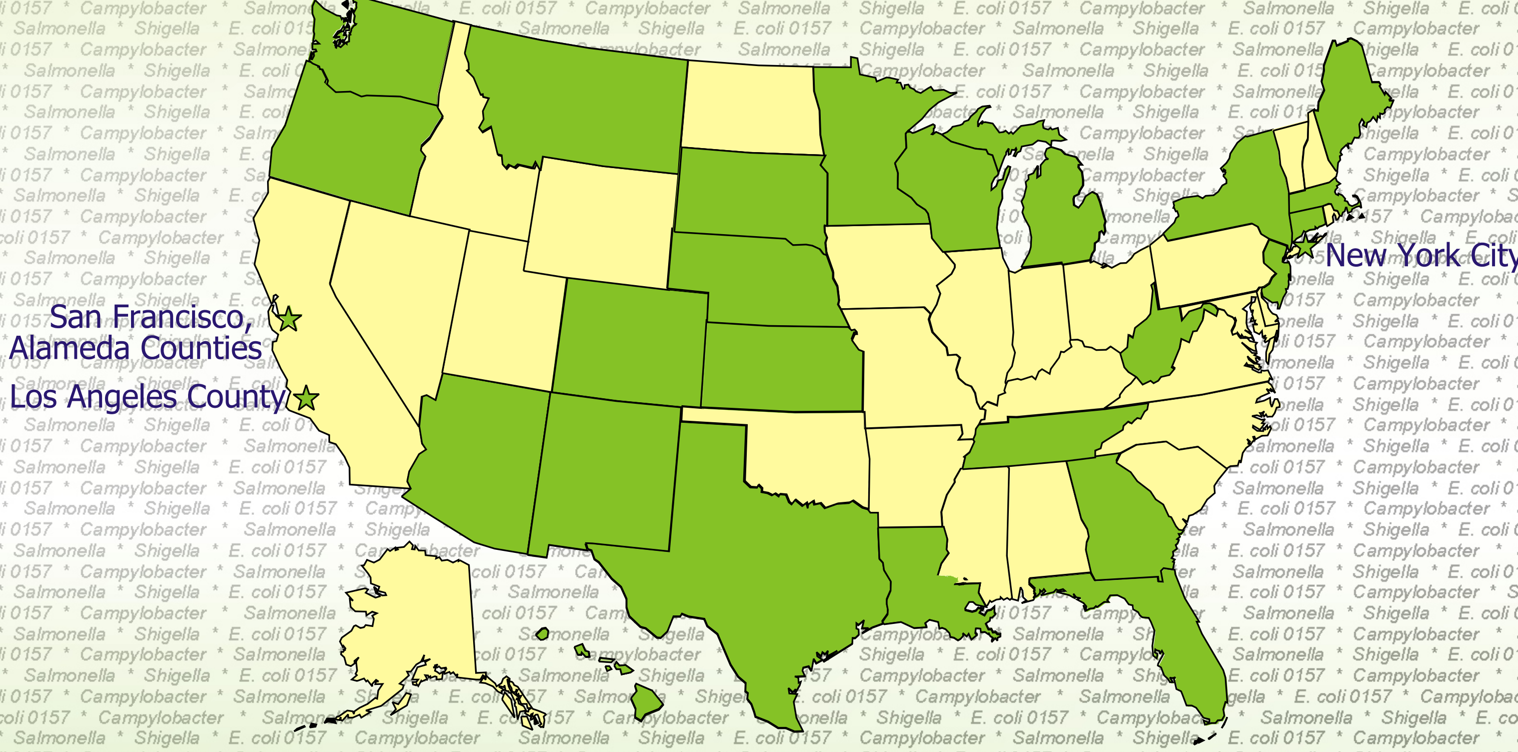
Human Isolates Final Report, 2002

NARMS

National Antimicrobial Resistance Monitoring System: Enteric Bacteria



CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

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Materials Available On-Line

All CDC NARMS Annual Reports and additional information about NARMS are posted on the CDC NARMS website. The address is: http://www.cdc.gov/narms

Additional general information about the NARMS surveillance program is posted on the FDA Center for Veterinary Medicine website at:
http://www.fda.gov/cvm/index/narms/narms_pg.html

Information on animal isolates in NARMS is available on the USDA-ARS website at:
http://www.ars-grin.gov/ars/SoAtlantic/Athens/arru/narms.html

General information about antimicrobial resistance is posted on the CDC website at:
http://www.cdc.gov/drugresistance

Information regarding CDC's Get Smart program can be found on the following website:
http://www.cdc.gov/drugresistance/community

General information about CDC's Foodborne Diseases Active Surveillance Network (FoodNet) can be found on: http://www.cdc.gov/foodnet

General information about the National Molecular Subtyping Network for Foodborne Disease Surveillance (PulseNet) can be found on: http://www.cdc.gov/pulsenet

General information about WHO Global Salm-Surv can be found on:
http://www.who.int/salmsurv/en

CDC *Salmonella* Annual Summaries are posted on the PHLIS website. The address is:
http://www.cdc.gov/ncidod/dbmd/phlisdata/salmonella.htm

CDC *Shigella* Annual Summaries are also posted on the PHLIS website. The address is: http://www.cdc.gov/ncidod/dbmd/phlisdata/shigella.htm

Part I

Narrative Report

Summary of 2002 Surveillance Data

Population

In 2002, 28 health departments, representing approximately 188 million persons (65% of the United States population), participated in the National Antimicrobial Resistance Monitoring System (NARMS) for Enteric Bacteria. NARMS *Campylobacter* surveillance was conducted in states participating in the Foodborne Diseases Active Surveillance Network (FoodNet). For more information about FoodNet, go to: http://www.cdc.gov/foodnet. Antimicrobial resistance among *Campylobacter* isolates was monitored in nine NARMS participating states that also participate in FoodNet, representing approximately 37.4 million persons (13% of the United States population); resistance among the other bacteria was monitored in all NARMS participating states.

Multidrug Resistance

Four multidrug-resistant strains accounted for 8% (169/2009) of non-Typhi *Salmonella*.

- *Salmonella* serotype Typhimurium R-type ACSSuT (resistant to at least ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, and tetracycline), was found in 4% (84/2009) of non-Typhi *Salmonella* isolates compared with 8% (103/1326) in 1996. These resistant isolates comprised 21% of all *Salmonella* Typhimurium.

- *Salmonella* serotype Newport MDR-AmpC (resistant to at least amoxicillin/clavulanic acid, ampicillin, cephalothin, ceftiofur, cefoxitin, chloramphenicol, streptomycin, sulfamethoxazole, tetracycline, and with decreased susceptibility [minimum inhibitory concentration (MIC) ≥ 2 μg/ml] to ceftriaxone was found in 3% (53/2009) of non-Typhi *Salmonella* isolates. These resistant isolates comprised 22% of all *Salmonella* Newport. In 1996, none of the multi-drug resistant strains were detected.

- *Salmonella* serotype Typhimurium R-type AKSSuT (resistant to at least ampicillin, kanamycin, streptomycin, sulfamethoxazole, and tetracycline) was found in 1% (24/2009) of non-Typhi *Salmonella* compared with 2% (27/1326) in 1996. These resistant isolates comprised 6% of all *Salmonella* Typhimurium.

- *Salmonella* serotype Heidelberg R-type AClCfCp (resistant to at least ampicillin, amoxicillin-clavulanic acid, ceftiofur, and cephalothin) was found in 0.4% (8/2009) of non-Typhi *Salmonella* compared with 0.1% (2/1326) in 1996. These resistant isolates comprised 8% of all *Salmonella* Heidelberg.

Clinically Important Resistance

Fluoroquinolones (e.g., ciprofloxacin) and third generation cephalosporins (e.g., ceftriaxone) are commonly used antimicrobial agents for the treatment of severe *Campylobacter* and *Salmonella* infections, including *Salmonella* serotype Typhi. Nalidixic acid is an elementary quinolone; resistance to nalidixic acid correlates with decreased susceptibility to ciprofloxacin. Ceftiofur is a third-generation cephalosporin used in food animals in the United States; resistance to ceftiofur correlates with decreased susceptibility to ceftriaxone. An important proportion of isolates tested by NARMS in 2002 demonstrated resistance or decreased susceptibility to these clinically important antimicrobials.

- In 2002, 20% (71/354) of *Campylobacter* isolates were resistant to ciprofloxacin, compared with 13% (28/217) in 1997.

- In 2002, 2% (37/2009) of non-Typhi *Salmonella* isolates were resistant to nalidixic acid, 1% (16/2009) had decreased susceptibility (MIC $\geq$ 0.25 μg/ml) to ciprofloxacin, and 0.05% (1/2009) was resistant to ciprofloxacin. Resistance to nalidixic acid was most common in serotypes Enteritidis, Typhimurium, Paratyphi (A,B), and Virchow. By comparison, in 1996, 0.4% (5/1326) of non-Typhi *Salmonella* isolates were resistant to nalidixic acid, 0.4% (5/1326) had decreased susceptibility to ciprofloxacin, and none were resistant to ciprofloxacin.

- In 2002, 4% (87/2009) of non-Typhi *Salmonella* isolates were resistant to ceftiofur, 4% (87/2009) had decreased susceptibility (MIC $\geq$ 2 μg/ml) to ceftriaxone, and 0.2% (4/2009) were resistant to ceftriaxone. Resistance to ceftiofur was most common in serotypes Newport, Typhimurium, and Heidelberg. By comparison, in 1996, 4% (53/1326) of non-Typhi *Salmonella* isolates were resistant to ceftiofur, 3% (37/1326) had decreased susceptibility to ceftriaxone, and none were resistant to ceftriaxone.

- In 2002, 24% (46/195) of *Salmonella* Typhi isolates were resistant to nalidixic acid, compared with 19% (31/166) in 1999.

Additional NARMS Activities

In addition to surveillance of resistance in pathogens, the NARMS program at the Centers for Disease Control and Prevention also includes public health research into the mechanisms of resistance, education efforts to promote prudent use of antimicrobials, and studies of resistance in commensal organisms. More information about other NARMS activities can be found at www.cdc.gov/narms.

Surveillance and Laboratory Testing Methods

The Centers for Disease Control and Prevention (CDC) monitor antimicrobial resistance in enteric bacteria from humans. In 2002, CDC's NARMS program was part of a collaboration with the U.S. Food and Drug Administration (FDA) Center for Veterinary Medicine and 28 state and local health departments. Other components of the interagency NARMS program conduct surveillance for resistance in foodborne bacterial pathogens isolated from animals, conducted by the Agriculture Research Service, United States Department of Agriculture (http://www.arru.saa.ars.usda.gov), and pathogens isolated from foods, conducted by the Center for Veterinary Medicine, FDA (http://www.fda.gov/cvm/index/narms/narms_pg.html).

Many NARMS activities are conducted within the framework of CDC's Emerging Infections Program's Epidemiology and Laboratory Capacity Program and the Foodborne Disease Active Surveillance Network (FoodNet). The primary purpose of NARMS is to monitor antimicrobial resistance among foodborne enteric bacteria isolated from humans. NARMS data are also used to provide platforms for additional studies including field investigations and molecular characterization of resistance determinants, and to guide efforts to mitigate antimicrobial resistance.

NARMS began in 1996 to monitor prospectively the antimicrobial resistance of human non-Typhi *Salmonella* and *Escherichia coli* O157 isolates. Testing of human *Campylobacter* isolates was added in 1997, and testing of human *Salmonella* Typhi and *Shigella* isolates was added in 1999. Before NARMS was established, CDC monitored antimicrobial resistance in *Salmonella, Shigella*, and *Campylobacter* using periodic surveys of isolates from a panel of sentinel counties. In 2002, there were 28 NARMS health department participants (Arizona, California, Colorado, Connecticut, Florida, Georgia, Hawaii, Kansas, Los Angeles County, Louisiana, Maine, Massachusetts, Maryland, Michigan, Minnesota, Montana, Nebraska, New Jersey, New Mexico, New York City, New York State, Oregon, South Dakota, Tennessee, Texas, Washington, West Virginia, Wisconsin), representing approximately 187 million persons (65% of the United States population) [Table 1]. In 2002, the nine NARMS participating state health departments (California, Colorado, Connecticut, Georgia, Maryland, Minnesota, New York, Oregon, and Tennessee), that also participate in FoodNet, monitored antimicrobial resistance among human *Campylobacter* isolates [Table 1].

In 2002, NARMS participating public health laboratories systematically selected every tenth non-Typhi *Salmonella,* every *Salmonella* Typhi, every tenth *Shigella*, and every fifth *E. coli* O157 isolate received at their laboratory, and forwarded the isolates to CDC for susceptibility testing. Non-Typhi *Salmonella* refers to all *Salmonella* serotypes except serotype Typhi. At CDC, *Salmonella*, *Shigella*, and *E. coli* O157 isolates are tested with a semi-automated system (Sensititre®, Trek Diagnostics, Westlake, OH) to determine the partial range MIC for 16 antimicrobial agents: amikacin, ampicillin, amoxicillin-clavulanic acid, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, and trimethoprim-sulfamethoxazole [Table 2].

Campylobacter isolates are forwarded to CDC for susceptibility testing. Selection of *Campylobacter* isolates to submit to NARMS was conducted by one of several ways. In Maryland, Minnesota, New York, and Tennessee, one isolate a week was selected (usually the first isolate received each week is selected, but otherwise isolates were randomly selected) from the collection of isolates sent to the state health department laboratory from almost all clinical laboratories in a geographical area (statewide in Maryland, Minnesota, and Tennessee, and metro Albany and Rochester areas in New York). In Georgia, all *Campylobacter i*solates received at the state laboratory from the Metropolitan Statistical Area (metro Atlanta area) were submitted to CDC. Once received, one isolate a week was selected (usually the first isolate received each week is selected, but otherwise isolates were randomly selected) from the collection of isolates from almost all clinical laboratories in metro Atlanta. In California, Colorado, Connecticut, and Oregon, one isolate a week was selected (usually the first isolate received each week is selected, but otherwise isolates were randomly selected) at one sentinel clinical laboratory. Sentinel clinical laboratories followed routine isolation practices for *Campylobacter*. At CDC, isolates were confirmed as *Campylobacter* by dark field microscopy and oxidase test. Identification to species level was performed using the hippurate hydrolysis test. Hippurate-positive isolates were identified as *C. jejuni*. Hippurate-negative isolates were identified as *C. jejuni* by the hippuricase gene-based PCR assay or as *C. coli* based on polymerase chain reaction (PCR) test for the coli-specific *ceuE* gene. Isolates that were determined not to be *C. jejuni* or *C. coli* were referred to the National *Campylobacter* Reference Laboratory at CDC for identification using genotypic and phenotypic methods. The E-test system was used to determine the MICs for 8 antimicrobial agents: azithromycin, chloramphenicol, ciprofloxacin, clindamycin, erythromycin, gentamicin, nalidixic acid, and tetracycline [Table 2]. No more than 53 *Campylobacter* isolates, per state in 2002, were included in NARMS analyses; if more than 53 isolates were received, only the first 4 or 5 isolates received each month, depending on the number of Mondays in the month, were included.

For all pathogens in this report, MIC results were dichotomized: isolates with intermediate susceptibility were categorized as susceptible. Analysis was restricted to one isolate (per pathogen) per patient. When established, National Committee for Clinical Laboratory Standards (NCCLS) interpretive criteria were used; ceftiofur resistance was defined as MIC ≥ 8 μg/ml [Table 2]. The amikacin dilutions included in the 2002 Sensititre® plate were limited (range: 0.5-4 μg/ml). The resistance breakpoint for amikacin, according to NCCLS guidelines, is a MIC ≥ 64 μg/ml. Therefore, isolates that had an amikacin MIC ≥ 4 μg/ml were additionally tested by E-test (AB BIODISK, Solna, Sweden) to determine amikacin susceptibility. Multidrug resistance was defined as resistance to two or more antimicrobial agents.

A review of NARMS *Campylobacter* data showed a higher than expected proportion of isolates that were resistant to erythromycin and gentamicin in 1997. Therefore, all NARMS *Campylobacter* isolates with any resistance in 1997 were re-tested. This report reflects these more recent test results. Furthermore, it was observed that more than 53 *Campylobacter* isolates were submitted to CDC NARMS from Georgia (N=81) and Minnesota (N=59) in 1998, and New York (N=54) in 1999. The additional isolates, from those states for those years, were excluded from analyses using the criterion that no more than four or five isolates could be included each month depending on the number of Mondays in that month until no more than the maximum number of isolates (N=53) per year, in each state, were included in NARMS. This report also reflects these changes.

Logistic regression analyses were performed to assess the change in antimicrobial resistance among *Salmonella* isolates tested in NARMS in 2002 compared to previous years for the following: 1) ceftriaxone, ciprofloxacin, and nalidixic acid resistance among non-Typhi *Salmonella*, 2) nalidixic acid resistance among *Salmonella* Typhi, 3) multidrug resistance among *Salmonella* Newport, and 4) multidrug resistance among *Salmonella* Typhimurium. Multivariate logistic regression analyses were performed to assess the change in ciprofloxacin resistance among *Campylobacter spp*. and *Campylobacter jejuni* isolates tested in NARMS in 2002 compared to previous years. All final multivariate models took into account both population variation and site variation.

When describing results from several years, multidrug resistance for *Salmonella*, *E. coli* O157, and *Shigella* isolates was limited to the 14 agents tested in all years from 1996 to 2002 (amoxicillin-clavulanic acid, ampicillin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole). Similarly, when describing multidrug resistance for several years for *Campylobacter* isolates, multidrug resistance was limited to the 6 agents tested in all years from 1997 to 2002 (chloramphenicol, ciprofloxacin, clindamycin, erythromycin, nalidixic acid, tetracycline).

In this report, the “baseline” prevalence of resistance used in the graphs included data from the first three years of surveillance, 1996, 1997, and 1998, for non-Typhi *Salmonella* and *E. coli* O157. For *Campylobacter*, the baseline prevalence of resistance includes data from the first two years of surveillance: 1997 and 1998.

Results

<u>Non-Typhi *Salmonella*</u>

Results for 2002

A total of 2112 non-Typhi *Salmonella* isolates were received at CDC in 2002 [Figure 1]; of these isolates, 2059 (97%) were viable and tested for antimicrobial susceptibility. Of these 2059 isolates, 50 isolates were eliminated from analysis because they were duplicate submissions (32 isolates) or the county of residence was outside the catchment area (18 isolates), leaving 2009 isolates tested for susceptibility to 16 antimicrobial agents for analysis.

Figures 2a-2p provide Sensititre® MIC results for the non-Typhi *Salmonella* isolates for 16 antimicrobial agents tested in 2002. Among the 2009 non-Typhi *Salmonella* isolates, 424 (21%) were resistant to one or more antimicrobial agents, 321 (16%) were resistant to two or more agents, 188 (9%) were resistant to five or more agents, and 69 (3%) were resistant to eight or more agents [Figure 3]. Of the 199 isolates resistant to five or more agents, 107 (54%) were serotype Typhimurium and 56 (28%) were serotype Newport. Of the 69 isolates resistant to eight or more agents, 53 (77%) were serotype Newport and 8 (12%) were serotype Typhimurium. The antimicrobial agents to which the 2009 *Salmonella* demonstrated the highest prevalence of resistance were tetracycline, streptomycin, ampicillin, and sulfamethoxazole: 299 (15%) were resistant to tetracycline, 265 (13%) were resistant to streptomycin, 259 (13%) were resistant to ampicillin, and 258 (13%) were resistant to sulfamethoxazole [Table 3, Figure 4]. Tables 4a through 4e show the correlation of resistance among non-Typhi *Salmonella*, *Salmonella* Typhi, *Shigella*, *E. coli* O157, and *Campylobacter* isolates, respectively. These correlation tables are useful to determine the co-resistance between and to antimicrobial agents. For example, among the 87 non-Typhi *Salmonella* isolates resistant to ceftiofur, 87 (100%) were additionally resistant to ampicillin and cephalothin, 86 (99%) were resistant to amoxicillin-clavulanic acid, 84 (97%) were resistant to cefoxitin, 72 (83%) were resistant to streptomycin, 71 (82%) were resistant to sulfamethoxazole and tetracycline, and 68 (78%) were resistant to chloramphenicol.

Among 2009 *Salmonella* isolates tested, 1946 (97%) could be serotyped, of which 393 (20%) were serotype Typhimurium (includes serotype Typhimurium var. Copenhagen), 338 (17%) were serotype Enteritidis, 239 (12%) were serotype Newport, 106 (5%) were serotype Javiana, and 105 (5%) were serotype Heidelberg. The 16 most common serotypes accounted for 78% (1571/2009) of isolates that were serotyped [Table 5]. The serotypes with the highest proportion of isolates that were pansusceptible (among the 16 most common serotypes) were Braenderup and Oranienburg (100%, respectively), Javiana (96%), and Mississippi (96%); the serotypes with the highest proportion of isolates that were resistant to one or more antimicrobial agents were Hadar (87%), Typhimurium (40%), Heidelberg (32%), and Newport (27%) [Table 6, Table 7]. Figures 5a-5p provide susceptibility results for each of the antimicrobial agents tested, for the 16 most common serotypes. Among the 393 *S.* Typhimurium isolates, 157 (40%) were resistant to one or more antimicrobial agents and 143 (36%) were multidrug resistant. Among the 338 *S.* Enteritidis isolates, 44 (13%) were resistant to one or more antimicrobial agents and 14 (4%) were multidrug resistant [Table 7]. Among the 239 *S*. Newport isolates, 65 (27%) were resistant to one or more antimicrobial agents and 60 (25%) were multidrug resistant; 88% (53/60) of the multidrug resistant *S.* Newport were resistant to 8 or more antimicrobials. Among the 105 *S*. Heidelberg isolates, 34 (32%) were resistant to one or more antimicrobial agents and 28 (27%) were multidrug- resistant. The serotypes with the highest proportion of multidrug resistance were Hadar (74%), Typhimurium (36%), Heidelberg (27%), and Newport (25%). Table 8 provides data on multidrug resistance among the most common serotypes in each site.

Figure 6 shows NARMS participating sites by census regions in the United States. Figure 7 shows the percent of *S*. Typhimurium isolates among non-Typhi *Salmonella* submitted by each of the nine census regions. In recent years, two multidrug-resistant phenotypes of *S.* Typhimurium have been frequently identified. The most prominent strain is resistant to at least ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, and tetracycline (R-type ACSSuT), a phenotype commonly associated with Definitive Phage Type 104 (DT104) [Table 9]. Among 393 *S.* Typhimurium isolates tested in 2002, 84 (21%) had at least the R-type ACSSuT resistance pattern [Figure 8]. Of the 84 *S.* Typhimurium isolates with at least the R-type ACSSuT resistance pattern, 17 (20%) were also resistant to amoxicillin-clavulanic acid, 10 (12%) to kanamycin, 7 (8%) to cefoxitin, 7 (8%) to ceftiofur, 7 (8%) to cephalothin, 5 (6%) to trimethoprim-sulfamethoxazole, 2 (2%) to gentamicin, and 2 (2%) to nalidixic acid [Table 10]. A second multidrug resistant strain, resistant to at least ampicillin, kanamycin, streptomycin, sulfamethoxazole, and tetracycline (R-type AKSSuT), was also common among *S*. Typhimurium [Table 10]. Among 393 *S.* Typhimurium isolates tested in 2002, 24 (6%) had at least the R-type AKSSuT resistance pattern [Figure 9]. Of the 24 *S.* Typhimurium isolates with at least the R-type AKSSuT resistance pattern, 10 (42%) were also resistant to chloramphenicol, 3 (13%) to gentamicin, 2 (8%) to amoxicillin-clavulanic acid, 2 (8%) to cefoxitin, 2 (8%) to ceftiofur, 2 (8%) to cephalothin, 1 (4%) to nalidixic acid, and 1 (4%) to trimethoprim-sulfamethoxazole [Table 10].

Figure 10 shows the percent of *S.* Newport isolates submitted by region. The most common multidrug-resistant phenotype among *S.* Newport was resistance to amoxicillin/clavulanic acid, ampicillin, cephalothin, cefoxitin, ceftiofur, chloramphenicol, streptomycin, sulfamethoxazole, tetracycline, and decreased susceptibility to ceftriaxone (MDR-AmpC). Among the 239 *S.* Newport isolates tested in 2002, 53 (22%) had at least the MDR-AmpC resistance pattern [Figure 11]. Of the 53 *S.* Newport with at least the MDR-AmpC resistance pattern, 22 (41%) were additionally resistant to kanamycin, 8 (15%) to gentamicin, 1 (2%) to nalidixic acid, 9 (17%) to trimethoprim-sulfamethoxazole, and 2 (4%) to ceftriaxone [Table 12].

Figure 12 shows the percent of *S*. Heidelberg isolates submitted by region. The most common multidrug-resistant phenotype among *S*. Heidelberg isolates was resistance to at least ampicillin, amoxicillin-clavulanic acid, ceftiofur, and cephalothin (R-type AClCfCp). Among the 105 *S*. Heidelberg isolates tested in 2002, 8 (8%) were at least R-type AClCfCp [Figure 13]. Of the 8 *S*. Heidelberg isolates with R-type AClCfCp, 2 (25%) were additionally resistant to streptomycin, 2 (25%) to tetracycline, 1 (12%) to chloramphenicol, 1 (12%) to sulfamethoxazole, and 1 (12%) to trimethoprim-sulfamethoxazole [Table 13].

The four most common multidrug resistant phenotypes in 2002 were *S*. Typhimurium with at least the ACSSuT resistance pattern, *S*. Newport with at least the MDR-AmpC resistance pattern, *S*. Typhimurium with at least the AKSSuT resistance pattern, and *S*. Heidelberg with at least the AClCfCp resistance pattern [Table 14]. These multidrug resistant phenotypes, respectively, accounted for 4%, 3%, 1%, and 0.4% of all non-Typhi *Salmonella* isolates and 26%, 16%, 7%, and 2% of the multidrug resistant non-Typhi *Salmonella* isolates in 2002. Table 15 describes the clinical source of all non-Typhi *Salmonella* isolates tested in 2002. Of the 2009 non-Typhi *Salmonella* isolates, 1688 (84%) were collected from stool specimens, 110 (5%) were from blood specimens, 125 (6%) were from other sources, and 86 (4%) were from an unknown source.

Table 16 shows the proportion of non-Typhi *Salmonella* isolates that showed resistance to nalidixic acid, decreased susceptibility to ciprofloxacin, or resistance to ciprofloxacin, and resistance to ceftiofur, decreased susceptibility to ceftriaxone, or resistance to ceftriaxone. Table 17 shows the proportion of non-Typhi *Salmonella* isolates with resistance to nalidixic acid or decreased susceptibility to ciprofloxacin by site. Sixteen non-Typhi *Salmonella* isolates (1%) had a decreased susceptibility to ciprofloxacin; of which, 1 (6%) was resistant to ciprofloxacin. Table 18 shows the proportion of non-Typhi *Salmonella* isolates with resistance to ceftiofur and decreased susceptibility to ceftriaxone by site. Eighty-seven non-Typhi *Salmonella* isolates (4%) had a decreased susceptibility to ceftriaxone; of which 4 (4%) were resistant to ceftriaxone.

Changes in Antimicrobial Resistance since 1996

In 1996, 34% (103/306) of *S.* Typhimurium isolates tested had at least the R-type ACSSuT resistance pattern [Table 19, Table 20]. This proportion was 35% (115/327) in 1997; after which, it decreased to 32% (120/377) in 1998, 28% in both 1999 (102/363) and 2000 (84/303), then 29% (96/325) in 2001, and 21% (84/393) in 2002. Using a logistic regression model, the proportion of *S*. Typhimurium isolates with at least the R-type ACSSuT resistance pattern in 2002 is statistically lower than in 1996 (OR=0.5, 95% CI [0.4, 0.8]). Although a decline also was seen among *S.* Typhimurium isolates with at least the R-type AKSSuT resistance pattern, the proportion of *S*. Typhimurium isolates with at least the R-type AKSSuT resistance pattern in 2002 is not statistically different than in 1996 (95% CI [0.3, 1.3]). In 1996, the prevalence of R-type AKSSuT among *S.* Typhimurium was 9% (27/306). This proportion rose to 13% (41/327) in 1997, then declined to 12% (47/377) in 1998, 11% (39/363) in 1999, 9% (28/303) in 2000, 5% (15/325) in 2001, and 6% (24/393) in 2002 [Table 19, Table 20].

