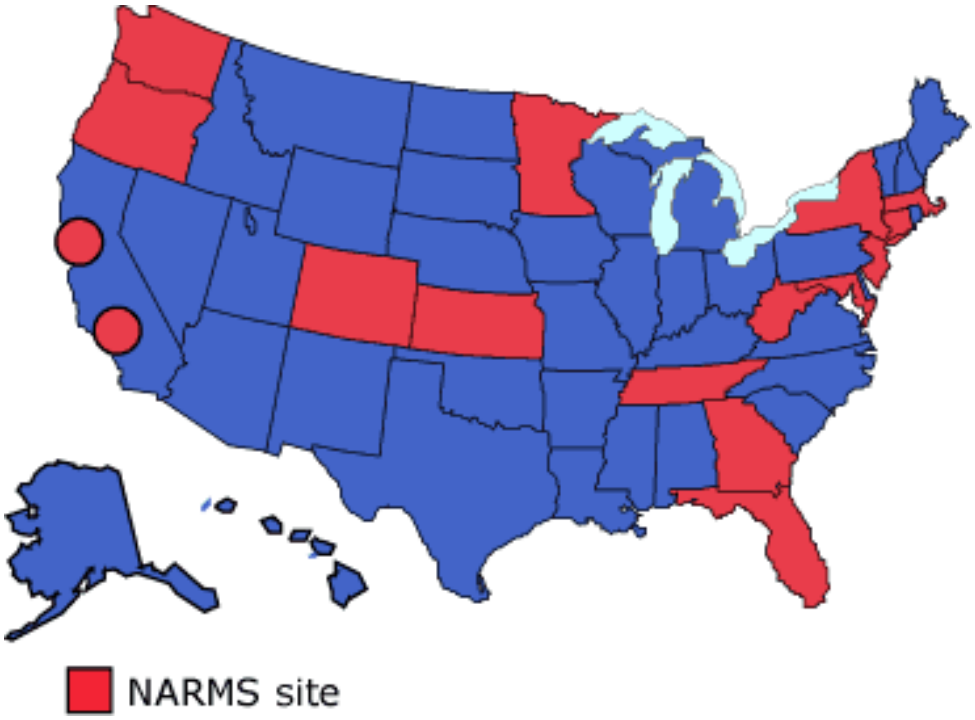
1997 Annual Report

CDC's Emerging Infections Program
National Antimicrobial Resistance Monitoring System:
Enteric Bacteria



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Division of Bacterial and Mycotic Diseases
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Summary

Summary

In 1997, there were 1314 *Salmonella* isolates**,** 171 *E. coli* O157:H7 isolates**,** and 250 *Campylobacter* isolates submitted to the National Antimicrobial Resistance Monitoring System (NARMS). Thirty-four percent of *Salmonella* isolates were resistant to one or more antimicrobial agents. Among *Salmonella* Typhimurium isolates, 62.7% were resistant to one or more antimicrobial agents. Thirty-five percent of *Salmonella* Typhimurium isolates had the multi-drug resistant pattern characteristic of DT104. No *Salmonella* isolates were resistant to ciprofloxacin; however, the percentage of *Salmonella* isolates with minimum inhibitory concentrations (MICs) ≥0.25 increased from 0.4% in l996 to 0.6% in l997. Among *E. coli* O157:H7 isolates, 12.4% were resistant to one or more antimicrobial agents. Among *Campylobacter* isolates, 85.7% were resistant to one or more antimicrobial agents; 13.4% were resistant to ciprofloxacin.

Methods

NARMS was launched in l996, within the framework of CDC's Emerging Infections Program's Epidemiology and Laboratory Capacity Program as a collaboration between CDC and 14 state and local health departments (CA, CO, CT, FL, GA, KS, Los Angeles County, MN, MA, NJ, New York City, OR, WA, and WV), to prospectively monitor the antimicrobial resistance of human non-typhoid *Salmonella* and *Escherichia coli* O157:H7 isolates. In July 1997, Maryland was added as the 15th NARMS site, bringing the population in NARMS to 83.5 million persons (32.1% of the United States population). In 1997, five states (CA, CT, GA, MN, OR) also began monitoring antimicrobial resistance among human *Campylobacter* isolates.

NARMS participating public health laboratories select every tenth *Salmonella* and every fifth *E. coli* O157:H7 isolate received at their laboratory, and forward the isolates to CDC for susceptibility testing. At CDC, a semi-automated system (Sensititre, Accumed, Westlake, OH) is used to determine the MICs for 17 antimicrobial agents: amikacin, ampicillin, amoxicillin-clavulanic acid, apramycin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole, and ticarcillin (Table 1). Public health laboratories from five states also select and forward *Campylobacter* isolates to CDC for susceptibility testing. For *Campylobacter*, the Etest system (AB BIODISK, Solna, Sweden) is used to determine the MICs for 7 antimicrobial agents: chloramphenicol, ciprofloxacin, clindamycin, erythromycin, nalidixic acid, tetracycline, and trimethoprim-sulfamethoxazole (Table 1). For all three pathogens in this report, MIC results are dichotomized, and isolates with intermediate susceptibility are

categorized as sensitive.

Results

Salmonella

A total of 1314 *Salmonella* isolates were received at CDC in 1997; 1301/1314 (99.0%) were tested for antimicrobial susceptibility (Table 2, Figure 1). Among *Salmonella* isolates, 443/1301 (34.1 %) were resistant to one or more agents, and 345/1301 (26.5%) were resistant to two or more agents. Among *Salmonella*, 328/1301 (25.2%) isolates were resistant to sulfamethoxazole, 284/1301 (21.8%) were resistant to tetracycline, 282/1301 (21.7%) were resistant to streptomycin, and 240/1301 (18.5%) were resistant to ampicillin. Correlation between ampicillin resistance and ticarcillin resistance was very high; 235/241 (97.5%) of isolates resistant to ampicillin were resistant to ticarcillin. All ticarcillin-resistant *Salmonella* isolates were also resistant to ampicillin. Ten (0.8 %) *Salmonella* isolates were resistant to nalidixic acid.

Five (0.4%) *Salmonella* isolates were resistant to ceftriaxone. No *Salmonella* isolates tested were resistant to amikacin, apramycin, or ciprofloxacin (Table 3, Figure 2). MICs of these agents for *Salmonella* are shown in Figures 3 and 6.

Of *Salmonella* isolates received which were serotyped, 301/1221 (24.7%) were serotype Enteritidis and 326/1221 (26.7%) were serotype Typhimurium (includes serotype Typhimurium var. Copenhagen) (Table 4, Figure 4). Among *S.* Enteritidis isolates, 78/301 (26.0%) were resistant to at least one or more antimicrobial agents. Among *S.* Typhimurium isolates, 202/326 (62.7%) were resistant to one more antimicrobial agents.

In recent years, a multidrug-resistant strain of *S.* Typhimurium has been identified, called *S.* Typhimurium DT104. Among 326 *S.* Typhimurium isolates tested, 115 (35.3%) were resistant to the five antimicrobial agents, ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, and tetracycline (ACSSuT), to which *S.* Typhimurium DT104 is commonly resistant (Table 5, Figure 5). Of the 115 *S.* Typhimurium isolates with the ACSSuT resistance pattern, 13 (11.3%) were also resistant to amoxicillin-clavulanic acid, 10 (8.7%) were also resistant to ceftiofur, and 9 (7.8%) were also resistant to kanamycin (Table 6). *S.* Typhimurium with the ACSSuT resistance pattern were more commonly isolated from blood (9/115 or 7.8%) than were other *S.* Typhimurium isolates (6/211 or 2.8%) and other *Salmonella* (47/975 or 4.8%) (Table 7).

The percentage of *Salmonella* isolates with ciprofloxacin MICs $\geq$0.25 increased from 0.4% (5/1326) in 1996 to 0.6% (8/1301) in 1997 (Figure 6). None had MICs $\geq$1.0. The percentage of *Salmonella* isolates resistant to nalidixic acid (MIC $\geq$32) increased from 0.4% (5/1326) in 1996 to 0.8% (11/1301) in 1997 (Figure 7).

E. coli O157:H7

A total of 171 *E. coli* O157:H7 isolates were received at CDC in 1997; 161/171 (94.2%) were tested for antimicrobial sensitivity (Table 2, Figure 1). Among *E. coli* O157:H7 isolates, 20/161 (12.4%) were resistant to one or more antimicrobial agents and 11/161 (6.8%) were resistant to two or more agents. The most common resistance among *E. coli* O157:H7 isolates was to sulfamethoxazole (18/161 or 10.6%) or cephalothin (6/161 or 3.7%). None of the *E. coli* O157:H7 isolates tested were resistant to amikacin, amoxicillin/clavulanic acid, ampicillin, apramycin, ceftiofur, ceftriaxone, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, trimethoprim-sulfamethoxazole, or ticarcillin (Table 8, Figure 8). The MICs for *E. coli* O157:H7 are shown in Figure 9.

Campylobacter

A total of 250 *Campylobacter jejuni* isolates were collected in 1997 and forwarded to CDC; 217/250 (86.8%) were tested for antimicrobial susceptibility (Table 2, Figure 1). Among *Campylobacter jejuni* isolates, 186/217 (85.7%) were resistant to one or more antimicrobial agents, and 108/217 (49.8%) were resistant to two or more agents. The most common resistance among *Campylobacter jejuni* isolates was to trimethoprim/sulfamethoxazole 149/217 (68.7%), followed by tetracycline 104/217 (47.9%), nalidixic acid 52/217 (23.9%), and ciprofloxacin 29/217 (13.4%) (Table 9, Figure 10). The MICs for *Campylobacter jejuni* are shown in Figure 11.

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Working Group

Centers for Disease Control and Prevention

Nina Marano, Karen Stamey, John Hatmaker, Tim Barrett, Joy Wells, Gerald Zirnstein, Cheryl Bopp, Paul Dabney, Fred Angulo, Foodborne and Diarrheal Diseases Branch, Division of Bacterial and Mycotic Diseases; National Center for Infectious Diseases

US Food and Drug Administration

Marissa Miller, Linda Tollefson, Office of Surveillance and Compliance, Division of Voluntary Compliance and Hearings Development, Center for Veterinary Medicine

US Dept of Agriculture

Paula Fedorka-Cray, Richard Russell Research Center, Agricultural Research Service

Participating Local and State Health Departments

California Department of Health Services
Sharon Abbott, Paul Kimsey, Sue Shallow, Duc Vugia

Colorado Department of Public Health and Environment
Mike Rau, Robert Quillan, Richard Hoffman

Connecticut Department of Public Health and Addiction Services
Bob Howard, Don Mayo, Terry Fiorentino

Florida Department of Health
Judy Taylor, Jody Baldy, Richard Hopkins

Georgia Division of Public Health
Marsha Ray, Suzanne Segler, Elizabeth Franco, Paul Blake

Kansas Department of Health and Environment
Robert Flaheart, June Sexton, Roger Carlson, Gianfranco Pezzino

Los Angeles County Department of Health Services
Liga Kilman, Debra Brown, Laurene Mascola

Massachusetts Department of Public Health
Joseph Peppie, Alfred DeMaria

Maryland Department of Health and Mental Hygiene
Melissa Kent, Peggy Pass, Glenn Morris

Minnesota Department of Health
Wanda Bayer, Fe Leano, John Besser, Craig Hedberg

New Jersey Department of Health
Keith Pilot, John Brook

New York City Department of Health
Alice Agasan, Marci Layton

Oregon Department of Human Resources
Steve Mauvais, Beletsachew Shiferaw, Paul Cieslak

Washington Public Health Laboratories
Jay Lewis, Donna Green, Jon Counts

West Virginia Department of Health and Human Resources
Doug McElfresh, Loretta Haddy

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Publications

1. Glynn MK, Bopp C, Dewitt W, Dabney P, Moktar M, Angulo F. Emergence of multidrug resistant *Salmonella Enterica* serotype Typhimurium DT104 infections in the United States. *New England Journal of Medicine* 1998; 338 (19): 1333-1338.

2. Tollefson L, Angulo FJ, Fedorka-Cray PJ. National surveillance for antibiotic resistance in zoonotic enteric pathogens. *Veterinary Clinics of North America: Food Animal Practice* 1998: 14(1):141-150.

3. Threlfall EJ, Angulo FJ, Wall PG. Ciprofloxacin-resistant *Salmonella typhimurium* DT104. *Veterinary Record* 1998;142:255-256.

Presentations

1. Marano N, Stamey K, Hatmaker J, Barrett T, Angulo FJ and the NARMS Working Group. The national antimicrobial resistance monitoring system (NARMS): trends in antimicrobial resistance. Emerging Antibiotic Resistance in Food Borne Enteric Pathogens Conference; 1998 August; Athens, Georgia.

2. Angulo FJ, Tauxe RV, Cohen ML. Public health impact of the emergence of antibiotic resistance in foodborne pathogens. Annual Meeting of the Institute of Food Technologists; 1998 June; Atlanta, Georgia.

3. Angulo FJ. Human health consequences of antimicrobial use in food animals. Annual Meeting of the American Feed Industry Association; 1998 Mar; Kansas City, Missouri.

4. Angulo FJ, Tauxe RV, Cohen ML. Significance and sources of antimicrobial-resistant *Salmonella*. The role of veterinary therapeutics in bacterial resistance development: animal and public health perspectives. American Academy of Veterinary Pharmacology and Therapeutics; 1998 Jan; College Park, Maryland.

Poster Presentations

1. Ribot EM, Angulo FJ, Barrett TJ. PCR amplification and characterization of intergron-associated

antimicrobial resistance genes from various strains of *Salmonella*. 98th General Meeting of the American Society for Microbiology; 1998 May, Atlanta, Georgia.

2. Zirnstein G, Bopp C, Dabney P, Voetsch D, Swaminathan B, Hatmaker J, Miller M, Tollefsen L, Angulo F, and the NARMS Working Group. The national antimicrobial resistance monitoring system. International Conference on Emerging Infectious Diseases, l998 March, Atlanta, Georgia.

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Table 1: Antimicrobial agents used for resistance testing for *Salmonella*, *E. coli* O157:H7, and *Campylobacter* isolates

Antimicrobial Agent	Antimicrobial Agent Concentration Ranges (ug/ml)	Breakpoints		
		(R)	(I)	(S)
Amikacin	4 - 32	≥64	32	≤16
Amoxicillin-Clav. Acid	0.5/0.25 - 32/16	≥32	16	≤8
Ampicillin	2 - 64	≥32	16	≤8
Apramycin**	2 - 16	≥32	16	≤8
Ceftiofur**	0.5 - 16	≥8	4	≤2
Ceftriaxone***	0.25 - 16	≥64	32	≤8
Cephalothin	1 - 32	≥32	16	≤8
Chloramphenicol Chloramphenicol*	4 - 32 0.125 - 256	≥32	16	≤8
Ciprofloxacin Ciprofloxacin*	0.015 - 2 0.016 - 32	≥4	2	≤1
Clindamycin*	0.032 - 256	≥4	1-2	≤0.5
Gentamicin	0.25 - 16	≥16	8	≤4
Erythromycin*	0.047 - 256	≥8	1-4	≤0.5
Kanamycin	16 - 64	≥64	32	≤16

Nalidixic Acid Nalidixic Acid*	4 - 64 0.047 - 256	≥32		≤16
Streptomycin**	32 - 256	≥64		≤32
Sulfamethoxazole	128 - 512	≥512		≤256
Tetracycline Tetracycline*	4 - 64 0.023 - 32	≥16	8	≤4
Ticarcillin	2 - 128	≥128	32	≤16
Trimeth.-Sulfa. Trimeth.-Sulfa.*	0.12/2.4 - 4/76 0.016 - 32	≥4/76		≤2/38

*** *Campylobacter* antimicrobial agents and concentration ranges used**
**** No NCCLS interpretive standards for this antimicrobial agent (veterinary use only)**

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Table 2: Population size and number isolates tested, by site

Site	Pop. Size No.	(%)	*Salmonella* No.	(%)	*E. coli* No.	(%)	*Campylobacter* No.	(%)
California (1)	2,053,882	(2.5)	62	(4.8)	2	(1.2)	42	(19.4)
Colorado	3,746,585	(4.5)	62	(4.8)	16	(9.9)		
Connecticut	3.274,662	(3.9)	65	(5.0)	8	(5.0)	49	(22.6)
Florida	14,165,570	(17.0)	68	(5.2)	4	(2.5)		
Georgia	7,200,882	(8.6)	11	(8.7)	11	(6.8)	32	(14.7)
Kansas	2.565,328	(3.1)	43	(3.3)	3	(1.9)		
Los Angeles (2)	9,138,789	(10.9)	191	(14.7)	4	(2.5)		
Massachusetts	6,073,550	(7.3)	129	(9.9)	25	(15.5)		
Maryland	5,042,438	(6.0)	29	(2.2)	1	(0.6)		
Minnesota	4,609,548	(5.5)	66	(5.1)	33	(20.5)	53	(24.4)
New Jersey	7,945,298	(9.5)	147	(11.3)	7	(4.3)		
New York City(3)	7,312,076	(8.8)	201	(15.4)	0	(0.0)		
Oregon	3,140,585	(3.8)	38	(2.9)	23	(14.3)	41	(18.9)
Washington	5,430,940	(6.5)	84	(6.5)	84	(14.9)		
West Virginia	1,828,140	(2.2)	3	(0.2)	0	(0.0)		
Totals	**83,528,273**	**(100.0)**	**1301**	**(100.0)**	**161**	**(100.0)**	**217**	**(100.0)**

(1) San Francisco and Alameda Counties
(2) Los Angeles County
(3) Five boroughs of New York City (Bronx, Brooklyn, New York, Queens, Richmond)

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Table 3: Antimicrobial Susceptibility by Pathogen

Salmonella, (N=1301)	RESULT (%)		
	SUSC	INTER	RESIST
ANTIMICROBIAL			
Amikacin	100.0	0	0
Amoxicillin / Clavulanic Acid	87.2	11.3	1.5
Ampicillin	81.5	0	18.5
Apramycin	99.5	0.5	0
Trimethoprim / Sulfamethoxazole	98.2	0	1.8
Ceftiofur	94.7	1.9	3.4
Ceftriaxone*	99.6	0.1	0.3
Cephalothin	93.9	2.8	3.3
Chloramphenicol	89.9	0.1	10.1
Ciprofloxacin	100.0	0	0
Gentamicin	96.8	0.2	2.9
Kanamycin	94.5	0.5	5.1
Nalidixic Acid	99.2	0	0.8
Streptomycin	78.3	0	21.7
Sulfamethoxazole	74.8	0	25.2
Tetracycline	77.8	0.5	21.8
Ticarcillin	81.4	0.5	18.1

*In l997,in each instance where an isolate had an MIC ≥16, the isolate was tested by broth dilution. Using broth dilution, the MIC was ≥64.

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Table 4: Frequency of *Salmonella* serotypes

Serotype	TOTAL	
	Number	Percent
TYPHIMURIUM	326	25.1
ENTERITIDIS	301	23.1
HEIDELBERG	75	5.8
NEWPORT	48	3.7
THOMPSON	32	2.5
HADAR	30	2.3
INFANTIS	29	2.2
MONTEVIDEO	27	2.1
ORANIENBURG	27	2.1
AGONA	25	1.9
JAVIANA	19	1.5
ST. PAUL	19	1.5
OTHER SEROTYPES	263	20.2
NOT SEROTYPED	80	6.1
TOTAL	1301	100.0

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Table 5: Percent *S.* Typhimurium by Site with ACSSUT Resistance Pattern

Site	Total Number of *S.* Typhimurium Cases	Total Number Resistant to ACSSUT	Percent ACSSUT of Total
CA	18	5	27.8
CO	26	10	38.5
CT	21	8	38.1
FL	2	1	50.0
GA	30	11	36.7
KS	10	2	20.0
LX	37	12	32.4
MA	40	14	35.0
MD	11	4	36.4
MN	24	1	4.2
NJ	39	15	38.5
NY	24	14	58.3
OR	13	3	23.1
WA	30	15	50.0
WV	1	0	0.0
TOTAL	**326**	**115**	**35.3**

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Table 6: Additional antimicrobial resistance for *S.* Typhimurium isolates with ACSSuT pattern

ACSSuT (N=115)	**Susc.** (%)	**Inter.** (%)	**Resis.** (%)
Amikacin	100.0	0	0
Amoxicillin-Clav.	7.0	81.7	11.3
Apramycin	100.0	0	0
Bactrim	99.1	0	0.9
Ceftiofur	87.8	3.5	8.7
Ceftriaxone*	97.4	0	2.6
Cephalothin	89.6	6.1	4.3
Ciprofloxacin	100.0	0	0
Gentamicin	98.3	0	1.7
Kanamycin	92.2	0	7.8
Nalidixic Acid	98.3	0	1.7
Ticarcillin	0	0	100.0

* Ceftriaxone - In l997, in each instance where an isolate had an MIC $\geq$ 16, isolates were tested by broth dilution for full range MICs. Using broth dilution, all MICs were $\geq$ 64.

