3	0.7		2.0	**3.4**					
	Cattle (443)	2.0	**14.7**	11.6-18.4						10.8	37.7	33.9	0.9	2.0	4.1	**10.6**					
	Swine (111)	0.9	**4.5**	1.7-10.7						4.5	45.9	43.2	0.9	0.9	0.9	**3.6**					
Ceftiofur	Chicken (624)	0.0	**8.7**	6.7-11.3						58.2	32.7	0.5		**0.6**	**8.0**						
	Turkey (148)	0.0	**5.4**	2.5-10.7						41.9	49.3	3.4			**5.4**						
	Cattle (443)	0.2	**16.3**	13.1-20.1					1.4	36.8	44.5	0.9	0.2	**2.0**	**14.2**						
	Swine (111)	1.8	**4.5**	1.7-10.7						35.1	55.9	2.7	1.8		**4.5**						
Ceftriaxone[5]	Chicken (624)	0.0	**8.7**	6.7-11.3					91.2	0.2			**0.2**	**1.4**	**5.4**	**1.3**	**0.2**	**0.2**			
	Turkey (148)	0.0	**5.4**	2.5-10.7					93.9	0.7				**0.7**	**2.0**	**2.0**	**0.7**				
	Cattle (443)	0.5	**16.0**	12.8-19.8					83.5			0.5	**0.2**	**2.5**	**7.9**	**4.1**	**1.4**				
	Swine (111)	0.0	**4.5**	1.7-10.7					95.5						**2.7**	**0.9**		**0.9**			

[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.

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

Table 3A (continued). Distribution of MICs and Occurrence of Resistance by Animal Source among *Salmonella* , 2008

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																					
Sulfonamides	Chicken (624)	N/A	**13.3**	10.8-16.3											31.7	49.5	5.1	0.2	0.2	**13.3**	
	Turkey (148)	N/A	**24.3**	17.8-32.2											23.0	43.2	9.5			**24.3**	
	Cattle (443)	N/A	**24.8**	20.9-29.1											22.1	46.5	6.3	0.2		**24.8**	
	Swine (111)	N/A	**31.5**	23.2-41.1											27.9	37.8	2.7			**31.5**	
Trimethoprim-Sulfamethoxazole	Chicken (624)	N/A	**0.3**	0-1.3				92.0	7.7					**0.3**							
	Turkey (148)	N/A	**1.4**	0.3-5.4				89.2	8.8		0.7			**1.4**							
	Cattle (443)	N/A	**4.5**	2.8-7.0				73.4	20.1	2.0			**1.1**	**3.4**							
	Swine (111)	N/A	**2.7**	0.7-8.3				77.5	18.0	1.8				**2.7**							
Penicillins																					
Ampicillin	Chicken (624)	0.0	**10.6**	8.3-13.3							87.5	1.4	0.5			**0.2**	**10.4**				
	Turkey (148)	0.0	**32.4**	25.1-40.7							66.9	0.7					**32.4**				
	Cattle (443)	0.0	**21.7**	18.0-25.9							75.8	2.0	0.5				**21.7**				
	Swine (111)	0.0	**14.4**	8.7-22.6							81.1	2.7	0.9	0.9			**14.4**				
Phenicols																					
Chloramphenicol	Chicken (624)	0.3	**1.8**	1.0-3.3								7.7	62.0	28.2	0.3	**0.2**	**1.6**				
	Turkey (148)	0.0	**2.7**	0.9-7.2								4.7	59.5	33.1		**0.7**	**2.0**				
	Cattle (443)	1.4	**19.6**	16.1-23.7								0.5	40.9	37.7	1.4		**19.6**				
	Swine (111)	2.7	**9.9**	5.3-17.4								1.8	32.4	53.2	2.7	**0.9**	**9.0**				
Quinolones																					
Ciprofloxacin	Chicken (624)	0.0	**0.0**	0.0-0.8	93.4	6.4	0.2														
	Turkey (148)	0.0	**0.0**	0.0-3.2	95.3	4.1		0.7													
	Cattle (443)	0.0	**0.0**	0.0-1.1	91.9	7.0	0.5		0.7												
	Swine (111)	0.0	**0.0**	0.0-4.2	95.5	4.5															
Nalidixic Acid	Chicken (624)	N/A	**0.0**	0.0-0.8						3.7	57.2	38.6	0.5								
	Turkey (148)	N/A	**0.7**	0-4.3						1.4	58.1	39.9				**0.7**					
	Cattle (443)	N/A	**0.7**	0.2-2.2							60.0	39.1	0.2			**0.7**					
	Swine (111)	N/A	**0.0**	0.0-4.2							60.4	37.8	1.8								
Tetracyclines																					
Tetracycline	Chicken (624)	1.4	**30.4**	26.8-34.2									68.1	1.4		**0.5**	**30.0**				
	Turkey (148)	0.0	**64.2**	55.9-71.8									35.8			**5.4**	**58.8**				
	Cattle (443)	0.0	**29.3**	25.1-33.8									70.7		**0.2**	**3.6**	**25.5**				
	Swine (111)	0.0	**51.4**	41.8-60.9									48.6		**0.9**	**7.2**	**43.2**				

[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, 1997-2008

Year			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of Isolates Tested		Chicken	214	561	1438	1173	1307	1500	1158	1280	1989	1380	994	624
		Turkey	107	240	713	518	550	244	262	236	227	304	271	148
		Cattle	24	284	1610	1388	893	1008	670	607	329	389	439	443
		Swine	111	793	876	451	418	379	211	308	301	304	211	111
Antimicrobial Class	**Antimicrobial**	**Isolate Source**												
Aminoglycosides	Amikacin	Chicken	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
		Turkey	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
		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
	Gentamicin	Chicken	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
		Turkey	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
		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
		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
	Kanamycin	Chicken	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
		Turkey	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
		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
		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
	Streptomycin	Chicken	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
		Turkey	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
		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
		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
β-Lactam/β-Lactamase Inhibitor Combinations	Amoxicillin-Clavulanic Acid	Chicken	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
		Turkey	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
		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
		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

Table 4A (continued). Resistance among *Salmonella* by Animal Source, 1997-2008

Year			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of Isolates Tested		Chicken	214	561	1438	1173	1307	1500	1158	1280	1989	1380	994	624
		Turkey	107	240	713	518	550	244	262	236	227	304	271	148
		Cattle	24	284	1610	1388	893	1008	670	607	329	389	439	443
		Swine	111	793	876	451	418	379	211	308	301	304	211	111
Antimicrobial Class	**Antimicrobial**	**Isolate Source**												
Cephems	Cefoxitin	Chicken	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
		Turkey	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
		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
		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
	Ceftiofur	Chicken	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
		Turkey	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
		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
		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
	Ceftriaxone[1]	Chicken	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
		Turkey	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
		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
		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
	Cephalothin	Chicken	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
		Turkey	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
		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
		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
Folate Pathway Inhibitors	Sulfonamides	Chicken	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
		Turkey	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
		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
		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
	Trimethoprim-Sulfamethoxazole	Chicken	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
		Turkey	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
		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
		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

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

Table 4A (continued). Resistance among *Salmonella* by Animal Source, 1997-2008

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

Table 5A. Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Chicken, 2008

Antimicrobial	Serotype (# 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	Kentucky (219)	0.0	**0.0**	0.0-2.1						3.2	66.2	28.3	2.3								
	Enteritidis (116)	0.0	**0.0**	0.0-4.0						21.6	73.3	4.3	0.9								
	Heidelberg (94)	0.0	**0.0**	0.0-4.9						12.8	62.8	23.4	1.1								
	Typhimurium var. 5- (39)	0.0	**0.0**	0.0-11.2						48.7	38.5	12.8									
	Typhimurium (31)	0.0	**0.0**	0.0-13.7						22.6	58.1	19.4									
	I 4,[5],12:i:- (23)	0.0	**0.0**	0.0-17.8							47.8	52.2									
	Infantis (14)	0.0	**0.0**	0.0-26.8							100.0										
	Montevideo (13)	0.0	**0.0**	0.0-28.3							23.1	69.2	7.7								
	Schwarzengrund (7)	0.0	**0.0**	0.0-43.9							42.9	57.1									
	I 4,12:i:- (6)	0.0	**0.0**	0.0-48.3							66.7	33.3									
	Senftenberg (6)	0.0	**0.0**	0.0-48.3							33.3	66.7									
Gentamicin	Kentucky (219)	0.0	**3.2**	1.4-6.8					40.2	55.3	1.4				**0.9**	**2.3**					
	Enteritidis (116)	0.0	**0.0**	0.0-4.0					70.7	29.3											
	Heidelberg (94)	2.1	**10.6**	5.5-19.1					50.0	35.1	2.1			2.1	**6.4**	**4.3**					
	Typhimurium var. 5- (39)	0.0	**5.1**	0.9-18.6					82.1	12.8					**5.1**						
	Typhimurium (31)	0.0	**6.5**	1.1-22.9					58.1	35.5					**6.5**						
	I 4,[5],12:i:- (23)	0.0	**4.3**	0.2-23.9					26.1	69.6					**4.3**						
	Infantis (14)	0.0	**0.0**	0.0-26.8					57.1	42.9											
	Montevideo (13)	0.0	**53.8**	26.1-79.6						46.2					**7.7**	**46.2**					
	Schwarzengrund (7)	0.0	**0.0**	0.0-43.9					42.9	57.1											
	I 4,12:i:- (6)	0.0	**16.7**	0.9-63.5					50.0	33.3						**16.7**					
	Senftenberg (6)	0.0	**0.0**	0.0-48.3						100.0											
Kanamycin	Kentucky (219)	0.0	**1.8**	0.6-4.9										97.7	0.5			**1.8**			
	Enteritidis (116)	0.0	**0.0**	0.0-4.0										100.0							
	Heidelberg (94)	0.0	**8.5**	4.0-16.5										90.4	1.1		**2.1**	**6.4**			
	Typhimurium var. 5- (39)	0.0	**5.1**	0.9-18.6										94.9				**5.1**			
	Typhimurium (31)	0.0	**12.9**	4.2-30.8										87.1				**12.9**			
	I 4,[5],12:i:- (23)	0.0	**0.0**	0.0-17.8										100.0							
	Infantis (14)	0.0	**0.0**	0.0-26.8										100.0							
	Montevideo (13)	0.0	**15.4**	2.7-46.4										84.6				**15.4**			
	Schwarzengrund (7)	0.0	**0.0**	0.0-43.9										100.0							
	I 4,12:i:- (6)	0.0	**0.0**	0.0-48.3										100.0							
	Senftenberg (6)	0.0	**0.0**	0.0-48.3										100.0							
Streptomycin	Kentucky (219)	N/A	**51.6**	44.8-58.4												48.4	**43.4**	**8.2**			
	Enteritidis (116)	N/A	**0.0**	0.0-4.0												100.0					
	Heidelberg (94)	N/A	**16.0**	9.5-25.3												84.0	**7.4**	**8.5**			
	Typhimurium var. 5- (39)	N/A	**7.7**	2.0-22.0												92.3	**7.7**				
	Typhimurium (31)	N/A	**3.2**	0.2-18.5												96.8	**3.2**				
	I 4,[5],12:i:- (23)	N/A	**8.7**	1.5-29.5												91.3	**4.3**	**4.3**			
	Infantis (14)	N/A	**0.0**	0.0-26.8												100.0					
	Montevideo (13)	N/A	**46.2**	20.4-73.9												53.8	**38.5**	**7.7**			
	Schwarzengrund (7)	N/A	**0.0**	0.0-43.9												100.0					
	I 4,12:i:- (6)	N/A	**16.7**	0.9-63.5												83.3	**16.7**				
	Senftenberg (6)	N/A	**0.0**	0.0-48.3												100.0					