In 1996 and 1997, none of the *S.* Newport isolates had at least the MDR-AmpC resistance pattern. This proportion increased to 1% (1/77) in 1998, 17% (17/98) in 1999, 22% (27/124) in 2000, 25% (31/124) in 2001, and 22% (53/239) in 2002 [Table 19, Table 20]. Using a logistic regression model, *S*. Newport isolates in 2002 were more likely to have at least the MDR-AmpC resistance pattern than isolates in 1996 ($p<.01$).

The percentage of non-Typhi *Salmonella* isolates that were resistant to nalidixic acid was 0.4% (5/1326) in 1996 and 2% (37/2009) in 2002; the percentage of non-Typhi *Salmonella* isolates with decreased susceptibility to ciprofloxacin was 0.4% (5/1326) in 1996 and 1% (16/2009) in 2002; the percentage resistant to ciprofloxacin was 0% in 1996 and 0.05% in 2002 [Table 19]. Using a logistic regression model, there was a significant difference in the proportion of non-Typhi *Salmonella* isolates resistant to nalidixic acid in 2002, compared to 1996 (OR=5.0, 95% CI [1.8, 13.7]). There was no significant difference in the proportion of non-Typhi *Salmonella* isolates with decreased susceptibility to ciprofloxacin in 2002, compared to 1996 (95% CI [0.7, 6.1]).

Additionally, the percentage of non-Typhi *Salmonella* isolates resistant to ceftiofur was 4% (53/1326) in 1996 and 4% (87/2009) in 2002; the percentage of non-Typhi *Salmonella* isolates with decreased susceptibility to ceftriaxone was 3% (37/1326) in 1996 and 4% (87/2009) in 2002; the percentage resistant to ceftriaxone was 0% in 1996 and 0.2% in 2002 [Table 19]. Using a logistic regression model, there was not a statistically significant difference in the proportion of non-Typhi *Salmonella* isolates with decreased susceptibility to ceftriaxone in 2002 compared to 1996 (95% CI [0.9, 2.7]).

For ceftriaxone, this report only includes antimicrobial susceptibility testing using Sensititre®. Previous annual reports included results using Sensititre® and retest results using E-test and by-hand broth microdilution. E-test criteria used in previous annual reports included isolates with a ceftriaxone MIC ≥ 16 µg/ml by Sensititre® (1996-1998). By-hand broth microdilution criteria included isolates with a ceftiofur MIC ≥ 4 µg/ml and/or ceftriaxone MIC ≥ 2 µg/ml by Sensititre® (1999-2001).

***Salmonella* Typhi**

Results for 2002

A total of 247 *S.* Typhi isolates were received at CDC in 2002 [Figure 1]; 228 (92%) were viable upon receipt and tested for antimicrobial susceptibility. Of these 228 isolates, 33 isolates were eliminated from analysis because they were duplicate submissions (27 isolates) or the county of residence was outside the catchment area (6 isolates), leaving 195 isolates for analysis. Among the 195 *S.* Typhi isolates, 50 (26%) were resistant to one or more antimicrobial agents and 14 (7%) were resistant to two or more agents [Table 34]. The most common resistances among the 195 *S.* Typhi isolates were to nalidixic acid (24%), streptomycin (7%), tetracycline (7%), and trimethoprim-sulfamethoxazole (7%) [Table 3, Figure 14]. Figures 15a-15p provide data on *Salmonella* Typhi MICs by antimicrobial agent. None of the *S.* Typhi isolates tested were resistant to amikacin, amoxicillin-clavulanic acid, cefoxitin, ceftiofur, ceftriaxone, ciprofloxacin, gentamicin, or kanamycin.

Changes in Antimicrobial Resistance since 1999

In 1999, 12% (20/166) of *S.* Typhi isolates tested were resistant to at least ampicillin, chloramphenicol, and trimethoprim-sulfamethoxazole (ACSuTm) [Table 21]. This proportion decreased to 9% (16/177) in 2000; after which, it rose to 18% (35/197) in 2001, then decreased again to 6% (11/195) in 2002. The percentage of *S*. Typhi isolates resistant to nalidixic acid increased from 19% (31/166) in 1999 to 24% (46/195) in 2002. Using a logistic regression model, there was no significant difference in the proportion of nalidixic acid-resistant *S*. Typhi isolates in 2002 than isolates in 1999 (95% CI [0.6, 2.9]).

Shigella

Results for 2002

A total of 740 *Shigella* isolates were received at CDC in 2002 [Figure 1]; 627 (85%) were viable and tested for antimicrobial susceptibility. Seven isolates were eliminated from analysis because they were duplicate submissions (5 isolates) or the county of residence was outside the catchment area (2 isolates), leaving 620 isolates for analysis. Of the 620 isolates analyzed, 536 (86%) were *S. sonnei*, 73 (12%) were *S. flexneri*, 7 (1%) were *S. boydii*, and 3 (0.5%) were *S. dysenteriae*. [Table 23]. Among the 620 *Shigella* isolates, 569 (92%) were resistant to one or more antimicrobial agents and 359 (58%) were multidrug resistant [Table 34]. The most common resistances among the 620 *Shigella* isolates were to ampicillin (77%), streptomycin (54%), trimethoprim-sulfamethoxazole (37%), sulfamethoxazole (32%), and tetracycline (31%) [Table 24, Figure 16]. The 536 *Shigella sonnei* isolates were most frequently resistant to ampicillin (78%), streptomycin (55%), trimethoprim-sulfamethoxaxole (38%), and sulfamethoxazole (30%) [Figure 17a]. The most common resistances among the 73 *Shigella flexneri* isolates were to tetracycline (78%), ampicillin (75%), and chloramphenicol (63%) [Figure 17b]. Figures 18a-18p and 19a-19p provide data on *Shigella sonnei* and *Shigella flexneri* MICs by antimicrobial agent. One *Shigella* isolate (0.2%) had decreased susceptibility to ceftriaxone; none were resistant to ceftriaxone. None of the *Shigella* isolates tested were resistant to amikacin, ceftriaxone, or ciprofloxacin.

Changes in Antimicrobial Resistance since 1999

In 1999, 78% (291/375) of *Shigella* isolates tested were resistant to ampicillin; this percentage increased to 80% (274/344) in 2001, then decreased to 77% (475/620) in 2002 [Table 25]. Among *Shigella sonnei*, the percentage of isolates resistant to ampicillin was 80% (219/275) in 1999, 83% (198/239) in 2001, and 77% (416/536) in 2002 [Table 26]. Among *Shigella flexneri*, 77% (67/87) of isolates were resistant to ampicillin in 1999, 73% (66/91) in 2001, and 75% (55/73) in 2002 [Table 27]. The percentage of *Shigella* isolates resistant to trimethoprim-sulfamethoxaxole was 51% (193/375) in 1999, 53% (239/451) in 2000, 47% (161/344) in 2001, and 37% (231/620) in 2002 [Table 25]. Among *Shigella sonnei*, the percentage of isolates resistant to trimethoprim-sulfamethoxaxole was 53% (146/275) in 1999, 55% (202/367) in 2000, 51% (121/239) in 2001, and 38% (203/536) in 2002 [Table 26]. Among *Shigella flexneri*, 48% (42/87) of isolates were resistant to trimethoprim-sulfamethoxaxole in 1999, 43% (32/75) in 2000, 34% (31/91) in 2001, and 29% (21/73) in 2002 [Table 27].

From 1999 to 2002 there was a decrease in the percentage of *Shigella* isolates with the ACSuTm (ampicillin, chloramphenicol, and trimethoprim-sulfamethoxazole) resistance pattern, representing 10% (37/375), 7% (31/451), 7% (24/344), and 3% (17/620) of isolates in 1999, 2000, 2001, and 2002, respectively. No *Shigella* isolates tested in 1999 and 2000 were resistant to ciprofloxacin; one isolate was resistant to ciprofloxacin in 2001, and none were resistant in 2002.

E. coli O157

Results for 2002

A total of 468 *E. coli* O157 isolates were received at CDC in 2002 [Figure 1]; 404 (97%) were viable and tested for antimicrobial susceptibility. Of these 404 isolates, 5 isolates were eliminated from analysis because they were duplicate submissions (1 isolate) or the county of residence was outside the catchment area (4 isolates), leaving 399 isolates for analysis. Among the 399 *E. coli* O157 isolates, 28 (7%) were resistant to one or more antimicrobial agents and 15 (4%) were multidrug resistant [Table 34]. The most common resistances among the 399 *E. coli* O157 isolates were to sulfamethoxazole (3%), tetracycline (3%), and streptomycin (2%) [Table 3, Figure 20]. Figures 21a-21p provide data on *E. coli* O157 MICs by antimicrobial agent. None of the *E. coli* O157 isolates tested were resistant to amikacin, amoxicillin/clavulanic acid, cefoxitin, ceftiofur, ceftriaxone, ciprofloxacin, or gentamicin. Four (1%) of the 399 *E. coli* O157 isolates were resistant to nalidixic acid; one (0.2%) had a decreased susceptibility to ciprofloxacin. None of the *E. coli* O157 isolates had a decreased susceptibility to ceftriaxone.

Changes in Antimicrobial Resistance since 1996

No *E. coli* O157 isolates were nalidixic acid-resistant from 1996 to 1998. The number of isolates resistant to nalidixic acid was 2 (1%) isolates in 1999, 2 (0.5%) in 2000, 3 (1%) in 2001, and 4 (1%) in 2002 [Table 22].

General Limitations

The major limitations in NARMS surveillance of non-Typhi *Salmonella*, *Salmonella* Typhi, *Shigella*, and *E. coli* O157 are the sampling scheme and the limited geographic area under surveillance. It is important to evaluate whether these limitations might affect the measured rates of antimicrobial resistance.

In 2002, NARMS participating public health laboratories systematically selected every tenth non-Typhi *Salmonella* and *Shigella* isolate, and every fifth *E. coli* O157 isolate received at their laboratory, and forwarded those isolates to CDC for antimicrobial susceptibility testing. NARMS participating public health laboratories are instructed to maintain a running count of non-Typhi *Salmonella*, *Shigella*, and *E. coli* O157 isolates received and to systematically select every tenth non-Typhi *Salmonella* and *Shigella* isolate and every fifth *E. coli* O157 isolate for NARMS; when the isolates are selected, the antimicrobial resistance pattern of the isolates is not known. It is therefore unlikely that the antimicrobial resistance pattern of an isolate would influence submission of the isolate to NARMS. Furthermore, a comparison of NARMS data with those generated by the Public Health Laboratory Information System (PHLIS) [see http://www.cdc.gov/ncidod/dbmd/phlisdata/default.htm] showed that in 2002 the top five *Salmonella* serotypes reported to PHLIS also were the top five *Salmonella* serotypes submitted to NARMS. Furthermore, CDC NARMS received approximately 10% of non-Typhi *Salmonella* reported to PHLIS by NARMS participating sites, suggesting that NARMS sites adhered to the sampling scheme. Given that NARMS receives every *Salmonella* Typhi isolate.surveillance of *Salmonella* Typhi is not subject to the same sampling limitation as non-Typhi *Salmonella*, *Shigella*, and *E. coli* O157.

There were 28 public health departments participating in NARMS surveillance of non-Typhi *Salmonella*, *Salmonella* Typhi, *Shigella*, and *E. coli* O157 in 2002, representing approximately 156 million persons or 56% of the United States population. Because NARMS 2002 surveillance was not nationwide, generalization to the United States population should be done with caution due to potential regional differences in the prevalence of antimicrobial resistance among these microorganisms.

Campylobacter

Results for 2002

A total of 511 presumptive *Campylobacter* isolates were received at CDC in 2002; of these isolates, 430 (84%) were viable upon receipt. Of these 430 isolates, isolates were eliminated from analysis because they were duplicate submissions (3 isolates), were not part of the sampling scheme (63), or were not *Campylobacter* (10 isolates), leaving 354 isolates tested for antimicrobial susceptibility to 8 antimicrobial agents for analysis. Of the 354 isolates tested, 329 (93%) were *C. jejuni* and 25 (7%) were *C. coli* [Table 28].

Among the 354 *Campylobacter* isolates tested, 180 (51%) were resistant to one or more antimicrobial agents and 74 (21%) were resistant to two or more agents [Table 34]. The most common resistances among the 354 *Campylobacter* isolates were to tetracycline (40%), nalidixic acid (21%), and ciprofloxacin (20%) [Table 31, Figure 22]. None of the *Campylobacter* isolates tested were resistant to chloramphenicol or gentamicin.

Among the 329 *Campylobacter jejuni* isolates, 170 (52%) were resistant to one or more antimicrobial agents and 70 (21%) were resistant to two or more agents [Table 34]. The most common resistances among the 329 *Campylobacter jejuni* isolates were to tetracycline (40%) followed by nalidixic acid (21%) and ciprofloxacin (21%) [Table 32, Figure 23a]. Figures 24a-24h provide data on *C. jejuni* MICs by antimicrobial agent. The proportion of ciprofloxacin-resistance *C. jejuni* varied by site: Colorado 8/28 (29%), Georgia 12/43 (28%), Oregon 9/33 (27%), Minnesota 13/51 (25%), Connecticut 7/30 (23%), Maryland 4/24 (17%), New York 7/46 (15%), California 6/47 (13%), and Tennessee 2/27 (7%) [Table 30].

Among the 25 *Campylobacter coli* isolates, 10 (40%) were resistant to one or more antimicrobial agents and 4 (16%) were resistant to two or more agents [Table 34]. The most common resistances among the 25 *Campylobacter coli* isolates were to tetracycline (40%), ciprofloxacin (12%), nalidixic acid (12%), and azithromycin (8%) [Table 33, Figure 23b]. Figures 25a-25h provide data on *C. coli* MICs by antimicrobial agent.

Changes in Antimicrobial Resistance since 1997

The percentage of *Campylobacter* isolates resistant to ciprofloxacin was 13% (28/217) in 1997, 13% (42/310) in 1998, 18% (58/318) in 1999, 14% (46/324) in 2000, 19% (75/384) in 2001, and 20% (71/354) in 2002 [Table 31]. The percentage of *Campylobacter jejuni* isolates resistant to ciprofloxacin was 12% (26/209) in 1997, 14% (41/297) in 1998, 18% (52/294) in 1999, 14% (43/306) in 2000, 18% (67/365) in 2001, and 21% (68/329) in 2002 [Table 32]. The percentage of *Campylobacter coli* isolates resistant to ciprofloxacin was 33% (2/6) in 1997, 0% (0/8) in 1998, 30% (6/20) in 1999, 25% (3/12) in 2000, 47% (8/17) in 2001, and 12% (3/25) in 2002 [Table 33]. During the same time period, the percentage of *Campylobacter* isolates resistant to nalidixic acid increased from 14% (31/217) in 1997 to 21% (73/354) in 2002; the percentage of *Campylobacter jejuni* isolates resistant to nalidixic acid increased from 13% (28/209) in 1997 to 21% (70/329) in 2002; whereas, the percentage of *Campylobacter coli* isolates resistant to nalidixic acid decreased from 50% (3/6) in 1997 to 12% (3/25) in 2002.

In the multivariate logistic regression model, the proportion of *Campylobacter* isolates resistant to ciprofloxacin in 2002, controlling for site variation and age, was 2.4 times higher (95% CI [1.4, 4.1]) than in 1997. This increase was relatively consistent, with the proportion of ciprofloxacin-resistant *Campylobacter* increasing every year compared with the previous year, except in 2000. When restricting the multivariate logistic regression analysis to *Campylobacter jejuni* isolates only, the proportion of *C. jejuni* isolates was 2.4 times more likely (95% CI [1.4, 4.1]) to be resistant to ciprofloxacin in 2002 than in 1997.

Limitations

Three limitations are evident in NARMS 2002 *Campylobacter* surveillance, the use of sentinel clinical laboratories in some states, the sampling scheme, and the limited geographic area under surveillance.

In four states that participated in NARMS *Campylobacter* surveillance in 2002 (California, Colorado, Connecticut, and Oregon), *Campylobacter* isolates were submitted to NARMS from one sentinel clinical laboratory. In Georgia, Maryland, Minnesota, New York, and Tennessee, the *Campylobacter* isolates submitted to NARMS were selected (usually the first isolate received each week is selected, but otherwise isolates were randomly selected) from all *Campylobacter* isolates from most clinical laboratories within a specific geographical area (metro Atlanta area in Georgia, statewide in Maryland and Minnesota, the metro Albany and Rochester areas in New York, and the metro Gallatin, Knoxville, and Nashville areas in Tennessee). In California, Colorado, Connecticut, and Oregon, the sentinel clinical laboratory selected the first *Campylobacter* isolate isolated each week for submission to NARMS; if no isolate was isolated in a week, then no isolate was submitted from that laboratory. Since none of the sentinel clinical laboratories used an isolation procedure that was more or less likely to yield antimicrobial-resistant *Campylobacter* isolates than other clinical laboratories in their respective states, it is unlikely that the use of a sentinel clinical laboratory would be associated with an increased or decreased likelihood of antimicrobial resistance among *Campylobacter* isolates submitted to NARMS.

In 2002, the NARMS participating public health laboratory in Maryland, Minnesota, New York, and Tennessee, FoodNet personnel in Georgia, and sentinel clinical laboratories in all other FoodNet sites, selected one *Campylobacter* isolate each week and forwarded the isolate to CDC. When the isolates were selected, the antimicrobial resistance pattern of the isolates was not known. Therefore, it is unlikely that the antimicrobial resistance pattern of an isolate would influence submission of the isolate to NARMS. However, the one-a-week sampling scheme could result in over- or under-sampling of antimicrobial-resistant isolates if the prevalence of such resistance is not uniform throughout the year. The impact of the over- or under-sampling may be variable among states.

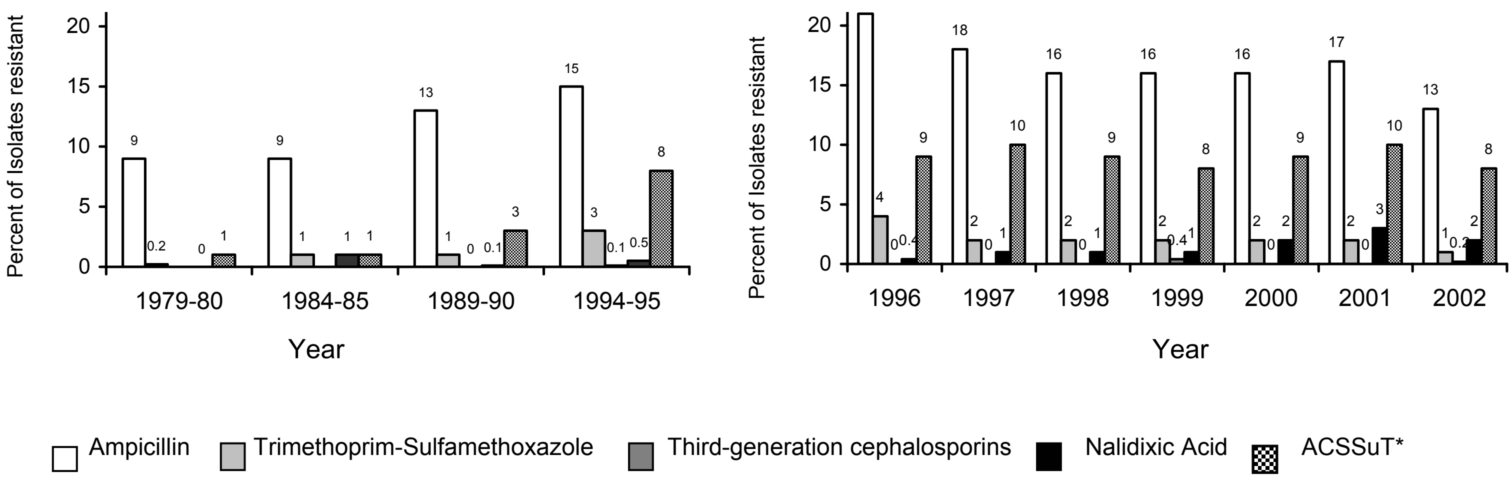
Campylobacter isolates were forwarded to CDC by nine FoodNet participating states in 2002, representing approximately 34 million persons or 13% of the United States population. Because NARMS 2002 *Campylobacter* surveillance was not nationwide, generalization to the United States population should be done with caution due to potential regional differences in the prevalence of antimicrobial resistance among *Campylobacter*.

Summary of Long Term Changes

Non-Typhi Salmonella isolates, 1979-2002

Sentinel county studies: 1979-1980, 1984-1985, 1989-1990, and 1994-1995

NARMS: 1996-2002

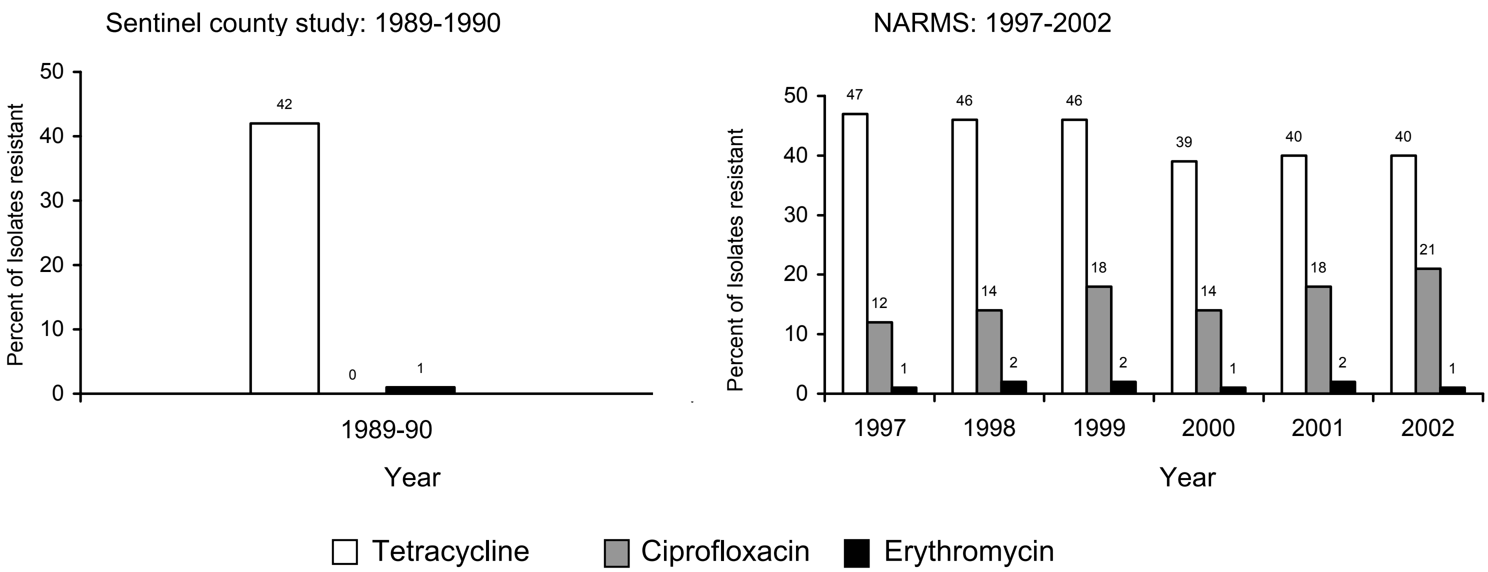


*ACSSuT = resistance to ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, and tetracycline; NT=Not Tested

For non-Typhi *Salmonella*, sentinel county surveys were conducted in 1979-80, 1984-85, 1989-90, and 1994-95 (1,2,3,4). Isolates were tested at CDC by disk diffusion. The National Antimicrobial Resistance Monitoring System (NARMS) for Enteric Bacteria began testing *Salmonella* in 1996. In NARMS, every 10th non-Typhi *Salmonella* isolate received at participating state public health laboratories is forwarded to CDC and tested by broth microdilution to determine partial range MICs to 16 antimicrobial agents.

Over the last quarter century, resistance among non-Typhi *Salmonella* has increased to a number of clinically important antimicrobial agents. Resistance to ampicillin and trimethoprim-sulfamethoxazole increased first, reaching 21% and 4%, respectively, in 1996. Resistance to third-generation cephalosporins (e.g., ceftriaxone), quinolones (e.g., nalidixic acid), and the ACSSuT resistance pattern increased more recently. A public health concern raised by this resistance is the loss of efficacious agents to treat serious *Salmonella* infections, especially in children. The clinical implications of current resistance levels are potential treatment failure, increased duration of illness, and increased length of hospitalization (3,5,6). For more information on treatment of *Salmonella* see Diagnosis and Management of Foodborne Illness: A Primer for Physicians (7).

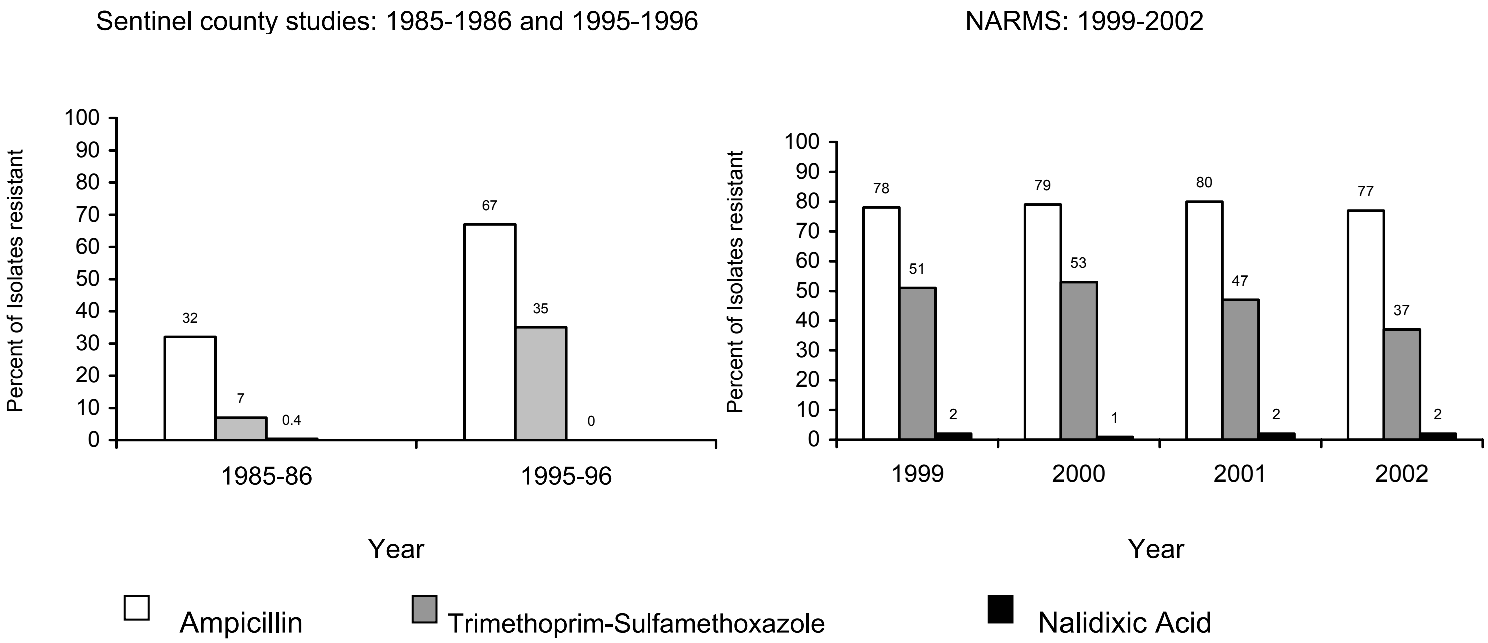
***Campylobacter jejuni* isolates, 1989-2002**



For *Campylobacter jejuni*, a sentinel county survey was conducted in 1989-90 (8). Isolates were received and tested at CDC. NARMS began testing *Campylobacter* in 1997. In NARMS, one *Campylobacter* isolate per week is forwarded to CDC from nine states and tested by E-test for susceptibility to eight antimicrobial agents.

Over the last 15 years, resistance among *Campylobacter jejuni* has increased to a number of clinically important antimicrobial agents. Resistance to tetracycline was already 42% in 1989-90. Resistance to ciprofloxacin increased more recently. No isolates resistant to ciprofloxacin were identified in 1989-90, 12% were resistant in 1997, and 21% in 2002. Resistance to erythromycin has remained low at 2% or less. Because the primary reservoir for *Campylobacter jejuni* is among poultry, it is likely that this increasing ciprofloxacin resistance is related to the use of fluoroquinolones, which were approved for use in poultry farming in 1995. A public health concern raised by this resistance is the threat to the efficacy of fluoroquinolones. The clinical implications of resistance to fluoroquinolones include an increased duration of illness and potential treatment failure (9). For more information on treatment of *Campylobacter* see Diagnosis and Management of Foodborne Illness: A Primer for Physicians (7).