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Table 7: Source of *Salmonella* Isolates

Isolate	BLOOD		STOOL		OTHER		Total	
	N	%	N	%	N	%	N	%
***S.* Typhimurium w/ ACSSUT**	9	7.8	98	85.2	8	7.0	115	100
Other Typhimurium	6	2.8	196	92.9	9	4.3	211	100
Other *Salmonella*	47	4.8	852	87.4	76	7.8	975	100
TOTAL	**62**	**4.8**	**1146**	**88.1**	**93**	**7.1**	**1307**	**100**

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Table 8: Antimicrobial Susceptibility by Pathogen

E. coli (N=161)	RESULT (%)		
	SUSC	INTER	RESIST
ANTIMICROBIAL			
Amikacin	100.0	0	0
Amoxicillin / Clavulanic Acid	100.0	0	0
Ampicillin	100.0	0	0
Apramycin	98.8	1.2	0
Trimethoprim / Sulfamethoxazole	100.0	0	0
Ceftiofur	98.8	1.2	0
Ceftriaxone	100.0	0	0
Cephalothin	90.1	6.2	3.7
Chloramphenicol	100.0	0	0
Ciprofloxacin	100.0	0	0
Gentamicin	100.0	0	0
Kanamycin	100.0	0	0
Nalidixic Acid	100.0	0	0
Streptomycin	97.5	0	2.5
Sulfamethoxazole	89.4	0	10.6
Tetracycline	96.9	0	3.1
Ticarcillin	100.0	0	0

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Table 9: Antimicrobial susceptibility of *Campylobacter*

Antimicrobial Agent	Susc. (%)	Inter. (%)	Resist. (%)
Chloramphenicol	91.5	2.5	6.0
Ciprofloxacin	85.7	0.9	13.4
Clindamycin	81.3	12.2	6.5
Erythromycin	30.4	61.8	7.8
Nalidixic Acid	76.1	0	23.9
Tetracycline	51.6	0.5	47.9
Trimethoprim-Sulfa	31.3	0	68.7

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Table 10: Number (%) of isolates resistant to specific number of antimicrobial agents, by pathogen

Number of antimicrobial agents resistant to	(N=1301) *Salmonella* N (%)	(N=161) *E. coli* N (%)	(N=217) *Campylobacter* N (%)
0	858 (65.9)	141 (87.6)	31 (14.3)
1	98 (7.5)	9 (5.6)	78 (35.8)
2	66 (5.1)	10 (6.2)	54 (24.8)
3	61 (4.7)	1 (0.6)	34 (15.6)
4	21 (1.6)	0 (0)	16 (7.3)
5	20 (1.5)	0 (0)	4 (1.8)
6	130 (10.0)	0 (0)	0 (0)
7	27 (2.1)	0 (0)	0 (0)
8	10 (0.8)	0 (0)	----------
9	4 (0.3)	0 (0)	----------
10	2 (0.2)	0 (0)	----------

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Figure 1: Number of isolates submitted, by site

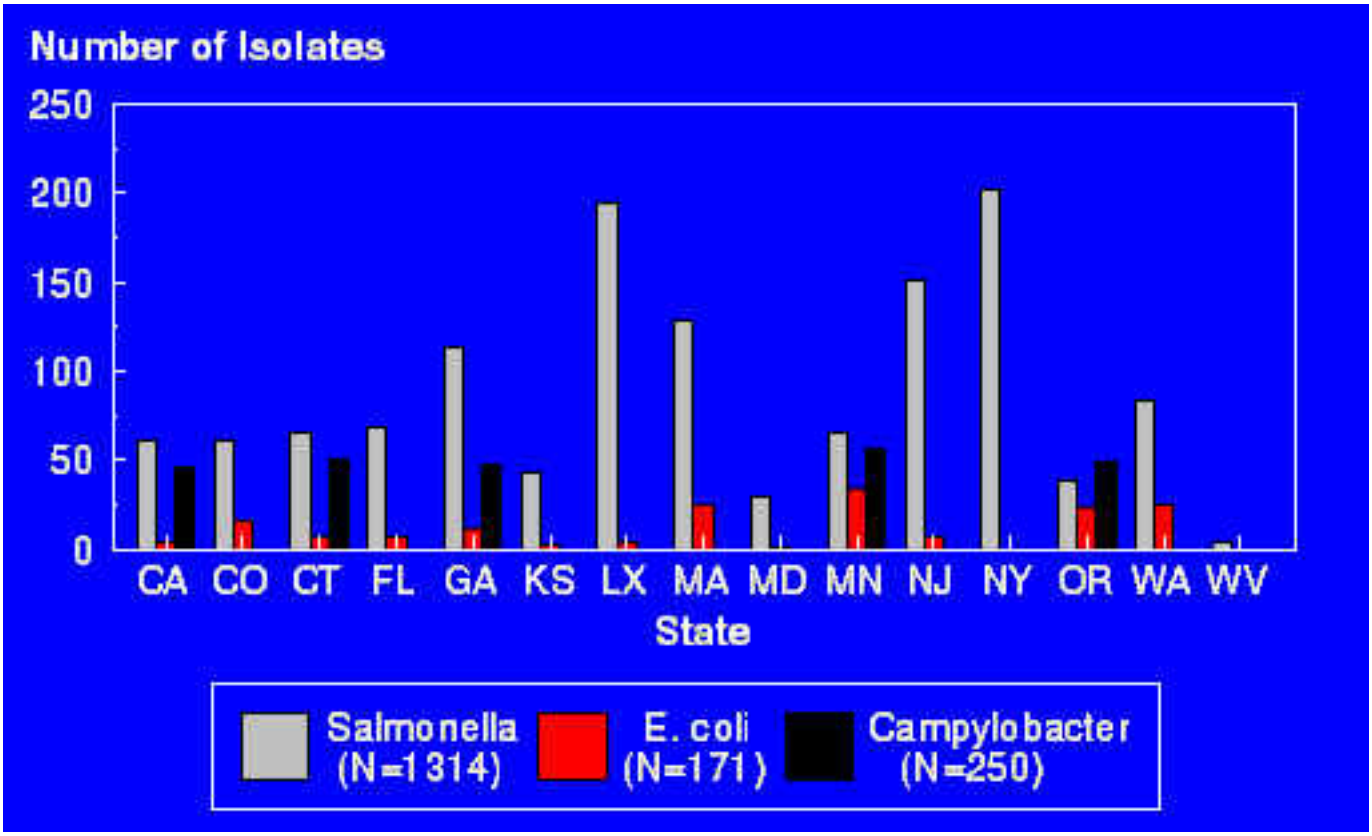

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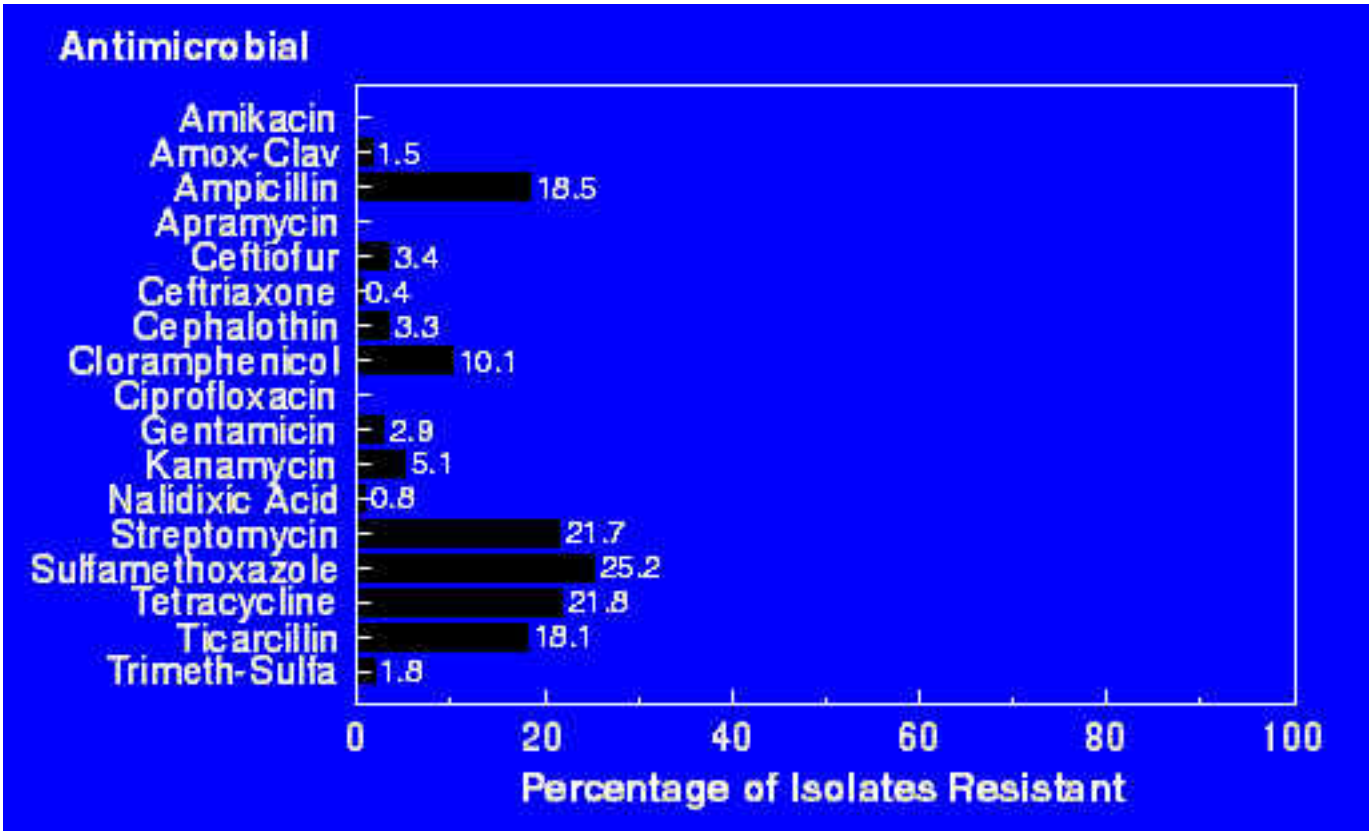
Figure 2: Resistance among *Salmonella* isolates for all sites



(N=1301)

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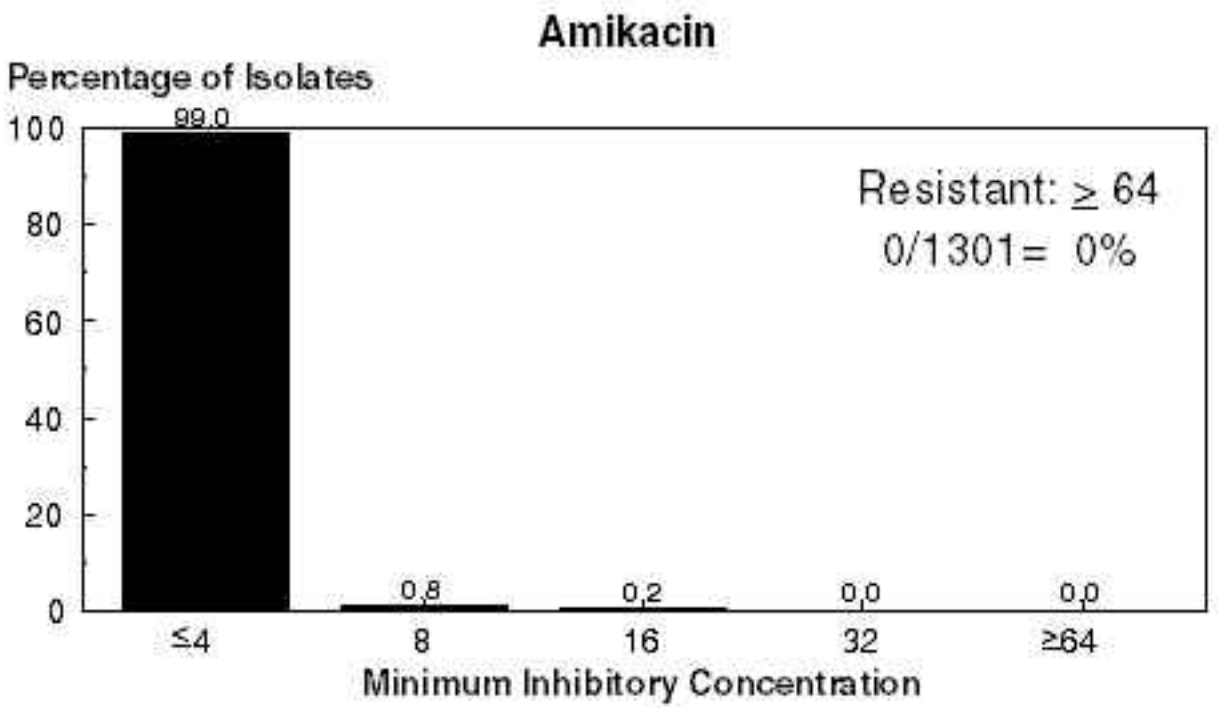
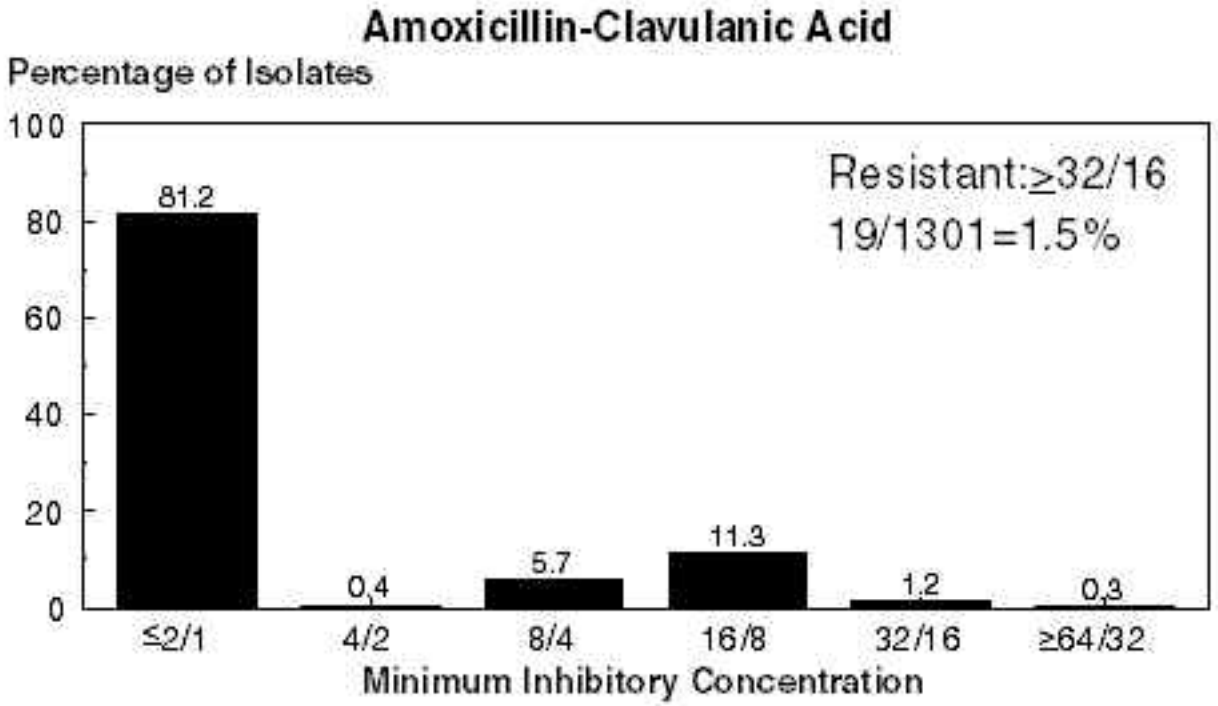
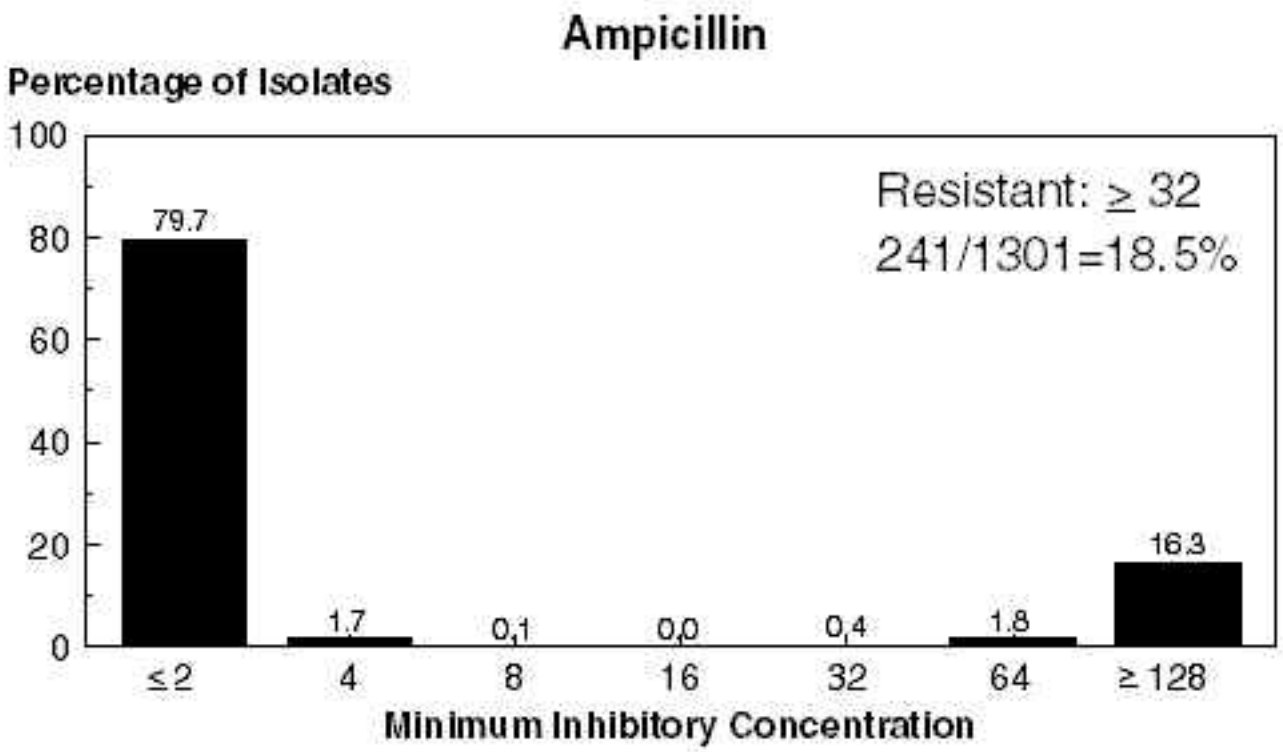
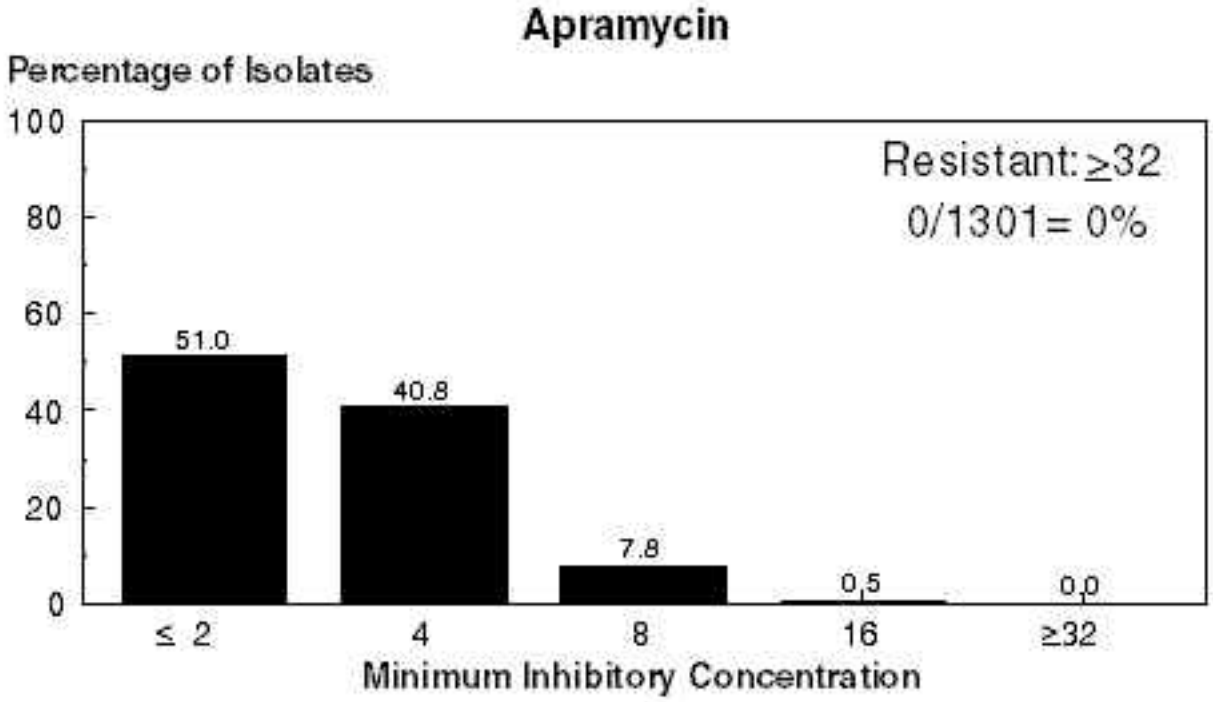
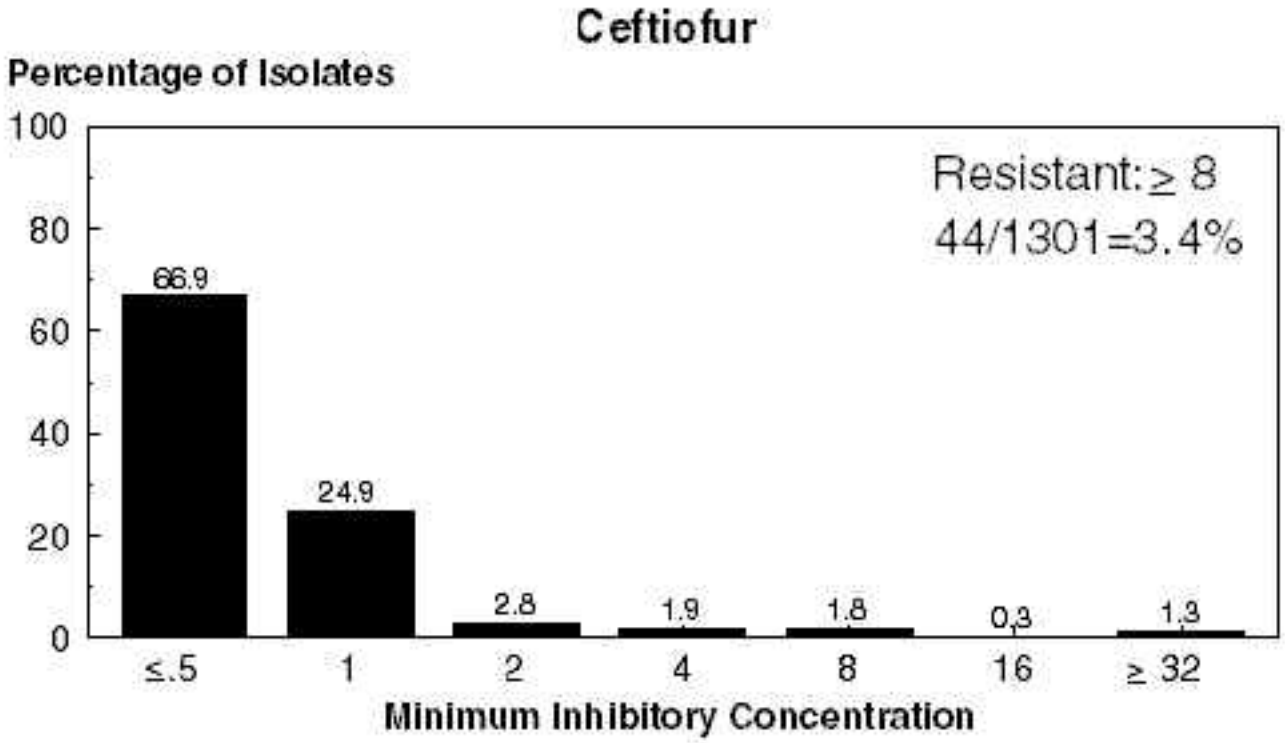
Figure 3: *Salmonella* MICs, by antimicrobial agent