[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 5A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Chicken, 2008

Antimicrobial	Serotype (# 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
β-Lactam/β-Lactamase Inhibitor Combinations																					
Amoxicillin-Clavulanic Acid	Kentucky (219)	0.5	**11.0**	7.3-16.1							88.1	0.5			0.5	**5.0**	**5.9**				
	Enteritidis (116)	0.0	**0.9**	0.1-5.5							94.8	2.6		1.7			**0.9**				
	Heidelberg (94)	1.1	**8.5**	4.0-16.5							85.1	1.1		4.3	1.1	**4.3**	**4.3**				
	Typhimurium var. 5- (39)	0.0	**28.2**	15.5-45.1							69.2			2.6		**7.7**	**20.5**				
	Typhimurium (31)	0.0	**19.4**	8.2-38.1							74.2		3.2	3.2		**3.2**	**16.1**				
	I 4,[5],12:i:- (23)	0.0	**4.3**	0.2-23.9							91.3			4.3			**4.3**				
	Infantis (14)	0.0	**0.0**	0.0-26.8							100.0										
	Montevideo (13)	0.0	**0.0**	0.0-28.3							100.0										
	Schwarzengrund (7)	0.0	**0.0**	0.0-43.9							100.0										
	I 4,12:i:- (6)	0.0	**0.0**	0.0-48.3							100.0										
	Senftenberg (6)	0.0	**0.0**	0.0-48.3							100.0										
Cephems																					
Cefoxitin	Kentucky (219)	0.5	**10.5**	6.9-15.5							27.4	53.0	8.2	0.5	0.5	**10.0**	**0.5**				
	Enteritidis (116)	0.0	**0.9**	0.1-5.5							8.6	73.3	17.2				**0.9**				
	Heidelberg (94)	0.0	**8.5**	4.0-16.5							35.1	52.1	3.2	1.1		**6.4**	**2.1**				
	Typhimurium var. 5- (39)	7.7	**20.5**	9.9-36.9								53.8	17.9		7.7	**17.9**	**2.6**				
	Typhimurium (31)	0.0	**19.4**	8.2-38.1							9.7	54.8	16.1			**9.7**	**9.7**				
	I 4,[5],12:i:- (23)	0.0	**4.3**	0.2-23.9							34.8	60.9				**4.3**					
	Infantis (14)	0.0	**0.0**	0.0-26.8									100.0								
	Montevideo (13)	0.0	**0.0**	0.0-28.3								100.0									
	Schwarzengrund (7)	0.0	**0.0**	0.0-43.9								100.0									
	I 4,12:i:- (6)	0.0	**0.0**	0.0-48.3								100.0									
	Senftenberg (6)	0.0	**0.0**	0.0-48.3									100.0								
Ceftiofur	Kentucky (219)	0.0	**11.0**	7.3-16.1						76.3	12.3	0.5		**0.5**	**10.5**						
	Enteritidis (116)	0.0	**0.9**	0.1-5.5						15.5	81.9	1.7			**0.9**						
	Heidelberg (94)	0.0	**8.5**	4.0-16.5						70.2	21.3				**8.5**						
	Typhimurium var. 5- (39)	0.0	**28.2**	15.5-45.1						59.0	12.8			**7.7**	**20.5**						
	Typhimurium (31)	0.0	**19.4**	8.2-38.1						64.5	16.1				**19.4**						
	I 4,[5],12:i:- (23)	0.0	**4.3**	0.2-23.9						78.3	17.4				**4.3**						
	Infantis (14)	0.0	**0.0**	0.0-26.8						7.1	92.9										
	Montevideo (13)	0.0	**0.0**	0.0-28.3						53.8	46.2										
	Schwarzengrund (7)	0.0	**0.0**	0.0-43.9						71.4	28.6										
	I 4,12:i:- (6)	0.0	**0.0**	0.0-48.3						83.3	16.7										
	Senftenberg (6)	0.0	**0.0**	0.0-48.3							100.0										
Ceftriaxone[5]	Kentucky (219)	0.0	**10.9**	7.3-16.1					88.6	0.5				**1.8**	**8.2**	**0.9**					
	Enteritidis (116)	0.0	**0.9**	0.1-5.5					99.1						**0.9**						
	Heidelberg (94)	0.0	**8.6**	4.0-16.5					91.5					**1.1**	**5.3**		**1.1**	**1.1**			
	Typhimurium var. 5- (39)	0.0	**28.3**	15.5-45.1					71.8				**2.6**	**7.7**	**15.4**	**2.6**					
	Typhimurium (31)	0.0	**19.4**	8.2-38.1					80.6						**9.7**	**9.7**					
	I 4,[5],12:i:- (23)	0.0	**4.3**	0.2-23.9					95.7					**4.3**							
	Infantis (14)	0.0	**0.0**	0.0-26.8					100.0												
	Montevideo (13)	0.0	**0.0**	0.0-28.3					100.0												
	Schwarzengrund (7)	0.0	**0.0**	0.0-43.9					100.0												
	I 4,12:i:- (6)	0.0	**0.0**	0.0-48.3					100.0												
	Senftenberg (6)	0.0	**0.0**	0.0-48.3					100.0												

[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.

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

Table 5A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Chicken, 2008

Antimicrobial	Serotype (# 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																					
Sulfonamides	Kentucky (219)	N/A	**4.1**	2.0-7.9											40.2	50.7	4.6	0.5		**4.1**	
	Enteritidis (116)	N/A	**0.9**	0.1-5.5											10.3	75.9	12.9			**0.9**	
	Heidelberg (94)	N/A	**12.8**	7.1-21.7											70.2	17.0				**12.8**	
	Typhimurium var. 5- (39)	N/A	**84.6**	68.8-93.6											2.6	12.8				**84.6**	
	Typhimurium (31)	N/A	**51.6**	33.4-69.4											19.4	29.0				**51.6**	
	I 4,[5],12:i:- (23)	N/A	**4.3**	0.2-23.9											13.0	82.6				**4.3**	
	Infantis (14)	N/A	**0.0**	0.0-26.8											14.3	57.1	28.6				
	Montevideo (13)	N/A	**23.1**	6.2-54.0											30.8	38.5			7.7	**23.1**	
	Schwarzengrund (7)	N/A	**0.0**	0.0-43.9												100.0					
	I 4,12:i:- (6)	N/A	**16.7**	0.9-63.5											33.3	50.0				**16.7**	
	Senftenberg (6)	N/A	**16.7**	0.9-63.5												83.3				**16.7**	
Trimethoprim-Sulfamethoxazole	Kentucky (219)	N/A	**0.0**	0.0-2.1				94.5	5.5												
	Enteritidis (116)	N/A	**0.0**	0.0-4.0				90.5	9.5												
	Heidelberg (94)	N/A	**0.0**	0.0-4.9				95.7	4.3												
	Typhimurium var. 5- (39)	N/A	**0.0**	0.0-11.2				74.4	25.6												
	Typhimurium (31)	N/A	**0.0**	0.0-13.7				77.4	22.6												
	I 4,[5],12:i:- (23)	N/A	**0.0**	0.0-17.8				95.7	4.3												
	Infantis (14)	N/A	**0.0**	0.0-26.8				92.9	7.1												
	Montevideo (13)	N/A	**0.0**	0.0-28.3				100.0													
	Schwarzengrund (7)	N/A	**0.0**	0.0-43.9				100.0													
	I 4,12:i:- (6)	N/A	**0.0**	0.0-48.3				100.0													
	Senftenberg (6)	N/A	**16.7**	0.9-63.5				83.3						**16.7**							
Penicillins																					
Ampicillin	Kentucky (219)	0.0	**11.4**	7.7-16.6							87.7		0.9				**11.4**				
	Enteritidis (116)	0.0	**2.6**	0.7-8.0							92.2	4.3	0.9				**2.6**				
	Heidelberg (94)	0.0	**13.8**	7.8-22.8							84.0	2.1					**13.8**				
	Typhimurium var. 5- (39)	0.0	**30.8**	17.6-47.8							69.2						**30.8**				
	Typhimurium (31)	0.0	**25.8**	12.5-44.9							74.2					**3.2**	**22.6**				
	I 4,[5],12:i:- (23)	0.0	**8.7**	1.5-29.5							87.0	4.3					**8.7**				
	Infantis (14)	0.0	**0.0**	0.0-26.8							100.0										
	Montevideo (13)	0.0	**0.0**	0.0-28.3							92.3	7.7									
	Schwarzengrund (7)	0.0	**0.0**	0.0-43.9							100.0										
	I 4,12:i:- (6)	0.0	**0.0**	0.0-48.3							100.0										
	Senftenberg (6)	0.0	**0.0**	0.0-48.3							100.0										

[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 5A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Chicken, 2008