***Shigella* isolates, 1985-2002**



For *Shigella*, sentinel county surveys were conducted in 1985-86 and 1995-96 (10). Isolates were received and tested at CDC. NARMS began testing *Shigella* in 1999. In NARMS, every 10th *Shigella* isolate received at participating state public health laboratories is forwarded to CDC and tested by broth microdilution to determine partial range MICs to 16 antimicrobial agents.

Over the last 17 years, resistance among *Shigella* has increased to a number of clinically important antimicrobial agents. Resistance to ampicillin was already 32% in 1985-86 and increased to 67% by 1995. Resistance to nalidixic acid emerged more recently. One *Shigella* isolate resistant to nalidixic acid was identified in 1985-86. The percentage of *Shigella* isolates resistant to nalidixic acid increased to 2% in 1999 and remains at 2% in 2002. A single isolate was resistant to ciprofloxacin in 2001. No resistance to ceftriaxone has been identified.

As *Shigella* have no environmental or animal reservoir except humans, it is likely that this resistance is related to the use of antimicrobials in human medicine. A public health concern raised by these resistances is the loss of efficacious agents to treat *Shigella* infections. The clinical implication of current resistance levels is potential treatment failure. This may be particularly important for infections related to international travel (11). For more information on treatment of *Shigella* see Diagnosis and Management of Foodborne Illness: A Primer for Physicians (7).

References

1. Riley L, Cohen M, Seals J, Blaser M, Birkness K, Hargrett N, Martin S, Feldman R. Importance of host factors in human salmonellosis caused by multiresistant strains of *Salmonella*. Journal of Infectious Diseases 1984; 149:878-83.

2. MacDonald K, Cohen M, Hargrett-Bean N, Wells J, Puhr N, Collin S, Blake P. Changes in antimicrobial resistance of *Salmonella* isolated from humans in the United States. JAMA 1987; 258:1496-9.

3. Lee L, Puhr N, Maloney E, Bean N, Tauxe R. Increase in antimicrobial-resistance *Salmonella* infectious in the United States, 1989-1990. Journal of Infectious Diseases 1994; 170:128-34.

4. Herikstad H, Hayes PS, Hogan J, Floyd P, Snyder L, Angulo FJ. Ceftriaxone-resistant *Salmonella* in the United States. Pediatric Infectious Disease Journal 1997; 16(9):904-5.

5. Molbak K, Baggesen D, Aarestrup F, Ebbesen J, Engberg J, Frydendahl K, Gerner-Smidt P, Petersen A, Wegener H. An outbreak of multidrug-resistant, quinolone-resistant *Salmonella enterica* serotype Typhimurium DT104. New England Journal of Medicine 1999; 341(19):1420-5.

6. Holmberg S, Solomon S, Blake P. Health and economic impacts of antimicrobial resistance. Reviews of Infectious Diseases 1987; 9:1065-78.

7. Available from URL: http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5002a1.htm

8. Gupta A, Nelson JM, Barrett TJ, Tauxe RV, Rossiter SP, Friedman CR, Joyce KW, Smith KE, Jones TF, Hawkins MA, Shiferaw B, Beebe JL, Vugia DJ, Rabatsky-Ehr, T, Benson JA, Root TP, Angulo FJ. Antimicrobial resistance among *Campylobacter* strains, United States, 1997-2001. Emerging Infectious Diseases Journal 2004; 10(6): 1102-9.

9. Nelson JM, Smith KE, Vugia DJ, Rabatsky-Her T, Segler S, Kassenborg H, Zansky S, Joyce K, Marano N, Hoekstra M, Angulo FJ. Prolonged diarrhea due to ciprofloxacin-resistant *Campylobacter* infections. Journal of Infectious Diseases 2004; 190: 1150-57.

10. Cook K, Boyce T, Puhr N, Tauxe R, Mintz E. Increasing antimicrobial-resistant *Shigella* infections in the United States. *In* Abstracts of the 36th Interscience Conference on Antimicrobial Agents and Chemotherapy, New Orleans, LA, September 1996.

11. National Committee for Clinical Laboratory Standards, 2001. Performance Standards for antimicrobial susceptibility testing. NCCLS approved standard M100-S11. National Committee for Clinical Laboratory Standards, Wayne, PA.

Publications and Abstracts, 2002

Publications

1. Crump J, Griffin P, Angulo FJ. Bacterial contamination of animal feed and its relationship to human foodborne illness. Clinical Infectious Diseases 2002; 35: 859-65.

2. Carattoli A, Tosini F, Giles W, Rupp M, Hinrichs S, Angulo FJ, Barrett TJ, Fey P. Characterization of plasmids carrying *cmy*-2 from expanded-spectrum cephalosporin-resistant *Salmonella* strains isolated in the United States between 1996 and 1998. American Society for Microbiology. May 2002: 1269-1275.

3. Ribot E, Wierzba R, Angulo FJ, Barrett TJ. *Salmonella enterica* serotype Typhimurium DT104 isolated from humans, United States, 1985, 1990, and 1995. Emerging Infectious Diseases Journal. April 2002; 8(4).

Abstracts

1. Anderson A, McClellan J, Joyce K, Barrett TJ, Angulo FJ, and the NARMS Working Group. Fluoroquinolone-resistant *Campylobacter jejuni* infections in the United States: NARMS data, 1997-2001. National Antimicrobial Resistance Monitoring System Annual Scientific Meeting. Hilton Head, SC. November 2002.

2. Anderson A, McClellan J, Joyce K, Barrett TJ, Angulo FJ, and the NARMS Working Group. Fluoroquinolone-resistant *Campylobacter jejuni* infections in the United States: NARMS data, 1997-2001. Infectious Diseases Society of America. Chicago, IL 2002.

3. Angulo FJ, Gupta A, Stevenson JE, Crowe C, McClellan J, Barrett TJ, Whichard J, and the NARMS Working Group. Emergence of Newport 9+, a highly resistant strain of *Salmonella* Newport in the United States. National Antimicrobial Resistance MOnitornign System Annual Scientific Meeting. Hilton Head, SC. November 2002.

4. Angulo FJ, Joyce K, McClellan J, Stamey K, Rossiter S, Barrett TJ, Anderson A, and the NARMS Working Group. Ciprofloxacin and ceftriaxone resistance among human non-Typhoidal Salmonella in the United States, 1996-2001. Infectious Diseases Society of America. Chicago, IL 2002.

5. Baker N, Angulo FJ, Joyce K, Stevenson JE, McClellan J, Whichard J, Gay K, Barrett TJ, and the NARMS Working Group. Ciprofloxacin and ceftriaxone resistance among human non-typhoidal *Salmonella* in the United States; 1996-2001. National Antimicrobial Resistance Monitoring System Annual Scientific Meeting. Hilton Head, SC. November 2002.

6. Bird M, Whichard J, Ribot E, Stevenson JE, Ahmed R, Barrett TJ. Assessing the emergence of a multidrug-resistant *Salmonella* serotype Newport using PFGE and plasmid profiling (1996-2000). Interscience Conference on Antimicrobial Agents and Chemotherapy. San Diego, CA 2002.

7. Chiller TM, McClellan J, Rossiter S, Stevenson JE, Gay K, Joyce K, Lewis K, Angulo FJ, and the EIP Enterococci Working Group. Antimicrobial resistance of enterococci isolates from outpatient stools in the United States, 1998-2001. Infectious Diseases Society of America. Chicago, IL 2002.

8. Drake A, McClellan J, Joyce K, Barrett TJ, Angulo FJ, and the NARMS Enterococci Working Group. High-level gentamicin-resistant enterococci and quinupristin/dalfopristin-resistant *E. faecium* from ground pork purchased from grocery stores. National Antimicrobial Resistance Monitoring System Annual Scientific Meeting. Hilton Head, SC. November 2002.

9. Fontana J, Stout A, Tyndall M, Bolstorff B, Rossiter S, Timperi R. The use of pulsed field gel electrophoresis and automated ribotyping to monitor the increased prevalence of a multidrug-resistant *Salmonella* serotype Newport in Massachusetts associated with cows. International Conference on Emerging Infectious Diseases. Atlanta, GA. March 2002.

10. Gay K, Joyce K, Stevenson JE, Angulo FJ, Barrett TJ, and the NARMS Working Group. Quinupristin-dalfopristin resistant *Enterococcus faecium* isolated from human stools, retail chicken, and retail pork: EIP Enterococci Project. International Conference on Emerging Infectious Diseases. Atlanta, GA. March 2002.

11. Gupta A, Stevenson JE, Crowe C, McClellan J, Barrett TJ, Whichard J, Angulo FJ, and the NARMS Working Group. Emergence of Newport 9+, a highly resistant strain of *Salmonella* Newport in the United States. Infectious Diseases Society of America. Chicago, IL 2002.

12. Gupta A, Crowe C, Fontana J, Stout A, Bolstorff B, McGuill M, Matvas B, Montgomery S, Pugsley N, Johnson B, Schoenfeld S, Angulo FJ. Cows, bugs, and drugs: an investigation of sporadic illnesses due to multidrug-resistant *Salmonella* Newport in Massachusetts and Vermont, 1998-2001. Epidemic Intelligence Service Annual Conference. Atlanta, GA 2002.

13. McClellan J, Reller M, Joyce K, Polyak C, Mintz E, Angulo FJ, and the NARMS Working Group. Emerging resistance to quinolones among *Salmonella* Typhi isolates in the United States, 1999-2001. National Antimicrobial Resistance Monitoring System Annual Scientific Meeting. Hilton Head, SC. November 2002.

14. McClellan J, Rossiter S, Joyce K, Stamey K, Anderson A, and the NARMS Working Group. Prevalence and consequences of fluoroquinolone-resistant *Campylobacter* infections: NARMS 1997-2000. International Conference on Emerging Infectious Diseases. Atlanta, GA. March 2002.

15. Molbak K, Varma J, Rossiter S, Lay J, Joyce K, Stamey K, Angulo FJ, and the NARMS Working Group. Antimicrobial resistance in *Salmonella* serotype Typhimurium, R-type ACSSuT, is associated with bacteremia: NARMS 1996-2000. International Conference on Emerging Infectious Diseases. Atlanta, GA. March 2002.

16. Reller M, McClellan J, Joyce K, Polyak C, Mintz E, Angulo FJ, and the NARMS Working Group. Emerging resistance to quinolones among Salmonella Typhi isolates in the United States, 1999-2001. Infectious Diseases Society of America. Chicago, IL 2002.

17. Rossiter S, Joyce K, Stevenson JE, Barrett TJ, Anderson A, and the NARMS Working Group. Multidrug resistance among human non-typhoidal *Salmonella i*solates in the United States: NARMS 1999-2000. International Conference on Emerging Infectious Diseases. Atlanta, GA. March 2002.

18. Rossiter S, McClellan J, Barrett TJ, Joyce K, Anderson A, and the NARMS Working Group. Emerging fluoroquinolone resistance among non-typhoidal *Salmonella* in the United States: NARMS 1996-2000. International Conference on Emerging Infectious Diseases. Atlanta, GA. March 2002.

19. Stevenson JE, White DG, Torpey DJ III, Craig AS, Smith KE, Park MM, Pascucilla MA, Anderson AD, and the FoodNet/NARMS Working Group. Enhanced surveillance for antimicrobial resistance among enteric bacteria: FoodNet/NARMS Retail Food Study. International Conference on Emerging Infectious Diseases. Atlanta, GA. March 2002.

20. Varma J, Molbak K, Rossiter S, Hawkins M, Jones T, Mauvais S, Rabatsky-Ehr T, Stenzel S, Vugia D, Park M, Joyce K, Stamey K, Chang H, Angulo FJ. Antimicrobial resistance in *Salmonella* is associated with increased hospitalization: FoodNet and NARMS 1996-2000. International Conference on Emerging Infectious Diseases. Atlanta, GA. March 2002.

21. Whichard J, Joyce K, Fey P, McClellan J, Angulo FJ, Barrett TJ, and the NARMS Working Group. Expanded-spectrum β-lactam resistance among human clinical enterobacteriaceae in the United States: Results and characterization of 2000 NARMS surveillance. International Conference on Emerging Infectious Diseases. Atlanta, GA. March 2002.

22. Wright J, Smith K, Tengelsen L, Grendon J, Boxrud D, Holland B, Anderson A. Outbreaks of multidrug-resistant *Salmonella* serotype Typhimurium infections associated with small animal veterinary facilities in Idaho, Minnesota, and Washington 1999. International Conference on Emerging Infectious Diseases. Atlanta, GA. March 2002.

Part II

Summary Tables and Graphs

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Table 1. Population size and number of isolates received and tested, by site, 2002

Site	Population Size*		Non-Typhi *Salmonella*		*Salmonella* Typhi		*Shigella*		*E. coli* O157		*Campylobacter***	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Arizona	5,441,125	(3)	46	(2)	0	(0)	18	(3)	6	(1)	N/A	
California (1)	25,195,409	(13)	44	(2)	10	(5)	8	(1)	6	(1)	52	(15)
Colorado	4,501,051	(2)	50	(2)	3	(1)	12	(2)	9	(2)	30	(8)
Connecticut	3,458,587	(2)	49	(2)	8	(4)	11	(2)	11	(3)	30	(8)
Florida	16,691,701	(9)	98	(5)	15	(8)	4	(1)	7	(2)	N/A	
Georgia	8,544,005	(4)	201	(10)	3	(1)	95	(15)	36	(9)	45	(13)
Hawaii	1,240,663	(1)	26	(1)	4	(2)	6	(1)	7	(2)	N/A	
Kansas	2,711,769	(1)	27	(1)	0	(0)	6	(1)	3	(1)	N/A	
Louisiana	4,476,192	(2)	103	(5)	1	(1)	38	(6)	0	(0)	N/A	
Los Angeles (2)	9,806,577	(5)	88	(4)	36	(18)	22	(3)	9	(2)	N/A	
Maine	1,294,894	(1)	15	(1)	0	(0)	1	(0.2)	8	(2)	N/A	
Maryland	5,450,525	(3)	115	(6)	11	(6)	103	(17)	8	(2)	28	(8)
Massachusetts	6,421,800	(3)	124	(6)	6	(3)	21	(3)	25	(6)	N/A	
Michigan	10,043,221	(5)	87	(4)	6	(3)	11	(2)	16	(4)	N/A	
Minnesota	5,024,791	(3)	57	(3)	4	(2)	19	(3)	28	(7)	53	(15)
Montana	910,372	(0.5)	7	(0)	0	(0)	0	(0)	3	(1)	N/A	
Nebraska	1,727,564	(1)	22	(1)	2	(1)	11	(2)	8	(2)	N/A	
New Jersey	8,575,252	(5)	86	(4)	11	(6)	75	(12)	19	(5)	N/A	
New Mexico	1,852,044	(1)	37	(2)	1	(0.5)	15	(2)	7	(2)	N/A	
New York City (3)	8,084,316	(4)	133	(7)	50	(26)	34	(5)	9	(2)	N/A	
New York State (4)	11,049,977	(6)	157	(8)	7	(4)	20	(3)	32	(8)	46	(13)
Oregon	3,520,355	(2)	35	(2)	0	(0)	8	(1)	37	(9)	38	(11)
South Dakota	760,437	(0.4)	19	(1)	0	(0)	9	(1)	9	(2)	N/A	
Tennessee	5,789,796	(3)	76	(4)	0	(0)	16	(3)	5	(1)	32	(9)
Texas	21,736,925	(12)	150	(7)	13	(7)	30	(5)	7	(2)	N/A	
Washington	6,067,060	(3)	76	(4)	3	(1)	18	(3)	42	(10)	N/A	
Wisconsin	5,439,692	(3)	58	(3)	1	(1)	5	(1)	38	(9)	N/A	
West Virginia	1,804,884	(1)	23	(1)	0	(0)	4	(1)	4	(1)	N/A	
Totals	**187,620,984**	**(100)**	**2009**	**(100)**	**195**	**(100)**	**620**	**(100)**	**399**	**(100)**	**354**	**(100)**

* County population 2002, U.S. Census Bureau, post-census estimates
** *Campylobacter* isolates are submitted only from FoodNet sites, population size of FoodNet sites is 37.4 million persons (see http://www.cdc.gov/foodnet/)
(1) Excluding Los Angeles County
(2) Los Angeles County
(3) Five boroughs of New York City (Bronx, Brooklyn, Manhattan, Queens, Staten Island)
(4) Excluding New York City

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Table 2. Antimicrobial agents used for susceptibility testing for *Salmonella*, *Shigella*, *E. coli* O157, and *Campylobacter* isolates, 2002

Antimicrobial Agent	Antimicrobial Agent Concentration Range (μg/ml)	Breakpoints [R]	[I]	[S]
Amikacin	0.5 – 4*	≥ 64	32	≤ 16
Amoxicillin – Clavulanic Acid	0.5/0.25 – 32/16	≥ 32/16	16/8	≤ 8/4
Ampicillin	2 – 32	≥ 32	16	≤ 8
Apramycin***	2 – 32	≥ 64	16 – 32	≤ 8
Azithromycin	0.016 – 256**	≥ 2	0.5-1	≤ 0.25
Cefoxitin	4-32	≥ 32 8	16	≤
Ceftiofur***	0.5 – 16	≥ 8	4	≤ 2
Ceftriaxone	0.25 – 64	≥ 64	16 - 32	≤ 8
Cephalothin	1 – 32	≥ 32	16	≤ 8
Chloramphenicol	4 – 32 0.016 – 256**	≥ 32	16	≤ 8
Ciprofloxacin	0.015 – 4 0.002 – 32**	≥ 4	2	≤ 1
Clindamycin	0.016 – 256**	≥ 4	1-2	≤ 0.5
Erythromycin	0.016 – 256**	≥ 8	1-4	≤ 0.5
Gentamicin	0.25 – 16 0.016 – 256**	≥ 16	8	≤ 4
Imipenem	0.25 – 8	≥ 16 4	8	≤
Kanamycin	16 – 64	≥ 64	32	≤ 16
Nalidixic Acid	4 –64 0.016 – 256**	≥ 32		≤ 16
Streptomycin	32 – 64	≥ 64		≤ 32
Sulfamethoxazole	128 – 512	≥ 512		≤ 256
Tetracycline	8 – 16 0.016 – 256**	≥ 16	8	≤ 4
Trimethoprim - Sulfamethoxazole	0.12/2.4 – 4/76	≥ 4/76		≤ 2/38

* The resistance breakpoint for amikacin, according to NCCLS guidelines, is a MIC ≥ 64 μg/ml. Isolates that had an amikacin MIC ≥ 4 μg/ml were additionally tested by E-test (AB BIODISK, Solna, Sweden) to determine amikacin susceptibility

** *Campylobacter* antimicrobial agents and concentration ranges used

*** No NCCLS interpretive standards for these antimicrobial agents

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Table 3. Antimicrobial resistance of *Salmonella, Shigella,* and *E. coli* O157 isolates, 2002

Antimicrobial Agent	**Non-Typhi *Salmonella* (N=2009)**		***Salmonella* Typhi (N=195)**		***Shigella* (N=620)**		***E. coli* O157 (N=399)**	
	N	**(%)**	**N**	**(%)**	N	(%)	**N**	**(%)**
Amikacin	0	(0)	0	(0)	0	(0)	0	(0)
Amoxicillin – Clavulanic Acid	106	(5)	0	(0)	16	(3)	0	(0)
Ampicillin	259	(13)	11	(6)	475	(77)	6	(1)
Cefoxitin	86	(4)	0	(0)	2	(0.3)	0	(0)
Ceftiofur	87	(4)	0	(0)	1	(0.2)	0	(0)
Ceftriaxone	4	(0.2)	0	(0)	0	(0)	0	(0)
Cephalothin	101	(5)	3	(1)	41	(7)	6	(1)
Chloramphenicol	172	(9)	12	(6)	47	(8)	5	(1)
Ciprofloxacin	1	(0.05)	0	(0)	0	(0)	0	(0)
Gentamicin	27	(1)	0	(0)	1	(0.2)	0	(0)
Kanamycin	76	(4)	0	(0)	5	(1)	2	(0.5)
Nalidixic Acid	37	(2)	46	(24)	10	(2)	4	(1)
Streptomycin	265	(13)	14	(7)	338	(54)	9	(2)
Sulfamethoxazole	258	(13)	12	(6)	197	(32)	14	(3)
Tetracycline	299	(15)	13	(7)	190	(31)	12	(3)
Trimethoprim - Sulfamethoxazole	28	(1)	13	(7)	231	(37)	2	(0.5)

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Table 4a. Additional resistance by antimicrobial agent for non-Typhi *Salmonella*, 2002

Resistance to: N	Pct.	Amika	AmoCl	Ampic	Cefox	Cefti	Ceftr	Cepha	Chlor	Cipro	Genta	Kanam	Naldx	Strep	Sulfa	Tetra	Tri-Sul
Amikacin [Amika] 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%
Amox-Clav [Amo-Cl] 106	5%	0 0%		104 98%	85 80%	86 81%	4 4%	93 88%	80 75%	1 1%	11 10%	29 27%	5 5%	84 79%	81 76%	83 78%	14 13%
Ampicillin [Ampic] 259	13%	0 0%	104 40%		84 32%	87 34%	4 2%	98 38%	165 64%	1 0.4%	15 6%	55 21%	6 2%	191 74%	193 75%	199 77%	25 10%
Cefoxitin [Cefox] 86	4%	0 0%	85 99%	84 98%		84 98%	4 5%	86 100%	67 78%	1 1%	11 13%	29 34%	4 5%	71 83%	69 80%	70 81%	14 16%
Ceftiofur [Cefti] 87	4%	0 0%	86 99%	87 100%	84 97%		4 5%	87 100%	68 78%	1 1%	11 13%	28 32%	4 5%	72 83%	71 82%	71 82%	15 17%
Ceftriaxone [Ceftr] 4	0.2%	0 0%	4 100%	4 100%	4 100%	4 100%		4 100%	3 75%	1 25%	1 25%	2 50%	1 25%	2 50%	3 75%	2 50%	0 0%
Cephalothin [Cepha] 101	5%	0 0%	93 92%	98 97%	86 85%	87 86%	4 4%		68 67%	1 1%	12 12%	31 31%	4 4%	74 73%	74 73%	73 72%	16 16%
Chloramphenicol [Chlor] 172	9%	0 0%	80 47%	165 96%	67 39%	68 40%	3 2%	68 40%		1 1%	12 7%	39 23%	5 3%	165 96%	168 98%	168 98%	21 12%
Ciprofloxacin [Cipro] 1	0.05%	0 0%	1 100%	1 100%	1 100%	1 100%	1 100%	1 100%	1 100%		0 0%	1 100%	1 100%	0 0%	1 100%	0 0%	0 0%
Gentamicin [Genta] 27	1%	0 0%	11 41%	15 56%	11 41%	11 41%	1 4%	12 44%	12 44%	0 0%		12 44%	1 4%	23 85%	27 100%	17 63%	4 15%
Kanamycin [Kanam] 76	4%	0 0%	29 38%	55 72%	29 38%	28 37%	2 3%	31 41%	39 51%	1 1%	12 16%		2 3%	68 89%	62 82%	71 93%	4 5%
Nalidixic Acid [Naldx] 37	2%	0 0%	5 14%	6 16%	4 11%	4 11%	1 3%	4 11%	5 14%	1 3%	1 3%	2 5%		6 16%	6 16%	7 19%	1 3%
Streptomycin [Strep] 265	13%	0 0%	84 32%	191 72%	71 27%	72 27%	2 1%	74 28%	165 62%	0 0%	23 9%	68 26%	6 2%		223 84%	239 90%	21 8%
Sulfamethoxazole [Sulfa] 258	13%	0 0%	81 31%	193 75%	69 27%	71 28%	3 1%	74 29%	168 65%	1 0.4%	27 10%	62 24%	6 2%	223 86%		219 85%	28 11%
Tetracycline [Tetra] 299	15%	0 0%	83 28%	199 67%	70 23%	71 24%	2 1%	73 24%	168 56%	0 0%	17 6%	71 24%	7 2%	239 80%	219 73%		22 7%
Trimeth-Sulfa [Tri-Su] 28	1%	0 0%	14 50%	25 89%	14 50%	15 54%	0 0%	16 57%	21 75%	0 0%	4 14%	4 14%	1 4%	21 75%	28 100%	22 79%	

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Table 4b. Additional resistance by antimicrobial agent for *Salmonella* Typhi, 2002

Resistance to: N	Pct.	Amika	AmoCl	Ampic	Cefox	Cefti	Ceftr	Cepha	Chlor	Cipro	Genta	Kanam	Naldx	Strep	Sulfa	Tetra	Tri-Sul
Amikacin [Amika] 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%
Amox-Clav [Amo-Cl] 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%
Ampicillin [Ampic] 11	6%	0 0%	0 0%		0 0%	0 0%	0 0%	3 27%	11 100%	0 0%	0 0%	0 0%	9 82%	11 100%	11 100%	11 100%	11 100%
Cefoxitin [Cefox] 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%
Ceftiofur [Cefti] 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%
Ceftriaxone [Ceftr] 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%
Cephalothin [Cepha] 3	2%	0 0%	0 0%	3 100%	0 0%	0 0%	0 0%		3 100%	0 0%	0 0%	0 0%	3 100%	3 100%	3 100%	3 100%	3 100%
Chloramphenicol [Chlor] 12	6%	0 0%	0 0%	11 92%	0 0%	0 0%	0 0%	3 25%		0 0%	0 0%	0 0%	10 83%	11 92%	11 92%	12 100%	12 100%
Ciprofloxacin [Cipro] 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%
Gentamicin [Genta] 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%
Kanamycin [Kanam] 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 [Naldx] 46	24%	0 0%	0 0%	9 20%	0 0%	0 0%	0 0%	3 7%	10 22%	0 0%	0 0%	0 0%		10 22%	9 20%	10 22%	10 22%
Streptomycin [Strep] 14	7%	0 0%	0 0%	11 79%	0 0%	0 0%	0 0%	3 21%	11 79%	0 0%	0 0%	0 0%	10 71%		12 86%	12 86%	12 86%
Sulfamethoxazole [Sulfa] 12	6%	0 0%	0 0%	11 92%	0 0%	0 0%	0 0%	3 25%	11 92%	0 0%	0 0%	0 0%	9 75%	12 100%		12 100%	12 100%
Tetracycline [Tetra] 13	7%	0 0%	0 0%	11 85%	0 0%	0 0%	0 0%	3 23%	12 92%	0 0%	0 0%	0 0%	10 77%	12 92%	12 92%		13 100%
Trimeth-Sulfa [Tri-Su] 13	7%	0 0%	0 0%	11 85%	0 0%	0 0%	0 0%	3 23%	12 92%	0 0%	0 0%	0 0%	10 77%	12 92%	12 92%	13 100%	

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Table 4c. Additional resistance by antimicrobial agent for *Shigella*, 2002