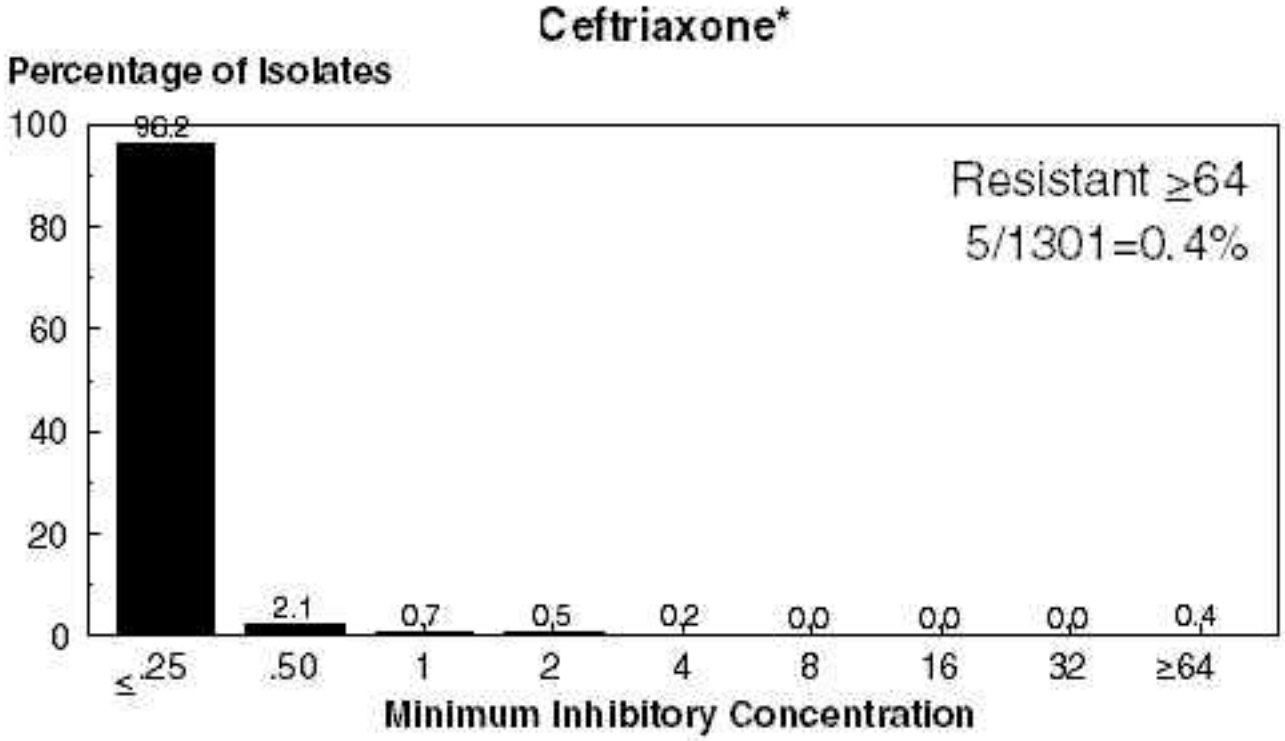




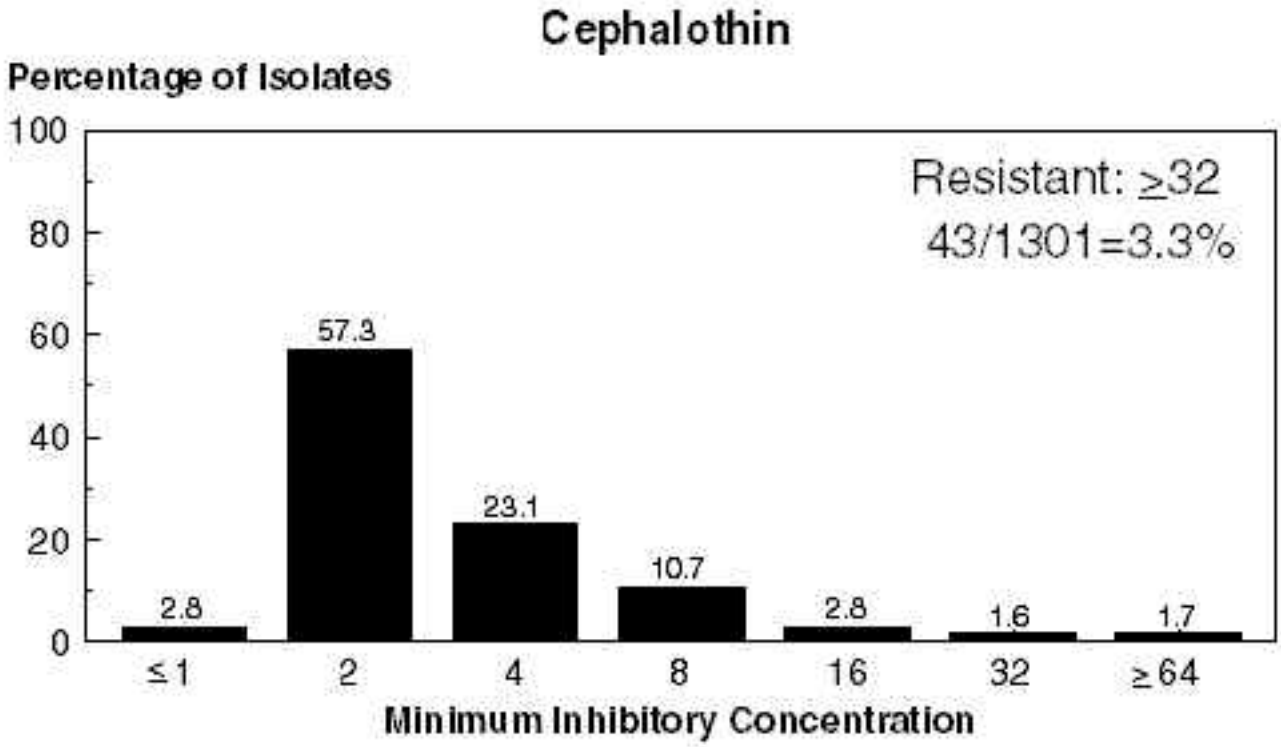

Ampicillin
Percentage of Isolates
100
80
60
40
20
0
Resistant: ≥ 32
241/1301=18.5%
79.7
1.7
0.1
0.0
0.4
1.8
16.3
≤2
4
8
16
32
64
≥128
Minimum Inhibitory Concentration

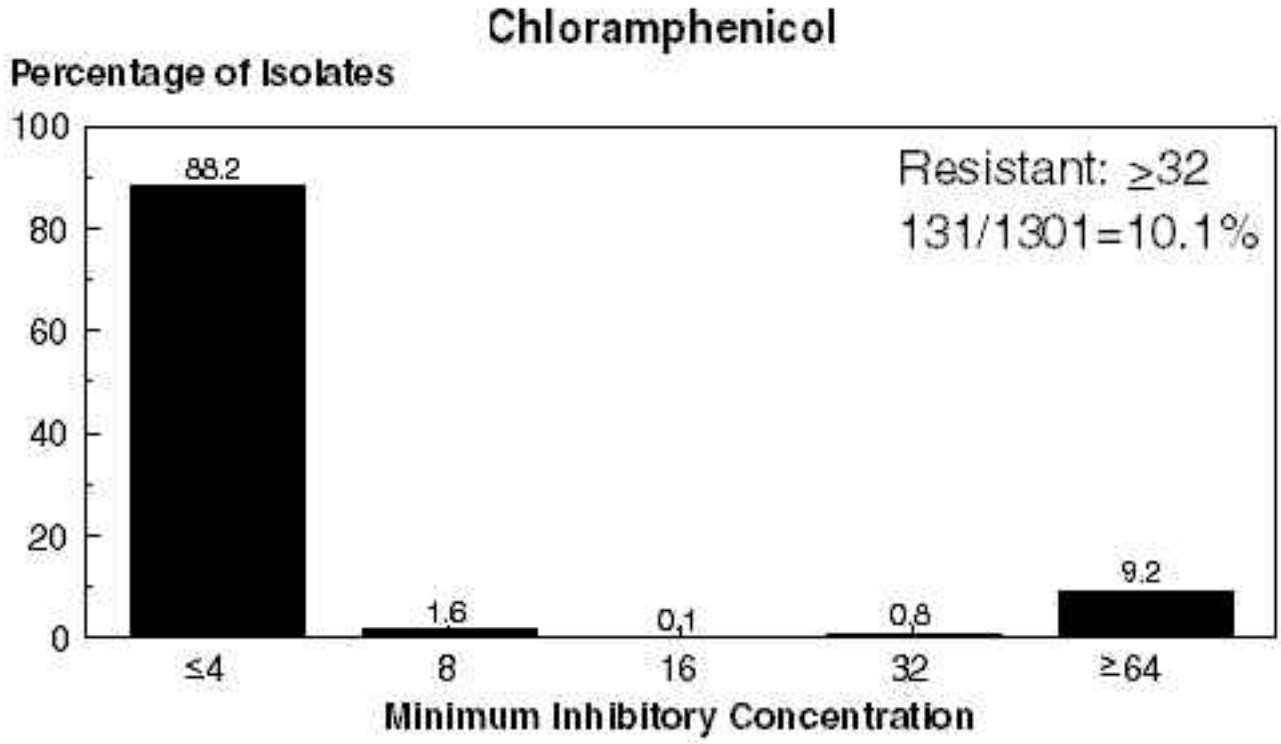

Apramycin
Percentage of Isolates
100
80
60
40
20
0
Resistant: ≥32
0/1301= 0%
51.0
40.8
7.8
0.5
0.0
≤ 2
4
8
16
≥32
Minimum Inhibitory Concentration

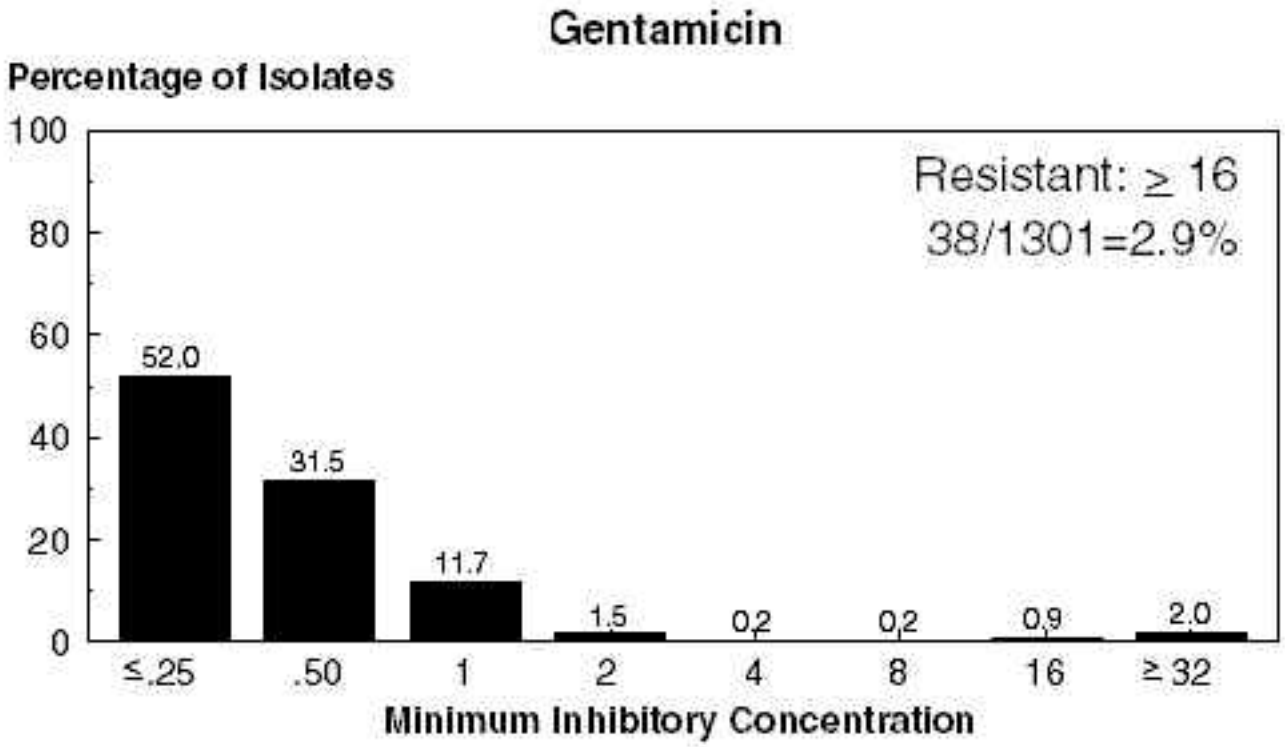


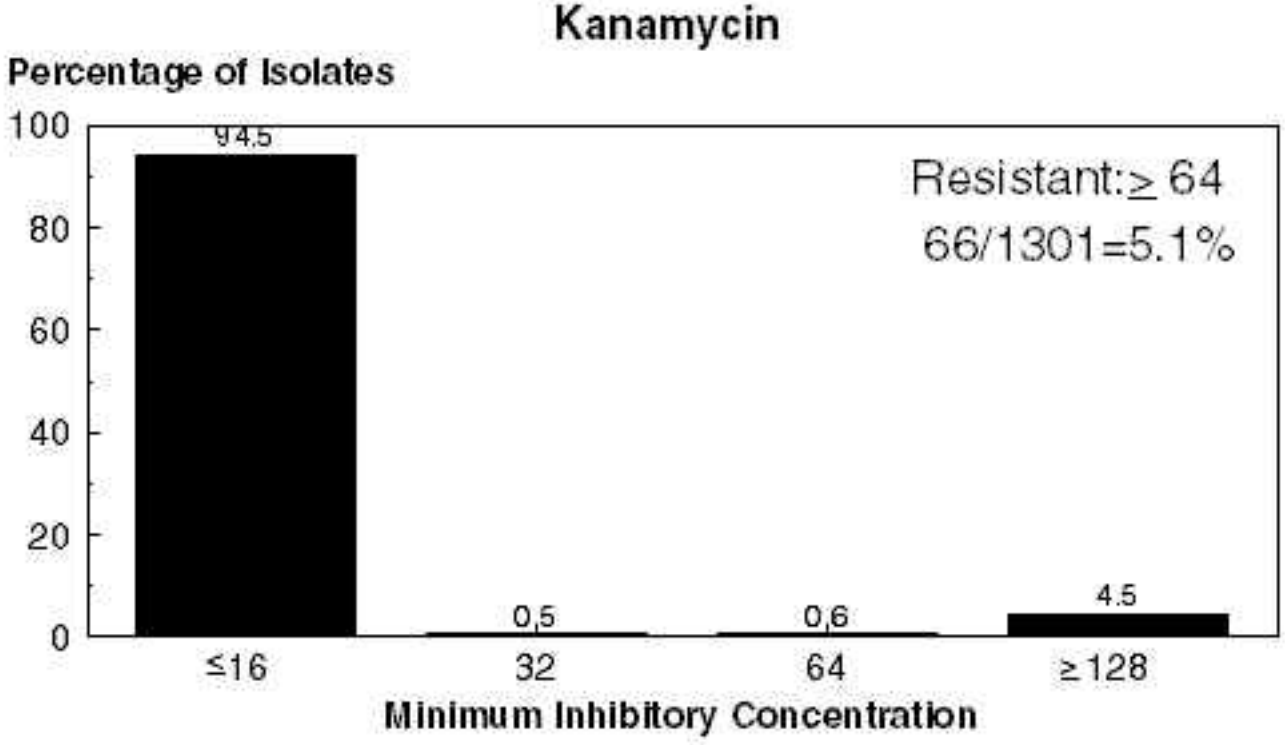


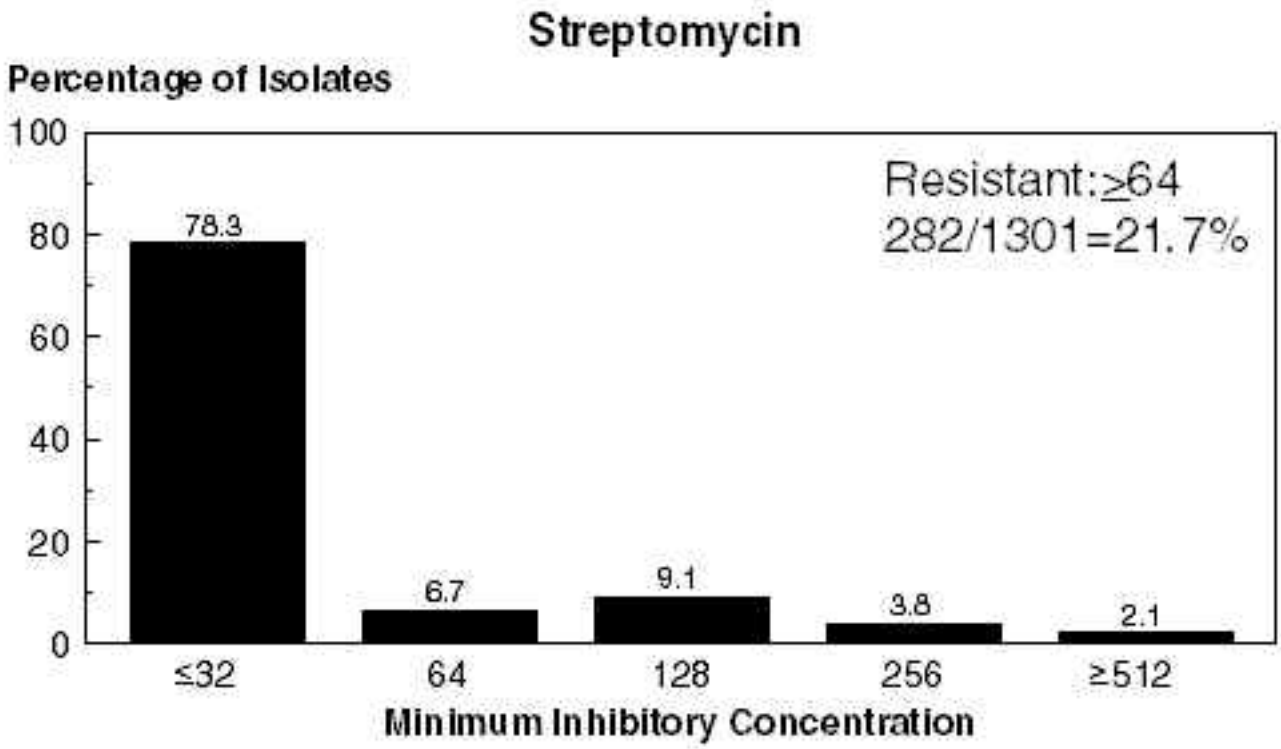
* In each instance where an isolate had an MIC ≥16, the isolate was tested by broth dilution and the MIC was ≥64

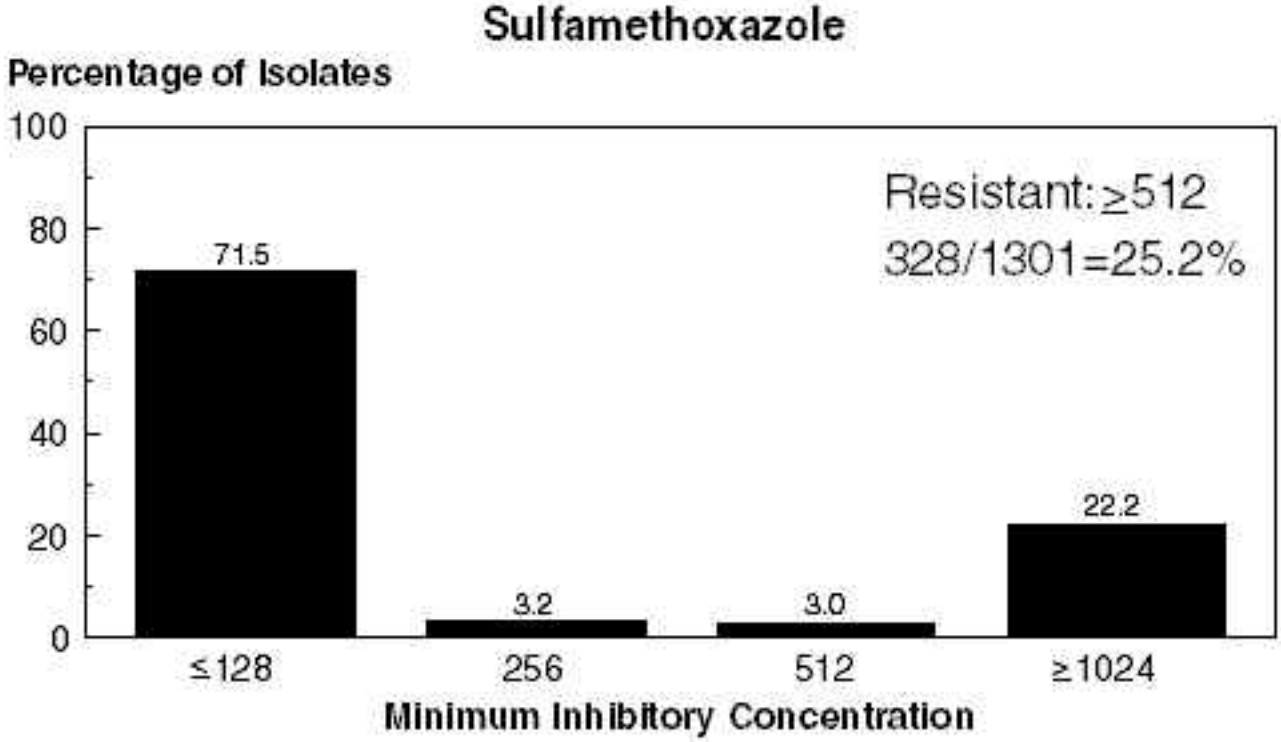

Cephalothin
Percentage of Isolates
100
80
60
40
20
0
Resistant: ≥32
43/1301=3.3%
57.3
23.1
10.7
2.8
2.8
1.6
1.7
≤1
2
4
8
16
32
≥64
Minimum Inhibitory Concentration