Antimicrobial	Serotype (# 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
Phenicols																					
Chloramphenicol	Kentucky (219)	0.0	**2.3**	0.9-5.6								21.0	76.3	0.5		**0.5**	**1.8**				
	Enteritidis (116)	0.9	**0.0**	0.0-4.0								0.9	52.6	45.7	0.9						
	Heidelberg (94)	0.0	**4.3**	1.4-11.2									25.5	70.2			**4.3**				
	Typhimurium var. 5- (39)	0.0	**0.0**	0.0-11.2									76.9	23.1							
	Typhimurium (31)	0.0	**3.2**	0.2-18.5									67.7	29.0			**3.2**				
	I 4,[5],12:i:- (23)	0.0	**0.0**	0.0-17.8									78.3	21.7							
	Infantis (14)	0.0	**0.0**	0.0-26.8									14.3	85.7							
	Montevideo (13)	0.0	**0.0**	0.0-28.3									61.5	38.5							
	Schwarzengrund (7)	0.0	**0.0**	0.0-43.9									71.4	28.6							
	I 4,12:i:- (6)	0.0	**0.0**	0.0-48.3								16.7	66.7	16.7							
	Senftenberg (6)	0.0	**0.0**	0.0-48.3									50.0	50.0							
Quinolones																					
Ciprofloxacin	Kentucky (219)	0.0	**0.0**	0.0-2.1	99.1	0.9															
	Enteritidis (116)	0.0	**0.0**	0.0-4.0	74.1	25.0	0.9														
	Heidelberg (94)	0.0	**0.0**	0.0-4.9	97.9	2.1															
	Typhimurium var. 5- (39)	0.0	**0.0**	0.0-11.2	97.4	2.6															
	Typhimurium (31)	0.0	**0.0**	0.0-13.7	93.5	6.5															
	I 4,[5],12:i:- (23)	0.0	**0.0**	0.0-17.8	95.7	4.3															
	Infantis (14)	0.0	**0.0**	0.0-26.8	92.9	7.1															
	Montevideo (13)	0.0	**0.0**	0.0-28.3	100.0																
	Schwarzengrund (7)	0.0	**0.0**	0.0-43.9	100.0																
	I 4,12:i:- (6)	0.0	**0.0**	0.0-48.3	100.0																
	Senftenberg (6)	0.0	**0.0**	0.0-48.3	100.0																
Nalidixic Acid	Kentucky (219)	N/A	**0.0**	0.0-2.1							10.0	82.6	7.3								
	Enteritidis (116)	N/A	**0.0**	0.0-4.0								25.9	73.3	0.9							
	Heidelberg (94)	N/A	**0.0**	0.0-4.9								27.7	72.3								
	Typhimurium var. 5- (39)	N/A	**0.0**	0.0-11.2								56.4	43.6								
	Typhimurium (31)	N/A	**0.0**	0.0-13.7								51.6	45.2	3.2							
	I 4,[5],12:i:- (23)	N/A	**0.0**	0.0-17.8								78.3	21.7								
	Infantis (14)	N/A	**0.0**	0.0-26.8								71.4	28.6								
	Montevideo (13)	N/A	**0.0**	0.0-28.3								61.5	38.5								
	Schwarzengrund (7)	N/A	**0.0**	0.0-43.9								28.6	71.4								
	I 4,12:i:- (6)	N/A	**0.0**	0.0-48.3							16.7	83.3									
	Senftenberg (6)	N/A	**0.0**	0.0-48.3								33.3	66.7								
Tetracyclines																					
Tetracycline	Kentucky (219)	2.3	**51.1**	44.3-57.9									46.6	2.3		**0.9**	**50.2**				
	Enteritidis (116)	0.0	**0.9**	0.1-5.5									99.1				**0.9**				
	Heidelberg (94)	3.2	**13.8**	7.8-22.8									83.0	3.2			**13.8**				
	Typhimurium var. 5- (39)	0.0	**82.1**	65.9-91.9									17.9				**82.1**				
	Typhimurium (31)	3.2	**41.9**	25.0-60.7									54.8	3.2			**41.9**				
	I 4,[5],12:i:- (23)	0.0	**0.0**	0.0-17.8									100.0								
	Infantis (14)	0.0	**0.0**	0.0-26.8									100.0								
	Montevideo (13)	0.0	**0.0**	0.0-28.3									100.0								
	Schwarzengrund (7)	0.0	**0.0**	0.0-43.9									100.0								
	I 4,12:i:- (6)	0.0	**16.7**	0.9-63.5									83.3				**16.7**				
	Senftenberg (6)	0.0	**16.7**	0.9-63.5									83.3			**16.7**					

[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 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 6A. Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Turkey, 2008

Antimicrobial	Serotype (# 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	Hadar (40)	0.0	**0.0**	0.0-10.9							45.0	52.5	2.5								
	Saintpaul (16)	0.0	**0.0**	0.0-24.1							50.0	43.8	6.2								
	III 18:z4,z23:- (14)	0.0	**0.0**	0.0-26.8						42.9	57.1										
	Schwarzengrund (9)	0.0	**0.0**	0.0-37.1							55.6	33.3	11.1								
	Heidelberg (8)	0.0	**0.0**	0.0-40.2							75.0	25.0									
	Newport (8)	0.0	**0.0**	0.0-40.2							75.0	25.0									
	Agona (6)	0.0	**0.0**	0.0-48.3							66.7	33.3									
	Senftenberg (6)	0.0	**0.0**	0.0-48.3							33.3	66.7									
	Worthington (6)	0.0	**0.0**	0.0-48.3							50.0	50.0									
Gentamicin	Hadar (40)	0.0	**15.0**	6.2-30.5					12.5	67.5	5.0				**2.5**	**12.5**					
	Saintpaul (16)	0.0	**6.2**	0.3-32.2					31.2	56.2	6.2					**6.2**					
	III 18:z4,z23:- (14)	0.0	**0.0**	0.0-26.8					92.9	7.1											
	Schwarzengrund (9)	0.0	**0.0**	0.0-37.1					55.6	44.4											
	Heidelberg (8)	12.5	**50.0**	17.4-82.6					25.0	12.5				12.5	**12.5**	**37.5**					
	Newport (8)	0.0	**25.0**	4.5-64.4					25.0	50.0					**12.5**	**12.5**					
	Agona (6)	0.0	**16.7**	0.9-63.5					33.3	50.0						**16.7**					
	Senftenberg (6)	0.0	**33.3**	6.0-75.9					16.7	50.0						**33.3**					
	Worthington (6)	0.0	**0.0**	0.0-48.3					33.3	50.0	16.7										
Kanamycin	Hadar (40)	0.0	**15.0**	6.2-30.5										85.0				**15.0**			
	Saintpaul (16)	0.0	**6.2**	0.3-32.2										93.8				**6.2**			
	III 18:z4,z23:- (14)	0.0	**7.1**	0.4-35.8										92.9				**7.1**			
	Schwarzengrund (9)	0.0	**0.0**	0.0-37.1										100.0							
	Heidelberg (8)	0.0	**50.0**	17.4-82.6										37.5	12.5		**12.5**	**37.5**			
	Newport (8)	0.0	**37.5**	10.2-74.1										62.5				**37.5**			
	Agona (6)	0.0	**16.7**	0.9-63.5										83.3				**16.7**			
	Senftenberg (6)	0.0	**0.0**	0.0-48.3										83.3	16.7						
	Worthington (6)	0.0	**0.0**	0.0-48.3										100.0							
Streptomycin	Hadar (40)	N/A	**75.0**	58.5-86.8												25.0	**60.0**	**15.0**			
	Saintpaul (16)	N/A	**0.0**	0.0-24.1												100.0					
	III 18:z4,z23:- (14)	N/A	**7.1**	0.4-35.8												92.9		**7.1**			
	Schwarzengrund (9)	N/A	**0.0**	0.0-37.1												100.0					
	Heidelberg (8)	N/A	**37.5**	10.2-74.1												62.5	**25.0**	**12.5**			
	Newport (8)	N/A	**25.0**	4.5-64.4												75.0	**12.5**	**12.5**			
	Agona (6)	N/A	**0.0**	0.0-48.3												100.0					
	Senftenberg (6)	N/A	**16.7**	0.9-63.5												83.3		**16.7**			
	Worthington (6)	N/A	**0.0**	0.0-48.3												100.0					

[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 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 6A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Turkey, 2008

Antimicrobial	Serotype (# of Isolates)	%I[1]	%R[2]	95% CI[3]	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)[4]																
β-Lactam/β-Lactamase Inhibitor Combinations																					
Amoxicillin-Clavulanic Acid	Hadar (40)	0.0	**42.5**	27.4-59.0							57.5						**42.5**				
	Saintpaul (16)	0.0	**18.8**	5.0-46.4							75.0	6.2					**18.8**				
	III 18:z4,z23:- (14)	0.0	**7.1**	0.4-35.8							92.9						**7.1**				
	Schwarzengrund (9)	0.0	**0.0**	0.0-37.1							100.0										
	Heidelberg (8)	0.0	**50.0**	17.4-82.6							50.0						**50.0**				
	Newport (8)	0.0	**25.0**	4.5-64.4							75.0						**25.0**				
	Agona (6)	0.0	**50.0**	13.9-86.1							50.0						**50.0**				
	Senftenberg (6)	0.0	**50.0**	13.9-86.1							50.0						**50.0**				
	Worthington (6)	0.0	**0.0**	0.0-48.3							100.0										
Cephems																					
Cefoxitin	Hadar (40)	0.0	**0.0**	0.0-10.9							2.5	92.5	5.0								
	Saintpaul (16)	0.0	**0.0**	0.0-24.1							12.5	75.0	6.2	6.2							
	III 18:z4,z23:- (14)	0.0	**7.1**	0.4-35.8							14.3	71.4	7.1			**7.1**					
	Schwarzengrund (9)	0.0	**0.0**	0.0-37.1								88.9	11.1								
	Heidelberg (8)	0.0	**12.5**	0.7-53.3							25.0	62.5				**12.5**					
	Newport (8)	0.0	**25.0**	4.5-64.4							25.0	50.0				**12.5**	**12.5**				
	Agona (6)	0.0	**16.7**	0.9-63.5									83.3				**16.7**				
	Senftenberg (6)	0.0	**33.3**	6.0-75.9									66.7				**33.3**				
	Worthington (6)	0.0	**0.0**	0.0-48.3								33.3	66.7								
Ceftiofur	Hadar (40)	0.0	**0.0**	0.0-10.9						27.5	67.5	5.0									
	Saintpaul (16)	0.0	**0.0**	0.0-24.1						43.8	56.2										
	III 18:z4,z23:- (14)	0.0	**7.1**	0.4-35.8						85.7	7.1				**7.1**						
	Schwarzengrund (9)	0.0	**0.0**	0.0-37.1						55.6	33.3	11.1									
	Heidelberg (8)	0.0	**12.5**	0.7-53.3						75.0	12.5				**12.5**						
	Newport (8)	0.0	**25.0**	4.5-64.4						62.5	12.5				**25.0**						
	Agona (6)	0.0	**16.7**	0.9-63.5							83.3				**16.7**						
	Senftenberg (6)	0.0	**33.3**	6.0-75.9							66.7				**33.3**						
	Worthington (6)	0.0	**0.0**	0.0-48.3						83.3	16.7										
Ceftriaxone[5]	Hadar (40)	0.0	**0.0**	0.0-10.9					100.0												
	Saintpaul (16)	0.0	**0.0**	0.0-24.1					100.0												
	III 18:z4,z23:- (14)	0.0	**7.1**	0.4-35.8					92.9					**7.1**							
	Schwarzengrund (9)	0.0	**0.0**	0.0-37.1					100.0												
	Heidelberg (8)	0.0	**12.5**	0.7-53.3					87.5						**12.5**						
	Newport (8)	0.0	**25.0**	4.5-64.4					75.0						**12.5**		**12.5**				
	Agona (6)	0.0	**16.7**	0.9-63.5					83.3							**16.7**					
	Senftenberg (6)	0.0	**33.4**	6.0-75.9					66.7						**16.7**	**16.7**					
	Worthington (6)	0.0	**0.0**	0.0-48.3					83.3	16.7											

[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 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.