Resistance to:	N	Pct.	Amika	AmoCl	Ampic	Cefox	Cefti	Ceftr	Cepha	Chlor	Cipro	Genta	Kanam	Naldx	Strep	Sulfa	Tetra	Tri-Su
Amikacin [Amika]				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%
Amox-Clav [Amo-Cl]			0		16	2	0	0	10	4	0	0	0	0	6	5	6	5
	16	3%	0%		100%	13%	0%	0%	63%	25%	0%	0%	0%	0%	38%	31%	38%	31%
Ampicillin [Ampic]			0	16		2	1	0	40	47	0	1	5	3	254	165	158	185
	475	77%	0%	3%		0.4%	0.2%	0%	8%	10%	0%	0.2%	1%	1%	53%	35%	33%	39%
Cefoxitin [Cefox]			0	2	2		0	0	2	0	0	0	0	0	1	1	0	1
	2	0.3%	0%	100%	100%		0%	0%	100%	0%	0%	0%	0%	0%	50%	50%	0%	50%
Ceftiofur [Cefti]			0	0	1	0		0	1	1	0	1	0	0	1	1	1	1
	1	0.2%	0%	0%	100%	0%		0%	100%	100%	0%	100%	0%	0%	100%	100%	100%	100%
Ceftriaxone [Ceftr]			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%
Cephalothin [Cepha]			0	10	40	2	1	0		2	0	1	0	0	19	19	16	19
	41	7%	0%	24%	98%	5%	2%	0%		5%	0%	2%	0%	0%	46%	46%	39%	46%
Chloramphenicol [Chlor]			0	4	47	0	1	0	2		0	1	2	2	23	23	46	17
	47	8%	0%	9%	100%	0%	2%	0%	4%		0%	2%	4%	4%	49%	49%	98%	36%
Ciprofloxacin [Cipro]			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%
Gentamicin [Genta]			0	0	1	0	1	0	1	1	0		0	0	1	1	1	1
	1	0.2%	0%	0%	100%	0%	100%	0%	100%	100%	0%		0%	0%	100%	100%	100%	100%
Kanamycin [Kanam]			0	0	5	0	0	0	0	2	0	0		1	5	5	5	3
	5	1%	0%	0%	100%	0%	0%	0%	0%	40%	0%	0%		20%	100%	100%	100%	60%
Nalidixic Acid [Naldx]			0	0	3	0	0	0	0	2	0	0	1		8	7	7	8
	10	2%	0%	0%	30%	0%	0%	0%	0%	20%	0%	0%	10%		80%	70%	70%	80%
Streptomycin [Strep]			0	6	254	1	1	0	19	23	0	1	5	8		179	154	219
	338	55%	0%	2%	75%	0.3%	0.3%	0%	6%	7%	0%	0.3%	1%	2%		53%	46%	65%
Sulfamethoxazole [Sulfa]			0	5	165	1	1	0	19	23	0	1	5	7	179		157	167
	197	32%	0%	3%	84%	1%	1%	0%	10%	12%	0%	1%	3%	4%	91%		80%	85%
Tetracycline [Tetra]			0	6	158	0	1	0	16	46	0	1	5	7	154	157		145
	190	31%	0%	3%	83%	0%	1%	0%	8%	24%	0%	1%	3%	4%	81%	83%		76%
Trimeth-Sulfa [Tri-Su]			0	5	185	1	1	0	19	17	0	1	3	8	219	167	145	
	231	37%	0%	2%	80%	0.4%	0.4%	0%	8%	7%	0%	0.4%	1%	3%	95%	72%	63%	

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Table 4d. Additional resistance by antimicrobial agent for *E. coli* O157, 2002

Resistance to:	N	Pct.	Amika	AmoCl	Ampic	Cefox	Cefti	Ceftr	Cepha	Chlor	Cipro	Genta	Kanam	Naldx	Strep	Sulfa	Tetra	Tri-Su
Amikacin [Amika]	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%
Amox-Clav [Amo-Cl]	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%
Ampicillin [Ampic]	6	1%	0 0%	0 0%		0 0%	0 0%	0 0%	1 17%	1 17%	0 0%	0 0%	2 33%	0 0%	4 67%	5 83%	3 50%	2 33%
Cefoxitin [Cefox]	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%
Ceftiofur [Cefti]	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%
Ceftriaxone [Ceftr]	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%
Cephalothin [Cepha]	6	1%	0 0%	0 0%	1 17%	0 0%	0 0%	0 0%		1 17%	0 0%	0 0%	1 17%	0 0%	1 17%	2 33%	1 17%	1 17%
Chloramphenicol [Chlor]	5	1%	0 0%	0 0%	1 20%	0 0%	0 0%	0 0%	1 20%		0 0%	0 0%	0 0%	0 0%	0 0%	5 100%	1 20%	0 0%
Ciprofloxacin [Cipro]	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%
Gentamicin [Genta]	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%
Kanamycin [Kanam]	2	0.5%	0 0%	0 0%	2 100%	0 0%	0 0%	0 0%	1 50%	0 0%	0 0%	0 0%		0 0%	2 100%	2 100%	2 100%	1 50%
Nalidixic Acid [Naldx]	4	1%	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%
Streptomycin [Strep]	9	2%	0 0%	0 0%	4 44%	0 0%	0 0%	0 0%	1 11%	0 0%	0 0%	0 0%	2 22%	0 0%		7 78%	6 67%	2 22%
Sulfamethoxazole [Sulfa]	14	4%	0 0%	0 0%	5 36%	0 0%	0 0%	0 0%	2 14%	5 36%	0 0%	0 0%	2 14%	0 0%	7 50%		8 57%	2 14%
Tetracycline [Tetra]	12	3%	0 0%	0 0%	3 25%	0 0%	0 0%	0 0%	1 8%	1 8%	0 0%	0 0%	2 17%	0 0%	6 50%	8 67%		1 8%
Trimeth-Sulfa [Tri-Su]	2	0.5%	0 0%	0 0%	2 100%	0 0%	0 0%	0 0%	1 50%	0 0%	0 0%	0 0%	1 50%	0 0%	2 100%	2 100%	1 50%	

National Antimicrobial Resistance Monitoring System For Enteric Bacteria
Table 4e. Additional resistance by antimicrobial agent for *Campylobacter*, 2002

Resistance to: N (%)	Azith	Chlor	Cipro	Clind	Eryth	Genta	Naldx	Tetra
Azithromycin [Azith] 8 (2)		0 0%	3 37%	8 100%	8 100%	0 0%	3 37%	3 37%
Chloramphenicol [Chlor] 0 (0)	0 0%		0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Ciprofloxacin [Cipro] 75 (19)	3 4%	0 0%		3 4%	3 4%	0 0%	73 97%	42 56%
Clindamycin [Clind] 8 (2)	8 100%	0 0%	3 37%		8 100%	0 0%	3 37%	3 37%
Erythromycin [Eryth] 8 (2)	8 100%	0 0%	3 37%	8 100%		0 0%	3 37%	3 37%
Gentamicin [Genta] 0 (0)	0 0%	0 0%	0 0%	0 0%	0 0%		0 0%	0 0%
Nalidixic Acid [Naldx] 77 (20)	3 4%	0 0%	73 95%	3 4%	3 4%	0 0%		43 56%
Tetracycline [Tetra] 156 (41)	3 2%	0 0%	42 27%	3 2%	3 2%	0 0%	43 28%	

Table 5. The 16 most common non-Typhi *Salmonella* Serotypes, 2002

Serotype	**N**	**(%)**
Typhimurium	393	(20)
Enteritidis	338	(17)
Newport	239	(12)
Javiana	106	(5)
Heidelberg	105	(5)
Montevideo	61	(3)
Saint Paul	54	(3)
Oranienburg	42	(2)
I 4,[5],12:i: -	38	(2)
Infantis	37	(2)
Muenchen	37	(2)
Braenderup	27	(1)
Berta	25	(1)
Hadar	23	(1)
Mississippi	23	(1)
Thompson	23	(1)
Not serotyped	63	(3)
Other serotypes	375	(19)
Total	**2009**	**(100)**

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Table 6. Frequency of pansusceptibility* and resistance to one or more antimicrobial agents among the 16 most common non-Typhi *Salmonella* serotypes, 2002

Serotype	Total Isolates		Pansusceptible Isolates		Resistant Isolates	
	Number	% of *Salmonella*	Number	% of Serotype	Number	% of Serotype
Braenderup	27	1	27	100	0	0
Oranienburg	42	2	42	100	0	0
Javiana	106	5	102	96	4	4
Mississippi	23	1	22	96	1	4
Infantis	37	2	35	95	2	5
Muenchen	37	2	35	95	2	5
Saint Paul	54	3	50	93	4	7
I 4,[5],12:i:-	38	2	35	92	3	8
Thompson	23	1	21	91	2	9
Montevideo	61	3	55	90	6	10
Berta	25	1	22	88	3	12
Enteritidis	338	17	294	87	44	13
Newport	239	12	174	73	65	27
Heidelberg	105	5	71	68	34	32
Typhimurium	393	20	236	60	157	40
Hadar	23	1	3	13	20	87

*Pansusceptible to 16 antimicrobial agents tested in 2001: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

National Antimicrobial Resistance Monitoring System For Enteric Bacteria
Table 7. Frequency of resistance and multidrug* resistance among the 16 most common non-Typhi *Salmonella* serotypes, 2002

Serotype	Total		Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Number resistant to ≥ 8 antimicrobial agents	
	N	(%)	N	%	N	%	N	%	N	%
Typhimurium	393	(20)	157	(40)	143	(36)	107	(27)	8	(2)
Enteritidis	338	(17)	44	(13)	14	(4)	2	(1)	0	(0)
Newport	239	(12)	65	(27)	60	(25)	56	(23)	53	(22)
Javiana	106	(5)	4	(4)	2	(2)	1	(1)	0	(0)
Heidelberg	105	(5)	34	(32)	28	(27)	3	(3)	1	(1)
Montevideo	61	(3)	6	(10)	3	(5)	1	(2)	0	(0)
Saint Paul	54	(3)	4	(7)	1	(2)	1	(2)	1	(2)
Oranienburg	42	(2)	0	(0)	0	(0)	0	(0)	0	(0)
I 4,[5],12:i: -	38	(2)	3	(8)	3	(8)	1	(3)	0	(0)
Infantis	37	(2)	2	(5)	1	(3)	1	(3)	1	(3)
Muenchen	37	(2)	2	(5)	2	(5)	0	(0)	0	(0)
Braenderup	27	(1)	0	(0)	0	(0)	0	(0)	0	(0)
Berta	25	(1)	3	(12)	2	(8)	0	(0)	0	(0)
Hadar	23	(1)	20	(87)	17	(74)	0	(0)	0	(0)
Mississippi	23	(1)	1	(4)	0	(0)	0	(0)	0	(0)
Thompson	23	(1)	2	(9)	1	(4)	0	(0)	0	(0)
Other Serotypes	375	(19)	73	(19)	43	(11)	15**	(4)	5***	(1)
Total Serotyped	1946	(97)	420	(22)	320	(16)	188	(9)	69	(3)
Not Serotyped	63	(3)	4	(6)	1	(2)	0	(0)	0	(0)
Total *Salmonella*	**2009**	**(100)**	**424**	**(21)**	**322**	**(16)**	**199**	**(10)**	**69**	**(3)**

*Multidrug resistant to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

**Includes serotypes Paratyphi B (5), Reading (2), Stanley (2), Agona (1), Brandenburg (1), Chester (1), Dublin (1), Mbandaka (1), and Senftenberg (1)

***Includes serotypes Reading (2), Agona (1), Brandenburg (1), Senftenberg (1)

Table 8. Frequency of multidrug* resistance among the most common non-Typhi *Salmonella* serotypes in each site, 2002

Site	Most Common Serotypes	Total		Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Number resistant to ≥ 8 antimicrobial agents	
		N	%	N	%	N	%	N	%	N	%
Arizona	Newport	7	15	1	14	1	14	1	14	1	14
	Typhimurium	7	15	4	57	4	57	4	57	0	0
	Paratyphi B	5	11	2	40	0	0	0	0	0	0
	Enteritidis	4	9	2	50	1	25	0	0	0	0
	Heidelberg	3	6	3	100	2	67	0	0	0	0
	Muenchen	3	6	0	0	0	0	0	0	0	0
	Oranienburg	3	6	0	0	0	0	0	0	0	0
	Other serotypes	14	30	3	21	1	7	1	7	0	0
	Total	**46**	**100**	**14**	**30**	**9**	**20**	**5**	**11**	**1**	**2**
California	Typhimurium	14	32	8	57	8	57	5	36	1	7
	Enteritidis	4	9	2	50	1	25	1	25	0	0
	Newport	3	7	2	67	2	67	2	67	2	67
	Oranienburg	3	7	0	0	0	0	0	0	0	0
	Saint Paul	3	7	1	33	0	0	0	0	0	0
	Heidelberg	2	4	0	0	0	0	0	0	0	0
	Montevideo	2	4	0	0	0	0	0	0	0	0
	Other serotypes	13	29	0	0	0	0	0	0	0	0
	Total	**44**	**100**	**13**	**29**	**11**	**25**	**8**	**18**	**3**	**7**

*Multidrug resistant to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

Table 8. Frequency of multidrug* resistance among the most common non-Typhi *Salmonella* serotypes in each site, 2002

Site	Most Common Serotypes	Total		Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Number resistant to ≥ 8 antimicrobial agents	
		N	%	N	%	N	%	N	%	N	%
Colorado	Enteritidis	10	20	0	0	0	0	0	0	0	0
	Newport	10	20	6	60	5	50	5	50	5	50
	Typhimurium	6	12	5	83	5	83	5	83	0	0
	Heidelberg	5	10	2	40	2	40	0	0	0	0
	Oranienburg	3	6	0	0	0	0	0	0	0	0
	Other serotypes	16	32	3	19	2	13	0	0	0	0
	Total	**50**	**100**	**16**	**32**	**14**	**28**	**10**	**20**	**5**	**10**
Connecticut	Enteritidis	13	27	1	8	0	0	0	0	0	0
	Typhimurium	12	24	4	33	3	25	2	17	0	0
	Newport	6	12	2	33	2	33	2	33	2	33
	Heidelberg	4	8	1	25	0	0	0	0	0	0
	Other serotypes	14	29	2	14	2	14	1	7	0	0
	Total	**49**	**100**	**10**	**20**	**7**	**14**	**5**	**10**	**2**	**4**

*Multidrug resistant to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

Table 8. Frequency of multidrug* resistance among the most common non-Typhi *Salmonella* serotypes in each site, 2002

Site	Most Common Serotypes	Total		Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Number resistant to ≥ 8 antimicrobial agents	
		N	%	N	%	N	%	N	%	N	%
Florida	Javiana	32	33	2	6	2	6	1	3	0	0
	Newport	18	18	1	6	0	0	0	0	0	0
	Saint Paul	9	9	0	0	0	0	0	0	0	0
	Miami	7	7	0	0	0	0	0	0	0	0
	Enteritidis	6	6	0	0	0	0	0	0	0	0
	Typhimurium	5	5	2	40	1	20	1	20	0	0
	Other serotypes	21	21	3	14	3	14	1	5	0	0
	Total	**98**	**100**	**8**	**8**	**6**	**6**	**3**	**3**	**0**	**0**
Georgia	Typhimurium	47	23	18	38	16	34	11	23	0	0
	Newport	41	20	7	17	7	17	6	15	5	12
	Javiana	35	17	0	0	0	0	0	0	0	0
	Enteritidis	15	7	3	20	1	7	0	0	0	0
	Mississippi	15	7	0	0	0	0	0	0	0	0
	Muenchen	10	5	0	0	0	0	0	0	0	0
	Other serotypes	38	19	9	24	6	16	1	3	0	0
	Total	**201**	**100**	**37**	**18**	**30**	**15**	**18**	**9**	**5**	**2**

*Multidrug resistant to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

Table 8. Frequency of multidrug* resistance among the most common non-Typhi *Salmonella* serotypes in each site, 2002

Site	Most Common Serotypes	Total		Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Number resistant to ≥ 8 antimicrobial agents	
		N	%	N	%	N	%	N	%	N	%
Hawaii	Typhimurium	9	35	1	11	0	0	0	0	0	0
	Newport	3	12	0	0	0	0	0	0	0	0
	Enteritidis	2	8	0	0	0	0	0	0	0	0
	Heidelberg	2	8	1	50	1	50	0	0	0	0
	Paratyphi B	2	8	1	50	1	50	0	0	0	0
	Other serotypes	8	31	1	13	1	13	0	0	0	0
	Total	**26**	**100**	**4**	**15**	**3**	**12**	**0**	**0**	**0**	**0**
Kansas	Newport	8	30	2	25	2	25	2	25	2	25
	Typhimurium	6	22	1	17	1	17	1	17	1	17
	Enteritidis	5	19	0	0	0	0	0	0	0	0
	Other serotypes	8	30	0	0	0	0	0	0	0	0
	Total	**27**	**100**	**3**	**11**	**3**	**11**	**3**	**11**	**3**	**11**
Louisiana	Newport	14	14	3	21	1	7	1	7	1	7
	Heidelberg	6	6	2	33	2	33	0	0	0	0
	Javiana	6	6	1	17	0	0	0	0	0	0
	Montevideo	5	5	0	0	0	0	0	0	0	0
	Typhimurium	5	5	1	20	1	20	1	20	0	0
	Not Serotyped	50	49	4	8	1	2	0	0	0	0
	Other serotypes	17	17	1	6	1	6	0	0	0	0
	Total	**103**	**100**	**12**	**12**	**6**	**6**	**2**	**2**	**1**	**1**

*Multidrug resistant to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

Table 8. Frequency of multidrug* resistance among the most common non-Typhi *Salmonella* serotypes in each site, 2002

Site	Most Common Serotypes	Total		Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Number resistant to ≥ 8 antimicrobial agents	
		N	%	N	%	N	%	N	%	N	%
Los Angeles	Typhimurium	23	26	12	52	12	52	10	43	0	0
	Enteritidis	17	19	3	18	3	18	1	6	0	0
	Newport	9	10	6	67	6	67	5	56	5	56
	Montevideo	7	8	0	0	0	0	0	0	0	0
	Heidelberg	6	7	2	33	1	17	0	0	0	0
	Other serotypes	26	30	11	42	8	31	1	4	0	0
	Total	**88**	**100**	**34**	**39**	**30**	**34**	**17**	**19**	**5**	**6**
Maine	Enteritidis	4	27	0	0	0	0	0	0	0	0
	Typhimurium	4	27	1	25	1	25	1	25	0	0
	Not Serotyped	1	7	0	0	0	0	0	0	0	0
	Agona	1	7	0	0	0	0	0	0	0	0
	Other serotypes	5	33	1	20	1	20	1	20	1	20
	Total	**15**	**100**	**2**	**13**	**2**	**13**	**2**	**13**	**1**	**7**
Maryland	Enteritidis	32	28	5	16	1	3	0	0	0	0
	Typhimurium	16	14	8	50	8	50	7	44	0	0
	I 4,[5],12:i:-	12	10	0	0	0	0	0	0	0	0
	Newport	12	10	0	0	0	0	0	0	0	0
	Javiana	5	4	0	0	0	0	0	0	0	0
	Other serotypes	38	33	6	16	2	5	2	5	1	3
	Total	**115**	**100**	**19**	**17**	**11**	**10**	**9**	**8**	**1**	**1**

*Multidrug resistant to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

Table 8. Frequency of multidrug* resistance among the most common non-Typhi *Salmonella* serotypes in each site, 2002

Site	Most Common Serotypes	Total		Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Number resistant to ≥ 8 antimicrobial agents	
		N	%	N	%	N	%	N	%	N	%
Massachusetts	Enteritidis	32	26	3	9	0	0	0	0	0	0
	Typhimurium	25	20	7	28	6	24	3	12	0	0
	Hadar	7	6	7	100	7	100	0	0	0	0
	Newport	7	6	3	43	3	43	3	43	3	43
	I 4,[5],12:i:-	6	5	2	33	2	33	1	17	0	0
	Heidelberg	5	4	2	40	1	20	0	0	0	0
	Other serotypes	42	34	5	12	1	2	0	0	0	0
	Total	**124**	**100**	**29**	**23**	**20**	**16**	**7**	**6**	**3**	**2**
Michigan	Enteritidis	22	25	4	18	2	9	0	0	0	0
	Typhimurium	16	18	7	44	7	44	6	38	0	0
	Heidelberg	7	8	2	29	1	14	0	0	0	0
	Newport	6	7	2	33	2	33	2	33	2	33
	Anatum	5	6	0	0	0	0	0	0	0	0
	I 4,[5],12:i:-	4	5	1	25	0	0	0	0	0	0
	Other serotypes	27	31	3	11	0	0	0	0	0	0
	Total	**87**	**100**	**19**	**22**	**13**	**15**	**8**	**9**	**2**	**2**

*Multidrug resistant to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

Table 8. Frequency of multidrug* resistance among the most common non-Typhi *Salmonella* serotypes in each site, 2002

Site	Most Common Serotypes	Total		Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Number resistant to ≥ 8 antimicrobial agents	
		N	%	N	%	N	%	N	%	N	%
Minnesota	Typhimurium	15	26	3	20	3	20	2	13	0	0
	Newport	9	16	2	22	1	11	1	11	1	11
	Enteritidis	8	14	1	13	0	0	0	0	0	0
	Infantis	3	5	1	33	1	33	1	33	1	33
	Anatum	2	3	0	0	0	0	0	0	0	0
	Not Serotyped	1	2	0	0	0	0	0	0	0	0
	Other serotypes	19	33	2	10	1	5	0	0	0	0
	Total	**57**	**100**	**9**	**16**	**6**	**11**	**4**	**7**	**2**	**4**
Montana	Not Serotyped	7	100	0	0	0	0	0	0	0	0
	Total	**7**	**100**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Nebraska	Typhimurium	11	50	5	45	3	27	3	27	0	0
	Heidelberg	2	9	1	50	1	50	0	0	0	0
	Muenchen	2	9	0	0	0	0	0	0	0	0
	Other serotypes	7	32	1	14	0	0	0	0	0	0
	Total	**22**	**100**	**7**	**32**	**4**	**18**	**3**	**14**	**0**	**0**

*Multidrug resistant to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

Table 8. Frequency of multidrug* resistance among the most common non-Typhi *Salmonella* serotypes in each site, 2002

Site	Most Common Serotypes	Total		Number resistant to > 1 antimicrobial agents		Number resistant to > 2 antimicrobial agents		Number resistant to > 5 antimicrobial agents		Number resistant to > 8 antimicrobial agents	
		N	%	N	%	N	%	N	%	N	%
New Jersey	Enteritidis	24	28	8	33	3	13	0	0	0	0
	Typhimurium	19	22	7	37	7	37	4	21	1	5
	Heidelberg	6	7	2	33	2	33	1	17	0	0
	Thompson	5	6	0	0	0	0	0	0	0	0
	Newport	4	5	3	75	3	75	3	75	3	75
	Other serotypes	28	33	6	21	5	18	2	7	1	4
	Total	**86**	**100**	**26**	**30**	**20**	**23**	**10**	**12**	**5**	**6**
New Mexico	Newport	6	16	1	17	1	17	1	17	1	17
	Typhimurium	6	16	3	50	3	50	2	33	0	0
	Montevideo	4	11	0	0	0	0	0	0	0	0
	Enteritidis	3	8	0	0	0	0	0	0	0	0
	Javiana	2	5	0	0	0	0	0	0	0	0
	Mbandaka	2	5	1	50	0	0	0	0	0	0
	Muenchen	2	5	0	0	0	0	0	0	0	0
	Other serotypes	12	32	2	17	1	8	0	0	0	0
	Total	**37**	**100**	**7**	**19**	**5**	**14**	**3**	**8**	**1**	**3**

*Multidrug resistant to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

Table 8. Frequency of multidrug* resistance among the most common non-Typhi *Salmonella* serotypes in each site, 2002

Site	Most Common Serotypes	Total		Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Number resistant to ≥ 8 antimicrobial agents	
		N	%	N	%	N	%	N	%	N	%
New York City	Typhimurium	33	25	18	55	16	48	12	36	1	3
	Enteritidis	32	24	5	16	1	3	0	0	0	0
	Heidelberg	10	8	3	30	3	30	1	10	0	0
	Hadar	4	3	3	75	2	50	0	0	0	0
	Infantis	4	3	0	0	0	0	0	0	0	0
	Berta	3	2	1	33	1	33	0	0	0	0
	Other serotypes	47	35	7	15	6	13	2	4	0	0
	Total	**133**	**100**	**37**	**28**	**29**	**22**	**15**	**11**	**1**	**1**
New York State	Enteritidis	43	27	2	5	0	0	0	0	0	0
	Typhimurium	19	12	8	42	8	42	5	26	0	0
	Newport	18	11	8	44	8	44	8	44	8	44
	Heidelberg	12	8	4	33	4	33	0	0	0	0
	Montevideo	6	4	0	0	0	0	0	0	0	0
	Paratyphi B	5	3	1	20	1	20	1	20	0	0
	Not Serotyped	1	1	0	0	0	0	0	0	0	0
	Other serotypes	53	34	10	19	5	9	1	2	1	2
	Total	**157**	**100**	**34**	**22**	**26**	**17**	**15**	**10**	**9**	**6**

*Multidrug resistant to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

Table 8. Frequency of multidrug* resistance among the most common non-Typhi *Salmonella* serotypes in each site, 2002

Site	Most Common Serotypes	Total		Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Number resistant to ≥ 8 antimicrobial agents	
		N	%	N	%	N	%	N	%	N	%
Oregon	Enteritidis	6	17	1	17	0	0	0	0	0	0
	Newport	6	17	5	83	5	83	5	83	5	83
	Typhimurium	6	17	2	33	2	33	2	33	1	17
	Hadar	4	11	3	75	2	50	0	0	0	0
	Montevideo	2	6	0	0	0	0	0	0	0	0
	Other serotypes	11	31	3	27	2	18	0	0	0	0
	Total	**35**	**100**	**14**	**40**	**11**	**31**	**7**	**20**	**6**	**17**
South Dakota	Typhimurium	6	32	4	67	3	50	2	33	1	17
	Enteritidis	3	16	0	0	0	0	0	0	0	0
	Heidelberg	3	16	0	0	0	0	0	0	0	0
	Derby	2	10	2	100	2	100	0	0	0	0
	Other serotypes	5	26	1	20	1	20	0	0	0	0
	Total	**19**	**100**	**7**	**37**	**6**	**32**	**2**	**11**	**1**	**5**

*Multidrug resistant to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

Table 8. Frequency of multidrug* resistance among the most common non-Typhi *Salmonella* serotypes in each site, 2002

Site	Most Common Serotypes	Total		Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Number resistant to ≥ 8 antimicrobial agents	
		N	%	N	%	N	%	N	%	N	%
Tennessee	Typhimurium	20	26	4	20	3	15	3	15	0	0
	Javiana	6	8	0	0	0	0	0	0	0	0
	Enteritidis	5	7	0	0	0	0	0	0	0	0
	Heidelberg	5	7	2	40	2	40	1	20	1	20
	I 4,[5],12:i:-	5	7	0	0	0	0	0	0	0	0
	Mississippi	5	7	1	20	0	0	0	0	0	0
	Newport	4	5	0	0	0	0	0	0	0	0
	Other serotypes	26	34	5	19	2	8	1	4	1	4
	Total	**76**	**100**	**12**	**16**	**7**	**9**	**5**	**7**	**2**	**3**
Texas	Typhimurium	28	19	6	21	5	18	3	11	0	0
	Newport	26	17	1	4	1	4	1	4	0	0
	Enteritidis	14	9	2	14	0	0	0	0	0	0
	Javiana	11	7	0	0	0	0	0	0	0	0
	Infantis	9	6	0	0	0	0	0	0	0	0
	Montevideo	7	5	0	0	0	0	0	0	0	0
	Oranienburg	7	5	0	0	0	0	0	0	0	0
	Other serotypes	48	32	9	19	6	12	1	2	1	2
	Total	**150**	**100**	**18**	**12**	**12**	**8**	**5**	**3**	**1**	**1**

*Multidrug resistant to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

Table 8. Frequency of multidrug* resistance among the most common non-Typhi *Salmonella* serotypes in each site, 2002

Site	Most Common Serotypes	Total		Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Number resistant to ≥ 8 antimicrobial agents	
		N	%	N	%	N	%	N	%	N	%
Washington	Typhimurium	17	22	11	65	11	65	8	47	1	6
	Enteritidis	11	14	1	9	0	0	0	0	0	0
	Oranienburg	7	9	0	0	0	0	0	0	0	0
	Berta	5	7	0	0	0	0	0	0	0	0
	Newport	4	5	2	50	2	50	2	50	2	50
	Braenderup	3	4	0	0	0	0	0	0	0	0
	Montevideo	3	4	1	33	1	33	0	0	0	0
	Other serotypes	26	34	3	11	2	8	1	4	0	0
	Total	**76**	**100**	**18**	**24**	**16**	**21**	**11**	**14**	**3**	**4**
Wisconsin	Enteritidis	16	28	1	6	1	6	0	0	0	0
	Newport	8	14	5	63	5	63	5	63	4	50
	Typhimurium	9	16	3	33	3	33	2	22	1	11
	Heidelberg	4	7	0	0	0	0	0	0	0	0
	I 4,[5],12:i:-	4	7	0	0	0	0	0	0	0	0
	Not Serotyped	3	5	0	0	0	0	0	0	0	0
	Other serotypes	14	24	1	7	1	7	1	7	1	7
	Total	**58**	**100**	**10**	**17**	**10**	**17**	**8**	**14**	**6**	**10**
West Virginia	Typhimurium	9	39	3	33	3	33	3	33	0	0
	Enteritidis	6	26	0	0	0	0	0	0	0	0
	Newport	4	17	1	25	1	25	0	0	0	0
	Other serotypes	4	17	1	25	0	0	0	0	0	0
	Total	**23**	**100**	**5**	**22**	**4**	**17**	**3**	**13**	**0**	**0**