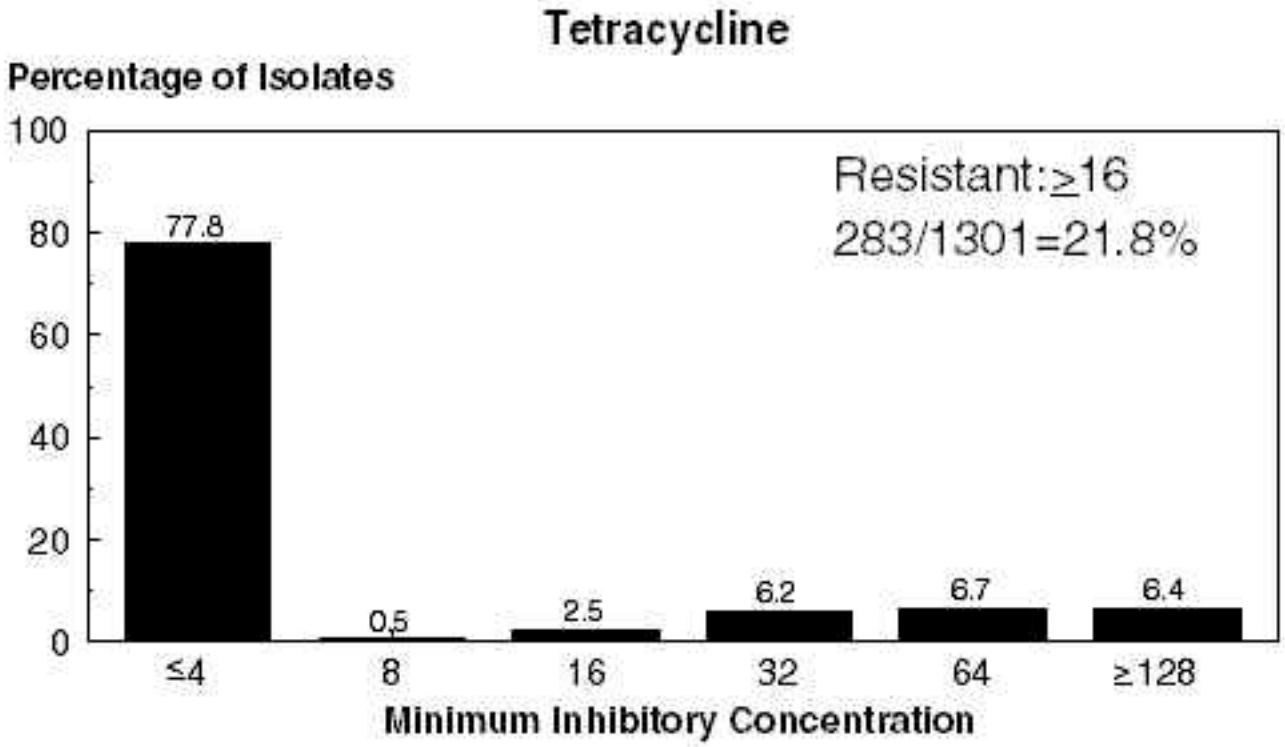

Chloramphenicol
Percentage of Isolates
100
80
60
40
20
0
Resistant: ≥32
131/1301=10.1%
88.2
1.6
0.1
0.8
9.2
≤4
8
16
32
≥64
Minimum Inhibitory Concentration

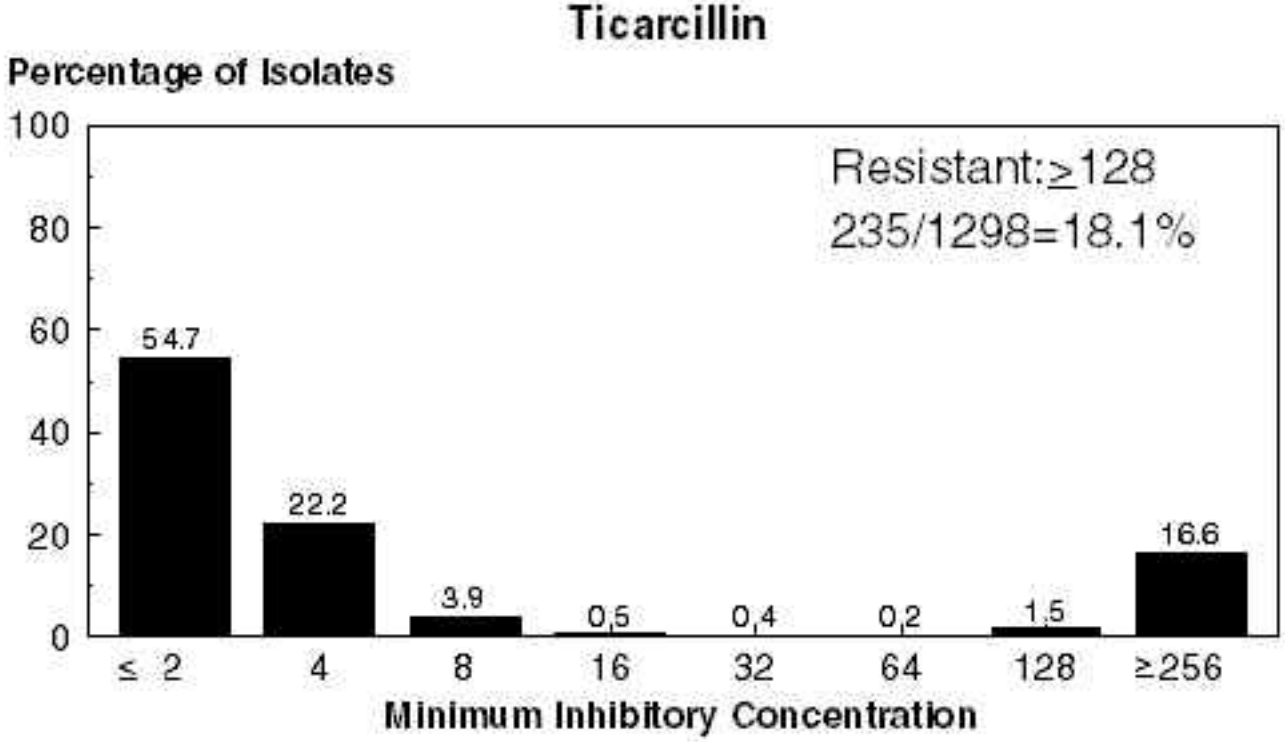

Gentamicin
Percentage of Isolates
100
80
60
40
20
0
Resistant: ≥ 16
38/1301=2.9%
52.0
31.5
11.7
1.5
0.2
0.2
0.9
2.0
≤.25
.50
1
2
4
8
16
≥ 32
Minimum Inhibitory Concentration

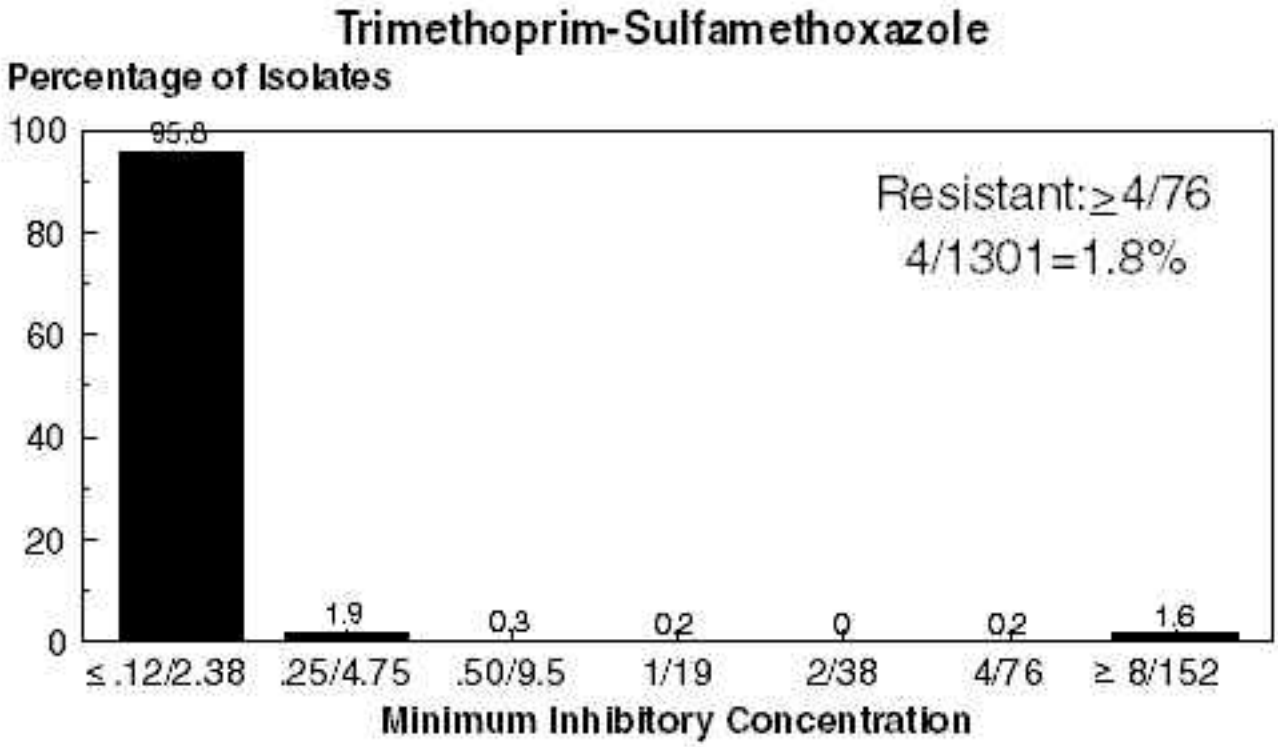

Kanamycin
Percentage of Isolates
100
80
60
40
20
0
Resistant:≥ 64
66/1301=5.1%
94.5
0.5
0.6
4.5
≤16
32
64
≥128
Minimum Inhibitory Concentration


Streptomycin
Percentage of Isolates
100
80
60
40
20
0
Resistant:≥64
282/1301=21.7%
78.3
6.7
9.1
3.8
2.1
≤32
64
128
256
≥512
Minimum Inhibitory Concentration


Sulfamethoxazole
Percentage of Isolates
100
80
60
40
20
0
Resistant:≥512
328/1301=25.2%
71.5
3.2
3.0
22.2
≤128
256
512
≥1024
Minimum Inhibitory Concentration


Tetracycline
Percentage of Isolates
100
80
60
40
20
0
Resistant:≥16
283/1301=21.8%
77.8
0.5
2.5
6.2
6.7
6.4
≤4
8
16
32
64
≥128
Minimum Inhibitory Concentration


Ticarcillin
Percentage of Isolates
100
80
60
40
20
0
Resistant:≥128
235/1298=18.1%
54.7
22.2
3.9
0.5
0.4
0.2
1.5
16.6
≤ 2
4
8
16
32
64
128
≥256
Minimum Inhibitory Concentration



Note: Ciprofloxacin and nalidixic acid
are presented in Figure 6.

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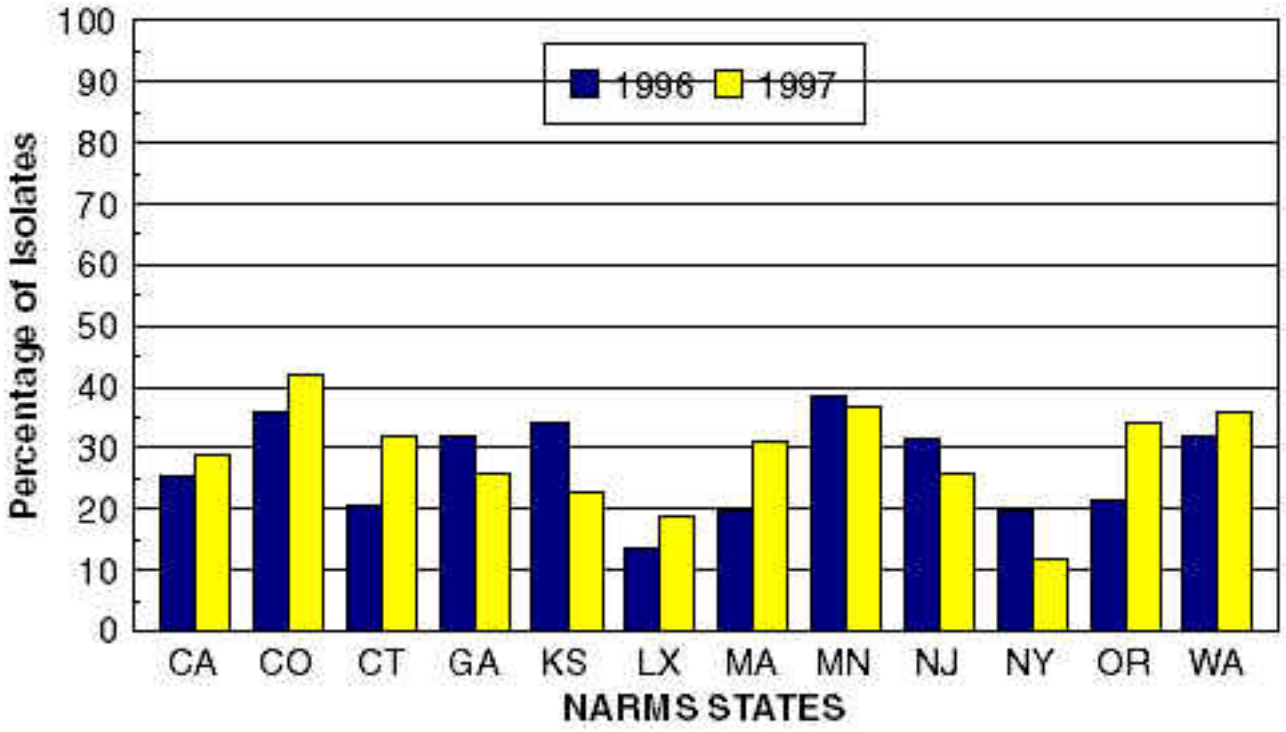
Figure 4: Percentage of *Salmonella* isolates submitted, identified as Typhimurium by site, 1996-1997



Total serotyped at state 1996=1239 Total Typhimurium received=306/1239=24.7%
Total serotyped at state 1997=1221 Total Typhimurium received=326/1221=26.7%

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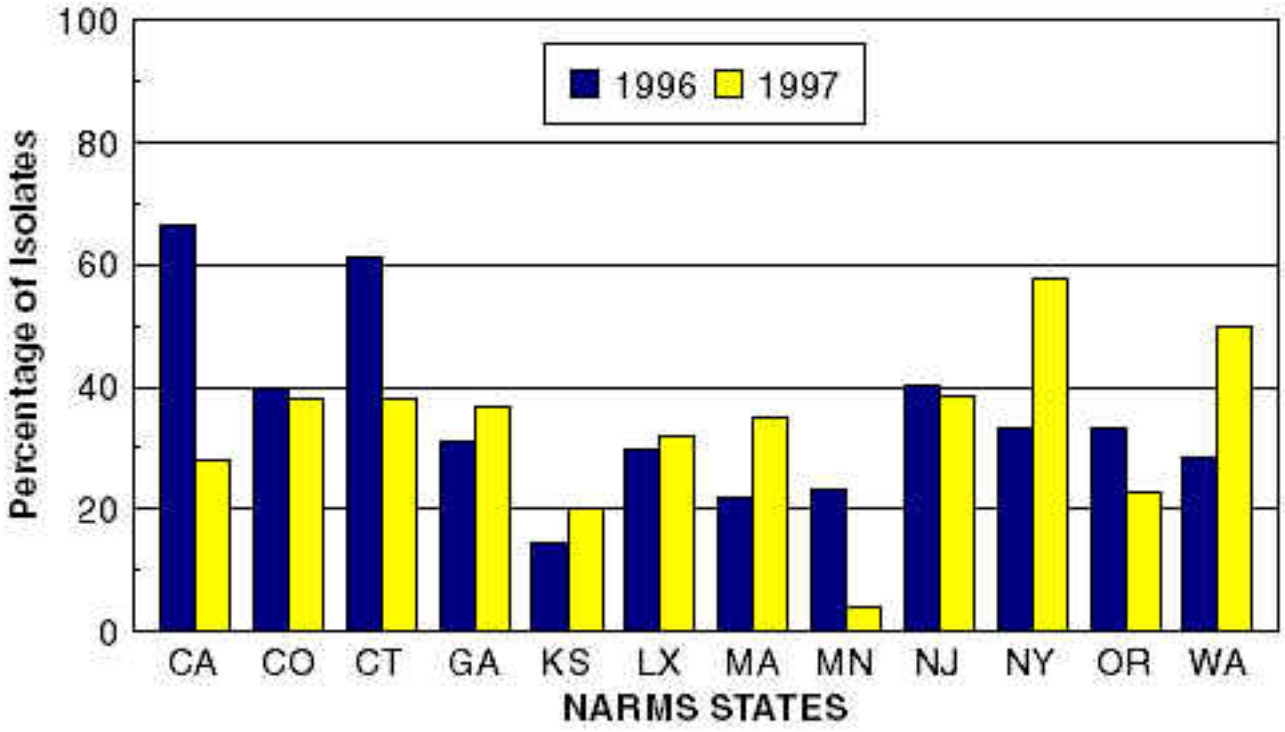
Figure 5: Percentage of *Salmonella* Typhimurium isolates submitted with ACSSuT pattern by state, 1996-1997



Percent of all 1996 Typhimurium with ACSSuT pattern: 103/306 =33.6%
Percent of all 1997 Typhimurium with ACSSuT pattern: 115/326 =35.3%

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Figure 6: Comparison of *Salmonella* Ciprofloxacin MICs, 1996 to 1997