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

Table 6A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Turkey, 2008

Antimicrobial	Serotype (# 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																					
Sulfonamides	Hadar (40)	N/A	**17.5**	7.9-33.4											7.5	72.5	2.5			**17.5**	
	Saintpaul (16)	N/A	**6.2**	0.3-32.2												50.0	43.8			**6.2**	
	III 18:z4,z23:- (14)	N/A	**7.1**	0.4-35.8											92.9					**7.1**	
	Schwarzengrund (9)	N/A	**22.2**	3.9-59.8											22.2	55.6				**22.2**	
	Heidelberg (8)	N/A	**37.5**	10.2-74.1											12.5	50.0				**37.5**	
	Newport (8)	N/A	**37.5**	10.2-74.1											12.5	50.0				**37.5**	
	Agona (6)	N/A	**50.0**	13.9-86.1											33.3	16.7				**50.0**	
	Senftenberg (6)	N/A	**0.0**	0.0-48.3												33.3	66.7				
	Worthington (6)	N/A	**0.0**	0.0-48.3											83.3	16.7					
Trimethoprim-Sulfamethoxazole	Hadar (40)	N/A	**0.0**	0.0-10.9				95.0	5.0												
	Saintpaul (16)	N/A	**0.0**	0.0-24.1				100.0													
	III 18:z4,z23:- (14)	N/A	**7.1**	0.4-35.8				92.9						**7.1**							
	Schwarzengrund (9)	N/A	**0.0**	0.0-37.1				88.9	11.1												
	Heidelberg (8)	N/A	**0.0**	0.0-40.2				75.0	25.0												
	Newport (8)	N/A	**0.0**	0.0-40.2				87.5	12.5												
	Agona (6)	N/A	**16.7**	0.9-63.5				50.0	33.3					**16.7**							
	Senftenberg (6)	N/A	**0.0**	0.0-48.3				83.3	16.7												
	Worthington (6)	N/A	**0.0**	0.0-48.3				100.0													
Penicillins																					
Ampicillin	Hadar (40)	0.0	**42.5**	27.4-59.0							57.5						**42.5**				
	Saintpaul (16)	0.0	**18.8**	5.0-46.4							75.0	6.2					**18.8**				
	III 18:z4,z23:- (14)	0.0	**7.1**	0.4-35.8							92.9						**7.1**				
	Schwarzengrund (9)	0.0	**0.0**	0.0-37.1							100.0										
	Heidelberg (8)	0.0	**50.0**	17.4-82.6							50.0						**50.0**				
	Newport (8)	0.0	**25.0**	4.5-64.4							75.0						**25.0**				
	Agona (6)	0.0	**50.0**	13.9-86.1							50.0						**50.0**				
	Senftenberg (6)	0.0	**50.0**	13.9-86.1							50.0						**50.0**				
	Worthington (6)	0.0	**0.0**	0.0-48.3							100.0										

[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 6A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Turkey, 2008

Antimicrobial	Serotype (# 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
Phenicols																					
Chloramphenicol	Hadar (40)	0.0	**0.0**	0.0-10.9								10.0	87.5	2.5							
	Saintpaul (16)	0.0	**0.0**	0.0-24.1									50.0	50.0							
	III 18:z4,z23:- (14)	0.0	**7.1**	0.4-35.8								14.3	78.6				**7.1**				
	Schwarzengrund (9)	0.0	**0.0**	0.0-37.1									44.4	55.6							
	Heidelberg (8)	0.0	**12.5**	0.7-53.3									37.5	50.0		**12.5**					
	Newport (8)	0.0	**12.5**	0.7-53.3								12.5	50.0	25.0			**12.5**				
	Agona (6)	0.0	**0.0**	0.0-48.3									16.7	83.3							
	Senftenberg (6)	0.0	**0.0**	0.0-48.3									16.7	83.3							
	Worthington (6)	0.0	**0.0**	0.0-48.3										100.0							
Quinolones																					
Ciprofloxacin	Hadar (40)	0.0	**0.0**	0.0-10.9	90.0	10.0															
	Saintpaul (16)	0.0	**0.0**	0.0-24.1	93.8	6.2															
	III 18:z4,z23:- (14)	0.0	**0.0**	0.0-26.8	100.0																
	Schwarzengrund (9)	0.0	**0.0**	0.0-37.1	100.0																
	Heidelberg (8)	0.0	**0.0**	0.0-40.2	100.0																
	Newport (8)	0.0	**0.0**	0.0-40.2	100.0																
	Agona (6)	0.0	**0.0**	0.0-48.3	100.0																
	Senftenberg (6)	0.0	**0.0**	0.0-48.3	83.3	16.7															
	Worthington (6)	0.0	**0.0**	0.0-48.3	100.0																
Nalidixic Acid	Hadar (40)	N/A	**0.0**	0.0-10.9								45.0	55.0								
	Saintpaul (16)	N/A	**0.0**	0.0-24.1								87.5	12.5								
	III 18:z4,z23:- (14)	N/A	**0.0**	0.0-26.8							7.1	92.9									
	Schwarzengrund (9)	N/A	**0.0**	0.0-37.1								44.4	55.6								
	Heidelberg (8)	N/A	**0.0**	0.0-40.2								50.0	50.0								
	Newport (8)	N/A	**0.0**	0.0-40.2							12.5	50.0	37.5								
	Agona (6)	N/A	**0.0**	0.0-48.3									100.0								
	Senftenberg (6)	N/A	**0.0**	0.0-48.3								16.7	83.3								
	Worthington (6)	N/A	**0.0**	0.0-48.3								83.3	16.7								
Tetracyclines																					
Tetracycline	Hadar (40)	0.0	**90.0**	75.4-96.7									10.0			**15.0**	**75.0**				
	Saintpaul (16)	0.0	**81.2**	53.6-95.0									18.8				**81.2**				
	III 18:z4,z23:- (14)	0.0	**7.1**	0.4-35.8									92.9			**7.1**					
	Schwarzengrund (9)	0.0	**55.6**	22.7-84.7									44.4				**55.6**				
	Heidelberg (8)	0.0	**87.5**	46.7-99.3									12.5				**87.5**				
	Newport (8)	0.0	**62.5**	25.9-89.8									37.5				**62.5**				
	Agona (6)	0.0	**66.7**	24.1-94.0									33.3				**66.7**				
	Senftenberg (6)	0.0	**0.0**	0.0-48.3									100.0								
	Worthington (6)	0.0	**66.7**	24.1-94.0									33.3				**66.7**				

[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 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 7A. Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Cattle, 2008

Antimicrobial	Serotype (# of Isolates)	%I[1]	%R[2]	95% CI[3]	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)[4]																
Aminoglycosides																					
Amikacin	Montevideo (104)	0.0	**0.0**	0.0-4.4							18.3	76.9	3.8	1.0							
	Dublin (53)	0.0	**0.0**	0.0-8.4						5.7	32.1	56.6	5.7								
	Newport (31)	0.0	**0.0**	0.0-13.7						12.9	54.8	25.8	6.5								
	Anatum (27)	0.0	**0.0**	0.0-15.5						11.1	81.5	7.4									
	Cerro (27)	0.0	**0.0**	0.0-15.5						3.7	40.7	44.4	11.1								
	Typhimurium (25)	0.0	**0.0**	0.0-16.6							60.0	40.0									
	Kentucky (22)	0.0	**0.0**	0.0-18.5							9.1	90.9									
	Muenster (18)	0.0	**0.0**	0.0-21.9							61.1	33.3	5.6								
	Agona (17)	0.0	**0.0**	0.0-22.9							82.4	17.6									
	Mbandaka (17)	0.0	**0.0**	0.0-22.9							11.8	64.7	17.6	5.9							
	Meleagridis (17)	0.0	**0.0**	0.0-22.9						5.9	76.5	17.6									
Gentamicin	Montevideo (104)	0.0	**0.0**	0.0-4.4					5.8	85.6	8.7										
	Dublin (53)	1.9	**11.3**	4.7-23.7					15.1	47.2	24.5			1.9	**5.7**	**5.7**					
	Newport (31)	0.0	**0.0**	0.0-13.7					38.7	58.1	3.2										
	Anatum (27)	0.0	**0.0**	0.0-15.5					59.3	40.7											
	Cerro (27)	0.0	**0.0**	0.0-15.5					22.2	63.0	14.8										
	Typhimurium (25)	0.0	**0.0**	0.0-16.6					40.0	60.0											
	Kentucky (22)	0.0	**0.0**	0.0-18.5					9.1	77.3	13.6										
	Muenster (18)	0.0	**0.0**	0.0-21.9					27.8	61.1	11.1										
	Agona (17)	0.0	**0.0**	0.0-22.9					5.9	88.2	5.9										
	Mbandaka (17)	0.0	**0.0**	0.0-22.9					5.9	52.9	41.2										
	Meleagridis (17)	0.0	**0.0**	0.0-22.9					64.7	35.3											
Kanamycin	Montevideo (104)	0.0	**0.0**	0.0-4.4										100.0							
	Dublin (53)	0.0	**58.5**	44.2-71.6										41.5			**1.9**	**56.6**			
	Newport (31)	0.0	**0.0**	0.0-13.7										100.0							
	Anatum (27)	0.0	**0.0**	0.0-15.5										100.0							
	Cerro (27)	0.0	**0.0**	0.0-15.5										100.0							
	Typhimurium (25)	0.0	**8.0**	1.4-27.5										92.0				**8.0**			
	Kentucky (22)	0.0	**0.0**	0.0-18.5										100.0							
	Muenster (18)	0.0	**0.0**	0.0-21.9										100.0							
	Agona (17)	0.0	**35.3**	15.3-61.4										64.7				**35.3**			
	Mbandaka (17)	0.0	**0.0**	0.0-22.9										100.0							
	Meleagridis (17)	0.0	**0.0**	0.0-22.9										100.0							
Streptomycin	Montevideo (104)	N/A	**1.0**	0.1-6.1												99.0	**1.0**				
	Dublin (53)	N/A	**79.2**	65.5-88.7												20.8		**79.2**			
	Newport (31)	N/A	**74.2**	55.1-87.5												25.8	**6.5**	**67.7**			
	Anatum (27)	N/A	**0.0**	0.0-15.5												100.0					
	Cerro (27)	N/A	**3.7**	0.2-20.9												96.3		**3.7**			
	Typhimurium (25)	N/A	**44.0**	25.0-64.7												56.0	**16.0**	**28.0**			
	Kentucky (22)	N/A	**4.5**	0.2-24.8												95.5	**4.5**				
	Muenster (18)	N/A	**5.6**	0.3-29.4												94.4		**5.6**			
	Agona (17)	N/A	**58.8**	33.4-80.6												41.2	**11.8**	**47.1**			
	Mbandaka (17)	N/A	**0.0**	0.0-22.9												100.0					
	Meleagridis (17)	N/A	**0.0**	0.0-22.9												100.0					

[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 7A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Cattle, 2008