*Multidrug resistant to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

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Table 9. *Salmonella* Typhimurium isolates with at least R-type ACSSuT*, R-type ACKSSuT**, or R-type AKSSuT*** resistance patterns, by site, 2002

Site	# non-Typhi *Salmonella* isolates tested	*Salmonella* Typhimurium		Typhimurium R-type ACSSuT		Typhimurium R-type ACKSSuT		Typhimurium R-type AKSSuT	
		N	%	N	%	N	%	N	%
Arizona	46	7	15	2	29	0	0	0	0
California	44	14	32	5	36	0	0	0	0
Colorado	50	6	12	4	67	1	17	2	33
Connecticut	49	12	24	1	8	0	0	0	0
Florida	98	5	5	1	20	0	0	0	0
Georgia	201	47	23	10	21	2	4	2	4
Hawaii	26	9	35	0	0	0	0	0	0
Kansas	27	6	22	1	17	0	0	0	0
Louisiana	103	5	5	1	20	0	0	0	0
Los Angeles	88	23	26	9	39	0	0	1	4
Maine	15	4	27	0	0	0	0	1	25
Maryland	115	16	14	5	31	1	6	3	19
Massachusetts	124	25	20	2	8	1	4	1	4
Michigan	87	16	18	6	38	0	0	0	0
Minnesota	57	15	26	2	13	1	7	1	7
Montana	7	0	0	0	0	0	0	0	0
Nebraska	22	11	50	3	27	1	9	1	9
New Jersey	86	19	22	3	16	0	0	1	5
New Mexico	37	6	16	1	17	0	0	1	17
New York City	133	33	25	10	30	0	0	1	3
New York State	157	19	12	3	16	0	0	0	0
Oregon	35	6	17	1	17	0	0	1	17
South Dakota	19	6	32	2	33	0	0	0	0
Tennessee	76	20	26	2	10	1	5	2	10
Texas	150	28	19	3	11	0	0	0	0
Washington	76	17	22	3	18	0	0	4	24
Wisconsin	58	9	16	2	22	1	11	1	11
West Virginia	23	9	39	2	22	1	11	1	11
Totals	**2009**	**393**	**20**	**84**	**21**	**10**	**3**	**24**	**6**

*R-type ACSSuT = ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, tetracycline
**R-type ACKSSuT = ampicillin, chloramphenicol, kanamycin, streptomycin, sulfamethoxazole, tetracycline
***R-type AKSSuT = ampicillin, kanamycin, streptomycin, sulfamethoxazole, tetracycline

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Table 10. Additional antimicrobial resistance for *Salmonella* Typhimurium isolates with at least R-type ACSSuT*, R-type ACKSSuT**, or R-type AKSSuT*** resistance patterns, 2002

Antimicrobial Agent	Typhimurium R-type ACSSuT (N=84)		Typhimurium R-type ACKSSuT (N=10)		Typhimurium R-type AKSSuT (N=24)	
	N	%	N	%	N	%
Amikacin	0	0	0	0	0	0
Amoxicillin-Clavulanic Acid	17	20	1	10	2	8
Cefoxitin	7	8	1	10	2	8
Ceftiofur	7	8	1	10	2	8
Ceftriaxone	0	0	0	0	0	0
Cephalothin	7	8	1	10	2	8
Chloramphenicol	NA		NA		10	42
Ciprofloxacin	0	0	0	0	0	0
Gentamicin	2	2	1	10	3	13
Kanamycin	10	12	NA		NA	
Nalidixic Acid	2	2	1	10	1	4
Trimethoprim-Sulfamethoxazole	5	6	1	10	1	4

**R-type ACSSuT = ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, tetracycline
***R-type ACKSSuT = ampicillin, chloramphenicol, kanamycin, streptomycin, sulfamethoxazole, tetracycline
****R-type AKSSuT = ampicillin, kanamycin, streptomycin, sulfamethoxazole, tetracycline

NA: Not Applicable

Table 11. *Salmonella* Newport isolates with at least MDR-AmpC* resistance pattern, by site, 2002

Site	# non-Typhi *Salmonella* isolates tested	*Salmonella* Newport		MDR - AmpC Newport	
		N	%	N	%
Arizona	46	7	15	1	2
California	44	3	7	2	5
Colorado	50	10	20	5	10
Connecticut	49	6	12	2	4
Florida	98	18	18	0	0
Georgia	201	41	20	5	2
Hawaii	26	3	12	0	0
Kansas	27	8	30	2	7
Louisiana	103	14	14	1	1
Los Angeles	88	9	10	5	6
Maine	15	1	7	1	7
Maryland	115	12	10	0	0
Massachusetts	124	7	6	3	2
Michigan	87	6	7	2	2
Minnesota	57	9	16	1	2
Montana	7	0	0	0	0
Nebraska	22	0	0	0	0
New Jersey	86	4	5	3	3
New Mexico	37	6	16	1	3
New York City	133	3	2	0	0
New York State	157	18	11	8	5
Oregon	35	6	17	5	14
South Dakota	19	2	11	0	0
Tennessee	76	4	5	0	0
Texas	150	26	17	0	0
Washington	76	4	5	2	3
Wisconsin	58	8	14	4	7
West Virginia	23	4	17	0	0
Totals	**2009**	**239**	**12**	**53**	**3**

*MDR-AmpC = Resistance to amoxicillin/clavulanic acid, ampicillin, cephalothin, cefoxitin, ceftiofur, chloramphenicol, sulfamethoxazole, streptomycin and tetracycline, and decreased susceptibility to ceftriaxone (MIC $\geq$ 2 μg/ml)

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Table 12. Additional antimicrobial resistance for *Salmonella* Newport isolates with at least MDR-AmpC* resistance pattern, 2002

Antimicrobial Agent	MDR - AmpC (N=53)	
	N	**%**
Amikacin	0	0
Ceftriaxone	2	4
Ciprofloxacin	0	0
Gentamicin	8	15
Kanamycin	22	41
Nalidixic Acid	1	2
Trimethoprim-Sulfamethoxazole	9	17

*MDR-AmpC = Resistance to amoxicillin/clavulanic acid, ampicillin, cephalothin, cefoxitin, ceftiofur, chloramphenicol, sulfamethoxazole, streptomycin and tetracycline, and decreased susceptibility to ceftriaxone (MIC $\geq$ 2 μg/ml)

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Table 13. Additional antimicrobial resistance for *Salmonella* Heidelberg isolates with R-type ACICfCp*, 2002

Antimicrobial Agent	*S*. Heidelberg R-type ACICfCp (N=8)	
	N	%
Amikacin	0	0
Cefoxitin	0	0
Ceftriaxone	0	0
Chloramphenicol	1	12
Ciprofloxacin	0	0
Gentamicin	0	0
Kanamycin	0	0
Nalidixic Acid	0	0
Streptomycin	2	25
Sulfamethoxazole	1	12
Tetracycline	2	25
Trimethoprim-Sulfamethoxazole	1	12

*R-type ACICfCp = Resistance to at least ampicillin, amoxicillin-clavulanic acid, ceftiofur, and cephalothin

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Table 14. Most common multidrug* resistant patterns among non-Typhi *Salmonella*, 2002

Resistance pattern	Number	% of *Salmonella*	% of multidrug-resistant *Salmonella*
S. Typhimurium R-type ACSSuT**	84	4	26
S. Typhimurium R-type AKSSuT***	24	1	7
S. Newport MDR-AmpC****	53	3	16
S. Heidelberg R-type AClCfCp*****	8	0.4	2

*Multidrug resistant to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole

**R-type ACSSUT = Resistant to at least ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, and tetracycline

***R-type AKSSuT = Resistant to at least ampicillin, kanamycin, streptomycin, sulfamethoxazole, and tetracycline

****MDR-AmpC = Resistant to at least amoxicillin/clavulanic ccid, ampicillin, cephalothin, cefoxitin, ceftiofur, chloramphenicol, sulfamethoxazole, streptomycin and tetracycline, and with decreased susceptibility to ceftriaxone (MIC $\geq$ 2 μg/ml)

*****R-type AClCfCp = Resistant to at least ampicillin, amoxicillin/clavulanic acid, ceftiofur, and cephalothin

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Table 15. Clinical source of non-Typhi *Salmonella* isolates, 2002

Isolate	Blood		Stool		Other		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
S. Typhimurium	16	4	341	87	22	6	14	4	393	20
S. Typhimurium -- ACSSuT	4	5	73	87	5	6	2	2	84	4
S. Typhimurium -- AKSSuT	2	9	21	87	0	0	1	4	24	1
All other *S.* Typhimurium	10	4	247	87	17	6	11	4	285	14
S. Enteritidis	15	4	297	88	16	5	10	3	338	17
S. Newport	7	3	207	87	9	4	16	7	239	12
S. Newport -- MDR-AmpC	3	6	45	85	1	2	4	7	53	3
All other *S.* Newport	4	2	162	87	8	4	12	6	186	9
S. Javiana	2	2	94	89	4	4	6	6	106	5
S. Heidelberg	15	14	82	78	7	7	1	1	105	5
S. Heidelberg - AClCfCp	1	12	6	75	1	12	0	0	8	0.4
All other *S.* Heidelberg	14	14	76	78	6	6	1	1	97	5
S. Montevideo	2	3	47	77	9	15	3	5	61	3
S. St. Paul	2	4	41	76	6	11	5	9	54	3
S. Oranienburg	3	7	31	74	4	10	4	10	42	2
S. Infantis	1	3	27	73	4	11	5	14	37	2
S. Muenchen	0	0	35	95	2	5	0	0	37	2
S. I 4,[5],12:i:-	4	10	33	87	0	0	1	3	38	2
S. Braenderup	0	0	25	93	1	4	1	4	27	1
S. Berta	1	4	20	80	4	16	0	0	25	1
S. Hadar	0	0	19	83	3	13	1	4	23	1
S. Misissippi	1	4	20	87	1	4	1	4	23	1
S. Thompson	3	13	20	87	0	0	0	0	23	1
Other *Salmonella*	38	9	349	80	33	8	18	4	438	22
Total	**110**	**5**	**1688**	**84**	**125**	**6**	**86**	**4**	**2009**	**100**

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Table 16. Proportion of non-Typhi *Salmonella* isolates (N=2009) with clinically important resistance: resistance to nalidixic acid, decreased susceptibility to ciprofloxacin, or resistance to ciprofloxacin; resistance to ceftiofur, decreased susceptibility to ceftriaxone, or resistance to ceftriaxone; 2002

Antimicrobial Agent	Number	% of *Salmonella*
Nalidixic Acid Resistance	37	2
Ciprofloxacin Decreased Susceptibility*	16	1
Ciprofloxacin Resistance	1	0.05
Ceftiofur Resistance	87	4
Ceftriaxone Decreased Susceptibility**	87	4
Ceftriaxone Resistance	4	0.2

*Ciprofloxacin decreased susceptibility = MIC ≥ 0.25 μg/ml

**Ceftriaxone decreased susceptibility = MIC ≥ 2 μg/ml

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Table 17. Proportion of non-Typhi *Salmonella* isolates submitted, by site, with resistance to nalidixic acid (MIC ≥ 32 µg/ml) or decreased susceptibility to ciprofloxacin (MIC ≥ 0.25 µg/ml), 2002

Site	# isolates with resistance to nalidixic acid	% with resistance to nalidixic acid	# isolates with decreased susceptibility to ciprofloxacin	% with decreased susceptibility to ciprofloxacin	# non-Typhi *Salmonella* isolates tested	Serotype (with at least decreased susceptibility to ciprofloxacin)
Arizona	2	4	1	2	46	Typhimurium (1)
California	1	2	1	2	44	Saint Paul (1)
Colorado	1	2	1	2	50	Paratyphi A (1)
Connecticut	1	2	0	0	49	
Florida	0	0	0	0	98	
Georgia	3	1	1	1	201	Enteritidis (1)
Hawaii	1	4	1	4	26	Bovismorbificans (1)
Kansas	0	0	0	0	27	
Louisiana	0	0	0	0	103	
Los Angeles	1	1	0	0	88	
Maine	1	7	0	0	15	
Maryland	1	1	0	0	115	
Massachusetts	2	2	1	1	124	Thompson (1)
Michigan	4	4	1	1	87	Paratyphi A (1)
Minnesota	2	3	0	0	57	
Montana	0	0	0	0	7	
Nebraska	0	0	0	0	22	
New Jersey	2	2	1	1	86	Paratyphi B (1)
New Mexico	2	5	1	3	37	Hadar (1)
New York City	2	1	2	2	133	Mbandaka (1), Typhimurium (1)
New York State	5	3	1	1	157	Bovismorbificans (1)
Oregon	2	6	1	3	35	Paratyphi A (1)
South Dakota	0	0	0	0	19	
Tennessee	0	0	0	0	76	
Texas	2	1	2	1	150	Enteritidis (1), Senftenberg (1)*
Washington	1	1	0	0	76	
Wisconsin	1	2	1	2	58	Typhimurium (1)
West Virginia	0	0	0	0	23	
Total	**37**	**2**	**16**	**1**	**2009**	**Paratyphi A (3), Typhimurium (3), Bovismorbificans (2), Enteritidis (2), Hadar (1), Mbandaka (1), Paratyphi B (1), St. Paul (1), Senftenberg (1)*, Thompson (1)**

*This isolate also was resistant to ciprofloxacin.

Table 18. Proportion of non-Typhi *Salmonella* isolates submitted, by site, with resistance to ceftiofur (MIC ≥ 8 µg/ml) or decreased susceptibility to ceftriaxone (MIC ≥ 2 µg/ml), 2002

Site	# isolates with resistance to ceftiofur	% with resistance to ceftiofur	# isolates with decreased susceptibility to ceftriaxone	% with decreased susceptibility to ceftriaxone	# non-Typhi *Salmonella* isolates tested	Serotype (with at least decreased susceptibility to ceftriaxone)
Arizona	1	2	1	2	46	Newport (1)
California	3	7	3	7	44	Newport (2), Typhimurium (1)
Colorado	5	10	5	10	50	Newport (5)
Connecticut	2	4	2	4	49	Newport (2)
Florida	0	0	0	0	98	Enteritidis (1)
Georgia	6	3	6	3	201	Newport (5), Typhimurium (1)
Hawaii	0	0	0	0	26	
Kansas	3	11	3	11	27	Newport (2), Typhimurium (1)
Louisiana	1	1	1	1	103	Newport (1)*
Los Angeles	5	6	5	6	88	Newport (5)
Maine	1	7	1	7	15	Newport (1)
Maryland	2	2	2	2	115	Agona (1), Typhimurium (1)
Massachusetts	8	6	8	6	124	Typhimurium (4), Newport (3), I 4,[5],12:i:- (1)
Michigan	2	2	2	2	87	Newport (2)
Minnesota	2	3	2	4	57	Infantis (1), Newport (1)
Montana	0	0	0	0	7	
Nebraska	1	4	1	9	22	Heidelberg (1)
New Jersey	5	6	5	6	86	Newport (3), Brandenberg (1), Typhimurium (1)
New Mexico	1	3	1	3	37	Newport (1)
New York City	5	4	5	4	133	Heidelberg (3), Mbandaka (1), Typhimurium (1)
New York State	13	8	13	8	157	Newport (8)*, Heidelberg (2), Typhimurium (2)*, St. Paul (1)
Oregon	7	20	7	20	35	Newport (5), Heldelberg (1), Typhimurium (1)

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Table 18. Proportion of non-Typhi *Salmonella* isolates submitted, by site, with resistance to ceftiofur (MIC ≥ 8 µg/ml) or decreased susceptibility to ceftriaxone (MIC ≥ 2 µg/ml), 2002

Site	# isolates with resistance to ceftiofur	% with resistance to ceftiofur	# isolates with decreased susceptibility to ceftriaxone	% with decreased susceptibility to ceftriaxone	# non-Typhi *Salmonella* isolates tested	Serotype (with at least decreased susceptibility to ceftriaxone)
South Dakota	1	5	1	5	19	Typhimurium (1)
Tennessee	2	3	2	3	76	Heidelberg (1), Reading (1)
Texas	1	1	1	1	150	Senftenberg (1)*
Washington	3	4	3	4	76	Newport (2), Typhimurium (1)
Wisconsin	7	12	7	12	58	Newport (4), Typhimurium (2), Reading (1)
West Virginia	0	0	0	0	23	
Total	**87**	**4**	**87**	**4**	**2009**	**Newport (53)*, Typhimurium (17)*, Heidelberg (8), Reading (2), Agona (1), Brandenburg (1), I 4,[5],12:i:- (1), Infantis (1), Mbandaka (1), St. Paul (1), Senftenberg (1)***

*These isolates also were resistant to ceftriaxone (N=4)

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Table 19. Summary: Antimicrobial resistance of non-Typhi *Salmonella* isolates, 1996-2002

Salmonella, Non-Typhi	1996	1997	1998	1999	2000	2001	2002
Salmonella isolates	1326	1301	1460	1498	1378	1419	2009
Isolates resistant to ≥ 1 antimicrobial agents*	37% (493)	34% (443)	27% (397)	26% (390)	26% (353)	28% (394)	21% (424)
Isolates resistant to ≥ 2 antimicrobial agents*	31% (404)	25% (328)	23% (333)	21% (317)	21% (284)	22% (315)	16% (321)
Isolates resistant to ≥ 5 antimicrobial agents*	12% (162)	14% (180)	13% (187)	11% (172)	12% (159)	12% (168)	9% (188)
Isolates resistant to ≥ 8 antimicrobial agents*	0.3% (4)	1% (10)	1% (13)	2% (31)	3% (41)	3% (40)	3% (69)
Serotyped *Salmonella* isolates	93% (1235)	94% (1225)	97% (1411)	98% (1469)	98% (1346)	99% (1399)	97% (1946)
Serotyped *Salmonella* which are Enteritidis	29% (357)	25% (303)	17% (244)	18% (270)	24% (319)	20% (282)	17% (338)
S. Enteritidis isolates resistant to ≥ 1 antimicrobial agents*	31% (110)	26% (78)	12% (30)	17% (45)	11% (35)	14% (40)	13% (44)
Serotyped *Salmonella* which are Typhimurium**	25% (306)	27% (327)	27% (377)	25% (363)	22% (303)	23% (325)	20% (393)
S. Typhimurium isolates resistant to ≥ 1 antimicrobial agents*	64% (196)	62% (204)	53% (200)	50% (180)	50% (153)	51% (165)	40% (157)
S. Typhimurium with at least ACSSuT resistance pattern***	34% (103)	35% (115)	32% (120)	28% (102)	28% (84)	29% (96)	21% (84)
Salmonella isolates that were at least Typhimurium ACSSuT***	8% (103)	9% (115)	8% (120)	7% (102)	6% (84)	7% (96)	4% (84)
S. Typhimurium with at least AKSSuT resistance pattern****	9% (27)	13% (41)	12% (47)	11% (39)	9% (28)	5% (15)	6% (24)
Salmonella isolates that were at least Typhimurium AKSSuT****	2% (27)	3% (41)	3% (47)	3% (39)	2% (28)	1% (15)	1% (24)
S. Typhimurium with at least ACKSSuT resistance pattern*****	4% (13)	3% (9)	4% (17)	3% (12)	3% (8)	1% (4)	2% (10)

*Using only antimicrobial agents (n=14) tested in all seven years

**Includes *S*. Typhimurium and *S*. Typhimurium variant Copenhagen

***ACSSuT = ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, and tetracycline

****AKSSuT = ampicillin, kanamycin, streptomycin, sulfamethoxazole, and tetracycline

*****ACKSSuT = ampicillin, chloramphenicol, kanamycin, streptomycin, sulfamethoxazole, and tetracycline

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Table 19. Summary: Antimicrobial resistance of non-Typhi *Salmonella* isolates, 1996-2002

Salmonella, Non-Typhi	1996	1997	1998	1999	2000	2001	2002
Salmonella isolates that were at least Typhimurium ACKSSuT	1% (13)	1% (9)	1% (17)	1% (12)	1% (8)	0.3% (4)	0.5% (10)
S. Typhimurium isolates at least ACSSuT, AKSSuT, or ACKSSuT	38% (117)	45% (147)	40% (150)	36% (129)	34% (104)	33% (107)	25% (98)
Serotyped *Salmonella* which are Newport	4% (51)	4% (48)	5% (77)	7% (98)	9% (124)	9% (124)	12% (239)
S. Newport isolates resistant to ≥ 1 antimicrobial agents*	18% (9)	12% (6)	5% (4)	23% (23)	24% (30)	35% (43)	27% (65)
S. Newport with at least MDR-AmpC resistance pattern**	0% (0)	0% (0)	1% (1)	17% (17)	22% (27)	25% (31)	22% (53)
Salmonella isolates that were at least Newport MDR-AmpC**	0% (0)	0% (0)	0.1% (1)	1% (17)	2% (27)	2% (31)	3% (53)
Serotyped *Salmonella* which are Heidelberg	6% (74)	6% (75)	7% (101)	6% (89)	6% (79)	7% (100)	5% (105)
S. Heidelberg with at least AClCfCp resistance pattern***	3% (2)	0% (0)	0% (0)	0% (0)	4% (3)	3% (3)	8% (8)
Salmonella isolates that were at least Heidelberg AClCfCp***	0.1% (2)	0% (0)	0% (0)	0% (0)	0.2% (3)	0.2% (3)	0.4% (8)
Nalidixic Acid (MIC ≥ 32)	0.4% (5)	1% (11)	1% (20)	1% (16)	2% (34)	3% (37)	2% (37)
Ciprofloxacin (MIC ≥ 0.25)	0.4% (5)	0.5% (7)	1% (10)	1% (15)	1% (20)	1% (15)	1% (16)
Ciprofloxacin (MIC ≥ 4)	0% (0)	0% (0)	0.1% (1)	0.1% (1)	0.4% (5)	0.2% (3)	0.05% (1)
Ceftiofur (MIC ≥ 8)	4% (53)	3% (44)	1% (14)	2% (31)	3% (44)	4% (58)	4% (87)
Ceftriaxone**** (MIC ≥ 2)	3% (37)	1% (13)	1% (14)	2% (33)	3% (45)	4% (56)	4% (87)
Ceftriaxone**** (MIC ≥ 64)	0% (0)	0% (0)	0% (0)	0.4% (6)	0% (0)	0% (0)	0.2% (4)

*Using only antimicrobial agents (n=14) tested in all seven years

**MDR-AmpC = ACSSuT, amoxicillin-clavulanic acid, cephalothin, cefoxitin, ceftiofur, decreased susceptibility to ceftriaxone (MIC ≥ 2 μg/ml)

***AClCfCp = ampicillin, amoxicillin-clavulanic acid, ceftiofur, and cephalothin

****For ceftriaxone, this report only includes antimicrobial susceptibility testing results using Sensititre®. Previous annual reports included results using Sensititre® and retest results using E-test and by-hand broth microdilution.

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Table 19. Summary: Antimicrobial resistance of non-Typhi *Salmonella* isolates, 1996-2002

Salmonella, Non-Typhi	1996	1997	1998	1999	2000	2001	2002
Amikacin (MIC ≥ 64)	Not Tested	0% (0)	0% (0)	0.1% (2)	0% (0)	0% (0)	0% (0)
Amox-Clav* (MIC ≥ 32)	1% (20)	1% (19)	2% (24)	2% (36)	4% (54)	5% (66)	5% (106)
Ampicillin (MIC ≥ 32)	21% (279)	18% (241)	16% (241)	16% (234)	16% (219)	17% (247)	13% (259)
Apramycin (MIC ≥ 64)	0% (0)	0% (0)	0% (0)	0.3% (5)	0.1% (2)	0% (0)	Not Tested
Cefoxitin (MIC ≥ 32)	Not Tested	Not Tested	Not Tested	Not Tested	3% (43)	3% (48)	4% (86)
Cephalothin (MIC ≥ 32)	3% (47)	3% (43)	2% (33)	4% (55)	4% (54)	4% (57)	5% (101)
Chloramphenicol (MIC ≥ 32)	11% (141)	10% (131)	10% (145)	9% (138)	10% (138)	12% (164)	9% (172)
Gentamicin (MIC ≥ 16)	5% (64)	3% (38)	3% (42)	2% (34)	3% (37)	2% (27)	1% (27)
Imipenem (MIC ≥ 16)	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	0% (0)	Not Tested
Kanamycin (MIC ≥ 64)	5% (65)	5% (66)	6% (84)	4% (66)	6% (77)	5% (68)	4% (76)
Streptomycin (MIC ≥ 64)	21% (275)	22% (282)	19% (273)	17% (253)	16% (223)	17% (241)	13% (265)
Sulfamethoxazole (MIC ≥ 512)	23% (305)	25% (328)	19% (283)	18% (271)	17% (235)	18% (251)	13% (258)
Tetracycline (MIC ≥ 16)	24% (321)	22% (283)	20% (295)	19% (291)	19% (256)	20% (280)	15% (299)
Trimeth-Sulfa** (MIC ≥ 4/76)	4% (51)	2% (24)	2% (34)	2% (31)	2% (29)	2% (28)	1% (28)

*Amox-Clav = amoxicillin-clavulanic acid

**Trimeth-Sulfa = trimethoprim-sulfamethoxazole

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Table 20. Summary: Multidrug* resistance of non-Typhi *Salmonella* isolates, 1996-2002

Non-Typhi *Salmonella*

Year	# isolates tested	Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Resistant to at least ACSSuT**		Resistant to at least AKSSuT***		Resistant to ceftiofur (MIC ≥ 8 μg/ml)		Decreased susceptibility to ceftriaxone (MIC ≥ 2 μg/ml)		Resistant to nalidixic acid (MIC ≥ 32 μg/ml)		Decreased susceptibility to ciprofloxacin (MIC ≥ 0.25 μg/ml)	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
1996	1326	493	37	404	31	162	12	117	9	31	2	53	4	37	3	5	0.4	5	0.4
1997	1301	443	34	328	25	180	14	125	10	46	3	44	3	13	1	11	1	7	0.5
1998	1460	397	27	333	23	187	13	130	9	50	3	14	1	14	1	20	1	10	1
1999	1498	390	26	317	21	172	11	127	8	44	3	31	2	33	2	16	1	15	1
2000	1378	353	26	284	21	159	12	122	9	44	3	44	3	45	3	34	2	20	1
2001	1419	394	28	315	22	168	12	142	10	28	2	58	4	56	4	37	3	15	1
2002	2009	424	21	321	16	188	9	156	8	49	2	87	4	87	4	37	2	16	1

Salmonella Enteritidis

Year	# isolates tested	Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Resistant to at least ACSSuT**		Resistant to at least AKSSuT***		Resistant to ceftiofur (MIC ≥ 8 μg/ml)		Decreased susceptibility to ceftriaxone (MIC ≥ 2 μg/ml)		Resistant to nalidixic acid (MIC ≥ 32 μg/ml)		Decreased susceptibility to ciprofloxacin (MIC ≥ 0.25 μg/ml)	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
1996	357	110	31	84	23	13	4	1	0.3	0	0	14	4	8	2	3	1	3	1
1997	303	78	26	37	12	6	2	1	0.3	1	0.3	15	5	1	0.3	4	1	2	1
1998	244	30	12	16	6	0	0	0	0	0	0	0	0	0	0	5	2	2	1
1999	270	45	17	28	10	2	1	2	1	0	0	1	0.4	1	0.4	7	3	6	2
2000	319	35	11	9	3	0	0	0	0	0	0	0	0	0	0	7	2	1	0.3
2001	282	40	14	16	6	3	1	0	0	1	0.3	7	2	7	2	12	4	0	0
2002	338	44	13	14	4	2	1	1	0.3	0	0	0	0	0	0	14	4	2	1

* Using only antimicrobial agents (n=14) tested in all seven years
**ACSSuT = ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, and tetracycline
***AKSSuT= ampicillin, kanamycin, streptomycin, sulfamethoxazole, and tetracycline

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Table 20. Summary: Multidrug* resistance of non-Typhi *Salmonella* isolates, 1996-2002