1996 (N=1326)
% >0.25: 5/1326=0.4%

1997 (N=1301)
% >0.25: 8/1301=0.6%

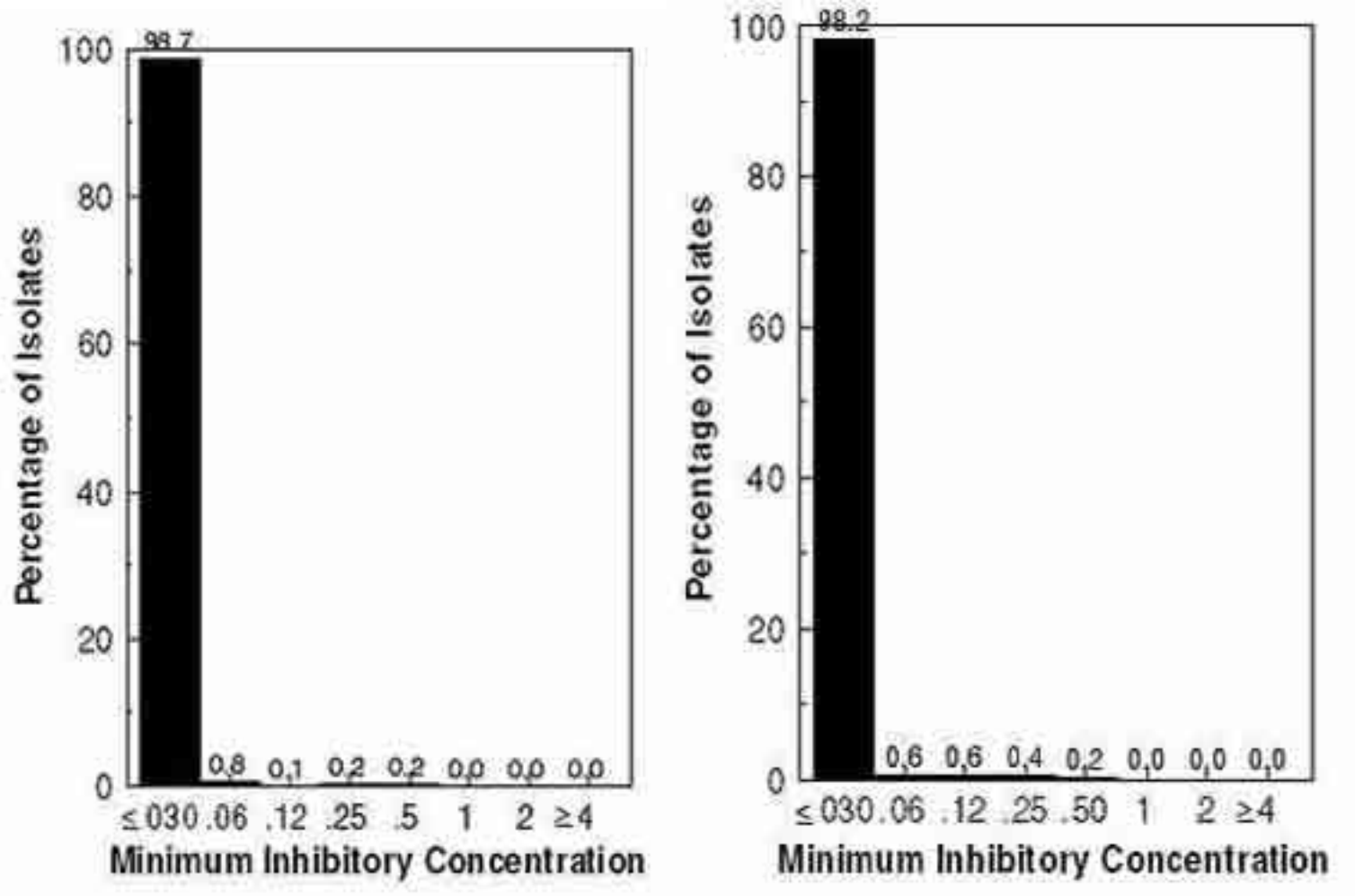

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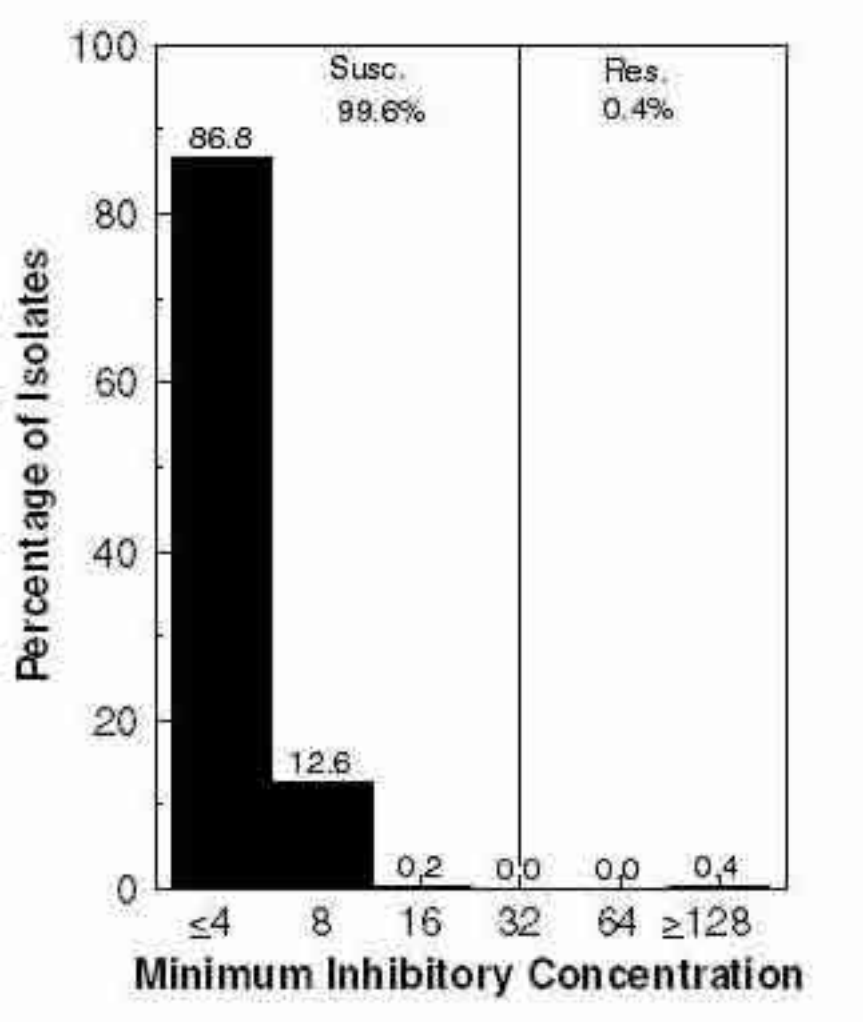
Figure 7: Comparison of *Salmonella* Nalidixic Acid MICs, 1996 to 1997

1996 (N=1326) 1997 (N=1301)



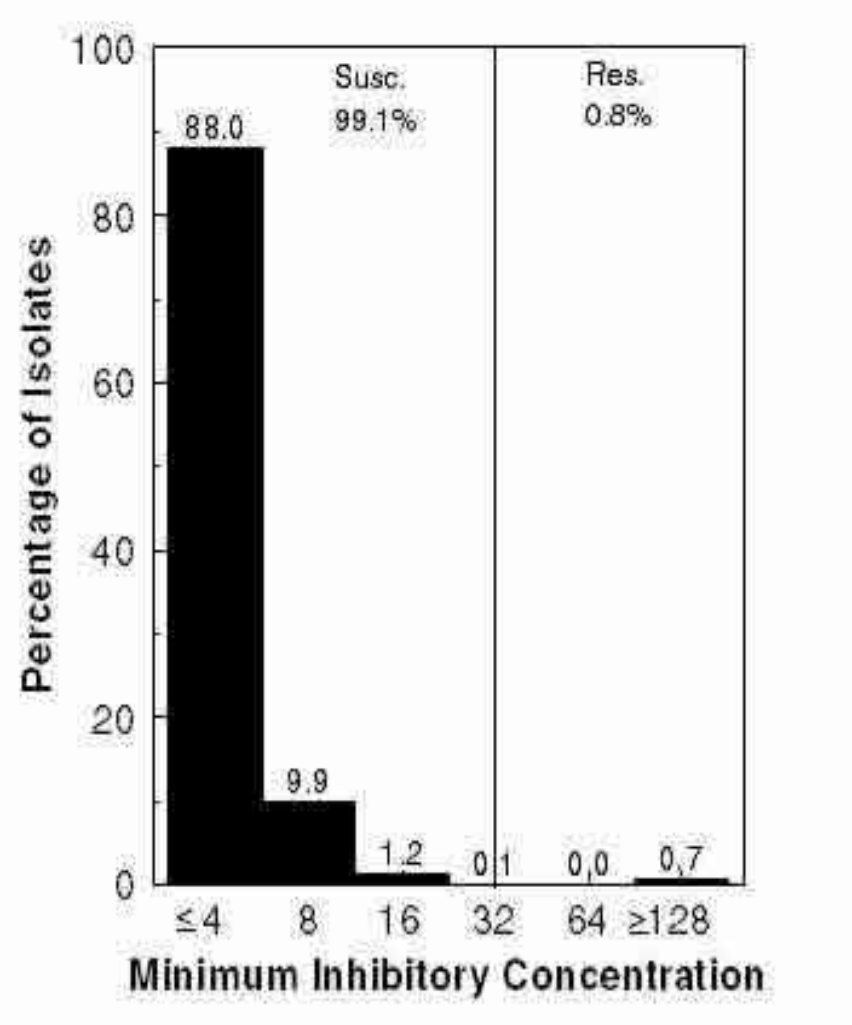


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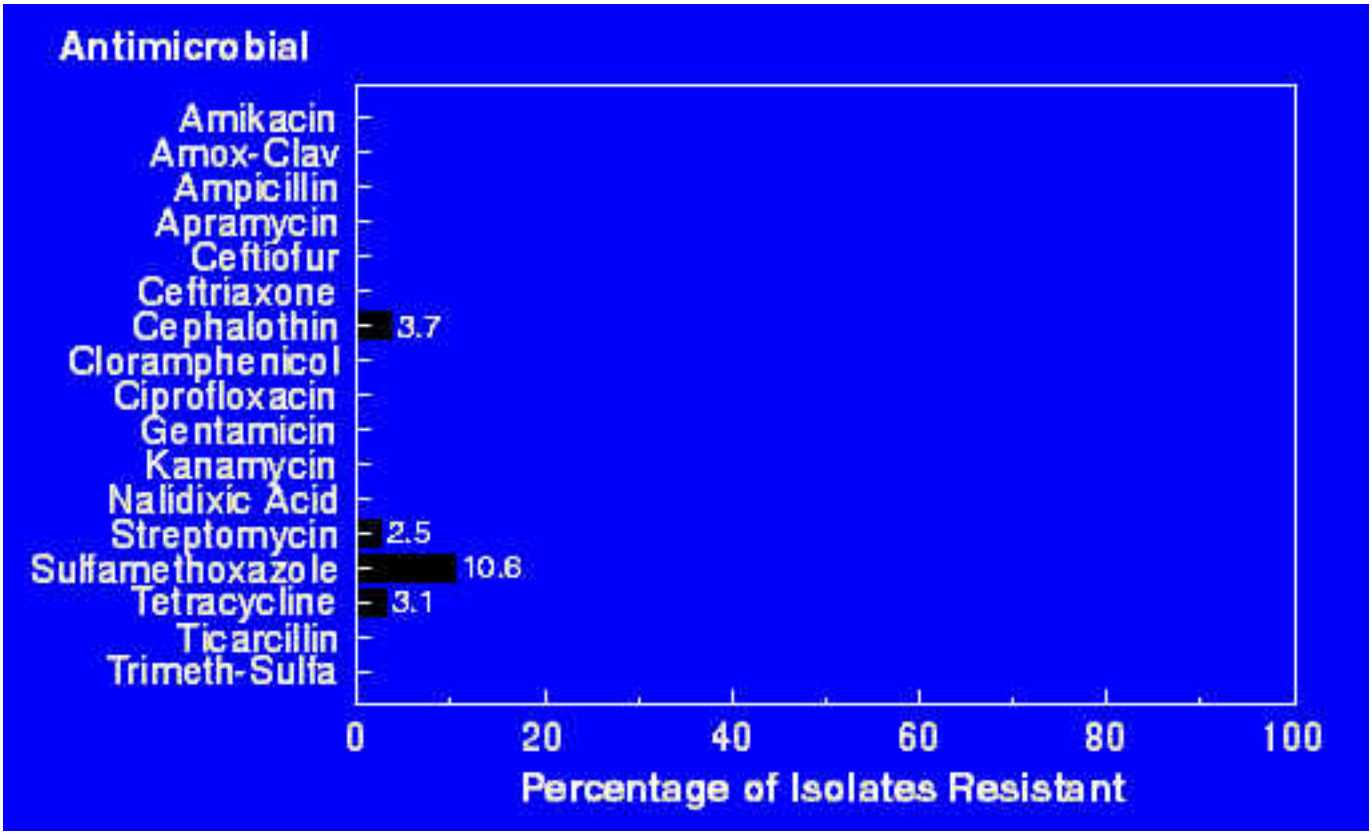
Figure 8: Resistance among *E. coli* O157:H7 isolates for all sites



N=161

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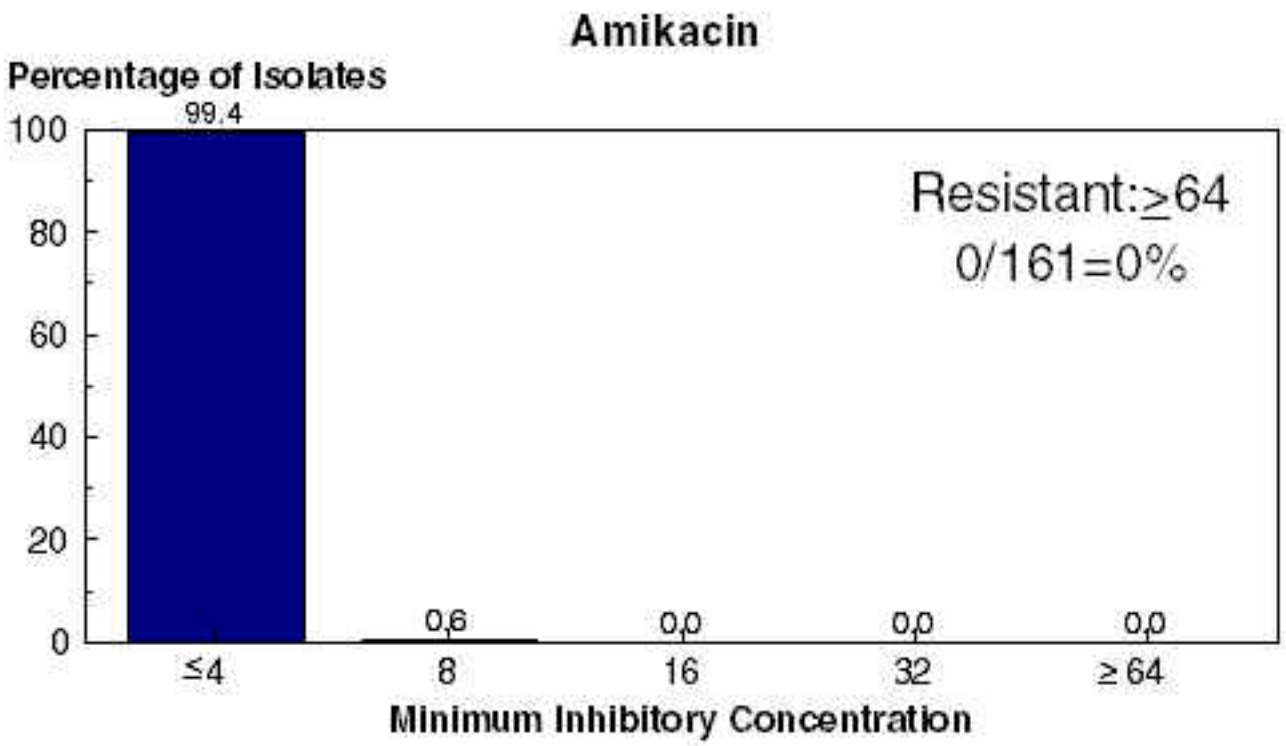
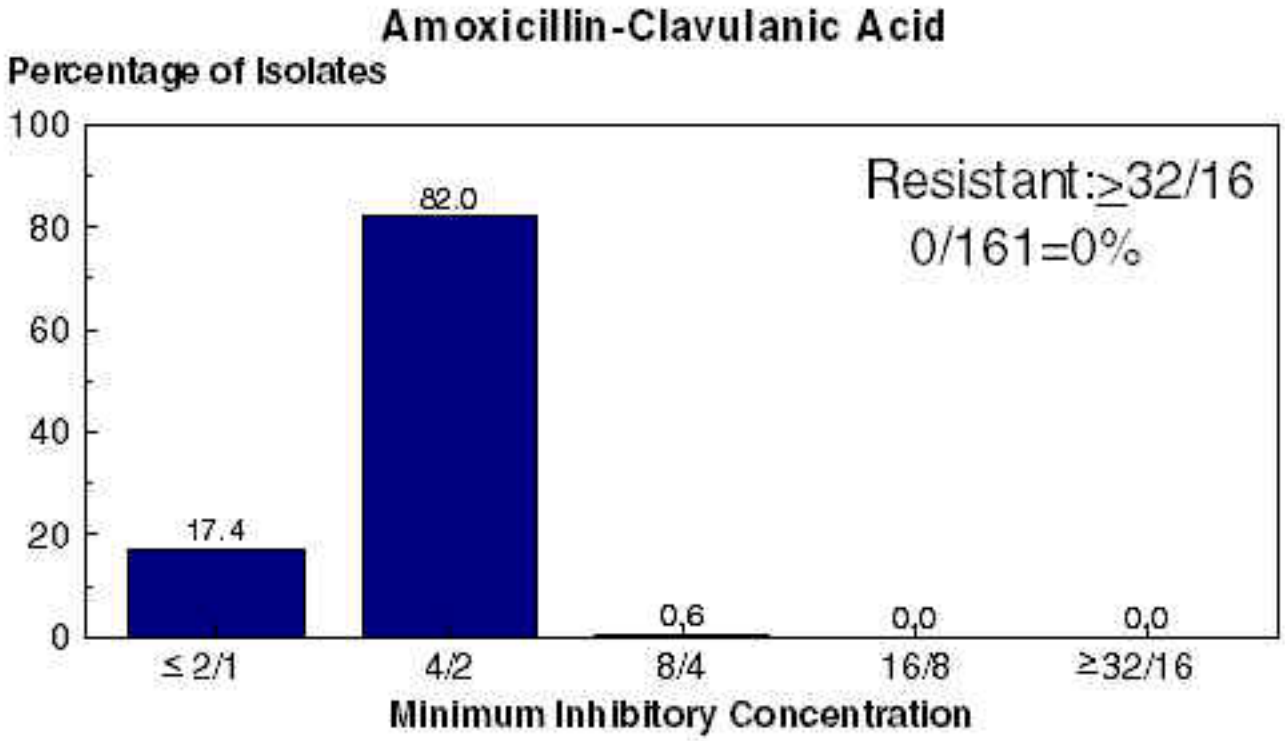
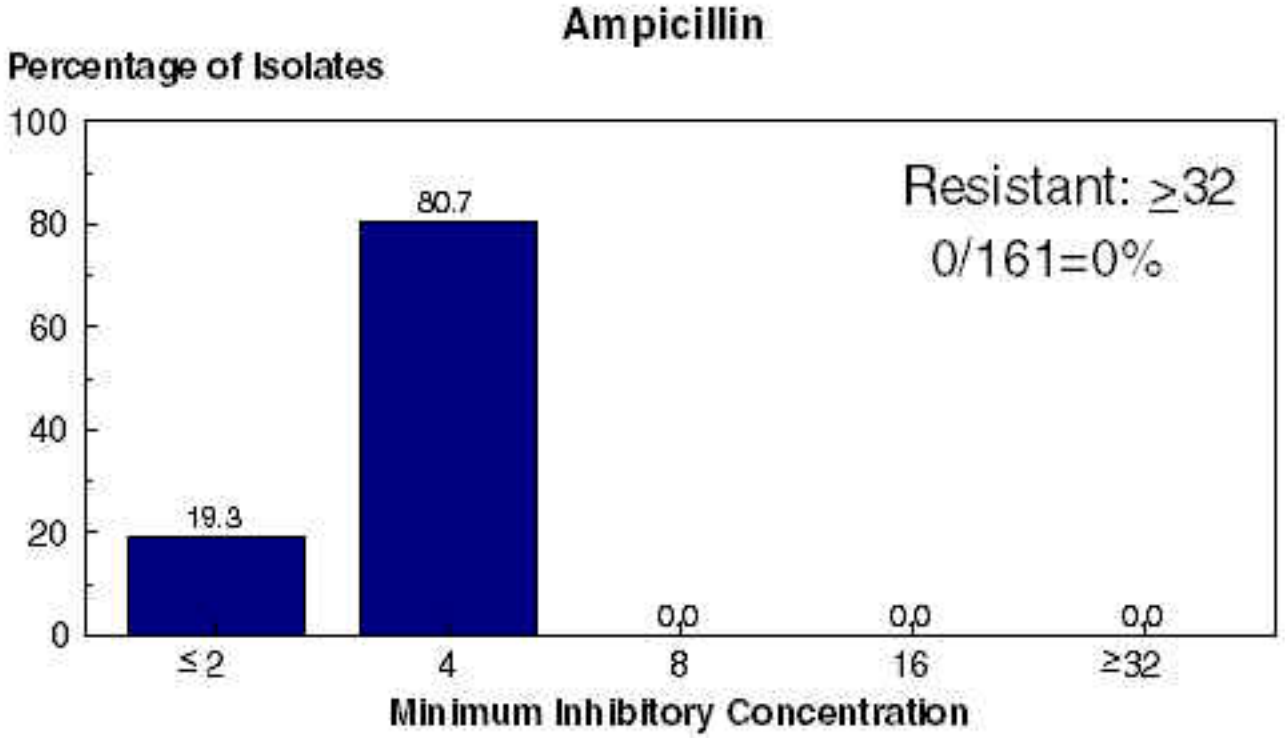
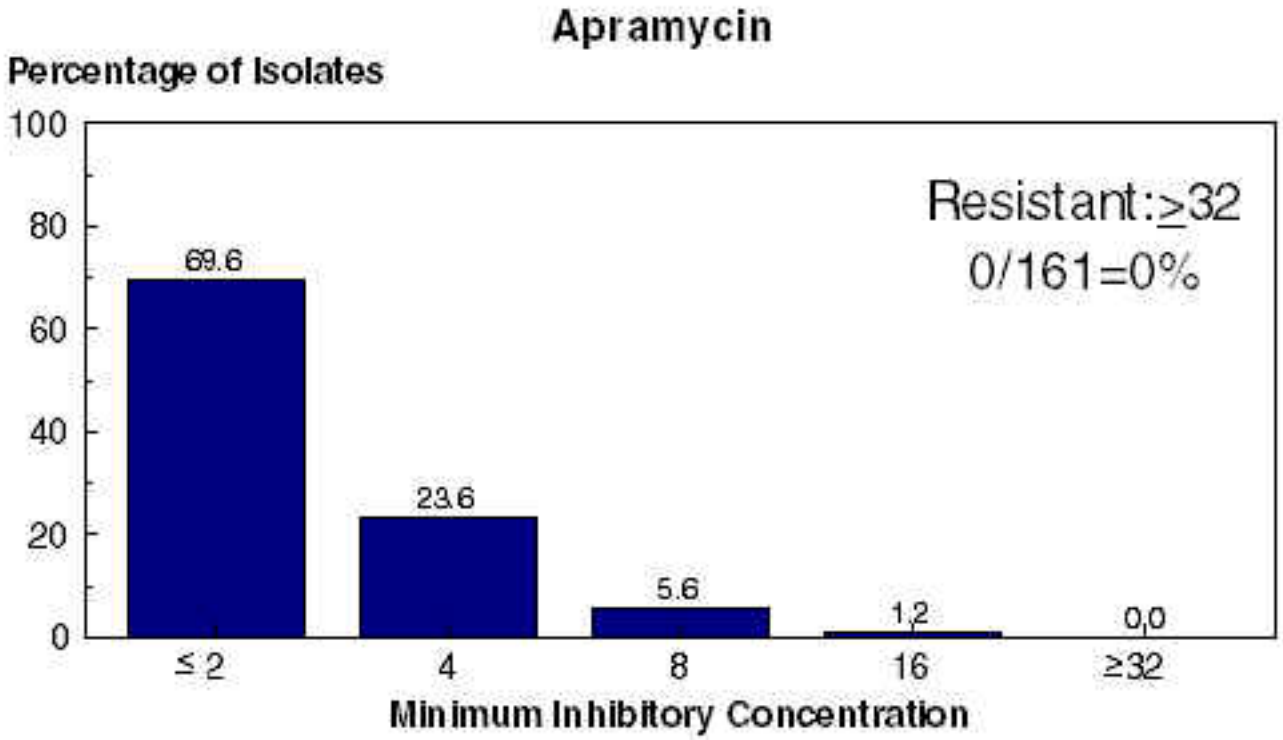
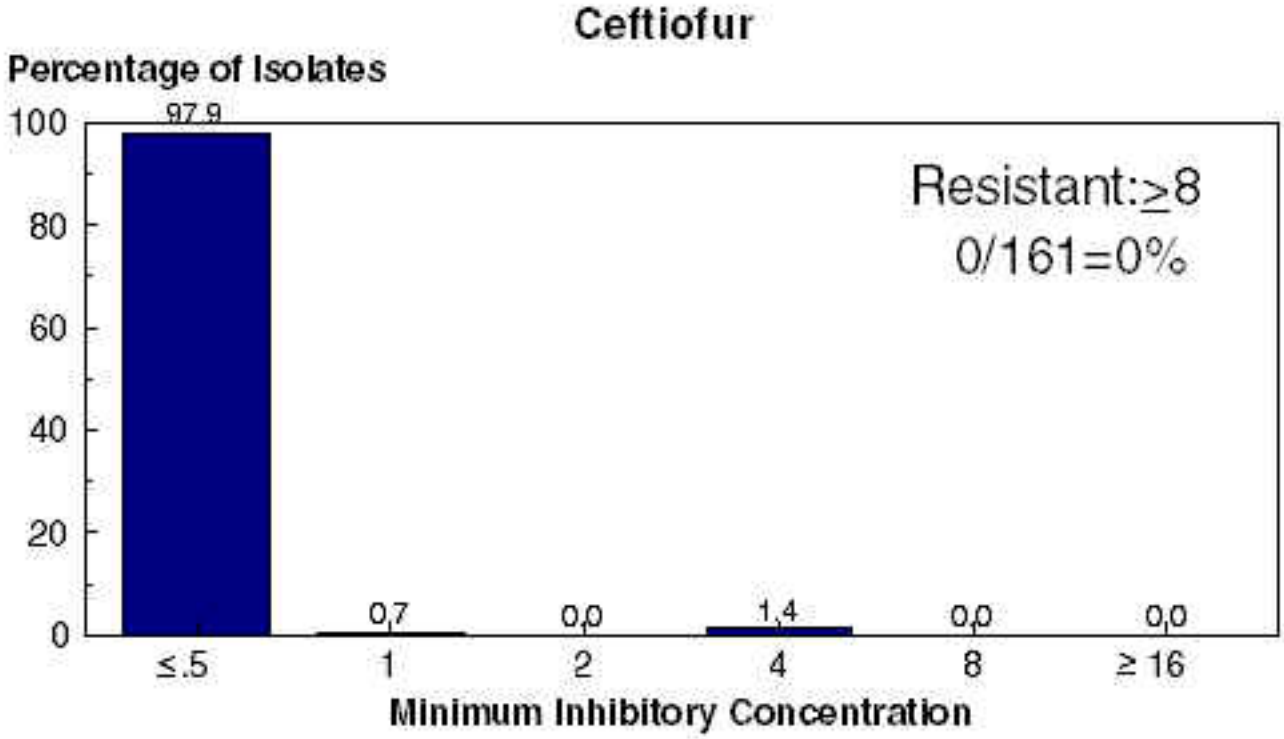
Figure 9: *E. coli* O157:H7 MICs, by antimicrobial agent