Antimicrobial	Serotype (# of Isolates)	%I[1]	%R[2]	95% CI[3]	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)[4]																
β-Lactam/β-Lactamase Inhibitor Combinations																					
Amoxicillin-Clavulanic Acid	Montevideo (104)	0.0	**0.0**	0.0-4.4							99.0			1.0							
	Dublin (53)	1.9	**56.6**	42.4-69.9							24.5	1.9	1.9	13.2	1.9	**7.5**	**49.1**				
	Newport (31)	6.5	**64.5**	45.4-80.2							22.6	3.2		3.2	6.5	**25.8**	**38.7**				
	Anatum (27)	0.0	**0.0**	0.0-15.5							100.0										
	Cerro (27)	0.0	**3.7**	0.2-20.9							96.3					**3.7**					
	Typhimurium (25)	8.0	**20.0**	7.6-41.3							52.0	4.0		16.0	8.0	**4.0**	**16.0**				
	Kentucky (22)	0.0	**0.0**	0.0-18.5							100.0										
	Muenster (18)	0.0	**0.0**	0.0-21.9							100.0										
	Agona (17)	0.0	**47.1**	23.9-71.5							52.9					**17.6**	**29.4**				
	Mbandaka (17)	0.0	**0.0**	0.0-22.9							100.0										
	Meleagridis (17)	0.0	**0.0**	0.0-22.9							100.0										
Cephems																					
Cefoxitin	Montevideo (104)	0.0	**0.0**	0.0-4.4							23.1	71.2	5.8								
	Dublin (53)	13.2	**47.2**	33.5-61.3							7.5	5.7	22.6	3.8	13.2	**5.7**	**41.5**				
	Newport (31)	0.0	**64.5**	45.4-80.2							6.5	22.6	6.5			**29.0**	**35.5**				
	Anatum (27)	0.0	**0.0**	0.0-15.5								3.7	92.6	3.7							
	Cerro (27)	0.0	**3.7**	0.2-20.9							14.8	66.7	14.8				**3.7**				
	Typhimurium (25)	4.0	**16.0**	5.3-36.9							8.0	60.0	12.0		4.0	**4.0**	**12.0**				
	Kentucky (22)	0.0	**0.0**	0.0-18.5								54.5	45.5								
	Muenster (18)	0.0	**0.0**	0.0-21.9								5.6	94.4								
	Agona (17)	0.0	**47.1**	23.9-71.5								5.9	47.1			**5.9**	**41.2**				
	Mbandaka (17)	0.0	**0.0**	0.0-22.9								29.4	70.6								
	Meleagridis (17)	0.0	**0.0**	0.0-22.9									94.1	5.9							
Ceftiofur	Montevideo (104)	0.0	**0.0**	0.0-4.4						63.5	35.6	1.0									
	Dublin (53)	1.9	**56.6**	42.4-69.9					7.5	17.0	11.3	5.7	1.9	**17.0**	**39.6**						
	Newport (31)	0.0	**64.5**	45.4-80.2						25.8	9.7				**64.5**						
	Anatum (27)	0.0	**0.0**	0.0-15.5						33.3	66.7										
	Cerro (27)	0.0	**3.7**	0.2-20.9						70.4	25.9				**3.7**						
	Typhimurium (25)	0.0	**20.0**	7.6-41.3						32.0	48.0				**20.0**						
	Kentucky (22)	0.0	**0.0**	0.0-18.5						36.4	63.6										
	Muenster (18)	0.0	**0.0**	0.0-21.9						16.7	83.3										
	Agona (17)	0.0	**47.1**	23.9-71.5							52.9				**47.1**						
	Mbandaka (17)	0.0	**0.0**	0.0-22.9						5.9	94.1										
	Meleagridis (17)	0.0	**0.0**	0.0-22.9							100.0										
Ceftriaxone[5]	Montevideo (104)	0.0	**0.0**	0.0-4.4					100.0												
	Dublin (53)	3.8	**54.7**	40.5-68.2					41.5			3.8	**1.9**	**9.4**	**30.2**	**11.3**	**1.9**				
	Newport (31)	0.0	**64.6**	45.4-80.2					35.5					**9.7**	**22.6**	**19.4**	**12.9**				
	Anatum (27)	0.0	**0.0**	0.0-15.5					100.0												
	Cerro (27)	0.0	**3.7**	0.2-20.9					96.3						**3.7**						
	Typhimurium (25)	0.0	**20.0**	7.6-41.3					80.0					**4.0**	**12.0**	**4.0**					
	Kentucky (22)	0.0	**0.0**	0.0-18.5					100.0												
	Muenster (18)	0.0	**0.0**	0.0-21.9					100.0												
	Agona (17)	0.0	**47.1**	23.9-71.5					52.9						**29.4**	**17.6**					
	Mbandaka (17)	0.0	**0.0**	0.0-22.9					100.0												
	Meleagridis (17)	0.0	**0.0**	0.0-22.9					100.0												

[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.

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

Table 7A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Cattle, 2008

					Distribution (%) of MICs (µg/ml)[4]																
Antimicrobial	**Serotype (# of Isolates)**	**%I[1]**	**%R[2]**	**[95% CI][3]**	**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	Montevideo (104)	N/A	**1.9**	0.3-7.4											40.4	53.8	2.9	1.0		**1.9**	
	Dublin (53)	N/A	**84.9**	71.8-92.8											15.1					**84.9**	
	Newport (31)	N/A	**74.2**	55.1-87.5												22.6	3.2			**74.2**	
	Anatum (27)	N/A	**0.0**	0.0-15.5											44.4	51.9	3.7				
	Cerro (27)	N/A	**3.7**	0.2-20.9											14.8	55.6	25.9			**3.7**	
	Typhimurium (25)	N/A	**48.0**	28.3-68.2											12.0	40.0				**48.0**	
	Kentucky (22)	N/A	**0.0**	0.0-18.5											4.5	81.8	13.6				
	Muenster (18)	N/A	**5.6**	0.3-29.4											5.6	66.7	22.2			**5.6**	
	Agona (17)	N/A	**82.4**	55.9-95.4											5.9	11.8				**82.4**	
	Mbandaka (17)	N/A	**0.0**	0.0-22.9											5.9	70.6	23.5				
	Meleagridis (17)	N/A	**0.0**	0.0-22.9											17.6	76.5	5.9				
Trimethoprim-Sulfamethoxazole	Montevideo (104)	N/A	**1.0**	0.1-6.1				89.4	9.6					**1.0**							
	Dublin (53)	N/A	**13.2**	5.9-25.9				17.0	58.5	11.3			**5.7**	**7.5**							
	Newport (31)	N/A	**12.9**	4.2-30.8				67.7	19.4					**12.9**							
	Anatum (27)	N/A	**0.0**	0.0-15.5				85.2	14.8												
	Cerro (27)	N/A	**0.0**	0.0-15.5				96.3	3.7												
	Typhimurium (25)	N/A	**0.0**	0.0-16.6				52.0	44.0	4.0											
	Kentucky (22)	N/A	**0.0**	0.0-18.5				86.4	13.6												
	Muenster (18)	N/A	**0.0**	0.0-21.9				83.3	16.7												
	Agona (17)	N/A	**29.4**	11.4-55.9				41.2	23.5	5.9				**29.4**							
	Mbandaka (17)	N/A	**0.0**	0.0-22.9				100.0													
	Meleagridis (17)	N/A	**0.0**	0.0-22.9				88.2	11.8												
Penicillins																					
Ampicillin		0.0	**1.0**	0.1-6.1							98.1	1.0					**1.0**				
	Dublin (53)	0.0	**73.6**	59.4-84.3							22.6	3.8					**73.6**				
	Newport (31)	0.0	**74.2**	55.1-87.5							25.8						**74.2**				
	Anatum (27)	0.0	**0.0**	0.0-15.5							96.3	3.7									
	Cerro (27)	0.0	**3.7**	0.2-20.9							92.6	3.7					**3.7**				
	Typhimurium (25)	0.0	**44.0**	25.0-64.7							44.0	8.0	4.0				**44.0**				
	Kentucky (22)	0.0	**0.0**	0.0-18.5							100.0										
	Muenster (18)	0.0	**0.0**	0.0-21.9							100.0										
	Agona (17)	0.0	**47.1**	23.9-71.5							52.9						**47.1**				
	Mbandaka (17)	0.0	**0.0**	0.0-22.9							94.1		5.9								
	Meleagridis (17)	0.0	**0.0**	0.0-22.9							100.0										

[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 7A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Cattle, 2008

Antimicrobial	Serotype (# 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
Phenicols																					
Chloramphenicol	Montevideo (104)	1.0	**1.0**	0.1-6.1									51.9	46.2	1.0		**1.0**				
	Dublin (53)	5.7	**75.5**	61.5-85.8								1.9	13.2	3.8	5.7		**75.5**				
	Newport (31)	0.0	**64.5**	45.4-80.2									29.0	6.5			**64.5**				
	Anatum (27)	0.0	**0.0**	0.0-15.5									40.7	59.3							
	Cerro (27)	0.0	**3.7**	0.2-20.9									88.9	7.4			**3.7**				
	Typhimurium (25)	4.0	**36.0**	18.7-57.4									24.0	36.0	4.0		**36.0**				
	Kentucky (22)	0.0	**0.0**	0.0-18.5								4.5	54.5	40.9							
	Muenster (18)	0.0	**0.0**	0.0-21.9									22.2	77.8							
	Agona (17)	0.0	**47.1**	23.9-71.5									5.9	47.1			**47.1**				
	Mbandaka (17)	0.0	**0.0**	0.0-22.9									17.6	82.4							
	Meleagridis (17)	0.0	**0.0**	0.0-22.9									64.7	35.3							
Quinolones																					
Ciprofloxacin	Montevideo (104)	0.0	**0.0**	0.0-4.4	97.1	2.9															
	Dublin (53)	0.0	**0.0**	0.0-8.4	62.3	32.1	3.8		1.9												
	Newport (31)	0.0	**0.0**	0.0-13.7	100.0																
	Anatum (27)	0.0	**0.0**	0.0-15.5	92.6	7.4															
	Cerro (27)	0.0	**0.0**	0.0-15.5	100.0																
	Typhimurium (25)	0.0	**0.0**	0.0-16.6	88.0	12.0															
	Kentucky (22)	0.0	**0.0**	0.0-18.5	100.0																
	Muenster (18)	0.0	**0.0**	0.0-21.9	100.0																
	Agona (17)	0.0	**0.0**	0.0-22.9	88.2	5.9			5.9												
	Mbandaka (17)	0.0	**0.0**	0.0-22.9	100.0																
	Meleagridis (17)	0.0	**0.0**	0.0-22.9	88.2	11.8															
Nalidixic Acid	Montevideo (104)	N/A	**0.0**	0.0-4.4								80.8	19.2								
	Dublin (53)	N/A	**1.9**	0.1-11.4								52.8	45.3				**1.9**				
	Newport (31)	N/A	**0.0**	0.0-13.7								74.2	25.8								
	Anatum (27)	N/A	**0.0**	0.0-15.5								22.2	77.8								
	Cerro (27)	N/A	**0.0**	0.0-15.5								88.9	11.1								
	Typhimurium (25)	N/A	**0.0**	0.0-16.6								44.0	56.0								
	Kentucky (22)	N/A	**0.0**	0.0-18.5								59.1	36.4	4.5							
	Muenster (18)	N/A	**0.0**	0.0-21.9								5.6	94.4								
	Agona (17)	N/A	**5.9**	0.3-30.8								58.8	35.3				**5.9**				
	Mbandaka (17)	N/A	**0.0**	0.0-22.9								76.5	23.5								
	Meleagridis (17)	N/A	**0.0**	0.0-22.9								41.2	58.8								
Tetracyclines																					
Tetracycline	Montevideo (104)	0.0	**7.7**	3.6-15.1									92.3			**1.0**	**6.7**				
	Dublin (53)	0.0	**81.1**	67.6-90.1									18.9				**81.1**				
	Newport (31)	0.0	**74.2**	55.1-87.5									25.8				**74.2**				
	Anatum (27)	0.0	**14.8**	4.8-34.6									85.2			**11.1**	**3.7**				
	Cerro (27)	0.0	**7.4**	1.3-25.7									92.6			**3.7**	**3.7**				
	Typhimurium (25)	0.0	**44.0**	25.0-64.7									56.0			**12.0**	**32.0**				
	Kentucky (22)	0.0	**13.6**	3.6-35.9									86.4				**13.6**				
	Muenster (18)	0.0	**5.6**	0.3-29.4									94.4				**5.6**				
	Agona (17)	0.0	**88.2**	62.2-97.9									11.8			**5.9**	**82.4**				
	Mbandaka (17)	0.0	**0.0**	0.0-22.9									100.0								
	Meleagridis (17)	0.0	**0.0**	0.0-22.9									100.0								