Salmonella Typhimurium

Year	# isolates tested	Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Resistant to at least ACSSuT**		Resistant to at least AKSSuT***		Resistant to ceftiofur (MIC≥8 μg/ml)		Decreased susceptibility to ceftriaxone (MIC ≥ 2μg/ml)		Resistant to nalidixic acid (MIC≥ 32 μg/ml)		Decreased susceptibility to ciprofloxacin (MIC ≥ 0.25μg/ml)	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
1996	306	196	64	177	58	125	41	103	34	27	9	13	4	7	2	1	0.3	1	0.3
1997	327	204	62	188	57	154	47	115	35	41	13	17	5	7	2	3	1	1	0.3
1998	377	200	53	193	51	158	42	120	32	47	12	8	2	7	2	2	0.5	1	0.3
1999	363	180	50	168	46	131	36	102	28	39	11	9	2	9	2	0	0	1	0.3
2000	303	153	50	143	47	108	36	84	28	28	9	11	4	11	4	4	1	2	1
2001	325	165	51	156	48	110	34	96	29	15	5	10	3	10	3	2	1	2	1
2002	393	157	40	143	36	107	27	84	21	24	6	17	4	17	4	5	1	3	1

Salmonella Newport

Year	# isolates tested	Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Number resistant to ≥ 8 antimicrobial agents		At least MDRAmpC-resistant****		Resistant to nalidixic acid (MIC≥32 μg/ml)		Decreased susceptibility to ciprofloxacin (MIC ≥ 0.25μg/ml)	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
1996	51	9	18	4	8	3	6	2	4	0	0	0	0	0	0
1997	48	6	12	3	6	2	4	2	4	0	0	0	0	0	0
1998	77	4	5	2	3	2	3	2	3	1	1	0	0	0	0
1999	98	23	23	17	17	17	17	17	17	17	17	0	0	0	0
2000	124	30	24	28	23	28	23	27	22	27	22	1	1	0	0
2001	124	43	35	39	31	33	27	31	25	31	25	0	0	0	0
2002	239	65	27	60	25	56	23	53	22	53	22	2	1	0	0

* Using only antimicrobial agents (n=14) tested in all seven years
**ACSSuT = ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, and tetracycline
***AKSSuT= ampicillin, kanamycin, streptomycin, sulfamethoxazole, and tetracycline
****MDR-AmpC = ACSSuT, amoxicillin-clavulanic acid, cephalothin, cefoxitin, ceftiofur, decreased susceptibility to ceftriaxone (MIC ≥ 2 μg/ml)

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Table 20. Summary: Multidrug* resistance of non-Typhi *Salmonella* isolates, 1996-2002

Salmonella Heidelberg

Year	# isolates tested	Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		At least R-type AClCfCp**		At least R-type ACSSuT***		Resistant to ceftiofur (MIC≥8 μg/ml)		Decreased susceptibility to ceftriaxone (MIC ≥ 2μg/ml)	
		N	%	N	%	N	%	N	%	N	%	N	%	N	%
1996	74	36	49	34	46	5	7	2	3	1	1	5	7	4	5
1997	75	27	36	20	27	3	4	0	0	0	0	1	1	0	0
1998	101	44	43	35	35	8	8	0	0	0	0	1	1	1	1
1999	89	29	33	25	28	7	8	0	0	1	1	0	0	0	0
2000	79	29	37	22	28	3	4	3	4	1	1	3	4	3	4
2001	100	36	36	30	30	3	3	3	3	1	1	3	3	3	3
2002	105	34	32	28	27	3	3	8	8	1	1	8	8	8	8

* Using only antimicrobial agents (n=14) tested in all seven years
**AClCfCp = ampicillin, amoxicillin-clavulanic acid, ceftiofur, and cephalothin
***ACSSuT = ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, and tetracycline

Table 21. Summary: Antimicrobial resistance of *Salmonella* Typhi isolates, 1999-2002

***Salmonella* Typhi**	**1999**	**2000**	**2001**	**2002**
Salmonella Typhi isolates	166	177	197	195
Isolates resistant to ≥ 1 antimicrobial agents*	30% 49	28% 50	41% 81	26% 50
Isolates resistant to ≥ 2 antimicrobial agents*	15% 25	12% 21	23% 45	7% 14
Salmonella Typhi with at least ACSSuT resistance pattern	9% 15	8% 14	17% 33	6% 11
Salmonella Typhi with at least ACSuTm** resistance pattern	12% 20	9% 16	18% 35	6% 11
Amikacin (MIC ≥ 64)	0% 0	1% 2	0% 0	0% 0
Amox-Clav** (MIC ≥ 32)	1% 1	0% 0	0% 0	0% 0
Ampicillin (MIC ≥ 32)	13% 21	9% 16	20% 40	6% 11
Cefoxitin (MIC ≥ 32)	Not Tested	2% 3	1% 1	0% 0
Ceftiofur (MIC ≥ 8)	1% 2	1% 1	0% 0	0% 0
Ceftriaxone (MIC ≥ 2)	1% 1	2% 2	0% 0	0% 0
Ceftriaxone (MIC ≥ 64)	1% 1	1% 1	0% 0	0% 0

*Using only antimicrobial agents (n=14) tested in all four years
**ACSuTm = ampicillin, chloramphenicol, sulfamethoxazole-trimethoprim
***Amox-Clav = amoxicillin-clavulanic acid

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Table 21. Summary: Antimicrobial resistance of *Salmonella* Typhi isolates, 1999-2002

***Salmonella* Typhi**	**1999**	**2000**	**2001**	**2002**
Cephalothin (MIC ≥ 32)	2% 4	1% 2	1% 1	1% 3
Chloramphenicol (MIC ≥ 32)	12% 20	11% 19	21% 41	6% 12
Ciprofloxacin (MIC ≥ 0.25)	15% 25	21% 38	20% 39	12% 23
Ciprofloxacin (MIC ≥ 4)	0% 0	0% 0	0% 0	0% 0
Gentamicin (MIC ≥ 16)	0% 0	1% 1	0% 0	0% 0
Kanamycin (MIC ≥ 64)	0% 0	1% 1	1% 1	0% 0
Nalidixic Acid (MIC ≥ 32)	19% 31	23% 41	30% 59	24% 46
Streptomycin (MIC ≥ 64)	14% 23	10% 18	20% 40	7% 14
Sulfamethoxazole (MIC ≥ 512)	17% 28	12% 21	21% 41	6% 12
Tetracycline (MIC ≥ 16)	9% 15	11% 19	21% 41	7% 13
Trimeth-Sulfa*** (MIC ≥ 4/76)	13% 21	9% 16	21% 41	7% 13

****Trimeth-Sulfa = trimethoprim-sulfamethoxazole

Table 22. Summary: Antimicrobial resistance of *E. coli* O157 isolates, 1996-2002

E. coli O157	1996	1997	1998	1999	2000	2001	2002
E. coli O157 isolates	201	161	318	292	407	277	399
Isolates resistant to ≥ 1 antimicrobial agents*	21% 42	12% 20	7% 23	10% 30	10% 40	9% 24	7% 28
Isolates resistant to ≥ 2 antimicrobial agents*	8% 15	7% 11	5% 17	4% 12	7% 27	5% 15	4% 15
Amikacin (MIC ≥ 64)	Not Tested	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0
Amox-Clav** (MIC ≥ 32)	0% 0	0% 0	0% 0	0% 1	1% 4	1% 2	0% 0
Ampicillin (MIC ≥ 32)	1% 3	0% 0	2% 8	1% 4	3% 11	2% 6	1% 6
Apramycin (MIC ≥ 64)	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	Not Tested
Cefoxitin (MIC ≥ 32)	Not Tested	Not Tested	Not Tested	Not Tested	1% 4	1% 2	0% 0
Ceftiofur (MIC ≥ 8)	5% 10	0% 0	0% 0	0% 0	1% 4	1% 3	0% 0
Ceftriaxone (MIC ≥ 2)	2% 5	1% 1	0% 0	0% 0	1% 4	1% 2	0% 0
Ceftriaxone (MIC ≥ 64)	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0
Cephalothin (MIC ≥ 32)	3% 6	4% 6	0% 0	1% 2	1% 5	1% 4	1% 6
Chloramphenicol (MIC ≥ 32)	1% 1	0% 0	0.3% 1	0% 0	4% 15	1% 4	1% 5
Ciprofloxacin (MIC ≥ 4)	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0
Gentamicin (MIC ≥ 16)	0% 0	0% 0	0% 0	0% 1	1% 2	0% 1	0% 0
Kanamycin (MIC ≥ 64)	0% 0	0% 0	0.3% 1	1% 2	1% 4	0% 0	0.5% 2
Nalidixic Acid (MIC ≥ 32)	0% 0	0% 0	0% 0	1% 2	0.5% 2	1% 3	1% 4
Streptomycin (MIC ≥ 64)	2% 4	2% 4	2% 6	3% 8	5% 21	2% 5	2% 9
Sulfamethoxazole (MIC ≥ 512)	14% 28	11% 17	6% 18	8% 24	6% 24	5% 14	3% 14
Tetracycline (MIC ≥ 16)	5% 10	3% 5	4% 14	3% 10	7% 29	5% 15	3% 12
Trimeth-Sulfa*** (MIC ≥ 4/76)	0% 0	0% 0	1% 2	1% 4	1% 3	1% 2	0.5% 2

*Using only antimicrobial agents (n=14) tested in all seven years
**Amox-Clav = amoxicillin-clavulanic acid
***Trimeth-Sulfa = trimethoprim-sulfamethoxazole

Table 23. Frequency of *Shigella* species, 2002

Species	**N**	**%**
sonnei	536	86
flexneri	73	12
boydii	7	1
dysenteriae	3	0.5
Unknown	1	0.2
Total	**620**	**100**

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Table 24. Antimicrobial resistance of *Shigella* isolates, by *Shigella* species, 2002

Antimicrobial Agent	**All *Shigella* (N =620)**		***Shigella sonnei* (N =536)**		***Shigella flexneri* (N =73)**		***Shigella boydii* (N =7)**	
	# Resistant	**% Resistant**	**# Resistant**	**% Resistant**	**# Resistant**	**% Resistant**	**# Resistant**	**% Resistant**
Amikacin	0	0	0	0	0	0	0	0
Amox-Clav*	16	3	12	2	4	5	0	0
Ampicillin	475	77	416	78	55	75	1	14
Cefoxitin	2	0.3	2	0.4	0	0	0	0
Ceftiofur	1	0.2	0	0	1	1	0	0
Ceftriaxone	0	0	0	0	0	0	0	0
Cephalothin	41	7	39	7	2	3	0	0
Chloramphenicol	47	8	1	0.2	46	63	0	0
Ciprofloxacin	0	0	0	0	0	0	0	0
Gentamicin	1	0.2	0	0	1	1	0	0
Kanamycin	5	1	2	0.4	3	4	0	0
Naladixic acid	10	2	8	1	2	3	0	0
Streptomycin	338	54	297	55	33	45	5	71
Sulfamethoxazole	197	32	160	30	30	41	4	57
Tetracycline	190	31	126	23	57	78	4	57
Trimethoprim-Sulfa**	231	37	203	38	21	29	4	57

*Amox-Clav = amoxicillin-clavulanic acid
**Trimethoprim-Sulfa = trimethoprim-sulfamethoxazole

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Table 25. Summary: Antimicrobial resistance of *Shigella* isolates, 1999-2002

Shigella spp.	**1999**	**2000**	**2001**	**2002**
Shigella isolates	375	451	344	620
Isolates resistant to ≥ 1 antimicrobial agents*	91% 341	93% 418	95% 327	92% 569
Isolates resistant to ≥ 2 antimicrobial agents*	65% 245	67% 302	71% 244	58% 359
Shigella with at least ACSSuT resistance pattern	9% 32	6% 25	6% 22	2% 12
Shigella with at least ACSuTm** resistance pattern	10% 37	7% 31	7% 24	3% 17
Amikacin (MIC ≥ 64)	0% 0	0.2% 1	0% 0	0% 0
Amox-Clav** (MIC ≥ 32)	1% 4	2% 10	4% 15	3% 16
Ampicillin (MIC ≥ 32)	78% 291	79% 356	80% 274	77% 475
Cefoxitin (MIC ≥ 32)	Not Tested	0.4% 2	1% 4	0.3% 2
Ceftiofur (MIC ≥ 8)	0% 0	0% 0	0% 0	0.2% 1
Ceftriaxone (MIC ≥ 2)	0% 0	1% 4	0% 0	0.2% 1
Ceftriaxone (MIC ≥ 64)	0% 0	0% 0	0% 0	0% 0

*Using only antimicrobial agents (n=14) tested in all four years
**ACSuTm = ampicillin, chloramphenicol, sulfamethoxazole-trimethoprim
***Amox-Clav = amoxicillin-clavulanic acid
****Trimeth-Sulfa = trimethoprim-sulfamethoxazole

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Table 25. Summary: Antimicrobial resistance of *Shigella* isolates, 1999-2002

	1999	2000	2001	2002
Cephalothin (MIC ≥ 32)	3% 12	8% 36	9% 31	7% 41
Chloramphenicol (MIC ≥ 32)	17% 65	14% 63	22% 74	8% 47
Ciprofloxacin (MIC ≥ 0.25)	1% 3	0.2% 1	0.3% 1	0.2% 1
Ciprofloxacin (MIC ≥ 4)	0% 0	0% 0	0.3% 1	0% 0
Gentamicin (MIC ≥ 16)	0.3% 1	0.2% 1	0% 0	0.2% 1
Kanamycin (MIC ≥ 64)	1% 2	1% 6	1% 2	1% 5
Nalidixic Acid (MIC ≥ 32)	2% 6	1% 5	2% 6	2% 10
Streptomycin (MIC ≥ 64)	56% 209	57% 258	53% 183	54% 338
Sulfamethoxazole (MIC ≥ 512)	56% 210	56% 252	56% 194	32% 197
Tetracycline (MIC ≥ 16)	57% 215	45% 202	59% 204	31% 190
Trimeth-Sulfa*** (MIC ≥ 4/76)	51% 193	53% 239	47% 161	37% 231

*Using only antimicrobial agents (n=14) tested in all four years
**ACSuTm = ampicillin, chloramphenicol, sulfamethoxazole-trimethoprim
***Amox-Clav = amoxicillin-clavulanic acid
****Trimeth-Sulfa = trimethoprim-sulfamethoxazole

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Table 26. Summary: Antimicrobial resistance of *Shigella sonnei* isolates, 1999-2002

Shigella sonnei	1999	2000	2001	2002
Shigella sonnei isolates	275	367	239	536
Isolates resistant to ≥ 1 antimicrobial agents*	89% 246	92% 339	95% 226	93% 498
Isolates resistant to ≥ 2 antimicrobial agents*	58% 160	63% 233	62% 149	55% 295
Shigella sonnei with at least ACSSuT resistance pattern	0.4% 1	1% 3	0% 0	0% 0
Shigella sonnei with at least ACSuTm** resistance pattern	2% 5	2% 7	1% 2	0.2% 1
Amikacin (MIC ≥ 64)	0% 0	0.3% 1	0% 0	0% 0
Amox-Clav** (MIC ≥ 32)	0.4% 1	2% 7	5% 11	2% 12
Ampicillin (MIC ≥ 32)	80% 219	80% 295	83% 198	77% 416
Cefoxitin (MIC ≥ 32)	Not Tested	1% 2	2% 4	0.4% 2
Ceftiofur (MIC ≥ 8)	0% 0	0% 0	0% 0	0% 0
Ceftriaxone (MIC ≥ 64)	0% 0	0% 0	0% 0	0% 0

*Using only antimicrobial agents (n=14) tested in all four years
**ACSuTm = ampicillin, chloramphenicol, sulfamethoxazole-trimethoprim
***Amox-Clav = amoxicillin-clavulanic acid
****Trimeth-Sulfa = trimethoprim-sulfamethoxazole

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Table 26. Summary: Antimicrobial resistance of *Shigella sonnei* isolates, 1999-2002

	1999	2000	2001	2002
Cephalothin (MIC ≥ 32)	3% 8	9% 32	13% 30	7% 39
Chloramphenicol (MIC ≥ 32)	2% 5	3% 10	1% 3	0.2% 1
Ciprofloxacin (MIC ≥ 0.25)	1% 2	0.3% 1	0% 0	0% 0
Ciprofloxacin (MIC ≥ 4)	0% 0	0% 0	0% 0	0% 0
Gentamicin (MIC ≥ 16)	0.4% 1	0.3% 1	0% 0	0% 0
Kanamycin (MIC ≥ 64)	1% 2	2% 6	0.4% 1	0.4% 2
Nalidixic Acid (MIC ≥ 32)	1% 4	1% 5	1% 2	1% 8
Streptomycin (MIC ≥ 64)	52% 143	56% 206	54% 129	55% 297
Sulfamethoxazole (MIC ≥ 512)	55% 150	56% 206	54% 130	30% 160
Tetracycline (MIC ≥ 16)	46% 127	34% 126	45% 107	23% 126
Trimeth-Sulfa*** (MIC ≥ 4/76)	53% 146	55% 202	51% 121	38% 203

*Using only antimicrobial agents (n=14) tested in all four years
**ACSuTm=Ampicillin, Chloramphenicol, Sulfamethoxazole-Trimethoprim
***Amox-Clav=Amoxicillin-Clavulanic Acid
****Trimeth-Sulfa=Trimethoprim-Sulfamethoxazole

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Table 27. Summary: Antimicrobial resistance of *Shigella flexneri* isolates, 1999-2002

Shigella flexneri	**1999**	**2000**	**2001**	**2002**
Shigella flexneri isolates	87	75	91	73
Isolates resistant to ≥ 1 antimicrobial agents*	95% 83	96% 72	97% 88	85% 62
Isolates resistant to ≥ 2 antimicrobial agents*	84% 73	83% 62	90% 82	77% 56
Shigella flexneri with at least ACSSuT resistance pattern	33% 29	29% 22	22% 20	16% 12
Shigella flexneri with at least ACSuTm** resistance pattern	34% 30	32% 24	23% 21	22% 16
Amikacin (MIC ≥ 64)	0% 0	0% 0	0% 0	0% 0
Amox-Clav** (MIC ≥ 32)	3% 3	4% 3	4% 4	5% 4
Ampicillin (MIC ≥ 32)	77% 67	77% 58	73% 66	75% 55
Cefoxitin (MIC ≥ 32)	Not Tested	0% 0	0% 0	0% 0
Ceftiofur (MIC ≥ 8)	0% 0	0% 0	0% 0	1% 1
Ceftriaxone (MIC ≥ 64)	0% 0	0% 0	0% 0	0% 0

*Using only antimicrobial agents (n=14) tested in all four years
**ACSuTm = ampicillin, chloramphenicol, sulfamethoxazole-trimethoprim
***Amox-Clav = amoxicillin-clavulanic acid
****Trimeth-Sulfa = trimethoprim-sulfamethoxazole

Table 27. Summary: Antimicrobial resistance of *Shigella flexneri* isolates, 1999-2002

	1999	2000	2001	2002
Cephalothin (MIC ≥ 32)	5% 4	3% 2	1% 1	3% 2
Chloramphenicol (MIC ≥ 32)	64% 56	69% 52	75% 68	63% 46
Ciprofloxacin (MIC ≥ 0.25)	1% 1	0% 0	1% 1	1% 1
Ciprofloxacin (MIC ≥ 4)	0% 0	0% 0	1% 1	0% 0
Gentamicin (MIC ≥ 16)	0% 0	0% 0	0% 0	1% 1
Kanamycin (MIC ≥ 64)	0% 0	0% 0	1% 1	4% 3
Nalidixic Acid (MIC ≥ 32)	1% 1	0% 0	3% 3	3% 2
Streptomycin (MIC ≥ 64)	63% 55	61% 46	47% 43	45% 33
Sulfamethoxazole (MIC ≥ 512)	59% 51	53% 40	57% 52	41% 30
Tetracycline (MIC ≥ 16)	92% 80	92% 69	95% 86	78% 57
Trimeth-Sulfa*** (MIC ≥ 4/76)	48% 42	43% 32	34% 31	29% 21

*Using only antimicrobial agents (n=14) tested in all four years
**ACSuTm = ampicillin, chloramphenicol, sulfamethoxazole-trimethoprim
***Amox-Clav = amoxicillin-clavulanic acid
****Trimeth-Sulfa = trimethoprim-sulfamethoxazole

Table 28. Frequency of *Campylobacter* species, 2002

Species	**N**	**%**
jejuni	329	93
coli	25	7
fetus	0	0
other species	0	0
Total	**354**	**100**

Table 29. Antimicrobial resistance of *Campylobacter* isolates, by *Campylobacter* species, 2002

Antimicrobial Agent	All *Campylobacter* (N =354)		*Campylobacter jejuni* (N =329)		*Campylobacter coli* (N =25)	
	# Resistant	% Resistant	# Resistant	% Resistant	# Resistant	% Resistant
Azithromycin	8	2	6	2	2	8
Chloramphenicol	0	0	0	0	0	0
Ciprofloxacin	71	20	68	21	3	12
Clindamycin	7	2	6	2	1	4
Erythromycin	6	2	5	1	1	4
Gentamicin	0	0	0	0	0	0
Naladixic acid	73	21	70	21	3	12
Tetracycline	141	40	131	40	10	40

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Table 30. Antimicrobial resistance of *Campylobacter jejuni* isolates, by site, 2002

Site	Antimicrobial Agent	*Campylobacter jejuni* (N =329) # Resistant	% Resistant within state
California (N=47)	Azithromycin	2	4
	Chloramphenicol	0	0
	Ciprofloxacin	6	13
	Clindamycin	1	2
	Erythromycin	2	4
	Gentamicin	0	0
	Naladixic acid	6	13
	Tetracycline	14	30
Colorado (N=28)	Azithromycin	1	4
	Chloramphenicol	0	0
	Ciprofloxacin	8	29
	Clindamycin	1	4
	Erythromycin	1	4
	Gentamicin	0	0
	Naladixic acid	8	29
	Tetracycline	9	32
Connecticut (N=30)	Azithromycin	0	0
	Chloramphenicol	0	0
	Ciprofloxacin	7	23
	Clindamycin	0	0
	Erythromycin	0	0
	Gentamicin	0	0
	Naladixic acid	7	23
	Tetracycline	16	53

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Table 30. Antimicrobial resistance of *Campylobacter jejuni* isolates, by site, 2002

Site	Antimicrobial Agent	*Campylobacter jejuni* (N =329) # Resistant	% Resistant within state
Georgia (N=43)	Azithromycin	3	7
	Chloramphenicol	0	0
	Ciprofloxacin	12	28
	Clindamycin	3	7
	Erythromycin	2	5
	Gentamicin	0	0
	Naladixic acid	12	28
	Tetracycline	19	44
Maryland (N=24)	Azithromycin	0	0
	Chloramphenicol	0	0
	Ciprofloxacin	4	17
	Clindamycin	1	4
	Erythromycin	0	0
	Gentamicin	0	0
	Naladixic acid	5	21
	Tetracycline	4	17
Minnesota (N=51)	Azithromycin	0	0
	Chloramphenicol	0	0
	Ciprofloxacin	13	25
	Clindamycin	0	0
	Erythromycin	0	0
	Gentamicin	0	0
	Naladixic acid	13	25
	Tetracycline	27	53

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Table 30. Antimicrobial resistance of *Campylobacter jejuni* isolates, by site, 2002

Site	Antimicrobial Agent	*Campylobacter jejuni* (N =329) # Resistant	% Resistant within state
New York State (N=46)	Azithromycin	0	0
	Chloramphenicol	0	0
	Ciprofloxacin	7	15
	Clindamycin	0	0
	Erythromycin	0	0
	Gentamicin	0	0
	Naladixic acid	8	17
	Tetracycline	15	33
Oregon (N=33)	Azithromycin	0	0
	Chloramphenicol	0	0
	Ciprofloxacin	9	27
	Clindamycin	0	0
	Erythromycin	0	0
	Gentamicin	0	0
	Naladixic acid	9	27
	Tetracycline	13	39
Tennessee (N=27)	Azithromycin	0	0
	Chloramphenicol	0	0
	Ciprofloxacin	2	7
	Clindamycin	0	0
	Erythromycin	0	0
	Gentamicin	0	0
	Naladixic acid	2	7
	Tetracycline	14	52

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Table 31. Summary: Antimicrobial resistance of *Campylobacter* isolates, 1997-2002

Campylobacter	1997	1998	1999	2000	2001	2002
Campylobacter isolates	217	310	318	324	384	354
Isolates resistant to ≥ 1 antimicrobial agents*	52% (113)	55% (170)	53% (169)	48% (155)	50% (193)	51% (180)
Isolates resistant to ≥ 2 antimicrobial agents*	16% (34)	18% (57)	21% (67)	16% (51)	21% (81)	21% (74)
Ciprofloxacin (MIC ≥ 4)	13% (28)	13% (42)	18% (58)	14% (46)	19% (75)	20% (71)
Nalidixic Acid (MIC ≥ 32)	14% (31)	17% (54)	21% (67)	17% (54)	20% (77)	21% (73)
Erythromycin (MIC ≥ 8)	2% (4)	3% (8)	2% (8)	1% (5)	2% (8)	2% (6)
Azithromycin (MIC ≥ 2)	Not Tested	2% (5)	3% (10)	2% (7)	2% (8)	2% (8)
Chloramphenicol (MIC ≥ 32)	1% (3)	2% (6)	0.3% (1)	0% (0)	0% (0)	0% (0)
Clindamycin (MIC ≥ 4)	2% (4)	1% (4)	2% (5)	1% (4)	2% (8)	2% (7)
Gentamicin (MIC ≥ 16)	Not Tested	0% (0)	0% (0)	0.3% (1)	0% (0)	0% (0)
Tetracycline (MIC ≥ 16)	47% (102)	45% (141)	44% (140)	38% (122)	41% (156)	40% (141)

*Using only *Campylobacter* antimicrobial agents (n=6) tested in all six years

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Table 32. Summary: Antimicrobial resistance of *Campylobacter jejuni* isolates, 1997-2002

Campylobacter jejuni	1997	1998	1999	2000	2001	2002
Campylobacter jejuni isolates	209	297	294	306	365	329
Isolates resistant to ≥ 1 antimicrobial agents*	51% (107)	54% (162)	53% (157)	49% (149)	50% (181)	52% (170)
Isolates resistant to ≥ 2 antimicrobial agents*	14% (30)	17% (50)	19% (57)	15% (45)	20% (73)	21% (70)
Ciprofloxacin (MIC ≥ 4)	12% (26)	14% (41)	18% (52)	14% (43)	18% (67)	21% (68)
Nalidixic Acid (MIC ≥ 32)	13% (28)	16% (47)	20% (59)	16% (49)	19% (69)	21% (70)
Erythromycin (MIC ≥ 8)	1% (3)	2% (7)	2% (6)	1% (4)	2% (7)	1% (5)
Azithromycin (MIC ≥ 2)	Not Tested	1% (4)	3% (8)	2% (6)	2% (7)	2% (6)
Chloramphenicol (MIC ≥ 32)	1% (2)	1% (2)	0.3% (1)	0% (0)	0% (0)	0% (0)
Clindamycin (MIC ≥ 4)	1% (2)	1% (3)	1% (3)	1% (3)	2% (7)	2% (6)
Gentamicin (MIC ≥ 16)	Not Tested	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Tetracycline (MIC ≥ 16)	47% (98)	46% (137)	46% (134)	39% (118)	40% (146)	40% (131)

*Using only *Campylobacter* antimicrobial agents (n=6) tested in all six years

Table 33. Summary: Antimicrobial resistance of *Campylobacter coli* isolates, 1997-2002

Campylobacter coli	1997	1998	1999	2000	2001	2002
Campylobacter coli isolates	6	8	20	12	17	25
Isolates resistant to > 1 antimicrobial agents*	83% (5)	50% (4)	50% (10)	33% (4)	65% (11)	40% (10)
Isolates resistant to > 2 antimicrobial agents*	50% (3)	50% (4)	35% (7)	25% (3)	47% (8)	16% (4)
Ciprofloxacin (MIC > 4)	33% (2)	0% (0)	30% (6)	25% (3)	47% (8)	12% (3)
Nalidixic Acid (MIC > 32)	50% (3)	50% (4)	30% (6)	25% (3)	41% (7)	12% (3)
Erythromycin (MIC > 8)	0% (0)	12% (1)	10% (2)	8% (1)	6% (1)	4% (1)
Azithromycin (MIC > 2)	Not Tested	12% (1)	10% (2)	8% (1)	6% (1)	8% (2)
Chloramphenicol (MIC > 32)	17% (1)	25% (2)	0% (0)	0% (0)	0% (0)	0% (0)
Clindamycin (MIC > 4)	17% (1)	12% (1)	10% (2)	8% (1)	6% (1)	4% (1)
Gentamicin (MIC > 16)	Not Tested	0% (0)	0% (0)	8% (1)	0% (0)	0% (0)
Tetracycline (MIC > 16)	67% (4)	50% (4)	30% (6)	25% (3)	59% (10)	40% (10)