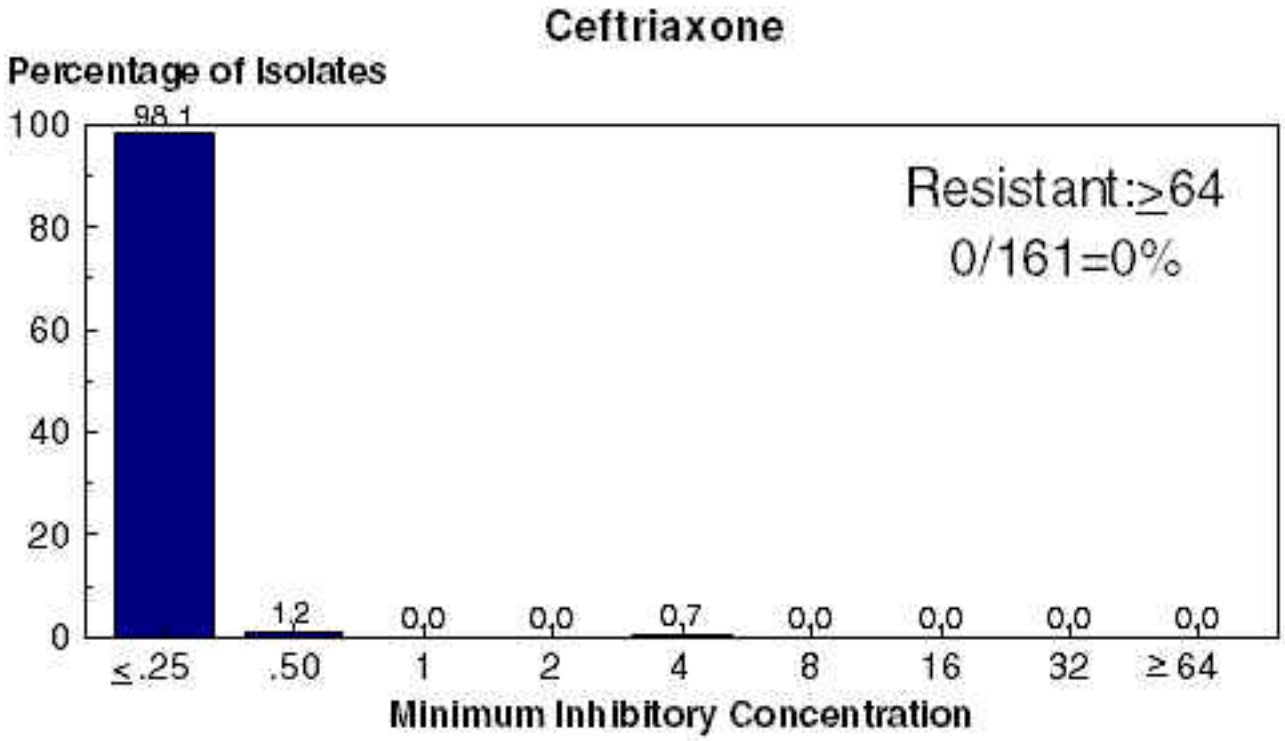


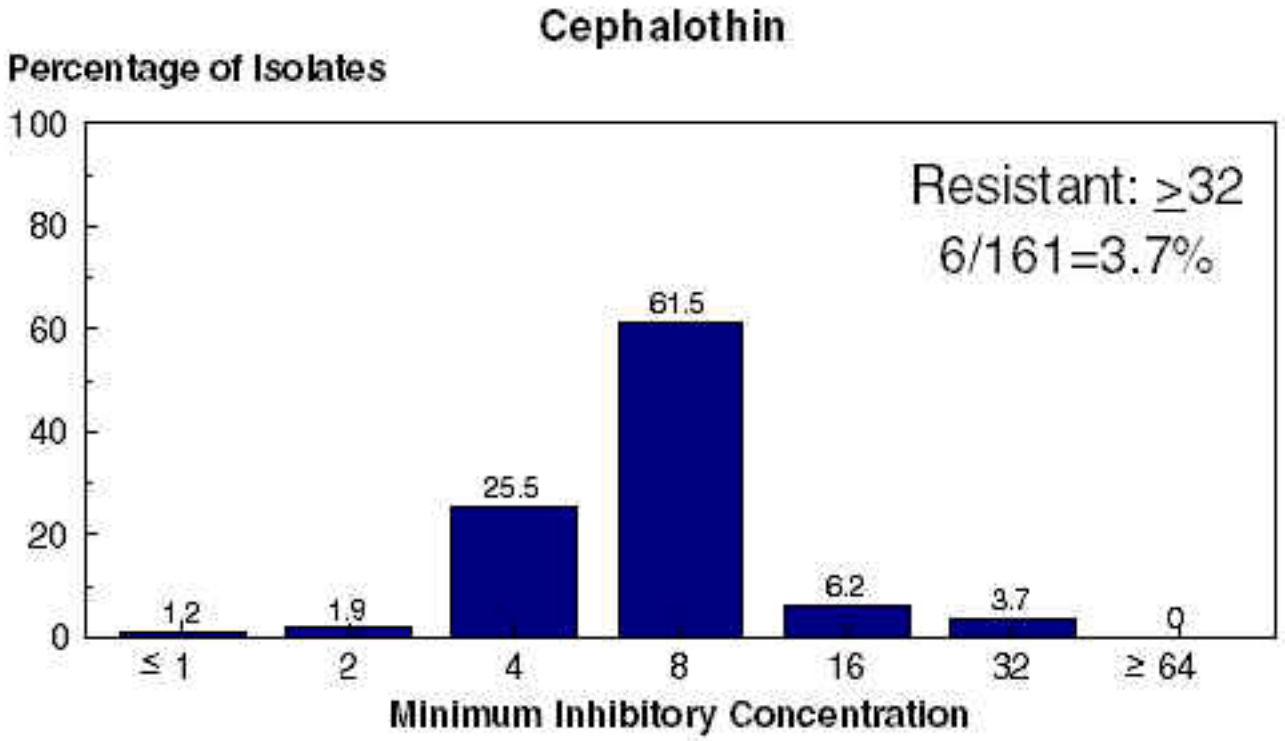

Amoxicillin-Clavulanic Acid
Percentage of Isolates
100
80
60
40
20
0
82.0
17.4
0.6
0.0
0.0
Resistant:≥32/16
0/161=0%
≤ 2/1
4/2
8/4
16/8
≥32/16
Minimum Inhibitory Concentration

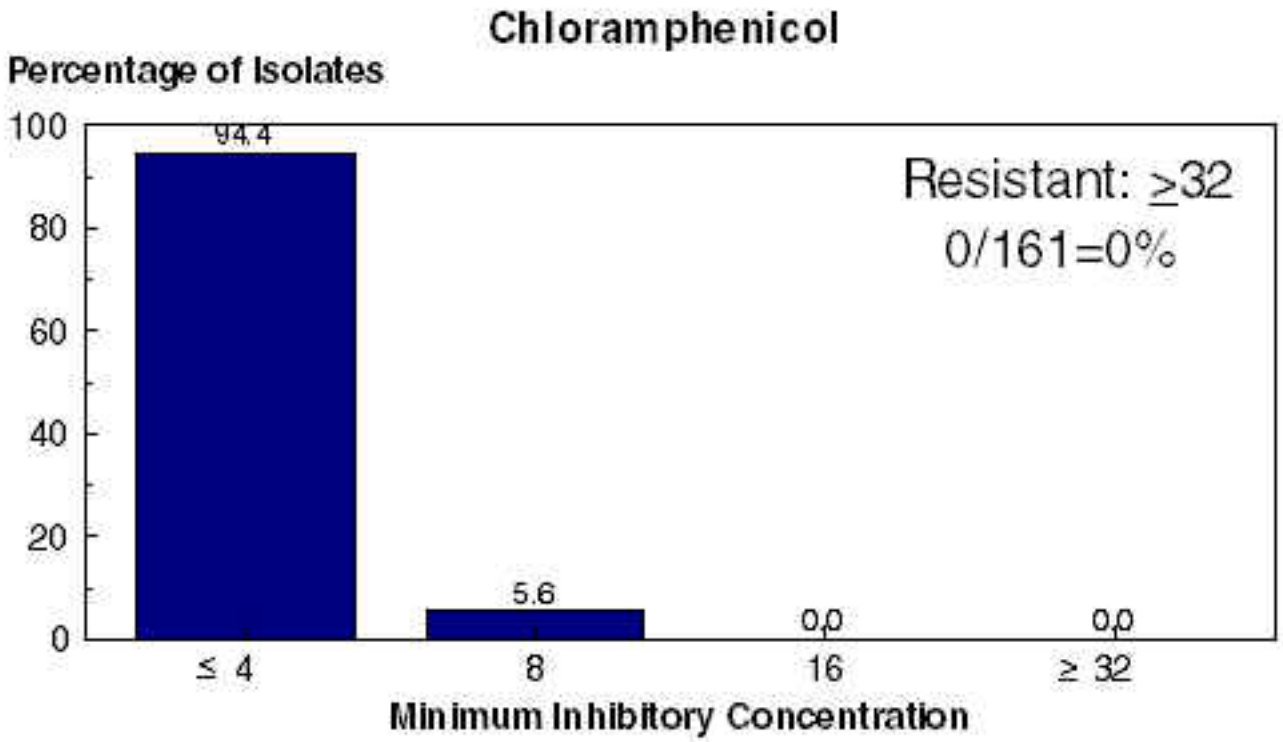

Ampicillin
Percentage of Isolates
100
80
60
40
20
0
80.7
19.3
0.0
0.0
0.0
Resistant: ≥32
0/161=0%
≤ 2
4
8
16
≥32
Minimum Inhibitory Concentration

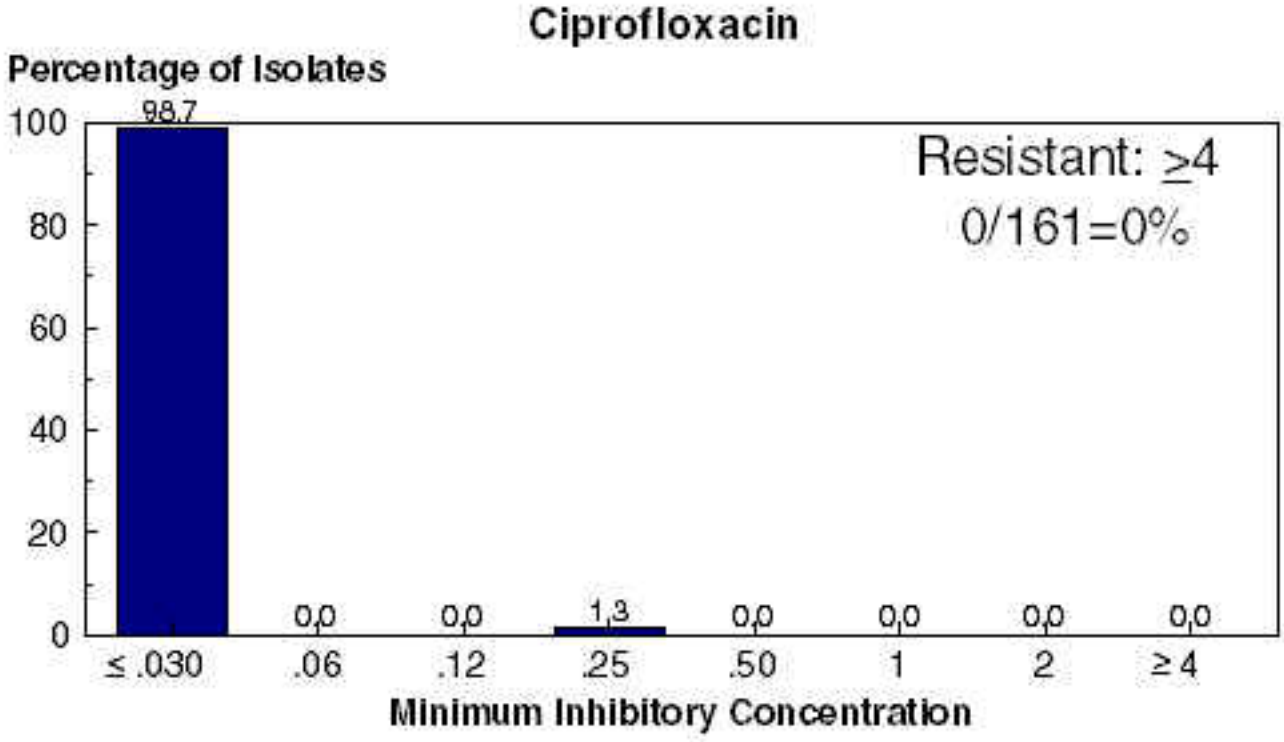

Apramycin
Percentage of Isolates
100
80
60
40
20
0
69.6
23.6
5.6
1.2
0.0
Resistant:≥32
0/161=0%
≤ 2
4
8
16
≥32
Minimum Inhibitory Concentration

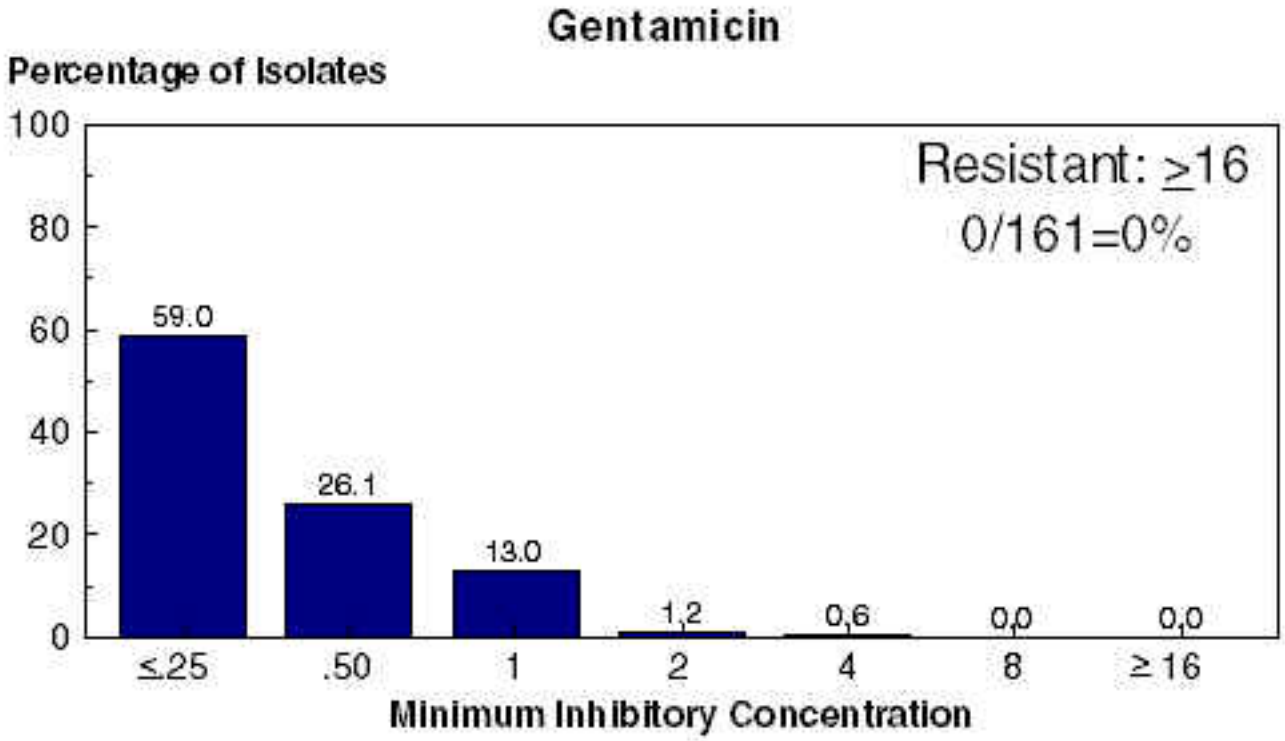

Ceftiofur
Percentage of Isolates
100
80
60
40
20
0
97.9
0.7
0.0
1.4
0.0
0.0
Resistant:≥8
0/161=0%
≤.5
1
2
4
8
≥ 16
Minimum Inhibitory Concentration

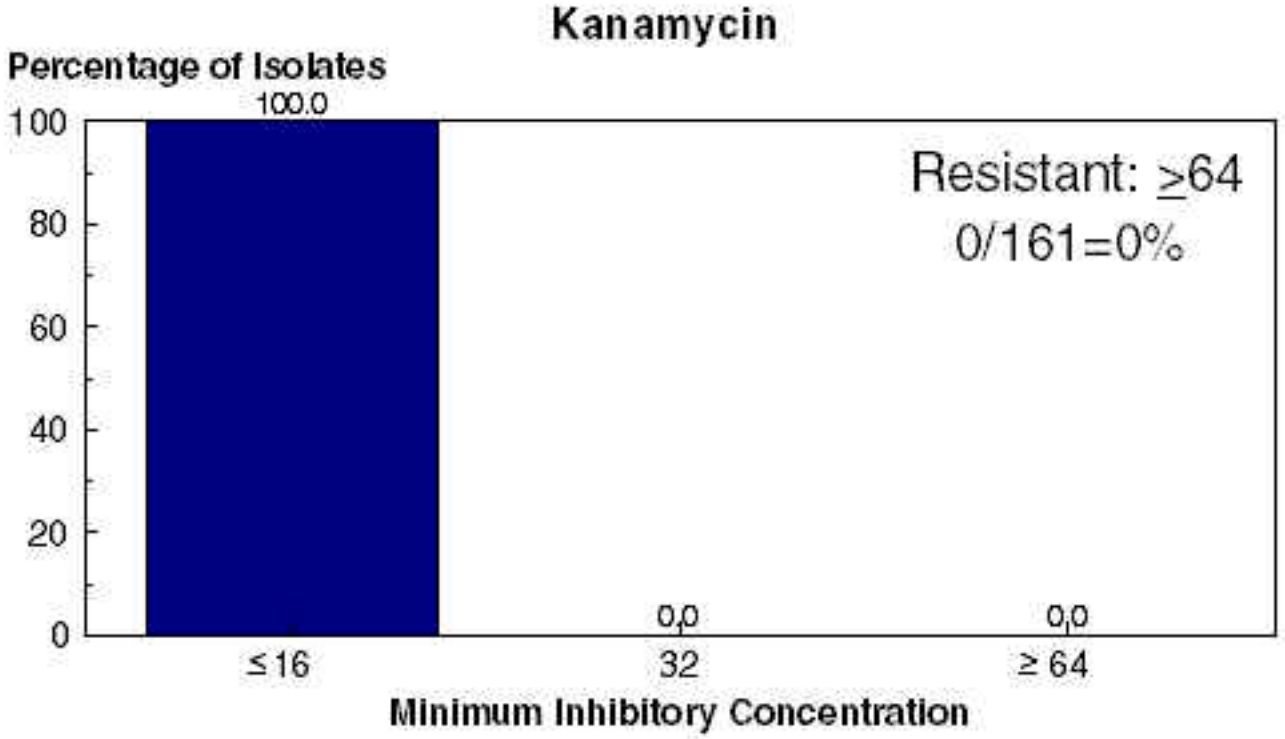

Ceftriaxone
Percentage of Isolates
100
80
60
40
20
0
98.1
1.2
0.0
0.0
0.7
0.0
0.0
0.0
0.0
≤.25
.50
1
2
4
8
16
32
≥64
Minimum Inhibitory Concentration
Resistant:≥64
0/161=0%