[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 8A. Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Swine, 2008

Antimicrobial	Isolate Source (# of Isolates)	%I[1]	%R[2]	95% CI[3]	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)[4]																
Aminoglycosides																					
Amikacin	Derby (25)	0.0	**0.0**	0.0-16.6							36.0	64.0									
	Infantis (15)	0.0	**0.0**	0.0-25.3						20.0	66.7	13.3									
	Agona (6)	0.0	**0.0**	0.0-48.3							83.3	16.7									
	London (6)	0.0	**0.0**	0.0-48.3							83.3	16.7									
	Saintpaul (6)	0.0	**0.0**	0.0-48.3							100.0										
	Typhimurium var. 5- (6)	0.0	**0.0**	0.0-48.3							33.3	66.7									
	Anatum (5)	0.0	**0.0**	0.0-53.7						20.0	80.0										
	Johannesburg (5)	0.0	**0.0**	0.0-53.7							20.0	80.0									
	Ohio (4)	0.0	**0.0**	0.0-60.4							100.0										
	Typhimurium (4)	0.0	**0.0**	0.0-60.4							50.0	25.0	25.0								
	Hadar (3)	0.0	**0.0**	0.0-69.0							100.0										
Gentamicin	Derby (25)	0.0	**0.0**	0.0-16.6					40.0	52.0	8.0										
	Infantis (15)	0.0	**0.0**	0.0-25.3					66.7	33.3											
	Agona (6)	0.0	**16.7**	0.9-63.5					50.0	33.3						**16.7**					
	London (6)	0.0	**0.0**	0.0-48.3					33.3	66.7											
	Saintpaul (6)	0.0	**0.0**	0.0-48.3					33.3	66.7											
	Typhimurium var. 5- (6)	0.0	**16.7**	0.9-63.5						83.3					**16.7**						
	Anatum (5)	0.0	**0.0**	0.0-53.7					60.0	40.0											
	Johannesburg (5)	0.0	**0.0**	0.0-53.7					20.0	80.0											
	Ohio (4)	0.0	**0.0**	0.0-60.4					25.0	75.0											
	Typhimurium (4)	0.0	**0.0**	0.0-60.4					25.0	75.0											
	Hadar (3)	0.0	**0.0**	0.0-69.0					66.7	33.3											
Kanamycin	Derby (25)	0.0	**4.0**	0.2-22.3										96.0				**4.0**			
	Infantis (15)	0.0	**0.0**	0.0-25.3										100.0							
	Agona (6)	0.0	**16.7**	0.9-63.5										83.3				**16.7**			
	London (6)	0.0	**0.0**	0.0-48.3										100.0							
	Saintpaul (6)	0.0	**0.0**	0.0-48.3										100.0							
	Typhimurium var. 5- (6)	0.0	**16.7**	0.9-63.5										83.3				**16.7**			
	Anatum (5)	0.0	**0.0**	0.0-53.7										100.0							
	Johannesburg (5)	0.0	**0.0**	0.0-53.7										100.0							
	Ohio (4)	0.0	**0.0**	0.0-60.4										100.0							
	Typhimurium (4)	0.0	**0.0**	0.0-60.4										100.0							
	Hadar (3)	0.0	**0.0**	0.0-69.0										100.0							
Streptomycin	Derby (25)	N/A	**72.0**	50.4-87.1												28.0		**72.0**			
	Infantis (15)	N/A	**0.0**	0.0-25.3												100.0					
	Agona (6)	N/A	**0.0**	0.0-48.3												100.0					
	London (6)	N/A	**16.7**	0.9-63.5												83.3		**16.7**			
	Saintpaul (6)	N/A	**0.0**	0.0-48.3												100.0					
	Typhimurium var. 5- (6)	N/A	**83.3**	36.5-99.1												16.7	**50.0**	**33.3**			
	Anatum (5)	N/A	**0.0**	0.0-53.7												100.0					
	Johannesburg (5)	N/A	**0.0**	0.0-53.7												100.0					
	Ohio (4)	N/A	**0.0**	0.0-60.4												100.0					
	Typhimurium (4)	N/A	**75.0**	21.9-98.7												25.0	**50.0**	**25.0**			
	Hadar (3)	N/A	**0.0**	0.0-69.0												100.0					

[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 8A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Swine, 2008

Antimicrobial	Serotype (# of Isolates)	%I[1]	%R[2]	[95% CI][3]	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)[4]																
β-Lactam/β-Lactamase Inhibitor Combinations																					
Amoxicillin-Clavulanic Acid	Derby (25)	0.0	**8.0**	1.4-27.5							92.0						**8.0**				
	Infantis (15)	0.0	**0.0**	0.0-25.3							100.0										
	Agona (6)	0.0	**16.7**	0.9-63.5							66.7		16.7				**16.7**				
	London (6)	0.0	**0.0**	0.0-48.3							100.0										
	Saintpaul (6)	0.0	**0.0**	0.0-48.3							100.0										
	Typhimurium var. 5- (6)	33.3	**0.0**	0.0-48.3							16.7			50.0	33.3						
	Anatum (5)	0.0	**20.0**	1.1-70.1							80.0						**20.0**				
	Johannesburg (5)	0.0	**0.0**	0.0-53.7							100.0										
	Ohio (4)	0.0	**0.0**	0.0-60.4							100.0										
	Typhimurium (4)	50.0	**0.0**	0.0-60.4								25.0		25.0	50.0						
	Hadar (3)	0.0	**0.0**	0.0-69.0							100.0										
Cephems																					
Cefoxitin	Derby (25)	0.0	**8.0**	1.4-27.5								32.0	60.0				**8.0**				
	Infantis (15)	0.0	**0.0**	0.0-25.3								6.7	93.3								
	Agona (6)	0.0	**16.7**	0.9-63.5								16.7	66.7				**16.7**				
	London (6)	0.0	**0.0**	0.0-48.3							16.7	83.3									
	Saintpaul (6)	0.0	**0.0**	0.0-48.3							33.3	66.7									
	Typhimurium var. 5- (6)	0.0	**0.0**	0.0-48.3								83.3	16.7								
	Anatum (5)	0.0	**20.0**	1.1-70.1								20.0	60.0				**20.0**				
	Johannesburg (5)	0.0	**0.0**	0.0-53.7								80.0	20.0								
	Ohio (4)	0.0	**0.0**	0.0-60.4								25.0	75.0								
	Typhimurium (4)	25.0	**0.0**	0.0-60.4								25.0	50.0		25.0						
	Hadar (3)	0.0	**0.0**	0.0-69.0								100.0									
Ceftiofur	Derby (25)	0.0	**8.0**	1.4-27.5						28.0	64.0				**8.0**						
	Infantis (15)	0.0	**0.0**	0.0-25.3						6.7	93.3										
	Agona (6)	16.7	**16.7**	0.9-63.5							66.7		16.7		**16.7**						
	London (6)	0.0	**0.0**	0.0-48.3						83.3	16.7										
	Saintpaul (6)	0.0	**0.0**	0.0-48.3						83.3	16.7										
	Typhimurium var. 5- (6)	0.0	**0.0**	0.0-48.3							83.3	16.7									
	Anatum (5)	0.0	**20.0**	1.1-70.1						20.0	60.0				**20.0**						
	Johannesburg (5)	0.0	**0.0**	0.0-53.7						100.0											
	Ohio (4)	0.0	**0.0**	0.0-60.4						50.0	50.0										
	Typhimurium (4)	25.0	**0.0**	0.0-60.4						25.0	25.0	25.0	25.0								
	Hadar (3)	0.0	**0.0**	0.0-69.0						33.3	66.7										
Ceftriaxone[5]	Derby (25)	0.0	**8.0**	1.4-27.5					92.0						**4.0**			**4.0**			
	Infantis (15)	0.0	**0.0**	0.0-25.3					100.0												
	Agona (6)	0.0	**16.7**	0.9-63.5					83.3							**16.7**					
	London (6)	0.0	**0.0**	0.0-48.3					100.0												
	Saintpaul (6)	0.0	**0.0**	0.0-48.3					100.0												
	Typhimurium var. 5- (6)	0.0	**0.0**	0.0-48.3					100.0												
	Anatum (5)	0.0	**20.0**	1.1-70.1					80.0						**20.0**						
	Johannesburg (5)	0.0	**0.0**	0.0-53.7					100.0												
	Ohio (4)	0.0	**0.0**	0.0-60.4					100.0												
	Typhimurium (4)	0.0	**0.0**	0.0-60.4					100.0												
	Hadar (3)	0.0	**0.0**	0.0-69.0					100.0												

[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.

[5] 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 (≥ 64µg/ml).