*Using only *Campylobacter* antimicrobial agents (n=6) tested in all six years

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Table 34. Frequency of resistance and multidrug* resistance among *Salmonella* Typhi, *Shigella*, *E. coli* O157, and *Campylobacter* isolates, 2002

Isolate	Total		Number resistant to ≥ 1 antimicrobial agents		Number resistant to ≥ 2 antimicrobial agents		Number resistant to ≥ 5 antimicrobial agents		Number resistant to ≥ 8 antimicrobial agents	
	N	%	N	%	N	%	N	%	N	%
Salmonella Typhi	195	100	50	26	14	7	11	6	3	1
Shigella	620	100	569	92	359	58	130	21	2	0.3
sonnei	536	86	498	93	295	55	106	20	0	0
flexneri	73	12	62	85	56	77	22	30	2	3
E. coli O157	399	100	28	7	15	4	2	0.5	0	0
Campylobacter	354	100	180	51	74	21	0	0	0	0
jejuni	329	93	170	52	70	21	0	0	0	0
coli	25	7	10	40	4	16	0	0	0	0

*Multidrug resistance for *Salmonella*, *Shigella*, *E. coli* O157 to 16 antimicrobial agents tested in 2002: amikacin, amoxicillin-clavulanic acid, ampicillin, cefoxitin, ceftiofur, ceftriaxone, cephalothin, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, sulfamethoxazole, tetracycline, trimethoprim-sulfamethoxazole; Multidrug resistance for *Campylobacter* to 8 antimicrobial agents tested in 2002: azithromycin, chloramphenicol, ciprofloxacin, clindamycin, erythromycin, gentamicin, naladixic acid, tetracycline

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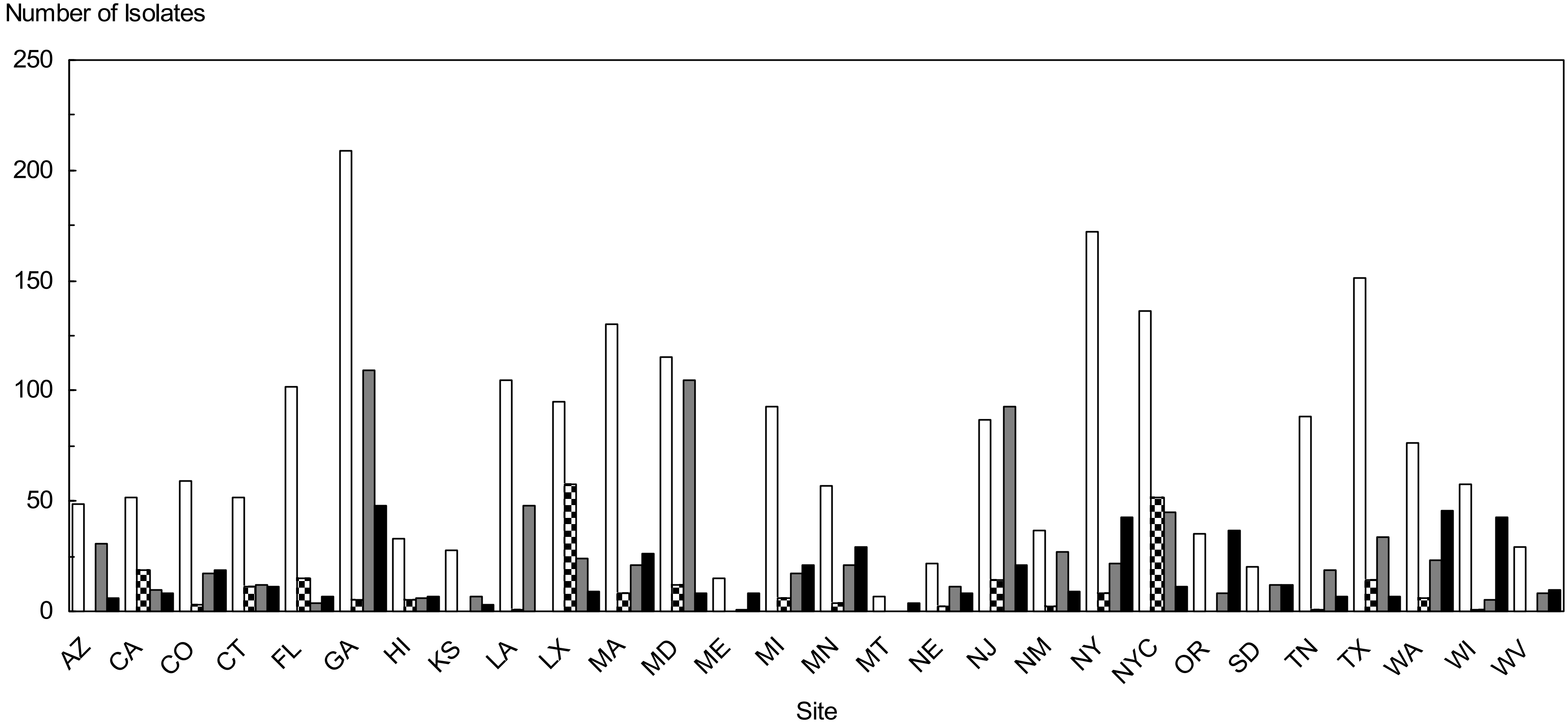
Figure 1. Number of isolates submitted, by site, 2002



Non-Typhi *Salmonella* (N=2112) *Salmonella Typhi* (N=247) *Shigella* (N=740) *E. coli* O157 (N=468)

LX=Los Angeles County NY=excluding New York City NYC=New York City

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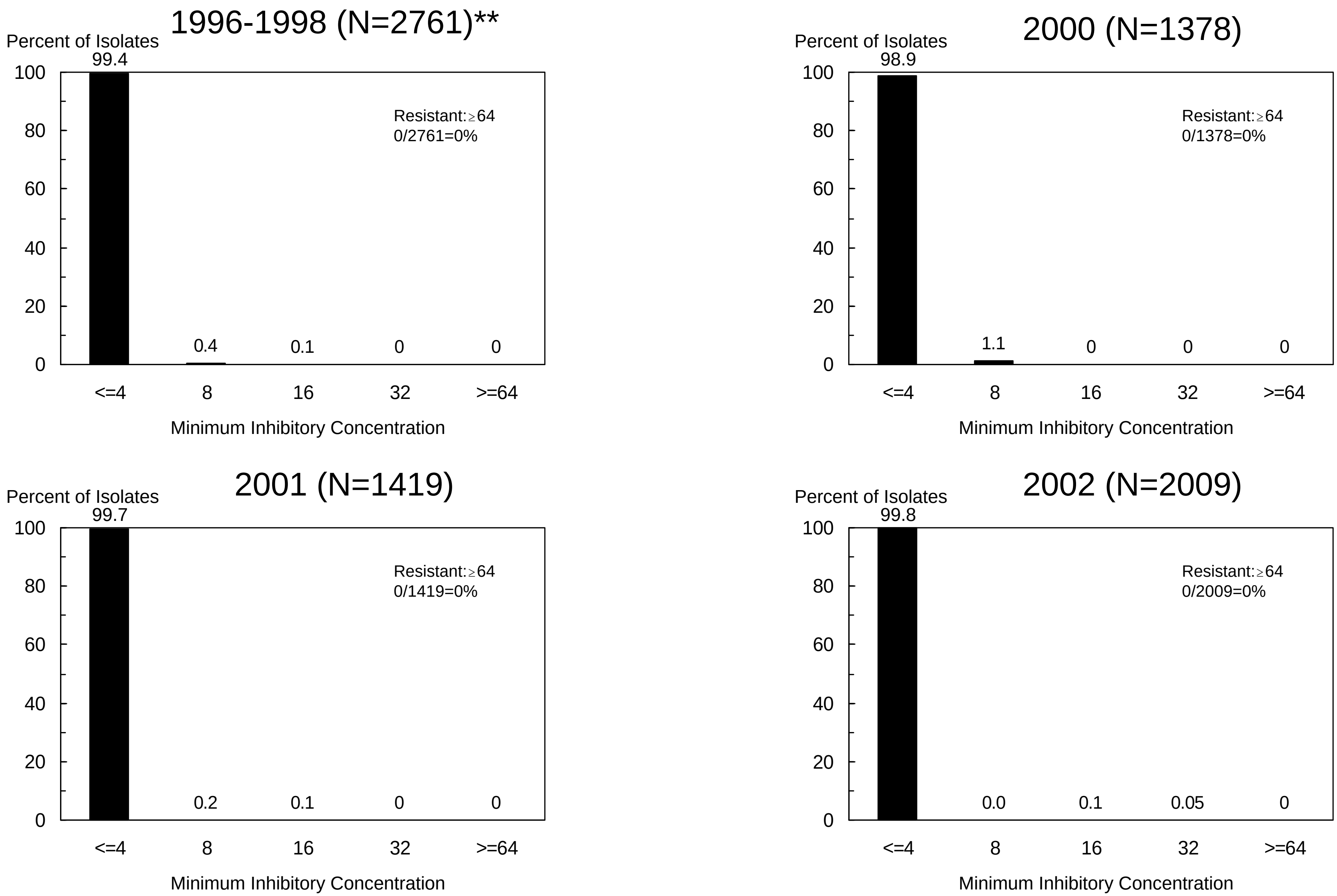
Figure 2a. MICs* for amikacin among non-Typhi *Salmonella* isolates, 1996-1998†, 2000-2002



*Sensititre range was from 0.5 to 4 ug/ml. Isolates with an amikacin MIC>4 ug/ml according to Sensititre® were tested by E-test (AB Biodisk, Solna, Sweden). The graphs depict a composite MIC distribution based on Sensititre® (0.5-4 ug/ml) and E-test (6-256 ug/ml) results

†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

**Not tested in 1996

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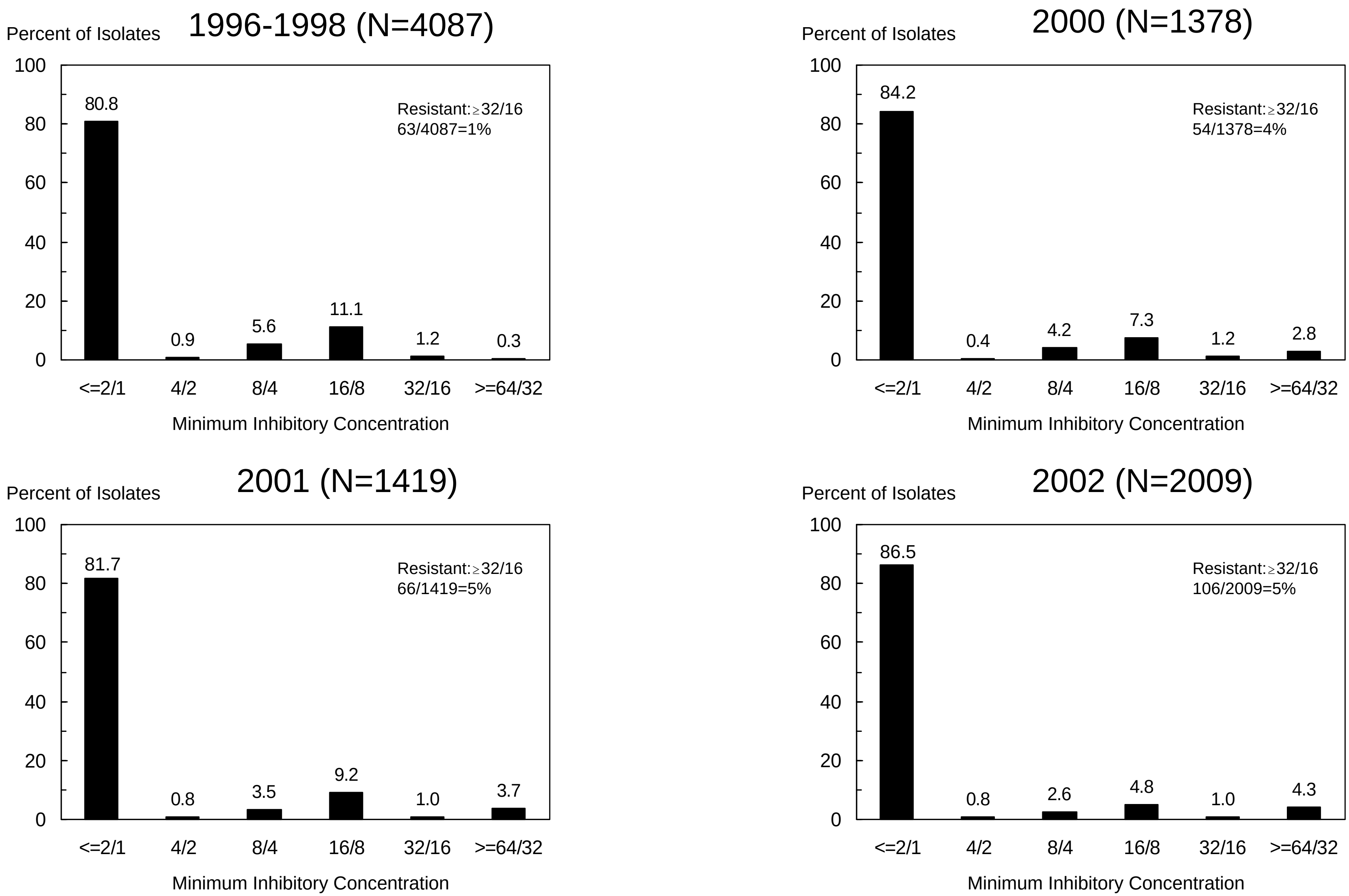
Figure 2b. MICs for amoxicillin-clavulanic acid among non-Typhi *Salmonella* isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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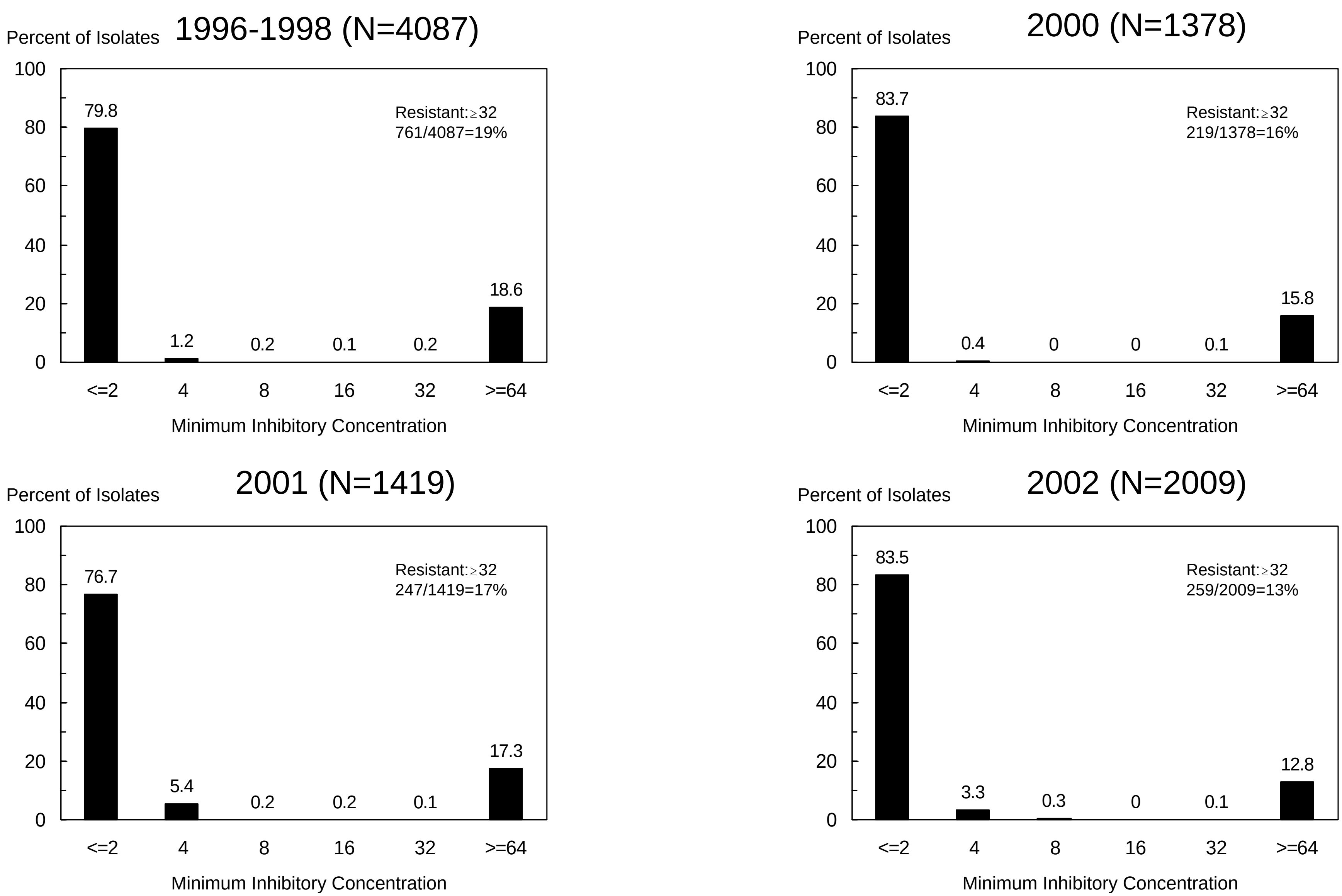
Figure 2c. MICs for ampicillin among non-Typhi *Salmonella* isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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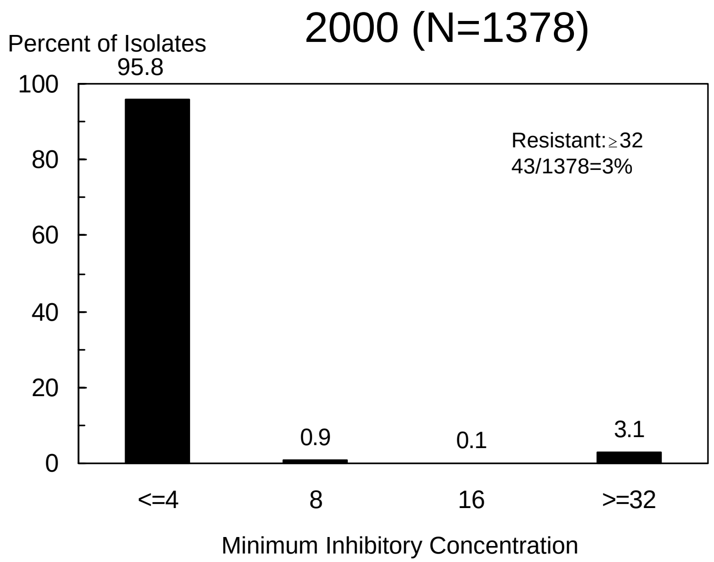
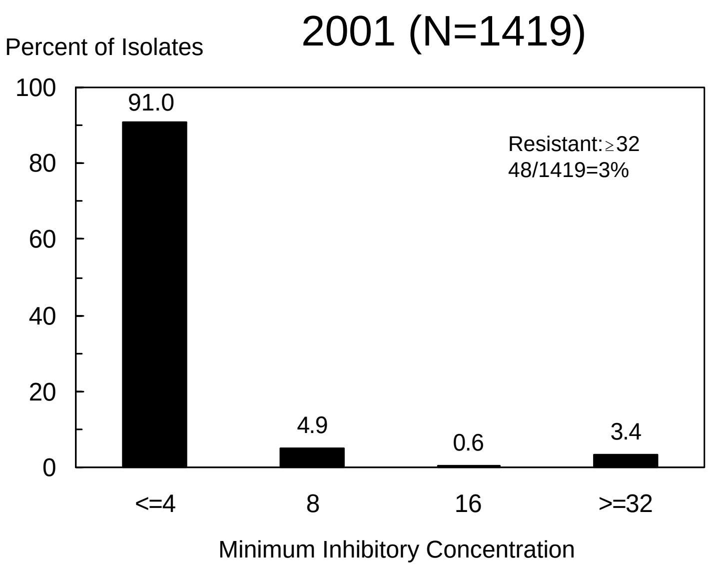
Figure 2d. MICs for cefoxitin among non-Typhi *Salmonella* isolates, 2000-2002