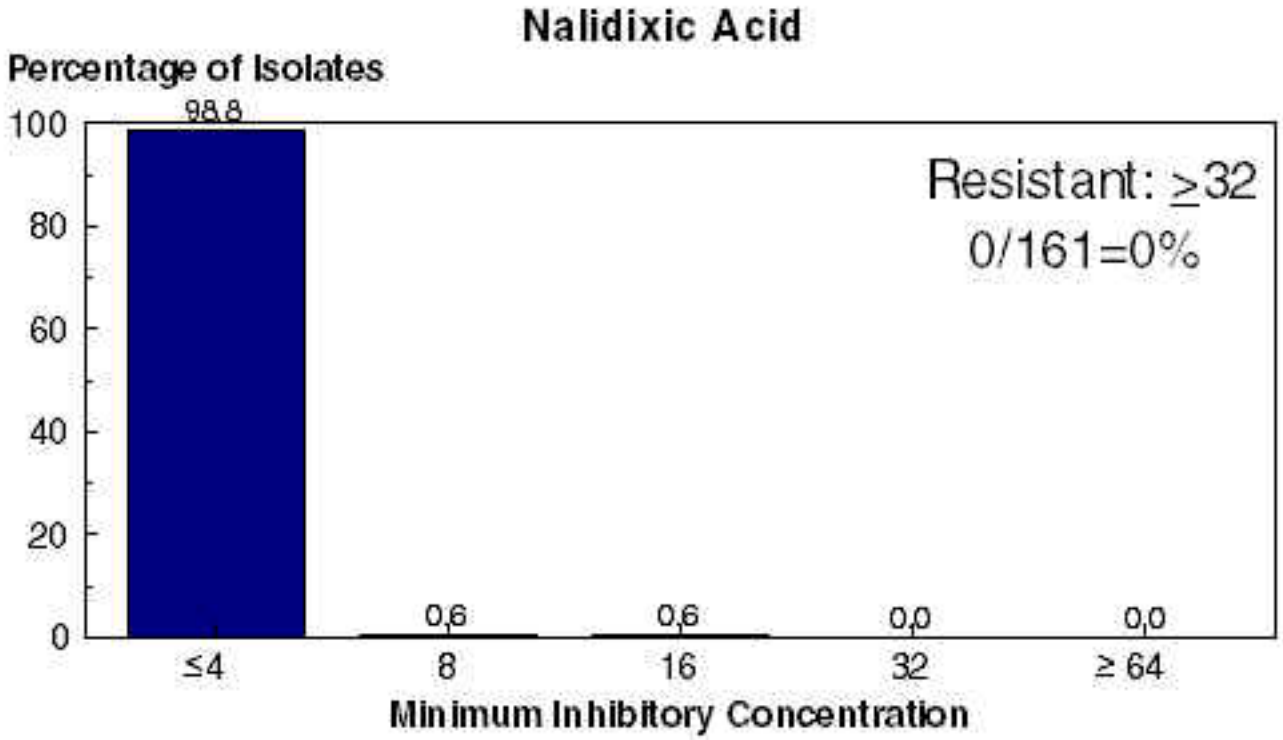

Cephalothin
Percentage of Isolates
100
80
60
40
20
0
1.2
1.9
25.5
61.5
6.2
3.7
0
≤1
2
4
8
16
32
≥64
Minimum Inhibitory Concentration
Resistant: ≥32
6/161=3.7%

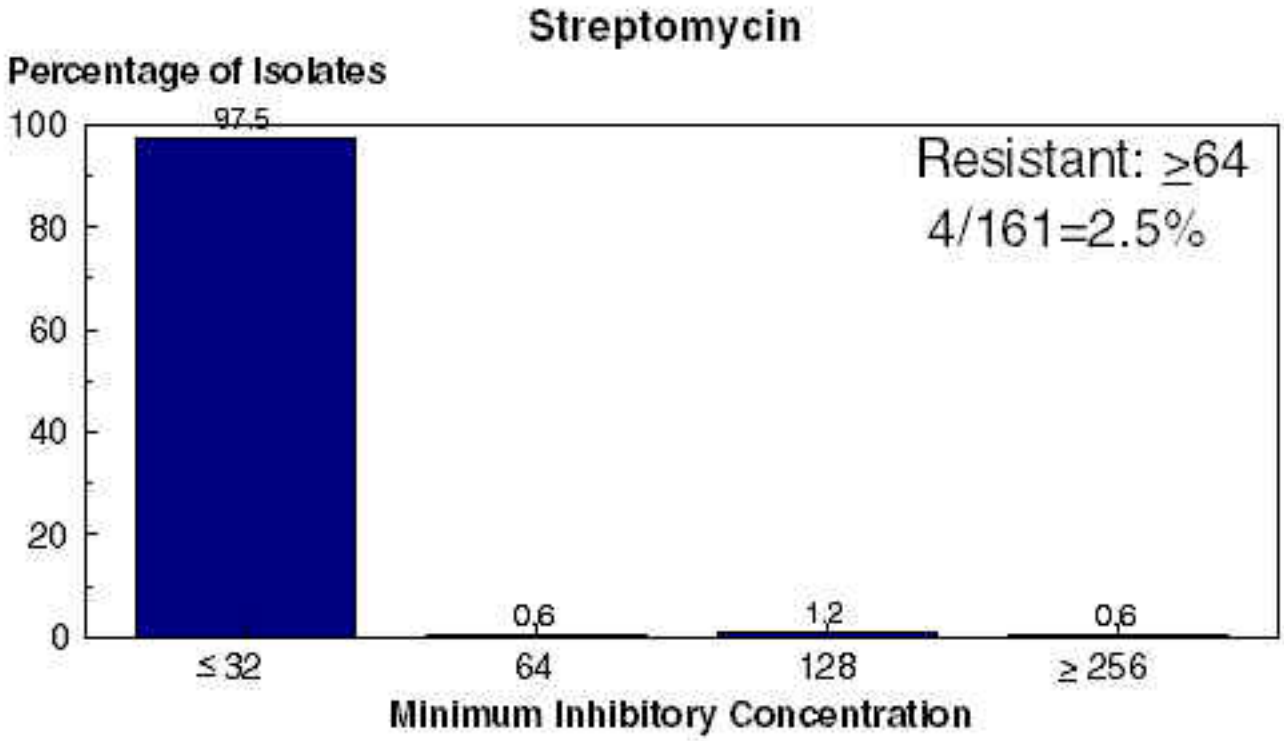

Chloramphenicol
Percentage of Isolates
100
80
60
40
20
0
94.4
5.6
0.0
0.0
Resistant: ≥32
0/161=0%
≤ 4
8
16
≥ 32
Minimum Inhibitory Concentration

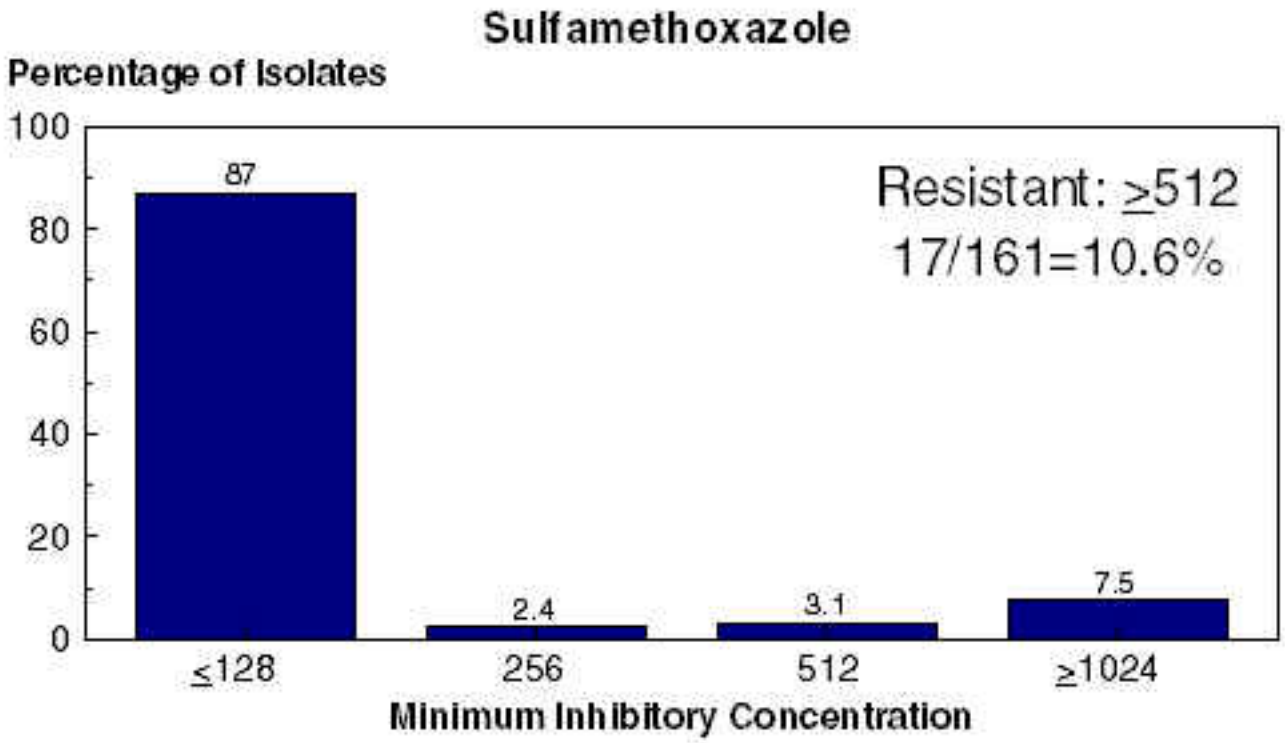

Ciprofloxacin
Percentage of Isolates
100
80
60
40
20
0
98.7
0.0
0.0
1.3
0.0
0.0
0.0
0.0
Resistant: ≥4
0/161=0%
≤ .030
.06
.12
.25
.50
1
2
≥ 4
Minimum Inhibitory Concentration

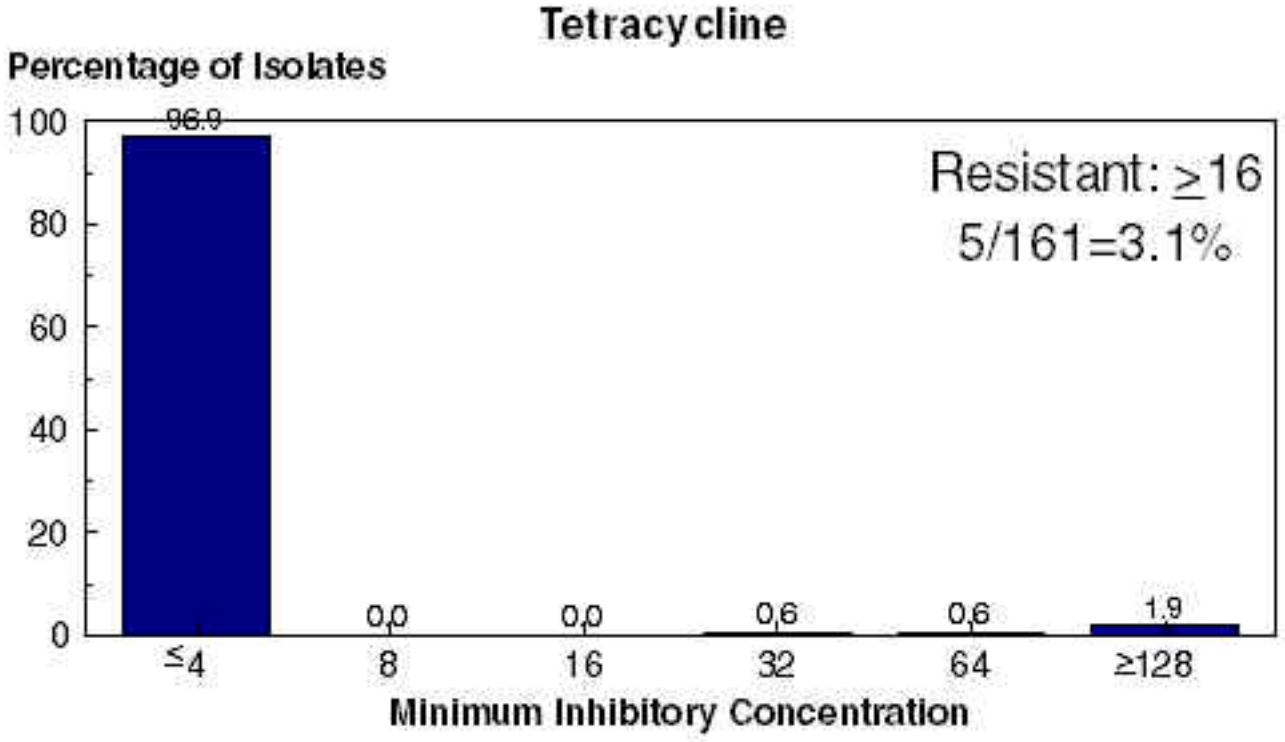

Gentamicin
Percentage of Isolates
100
80
60
40
20
0
Resistant: ≥16
0/161=0%
59.0
26.1
13.0
1.2
0.6
0.0
0.0
≤.25
.50
1
2
4
8
≥16
Minimum Inhibitory Concentration


Kanamycin
Percentage of Isolates
100
80
60
40
20
0
100.0
Resistant: ≥64
0/161=0%
0.0
0.0
≤16
32
≥64
Minimum Inhibitory Concentration


Nalidixic Acid
Percentage of Isolates
100
80
60
40
20
0
98.8
0.6
0.6
0.0
0.0
Resistant: ≥32
0/161=0%
≤4
8
16
32
≥ 64
Minimum Inhibitory Concentration


Streptomycin
Percentage of Isolates
100
80
60
40
20
0
97.5
0.6
1.2
0.6
Resistant: ≥64
4/161=2.5%
≤ 32
64
128
≥ 256
Minimum Inhibitory Concentration


Sulfamethoxazole
Percentage of Isolates
100
80
60
40
20
0
87
2.4
3.1
7.5
Resistant: ≥512
17/161=10.6%
≤128
256
512
≥1024
Minimum Inhibitory Concentration


Tetracycline
Percentage of Isolates
100
80
60
40
20
0
96.9
0.0
0.0
0.6
0.6
1.9
Resistant: ≥16
5/161=3.1%
≤4
8
16
32
64
≥128
Minimum Inhibitory Concentration

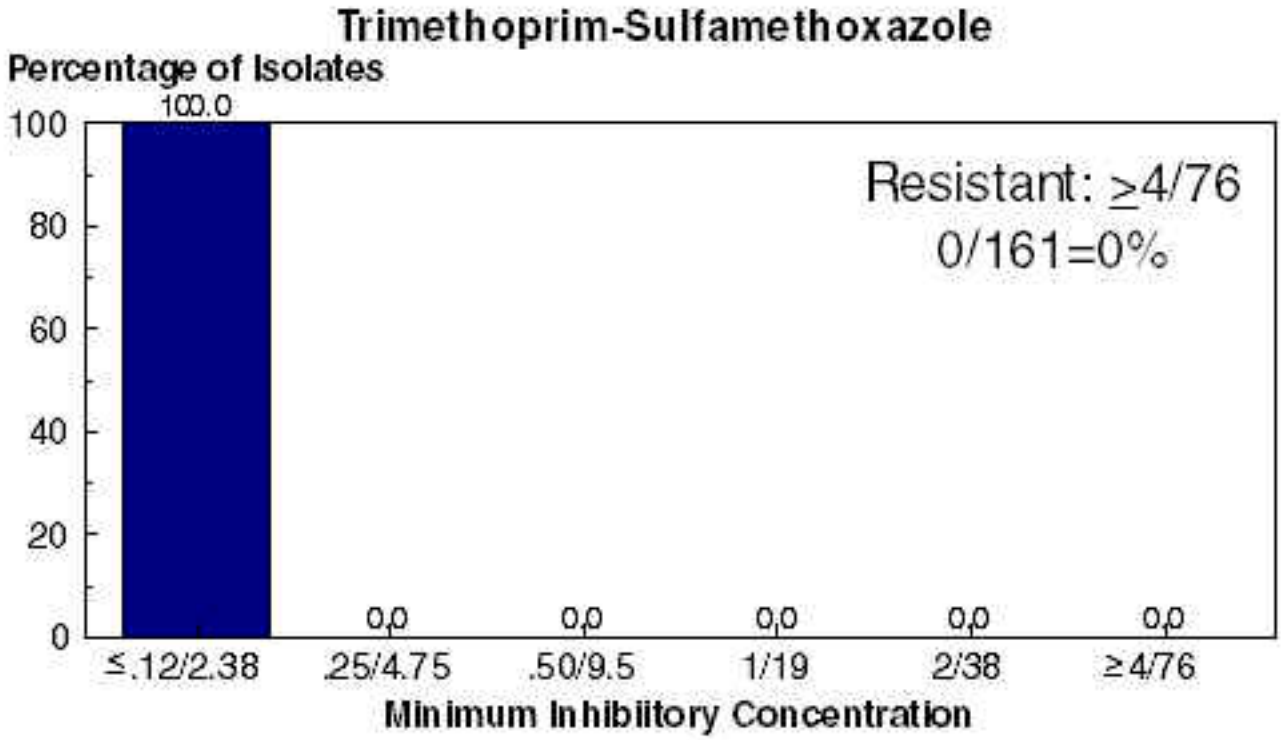


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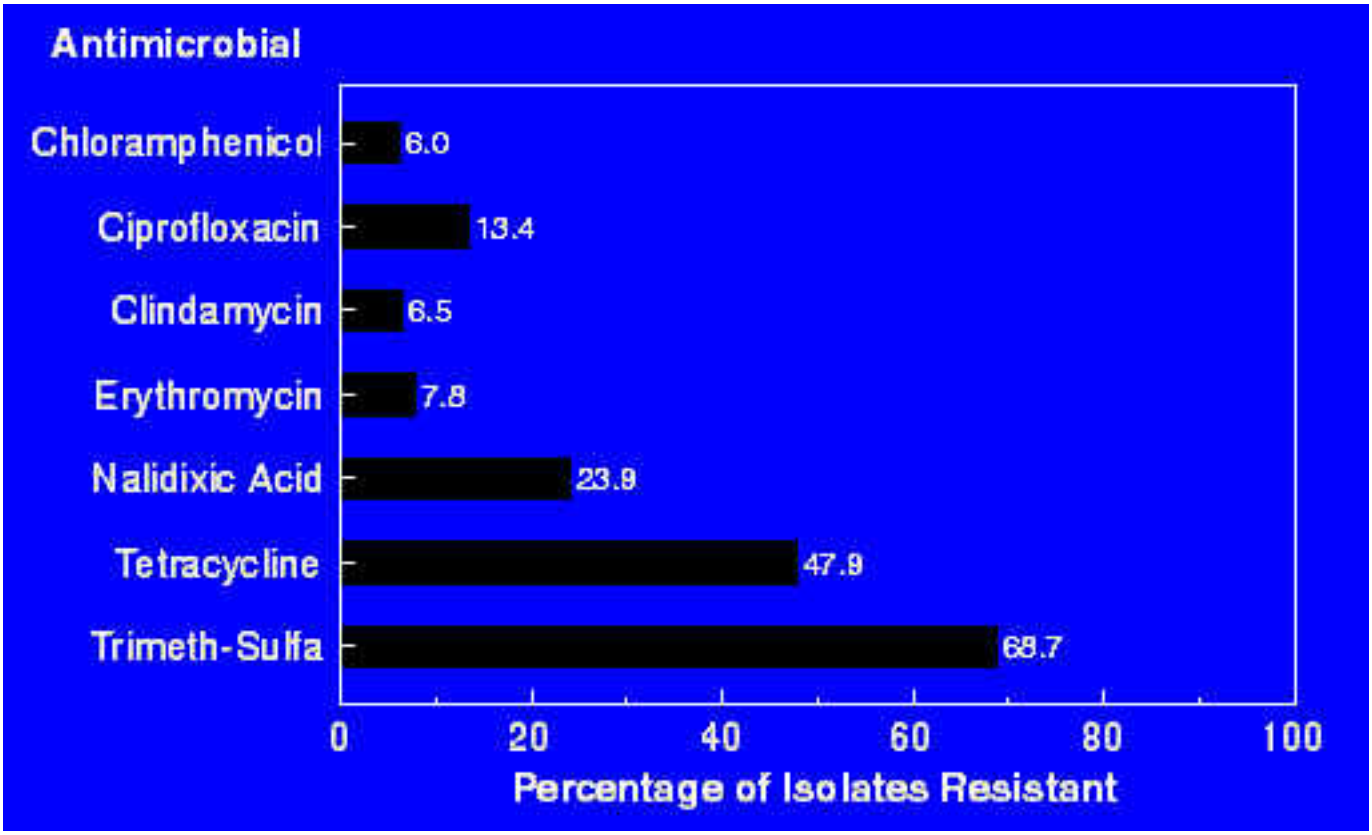
Figure 10: Resistance among *Campylobacter jejuni* isolates for all sites