Table 8A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Swine, 2008

Antimicrobial	Serotype (# 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																					
Sulfonamides	Derby (25)	N/A	**72.0**	50.4-87.1											8.0	20.0				**72.0**	
	Infantis (15)	N/A	**0.0**	0.0-25.3											40.0	46.7	13.3				
	Agona (6)	N/A	**66.7**	24.1-94.0											16.7	16.7				**66.7**	
	London (6)	N/A	**0.0**	0.0-48.3											16.7	83.3					
	Saintpaul (6)	N/A	**0.0**	0.0-48.3											100.0						
	Typhimurium var. 5- (6)	N/A	**100.0**	51.7-100																**100.0**	
	Anatum (5)	N/A	**0.0**	0.0-53.7											40.0	60.0					
	Johannesburg (5)	N/A	**0.0**	0.0-53.7											60.0	40.0					
	Ohio (4)	N/A	**0.0**	0.0-60.4											50.0	50.0					
	Typhimurium (4)	N/A	**50.0**	9.2-90.8												50.0				**50.0**	
	Hadar (3)	N/A	**0.0**	0.0-69.0											100.0						
Trimethoprim-Sulfamethoxazole	Derby (25)	N/A	**4.0**	0.2-22.3				60.0	36.0					**4.0**							
	Infantis (15)	N/A	**0.0**	0.0-25.3				100.0													
	Agona (6)	N/A	**16.7**	0.9-63.5				50.0	33.3					**16.7**							
	London (6)	N/A	**0.0**	0.0-48.3				100.0													
	Saintpaul (6)	N/A	**0.0**	0.0-48.3				100.0													
	Typhimurium var. 5- (6)	N/A	**16.7**	0.9-63.5				33.3	33.3	16.7				**16.7**							
	Anatum (5)	N/A	**0.0**	0.0-53.7				80.0	20.0												
	Johannesburg (5)	N/A	**0.0**	0.0-53.7				80.0	20.0												
	Ohio (4)	N/A	**0.0**	0.0-60.4				75.0	25.0												
	Typhimurium (4)	N/A	**0.0**	0.0-60.4				75.0		25.0											
	Hadar (3)	N/A	**0.0**	0.0-69.0				100.0													
Penicillins																					
Ampicillin	Derby (25)	0.0	**8.0**	1.4-27.5							92.0						**8.0**				
	Infantis (15)	0.0	**0.0**	0.0-25.3							86.7	13.3									
	Agona (6)	0.0	**33.3**	6.0-75.9							66.7						**33.3**				
	London (6)	0.0	**0.0**	0.0-48.3							100.0										
	Saintpaul (6)	0.0	**0.0**	0.0-48.3							100.0										
	Typhimurium var. 5- (6)	0.0	**83.3**	36.5-99.1							16.7						**83.3**				
	Anatum (5)	0.0	**20.0**	1.1-70.1							80.0						**20.0**				
	Johannesburg (5)	0.0	**0.0**	0.0-53.7							100.0										
	Ohio (4)	0.0	**0.0**	0.0-60.4							100.0										
	Typhimurium (4)	0.0	**50.0**	9.2-90.8									25.0	25.0			**50.0**				
	Hadar (3)	0.0	**0.0**	0.0-69.0							100.0										

[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 8A (continued). Distribution of MICs and Occurrence of Resistance for Top Serotypes Tested from Swine, 2008

Antimicrobial	Serotype (# 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
Phenicols																					
Chloramphenicol	Derby (25)	0.0	**12.0**	3.2-32.3									16.0	72.0			**12.0**				
	Infantis (15)	0.0	**0.0**	0.0-25.3									13.3	86.7							
	Agona (6)	0.0	**0.0**	0.0-48.3									16.7	83.3							
	London (6)	0.0	**0.0**	0.0-48.3								16.7	66.7	16.7							
	Saintpaul (6)	0.0	**0.0**	0.0-48.3									83.3	16.7							
	Typhimurium var. 5- (6)	16.7	**50.0**	13.9-86.1									16.7	16.7	16.7		**50.0**				
	Anatum (5)	0.0	**0.0**	0.0-53.7								20.0	20.0	60.0							
	Johannesburg (5)	0.0	**0.0**	0.0-53.7									40.0	60.0							
	Ohio (4)	0.0	**0.0**	0.0-60.4									25.0	75.0							
	Typhimurium (4)	25.0	**50.0**	9.2-90.8										25.0	25.0	**25.0**	**25.0**				
	Hadar (3)	0.0	**0.0**	0.0-69.0									100.0								
Quinolones																					
Ciprofloxacin	Derby (25)	0.0	**0.0**	0.0-16.6	100.0																
	Infantis (15)	0.0	**0.0**	0.0-25.3	100.0																
	Agona (6)	0.0	**0.0**	0.0-48.3	100.0																
	London (6)	0.0	**0.0**	0.0-48.3	100.0																
	Saintpaul (6)	0.0	**0.0**	0.0-48.3	100.0																
	Typhimurium var. 5- (6)	0.0	**0.0**	0.0-48.3	83.3	16.7															
	Anatum (5)	0.0	**0.0**	0.0-53.7	100.0																
	Johannesburg (5)	0.0	**0.0**	0.0-53.7	80.0	20.0															
	Ohio (4)	0.0	**0.0**	0.0-60.4	100.0																
	Typhimurium (4)	0.0	**0.0**	0.0-60.4	50.0	50.0															
	Hadar (3)	0.0	**0.0**	0.0-69.0	100.0																
Nalidixic Acid	Derby (25)	N/A	**0.0**	0.0-16.6								80.0	20.0								
	Infantis (15)	N/A	**0.0**	0.0-25.3								80.0	20.0								
	Agona (6)	N/A	**0.0**	0.0-48.3								33.3	66.7								
	London (6)	N/A	**0.0**	0.0-48.3								66.7	33.3								
	Saintpaul (6)	N/A	**0.0**	0.0-48.3								66.7	33.3								
	Typhimurium var. 5- (6)	N/A	**0.0**	0.0-48.3								33.3	50.0	16.7							
	Anatum (5)	N/A	**0.0**	0.0-53.7								20.0	80.0								
	Johannesburg (5)	N/A	**0.0**	0.0-53.7									100.0								
	Ohio (4)	N/A	**0.0**	0.0-60.4								75.0	25.0								
	Typhimurium (4)	N/A	**0.0**	0.0-60.4								25.0	50.0	25.0							
	Hadar (3)	N/A	**0.0**	0.0-69.0								100.0									
Tetracyclines																					
Tetracycline	Derby (25)	0.0	**92.0**	72.5-98.6									8.0				**92.0**				
	Infantis (15)	0.0	**0.0**	0.0-25.3									100.0								
	Agona (6)	0.0	**83.3**	36.5-99.1									16.7				**83.3**				
	London (6)	0.0	**50.0**	13.9-86.1									50.0				**50.0**				
	Saintpaul (6)	0.0	**0.0**	0.0-48.3									100.0								
	Typhimurium var. 5- (6)	0.0	**100.0**	51.7-100												**66.7**	**33.3**				
	Anatum (5)	0.0	**60.0**	17.0-92.7									40.0		**20.0**	**20.0**	**20.0**				
	Johannesburg (5)	0.0	**40.0**	7.3-83.0									60.0				**40.0**				
	Ohio (4)	0.0	**0.0**	0.0-60.4									100.0								
	Typhimurium (4)	0.0	**100.0**	39.6-100												**25.0**	**75.0**				
	Hadar (3)	0.0	**100.0**	31.0-100												**33.3**	**66.7**				

[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 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 9A. *Salmonella* Typhimurium with ACSSuT and ACSuT Resistance Pattern, 2008

	Typhimurium	Percent of		Typhimurium variant 5-	Percent of		Grand Total	Percent of	
		Typhimurium n=64	Total n=1326		Typhimurium variant 5- n=50	Total n=1326		All Typhimurium n=114	Total n=1326
Resistance Pattern									
A C S Su T (penta-resistant)	11	17.2	0.8	4	8.0	0.3	15	13.2	1.1
A C Su T (quad-resistant)	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
Total	**11**	**17.2**	**0.8**	**4**	**8.0**	**0.3**	**15**	**13.2**	**1.1**

Table 10A. *Salmonella* Typhimurium that were DT104 or DT104 Complex Isolates, 2008

	Typhimurium	Percent of		Typhimurium variant 5-	Percent of		Grand Total	Percent of	
		Typhimurium n=64	Total n=1326		Typhimurium variant 5- n=50	Total n=1326		All Typhimurium n=114	Total n=1326
A C S Su T (penta-resistant)									
DT104	3	4.7	0.2	1	2.0	0.1	4	3.5	0.3
DT104A	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
DT104B	1	1.6	0.1	2	4.0	0.2	3	2.6	0.2
Total	**4**	**6.3**	**0.3**	**3**	**6.0**	**0.2**	**7**	**6.1**	**0.5**

Table 11A. Phage Types other than DT104 for *S.* Typhimurium with ACSSuT Resistance Pattern, 2008

	Typhimurium	Percent of		Typhimurium variant 5-	Percent of		Grand Total	Percent of	
		Typhimurium n=64	Total n=1326		Typhimurium variant 5- n=50	Total n=1326		All Typhimurium n=114	Total n=1326
A C S Su T (penta-resistant)									
DT12	1	1.6	0.1	0	0.0	0.0	1	0.9	0.1
DT193	4	6.3	0.3	1	2.0	0.1	5	4.4	0.4
U302	1	1.6	0.1	0	0.0	0.0	1	0.9	0.1
Untypable	1	1.6	0.1	0	0.0	0.0	1	0.9	0.1
Total	**7**	**10.9**	**0.5**	**1**	**2.0**	**0.1**	**8**	**7.0**	**0.6**

Table 12A. Confirmed *S*. Typhimurium DT104[1,2] Isolates, 1997-2008

Year	Chicken			Turkey			Cattle			Swine		
	n (DT104)	% (All *S*.Typhimurium)	% (Chicken)	n (DT104)	% (All *S*.Typhimurium)	% (Turkey)	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	15.4	0.9	3	6.8	1.4

[1] Includes isolates that are DT104 complex (A or B)
[2] Includes *S.* Typhimurium and *S*.Typhimurium variant 5-

Table 13A. MDR *Salmonella* from Chicken, 1997-2008

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of Isolates Tested	214	561	1438	1173	1307	1500	1158	1280	1989	1380	994	624
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%
(Pan-susceptible)	113	329	846	668	871	930	708	803	1217	790	536	377
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%
	101	232	592	505	436	570	454	477	772	590	458	247
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%
	60	172	459	378	330	424	315	399	622	434	300	208
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%
	21	75	177	177	133	213	156	202	301	226	177	71
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%
	7	22	71	79	47	115	79	126	174	142	122	47
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%
	3	15	43	64	41	85	57	103	117	91	74	38
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%
	3	15	24	50	32	29	17	12	31	22	15	9
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	1	2	0	1	0	0	1	2	0	0	0
At Least ACSSuTAuCf[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%
	0	3	5	32	14	13	12	5	18	15	14	7
At Least Ceftiofur and Nalidixic	0.0%	0.0%	0.1%	0.1%	0.0%	0.6%	0.1%	0.2%	0.1%	0.0%	0.0%	0.0%
Acid Resistant	0	0	1	1	0	9	1	3	1	0	0	0

Table 14A. MDR *Salmonella* from Turkey, 1997-2008

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of Isolates Tested	107	240	713	518	550	244	262	236	227	304	271	148
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%
(Pan-susceptible)	35	99	232	173	174	73	63	79	63	85	42	32
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%
	72	141	481	345	376	171	199	157	164	219	229	116
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%
	52	108	380	264	309	113	112	118	121	141	163	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%
	27	57	187	112	167	59	57	64	64	83	91	44
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%
	6	15	77	52	81	27	25	24	26	37	41	15
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%
	5	2	36	25	33	16	8	13	14	18	19	6
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%
	4	2	27	17	20	11	6	11	9	12	13	3
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	1	3	4	4	2	0	1	0	1	0	0
At Least ACSSuTAuCf[4]	3.7%	0.4%	3.4%	1.9%	2.9%	1.6%	0.8%	2.1%	1.8%	2.3%	4.1%	0.7%
	4	1	24	10	16	4	2	5	4	7	11	1
At Least Ceftiofur 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%
Acid Resistant	2	0	19	6	8	3	1	2	2	1	2	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]ACSSuTAuCf: resistance to at least ACSSuT, amoxicillin-clavulanic acid, and ceftiofur

Table 15A. MDR *Salmonella* from Cattle, 1997-2008

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of Isolates Tested	24	284	1610	1388	893	1008	670	607	329	389	439	443
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%
(Pan-susceptible)	16	208	1200	972	624	648	409	398	208	263	316	305
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%
	8	76	410	416	269	360	261	209	121	126	123	138
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%
	5	49	254	303	193	281	213	145	94	101	101	114
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%
	3	39	214	275	169	247	198	128	91	93	97	104
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%
	2	26	175	242	151	223	184	114	82	86	92	97
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%
	2	13	128	195	135	195	158	108	76	78	83	84
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%
	1	12	123	182	130	172	121	99	67	71	71	80
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%
	0	6	35	23	21	24	18	7	14	16	11	0
At Least ACSSuTAuCf[4]	0.0%	2.1%	3.7%	8.9%	11.0%	14.6%	15.1%	11.9%	17.6%	16.2%	13.7%	14.9%
	0	6	59	124	98	147	101	72	58	63	60	66
At Least Ceftiofur 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%
Acid Resistant	0	0	1	1	3	2	3	6	3	1	1	3

Table 16A. MDR *Salmonella* from Swine, 1997-2008

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of Isolates Tested	111	793	876	451	418	379	211	308	301	304	211	111
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%
(Pan-susceptible)	49	390	428	195	182	152	113	115	134	105	91	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%
	62	403	448	256	236	227	98	193	167	199	120	58
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%
	48	273	309	201	168	164	72	127	122	110	81	41
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%
	29	190	231	156	128	129	50	103	96	69	59	33
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%
	17	89	86	77	38	48	23	47	40	29	37	16
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%
	5	64	64	42	30	34	20	38	31	18	24	9
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%
	5	62	62	39	30	29	16	37	29	16	23	9
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%
	0	4	4	0	4	2	2	2	5	1	4	0
At Least ACSSuTAuCf[4]	0.0%	0.1%	0.6%	1.3%	2.2%	1.8%	1.9%	1.0%	2.7%	1.0%	0.5%	2.7%
	0	1	5	6	9	7	4	3	8	3	1	3
At Least Ceftiofur 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%
Acid Resistant	0	0	0	0	0	1	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]ACSSuTAuCf: resistance to at least ACSSuT, amoxicillin-clavulanic acid, and ceftiofur

B. *Campylobacter*

Table 1B. *Campylobacter* Species Tested from Chicken, 1998-2008[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
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
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
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

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

Figure 1B. *Campylobacter* Species Tested from Chicken, 1998-2008

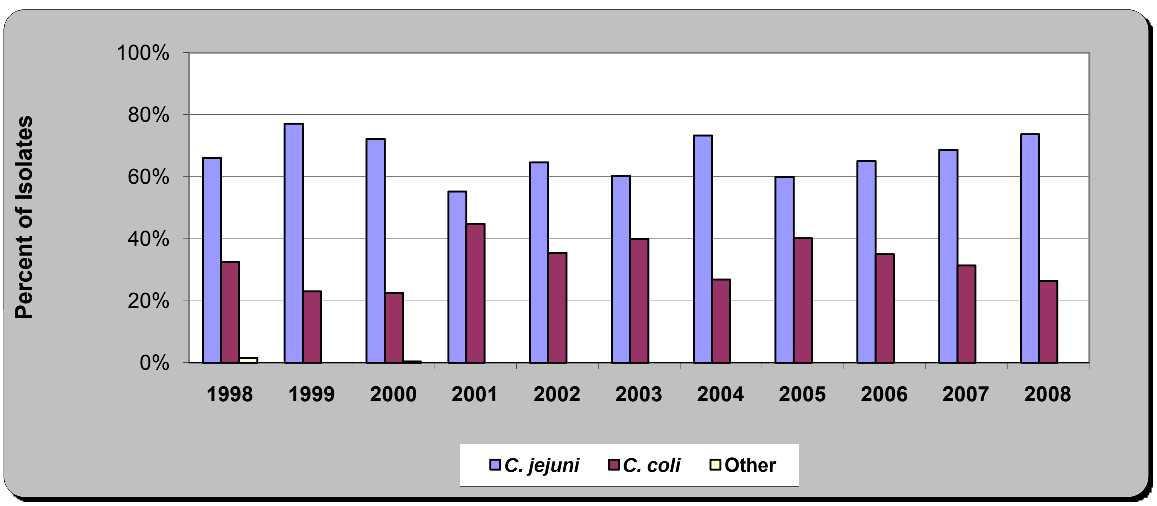

Table 2B. Distribution of MICs and Occurrence of Resistance among *Campylobacter*, 2008

Antimicrobial	Isolate Species (# of Isolates) C. coli (28) C. jejuni (78)	%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	3.6	0.2-20.3					25.0	67.9	3.6						**3.6**	
	C. jejuni	0.0	1.3	0.1-7.9				12.8	39.7	43.6	2.6						**1.3**	
Lincosamides																		
Clindamycin	*C. coli*	7.1	3.6	0.2-20.3			14.3	39.3	35.7				7.1	**3.6**				
	C. jejuni	0.0	0.0	0.0-5.8		2.6	43.6	44.9	7.7			1.3						
Macrolides/Ketolides																		
Azithromycin	*C. coli*	0.0	10.7	2.8-29.4		10.7	64.3	14.3										**10.7**
	C. jejuni	0.0	1.3	0.1-7.9	11.5	60.3	26.9											**1.3**
Erythromycin	*C. coli*	0.0	10.7	2.8-29.4					28.6	21.4	35.7	3.6				**7.1**		**3.6**
	C. jejuni	0.0	1.3	0.1-7.9				14.1	48.7	34.6	1.3						**1.3**	
Telithromycin	*C. coli*	0.0	3.6	0.2-20.3				3.6	17.9	14.3	35.7	25.0			**3.6**			
	C. jejuni	0.0	0.0	0.0-5.8					24.4	52.6	19.2	2.6	1.3					
Phenicols																		
Florfenicol	*C. coli*	0.0	0.0	0.0-15.0						21.4	78.6							
	C. jejuni	0.0	0.0	0.0-5.8						47.4	51.3	1.3						
Quinolones																		
Ciprofloxacin	*C. coli*	0.0	14.3	4.7-33.6			35.7	42.9	7.1				**3.6**	**3.6**	**7.1**			
	C. jejuni	0.0	32.1	22.2-43.8		1.3	47.4	17.9	1.3				**2.6**	**23.1**	**6.4**			
Nalidixic acid	*C. coli*	0.0	14.3	4.7-33.6									82.1	3.6			**7.1**	**7.1**
	C. jejuni	0.0	33.3	23.3-45.0									66.7				**11.5**	**21.8**
Tetracyclines																		
Tetracycline	*C. coli*	0.0	60.7	40.7-77.9				7.1	28.6	3.6					**3.6**	**3.6**	**10.7**	**42.9**
	C. jejuni	1.3	53.8	42.2-65.0				20.5	17.9	6.4				1.3	**2.6**	**10.3**	**19.2**	**21.8**

[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* , 1998-2008[1,2]

Year			1998	1999	2000	2001[3]	2002	2003	2004	2005	2006	2007	2008
Number of Isolates Tested		*C. coli*	63	168	172	52	288	247	186	380	123	76	28
		C. jejuni	128	563	590	64	526	374	508	567	228	166	78
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
		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
Lincosamides	Clindamycin	*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
		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
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
		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
	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
		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
	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
		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
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
		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
	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
		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
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
		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
	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
		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
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
		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

[1]From 1998 through 2004, the Etest method was used for susceptibility testing while in 2005 testing was conducted using broth microdilution. For breakpoints, please refer to Table 2 in the sampling and testing methods section. Etest MICs were not rounded up prior to categorization.

[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* , 1998-2008

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of Isolates Tested	63	168	172	52	288	247	186	380	123	76	28
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
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
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
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
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
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

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

Table 5B. MDR *C. jejuni* , 1998-2008

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Number of Isolates Tested	128	563	590	64	526	374	508	567	228	166	78
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
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
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
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
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
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

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

C. *Escherichia coli*

Table 1C. Number of *E. coli* Tested from Chicken, 2000-2008

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

Table 2C. Distribution of MICs and Occurrence of Resistance among *E. coli*, 2008

Antimicrobial	%I[1]	%R[2]	95% CI[3]	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)[4]																
Aminoglycosides																				
Amikacin	0.0	**0.0**	0.0-0.5						1.1	11.9	64.1	21.5	1.4							
Gentamicin	3.4	**44.5**	41.4-47.7					2.4	25.1	22.9	1.3	0.3	3.4	**9.7**	**34.8**					
Kanamycin	5.0	**10.2**	8.4-12.3										72.0	12.8	5.0	**0.7**	**9.5**			
Streptomycin	N/A	**54.6**	51.4-57.7												45.4	**17.0**	**37.5**			
β-Lactam/β-Lactamase Inhibitor Combinations																				
Amoxicillin-Clavulanic Acid	0.9	**13.7**	11.6-16.0							3.4	31.5	39.8	10.6	0.9	**12.0**	**1.7**				
Cephems																				
Cefoxitin	1.8	**13.8**	11.7-16.1						0.1	1.6	18.9	51.4	12.4	1.8	**6.8**	**7.0**				
Ceftiofur	3.1	**10.5**	11.5-15.8				3.8	44.2	35.6	2.4	0.4	3.1	**6.7**	**3.8**						
Ceftriaxone[5]	0.2	**13.5**	11.5-15.8					85.5	0.7	0.1	0.2	**2.5**	**5.2**	**4.9**	**0.9**					
Folate Pathway Inhibitors																				
Sulfonamides	N/A	**52.7**	49.5-55.9												43.2	3.5	0.4		**0.1**	**52.7**
Trimethoprim-Sulfamethoxazole	N/A	**9.1**	7.4-11.1				60.6	19.4	5.7	4.3	0.9		**9.1**							
Penicillins																				
Ampicillin	0.0	**23.5**	20.9-26.3							10.5	40.8	23.4	1.7		**0.5**	**23.0**				
Phenicols																				
Chloramphenicol	0.6	**1.0**	0.5-1.9								9.5	65.4	23.4	0.6		**1.0**				
Quinolones																				
Ciprofloxacin	0.0	**0.6**	0.2-1.4	92.9	1.1	0.2	2.3	2.8				**0.1**	**0.5**							
Nalidixic Acid	N/A	**6.0**	4.6-7.7						1.3	26.0	62.3	4.2	0.2	0.1	**0.9**	**5.1**				
Tetracyclines																				
Tetracycline	1.3	**47.4**	44.2-50.6									51.3	1.3	**3.3**	**15.1**	**28.9**				

[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.

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

Table 3C. Antimicrobial Resistance among *E. coli* , 2000-2008

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

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

Table 4C. MDR *E. coli* , 2000-2008

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

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