N=217

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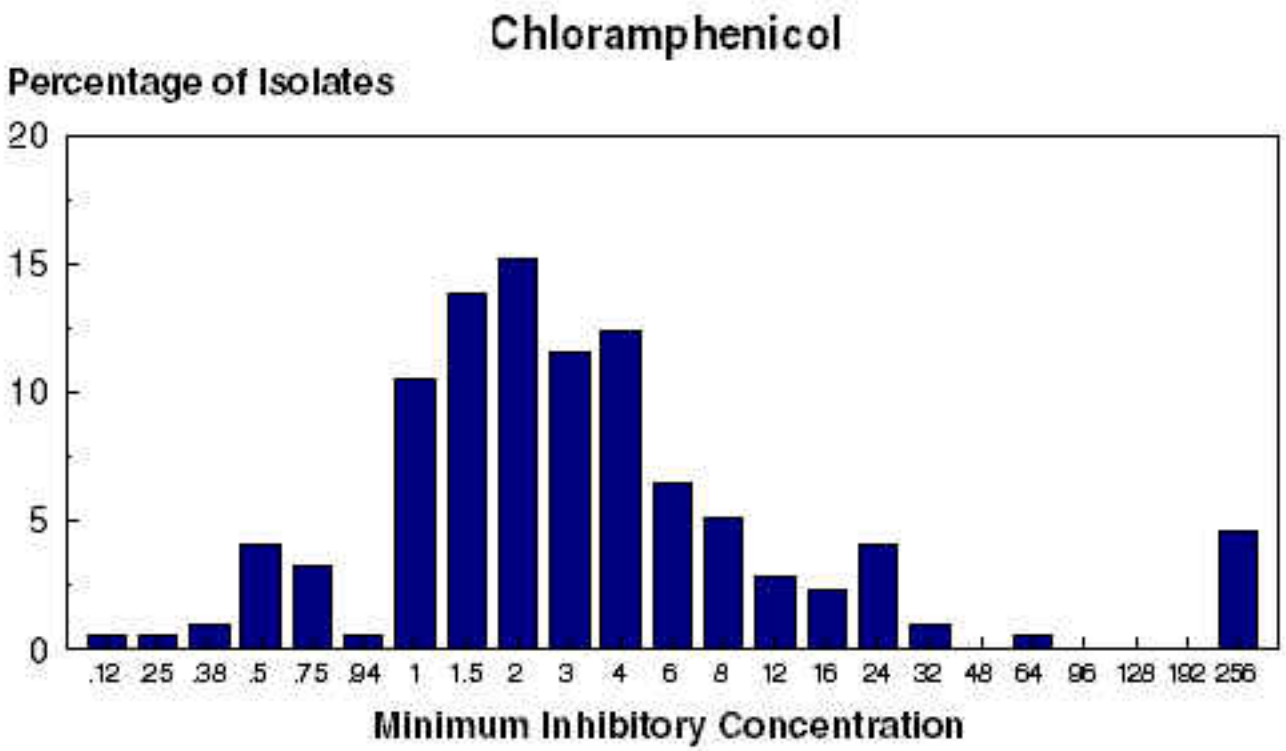
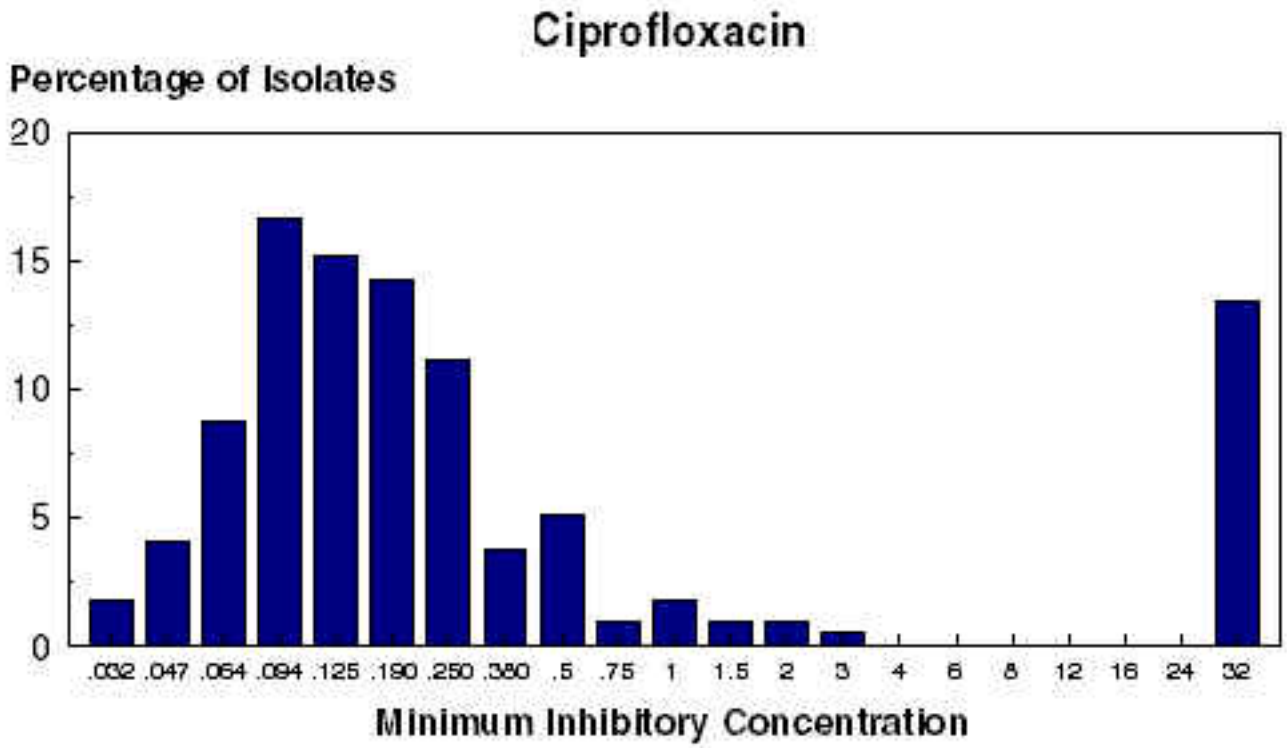
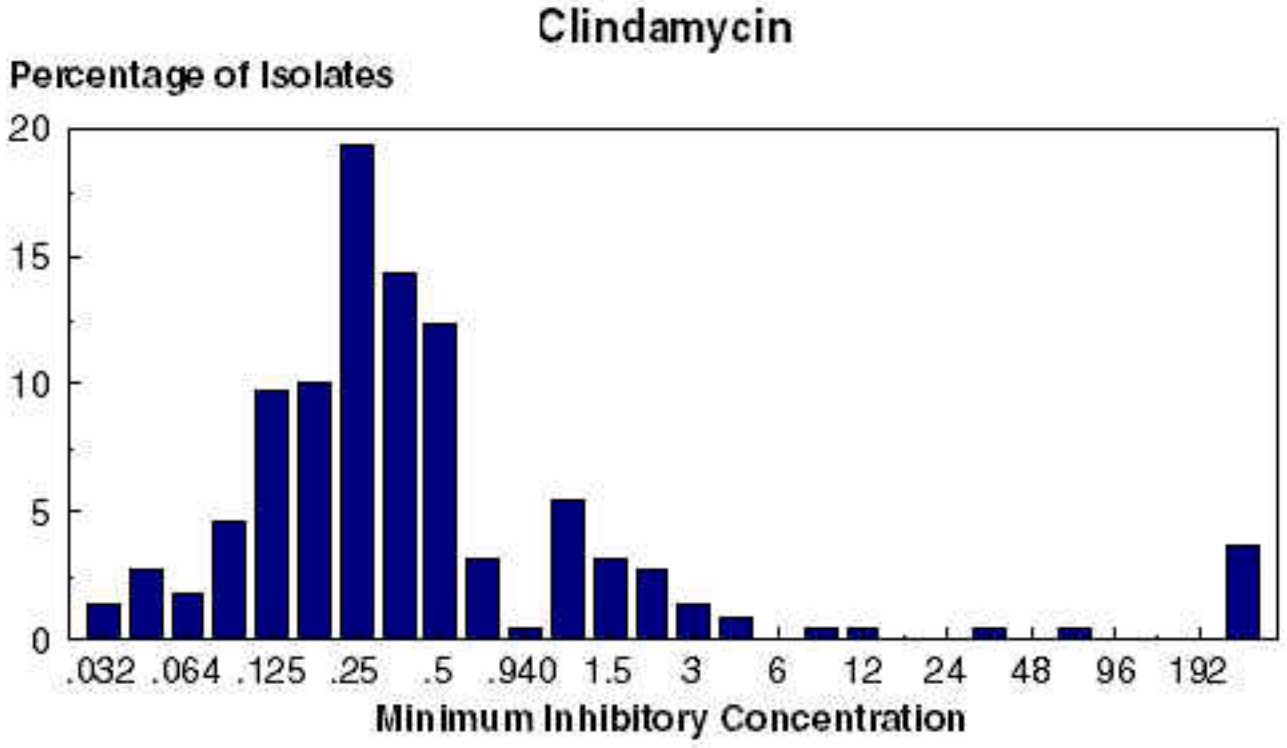
National Antimicrobial Resistance Monitoring System
1997 Annual Report
Figure 11: *Campylobacter jejuni* MICs, by antimicrobial agent



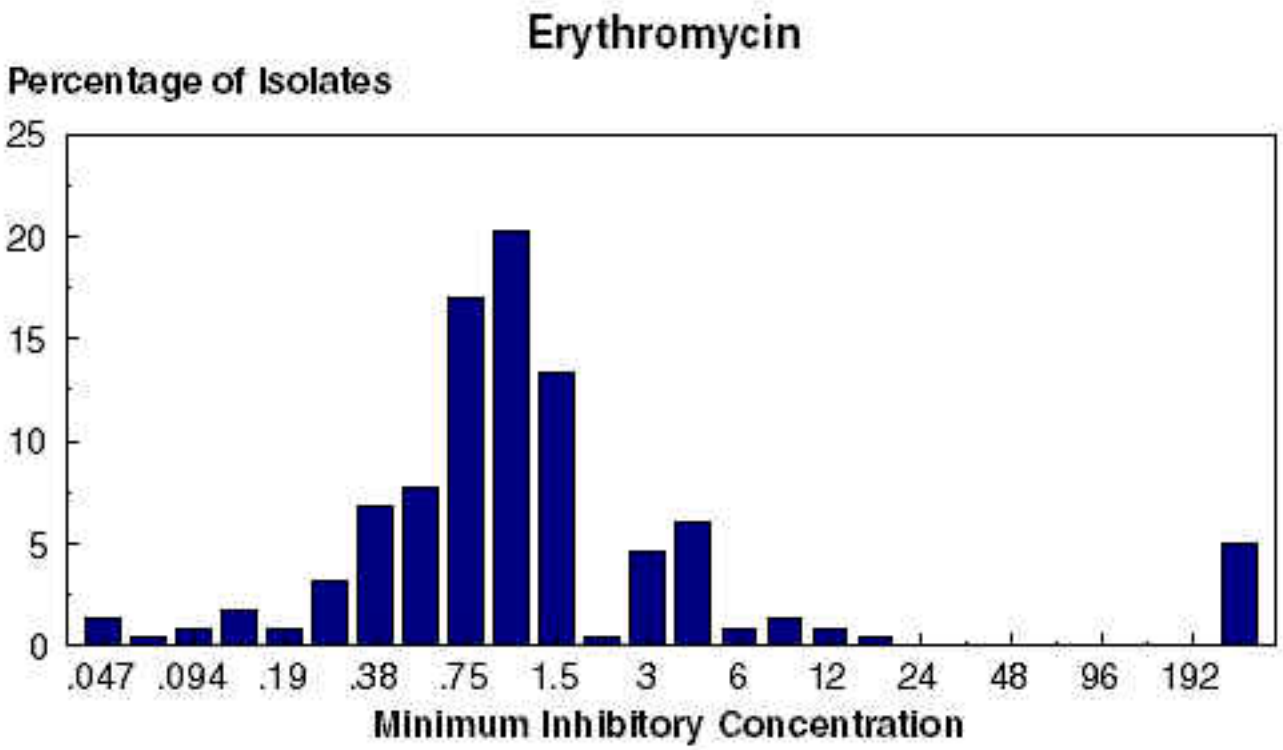
Resistant: ≥32
13/217=6.0%



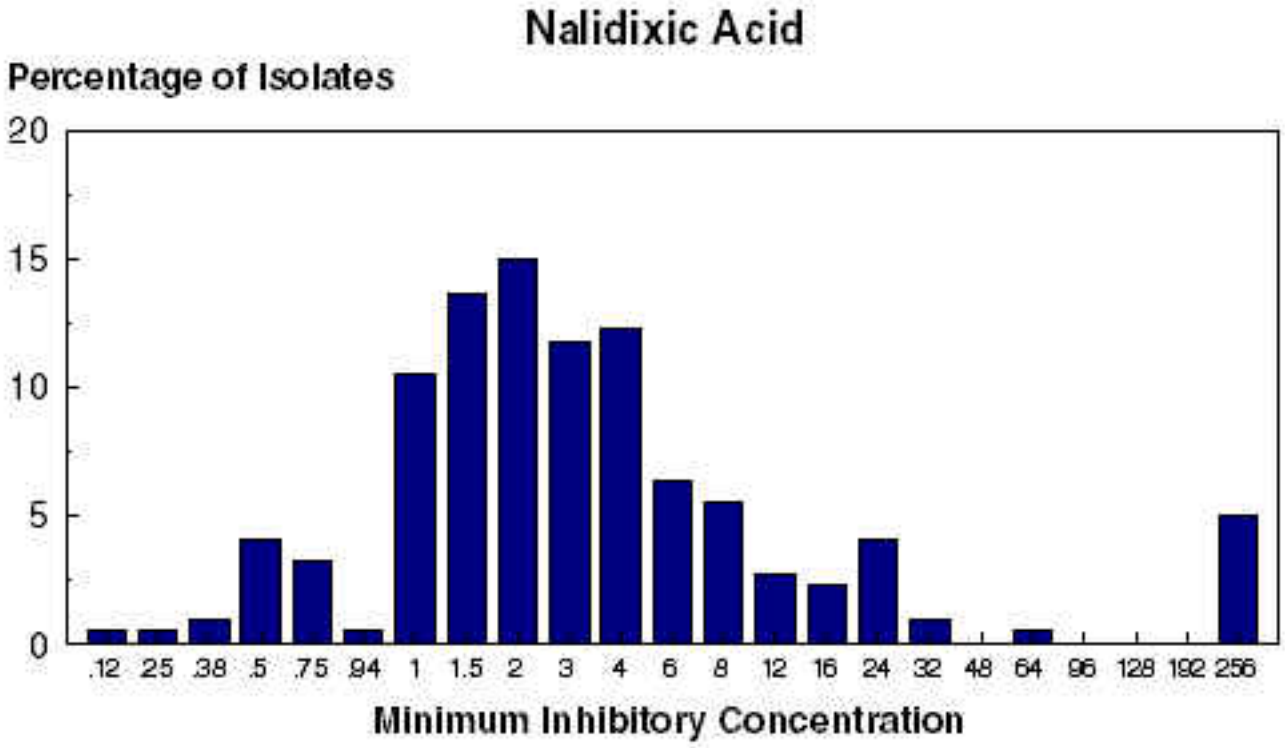
Resistant: ≥4
29/217=13.4%



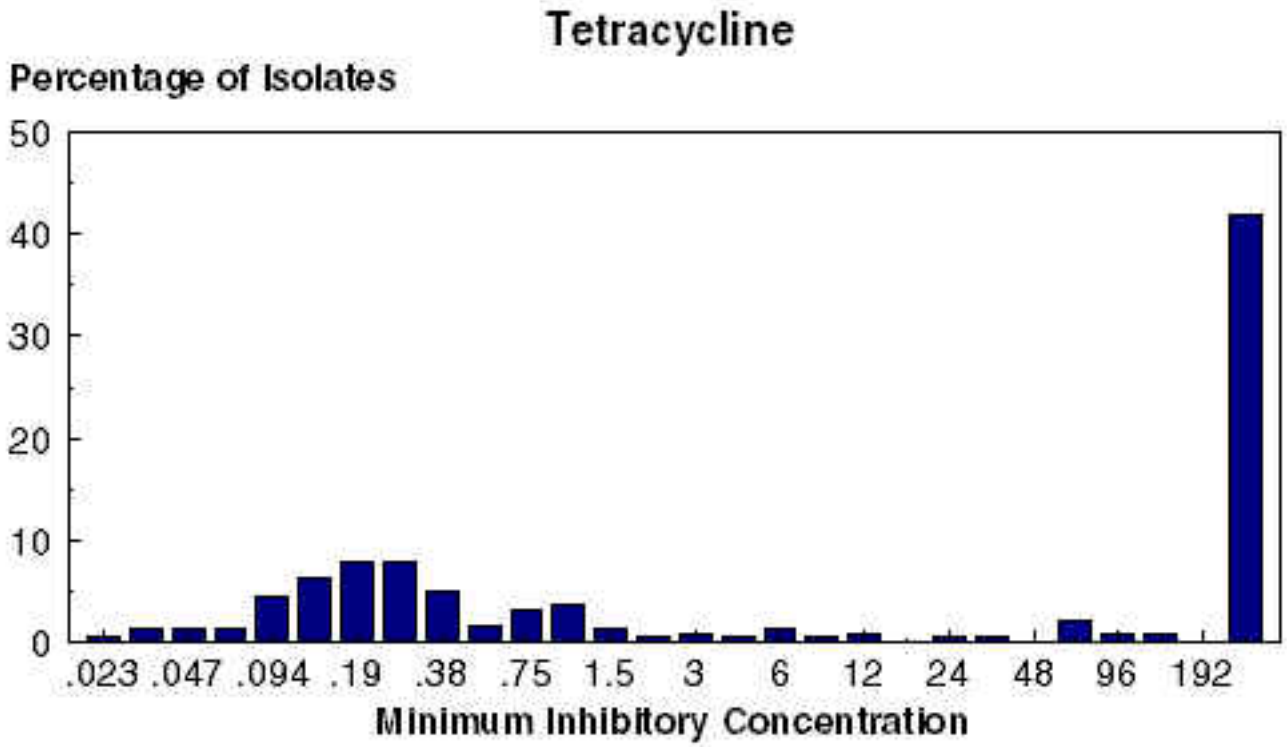
Resistant : ≥ 4
14/217=6.5%



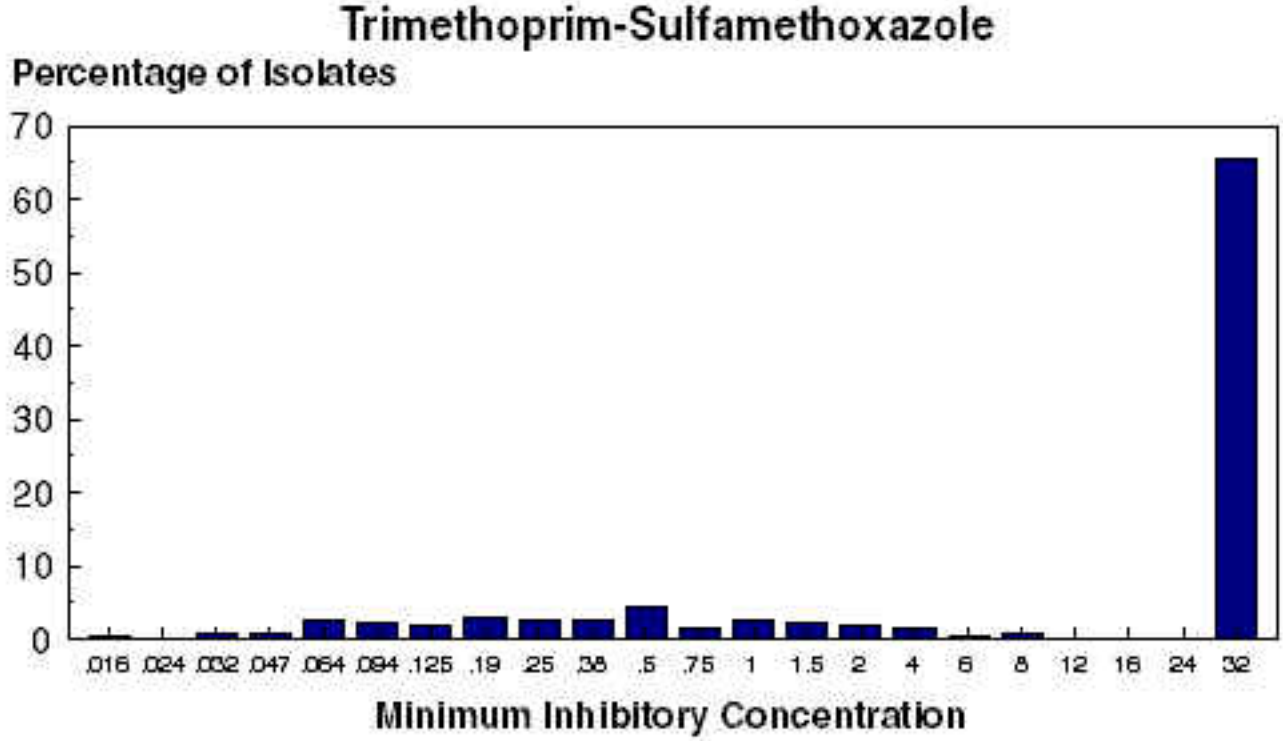
Resistant: ≥ 8
17/217=7.8%



Resistant: ≥ 32
52/217=23.9%



Resistant: ≥ 16
104/217=47.9%



Resistant: ≥ 4/76

149/217=68.7%

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