Not Tested in 1996-1998





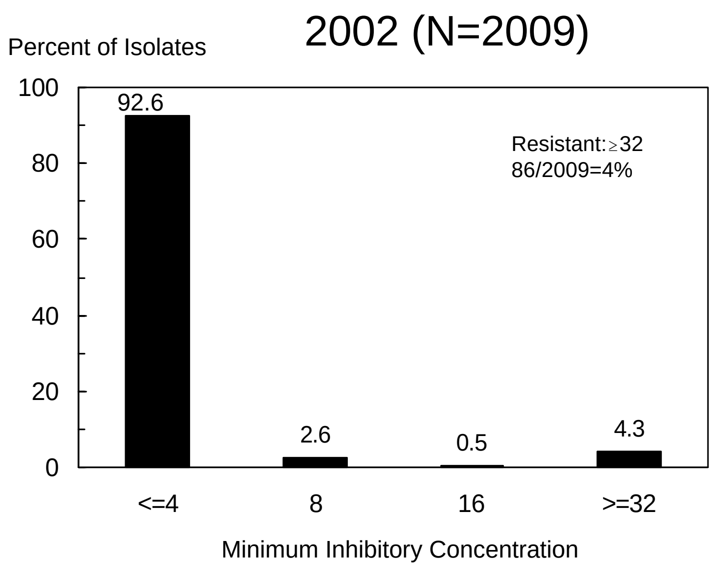


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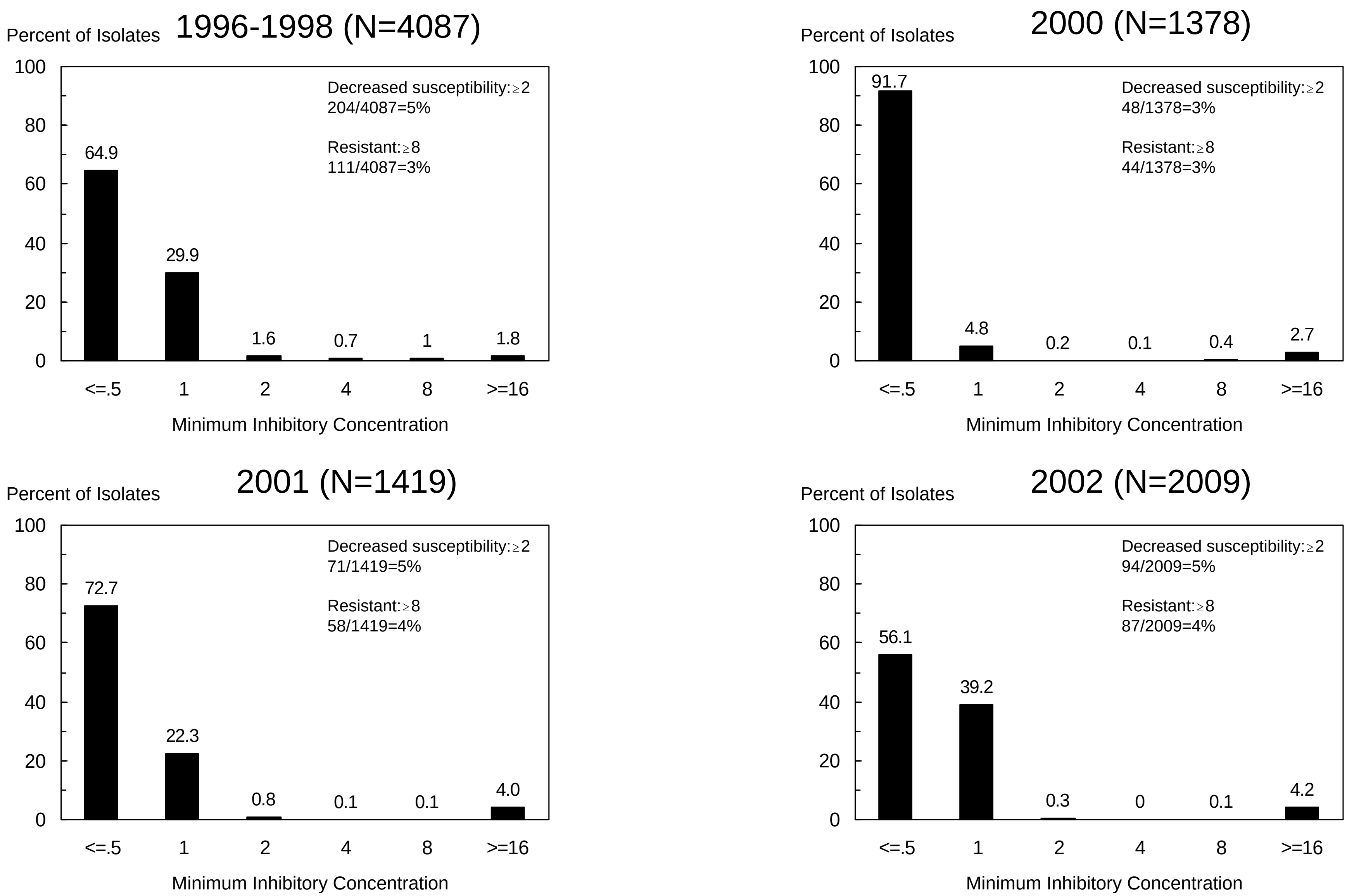
Figure 2e. MICs for ceftiofur among non-Typhi *Salmonella* isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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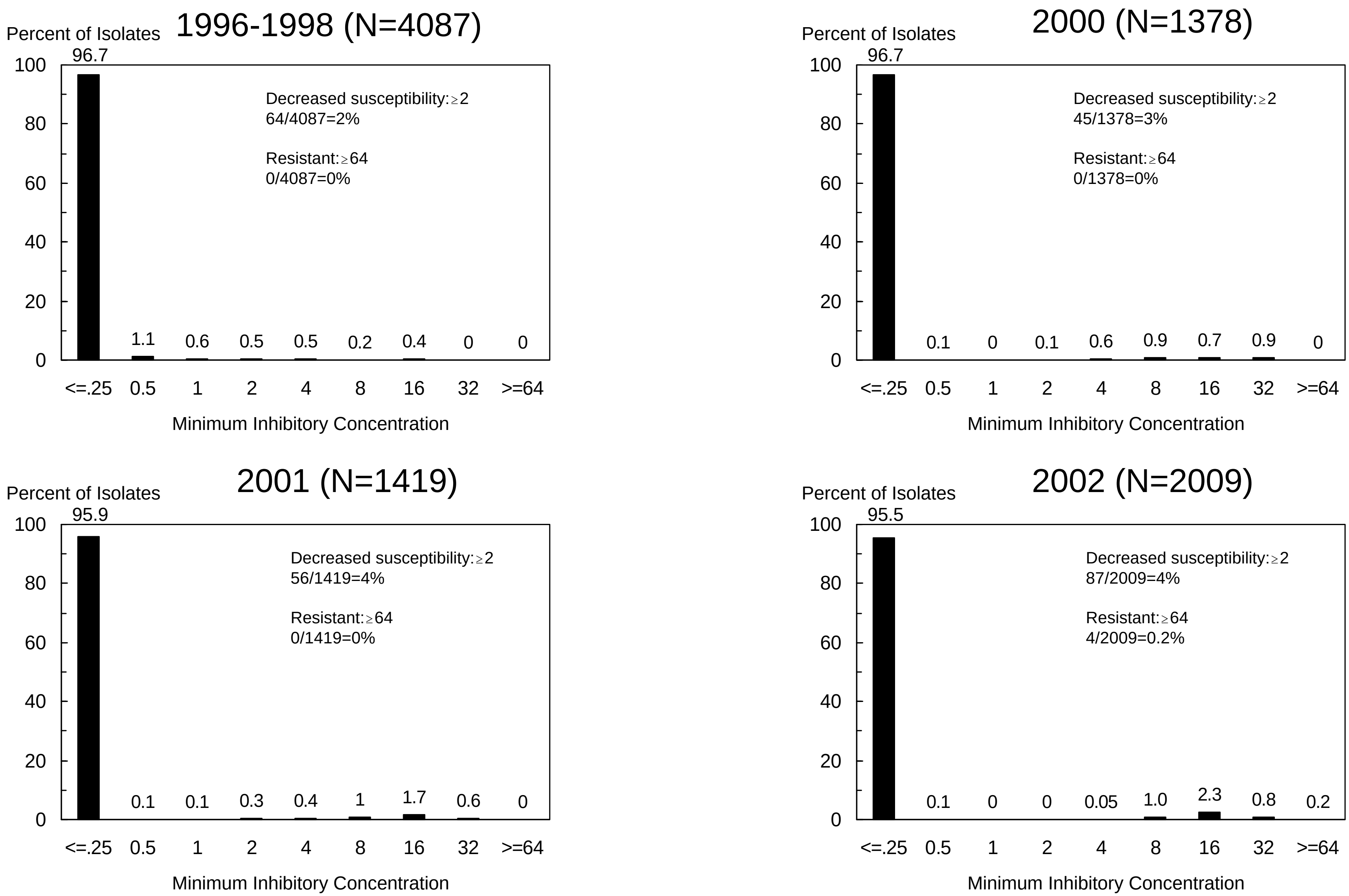
Figure 2f. MICs for ceftriaxone among non-Typhi *Salmonella* isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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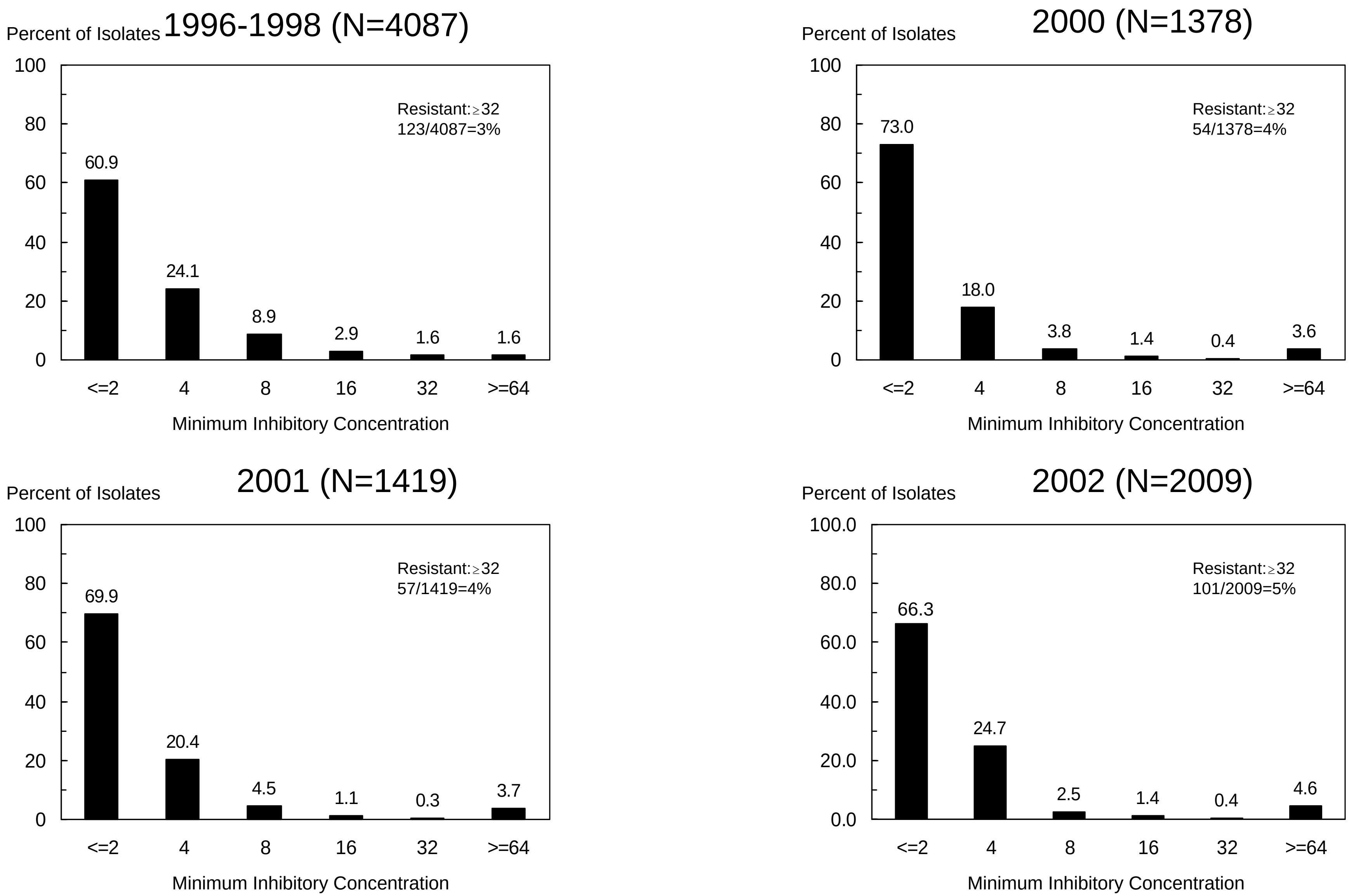
Figure 2g. MICs for cephalothin among non-Typhi *Salmonella* isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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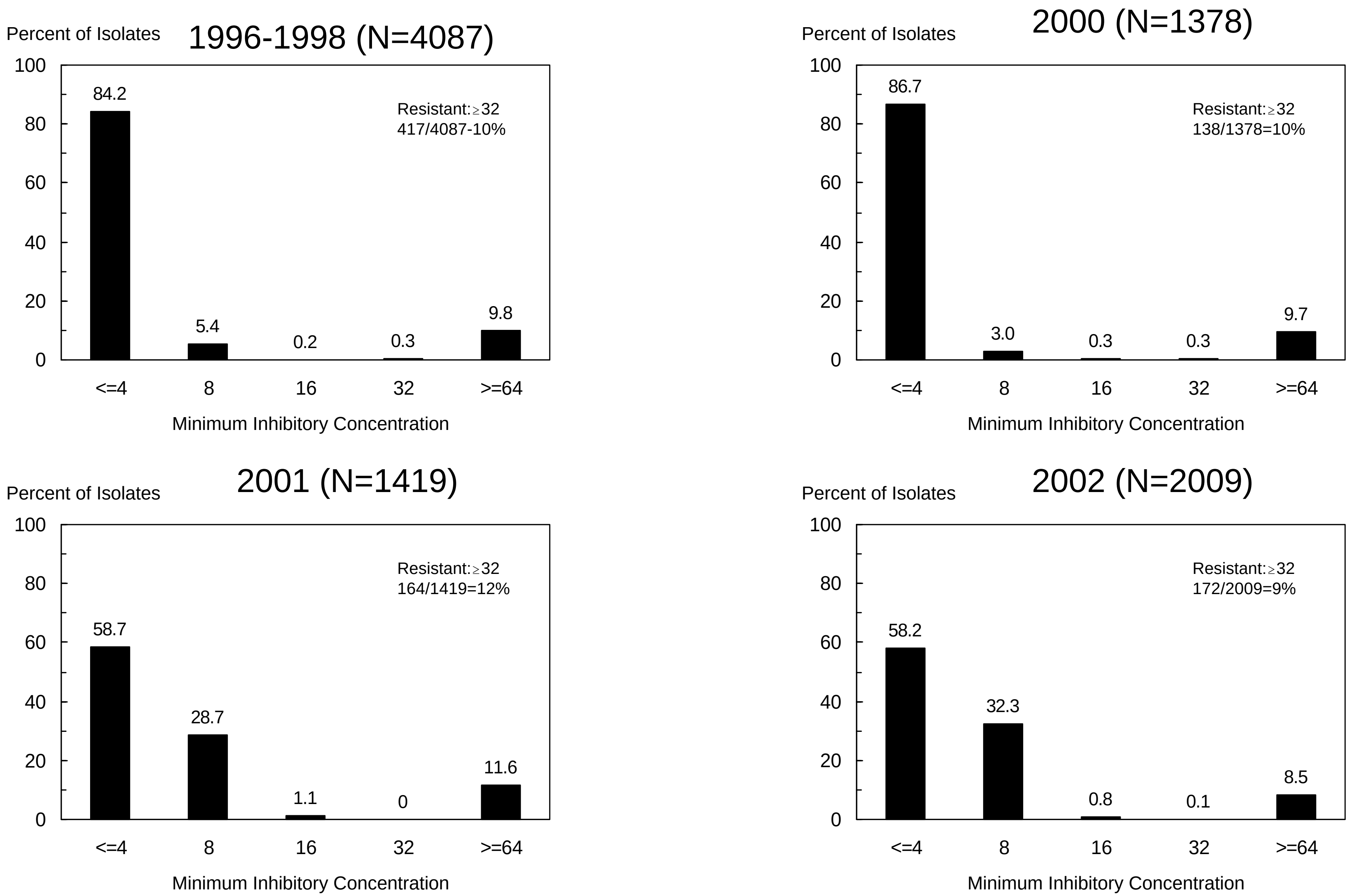
Figure 2h. MICs for chloramphenicol among non-Typhi *Salmonella* isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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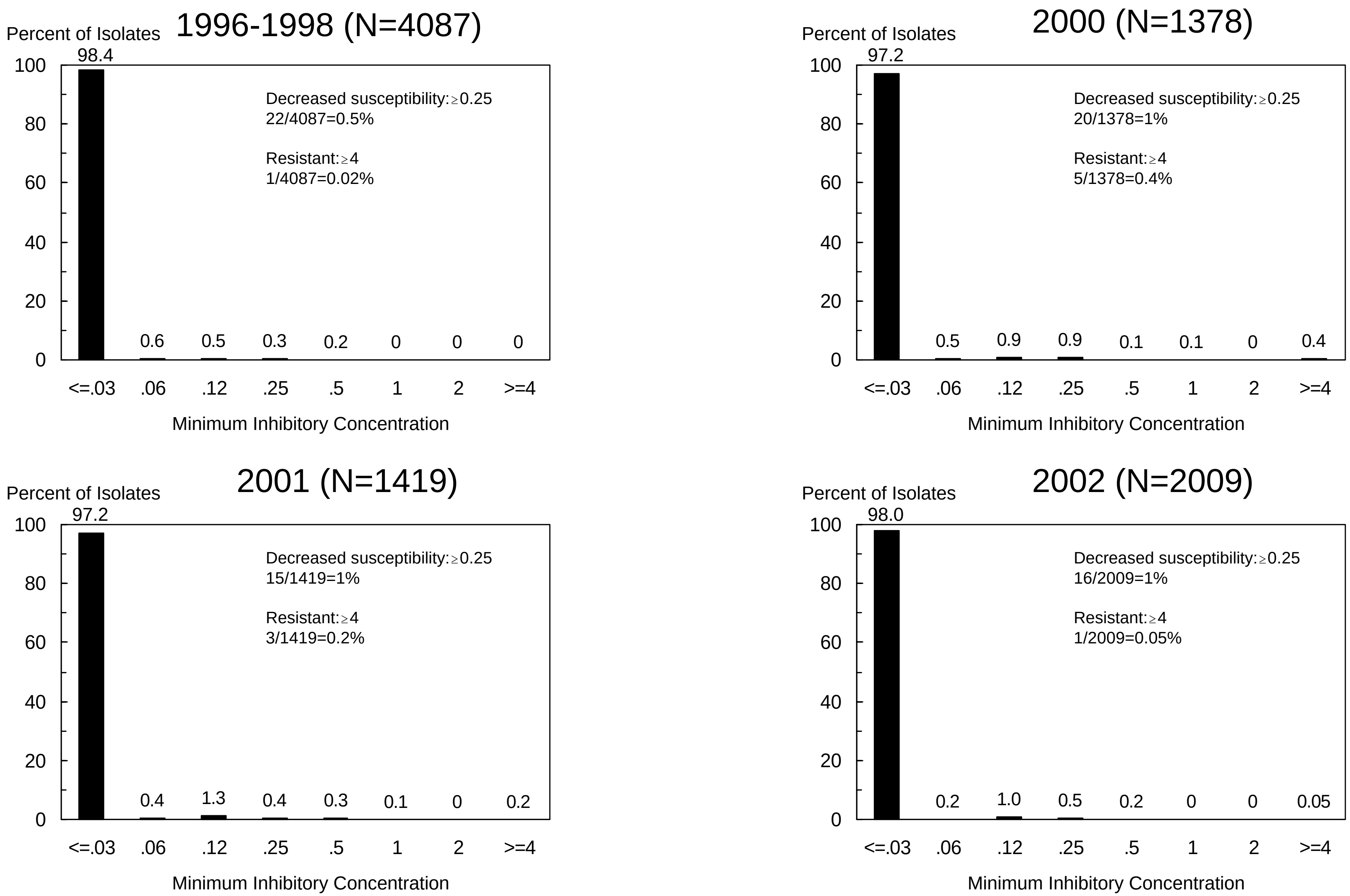
Figure 2i. MICs for ciprofloxacin among non-Typhi *Salmonella* isolates 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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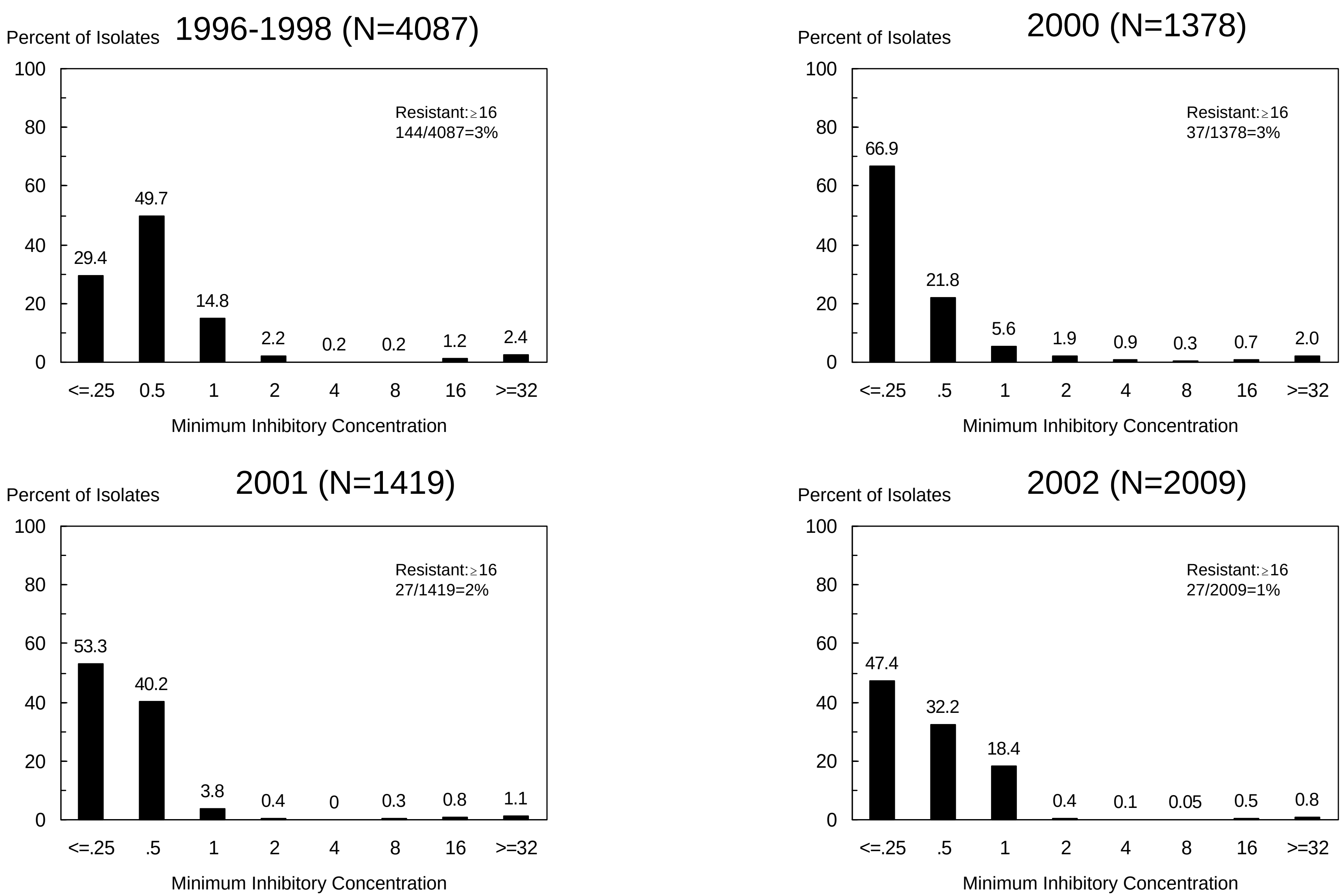
Figure 2j. MICs for gentamicin among non-Typhi *Salmonella* isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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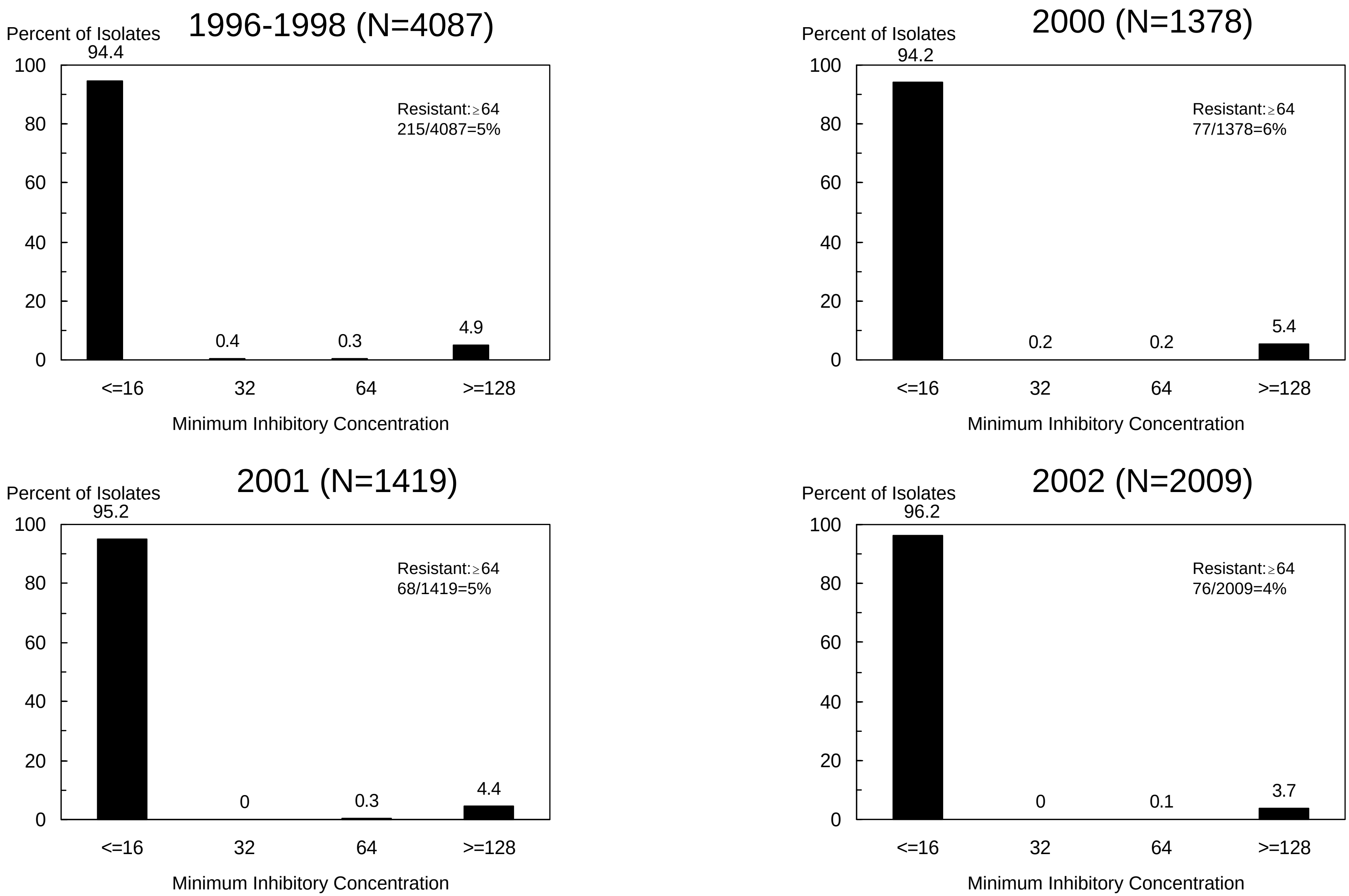
Figure 2k. MICs for kanamycin among non-Typhi *Salmonella* isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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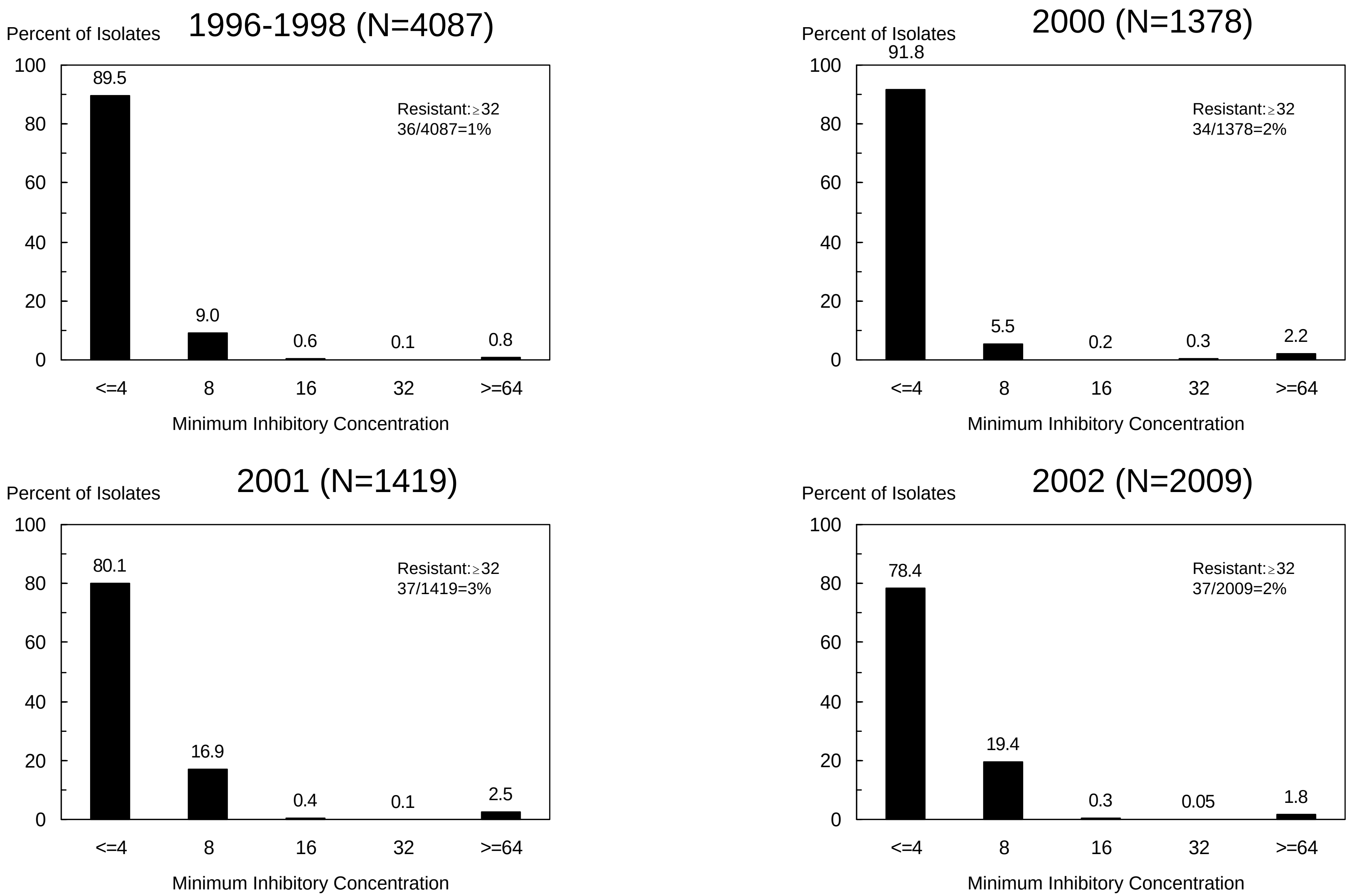
Figure 2l. MICs for nalidixic acid among non-Typhi *Salmonella* isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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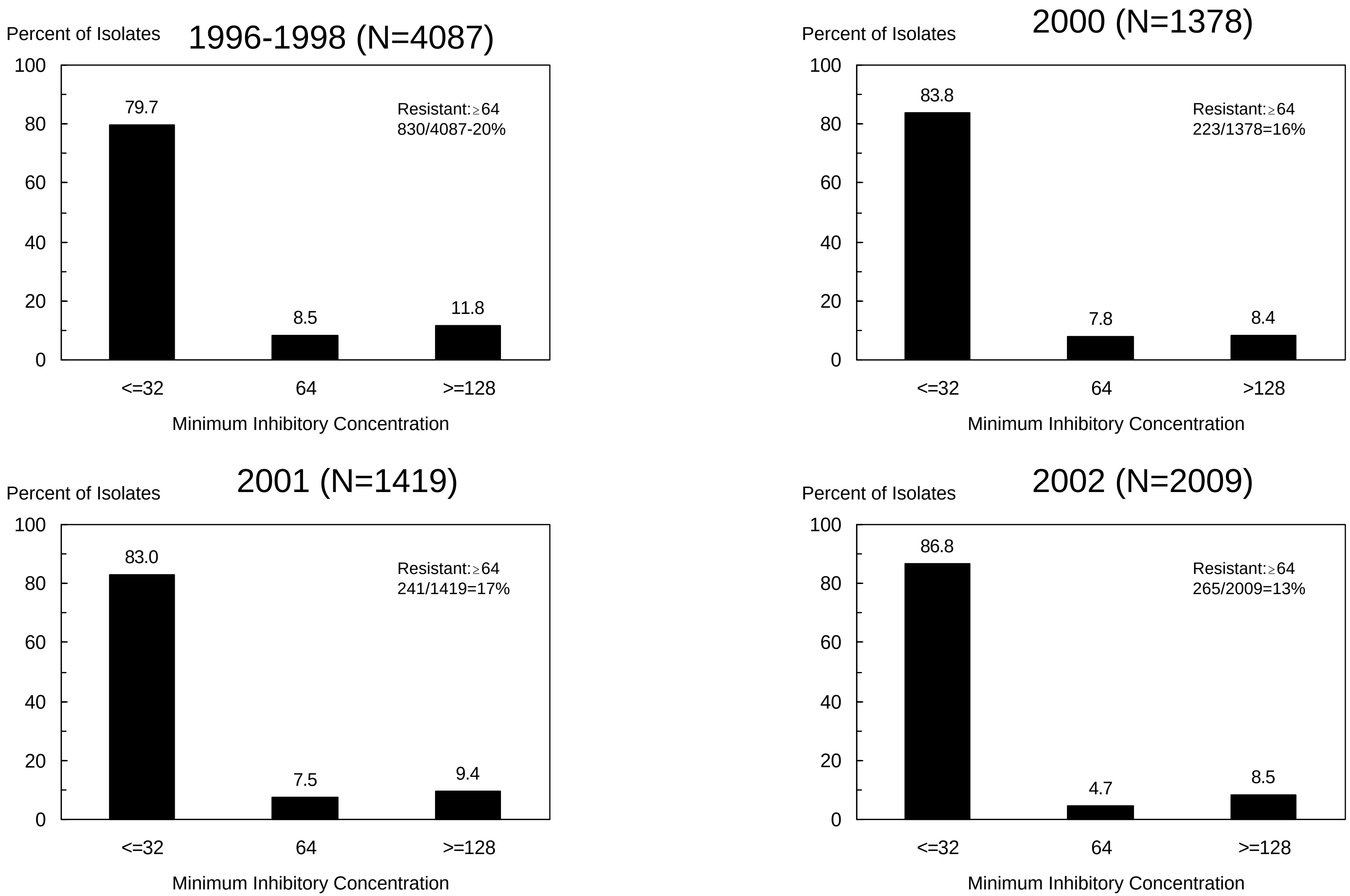
Figure 2m. MICs for streptomycin among non-Typhi *Salmonella* isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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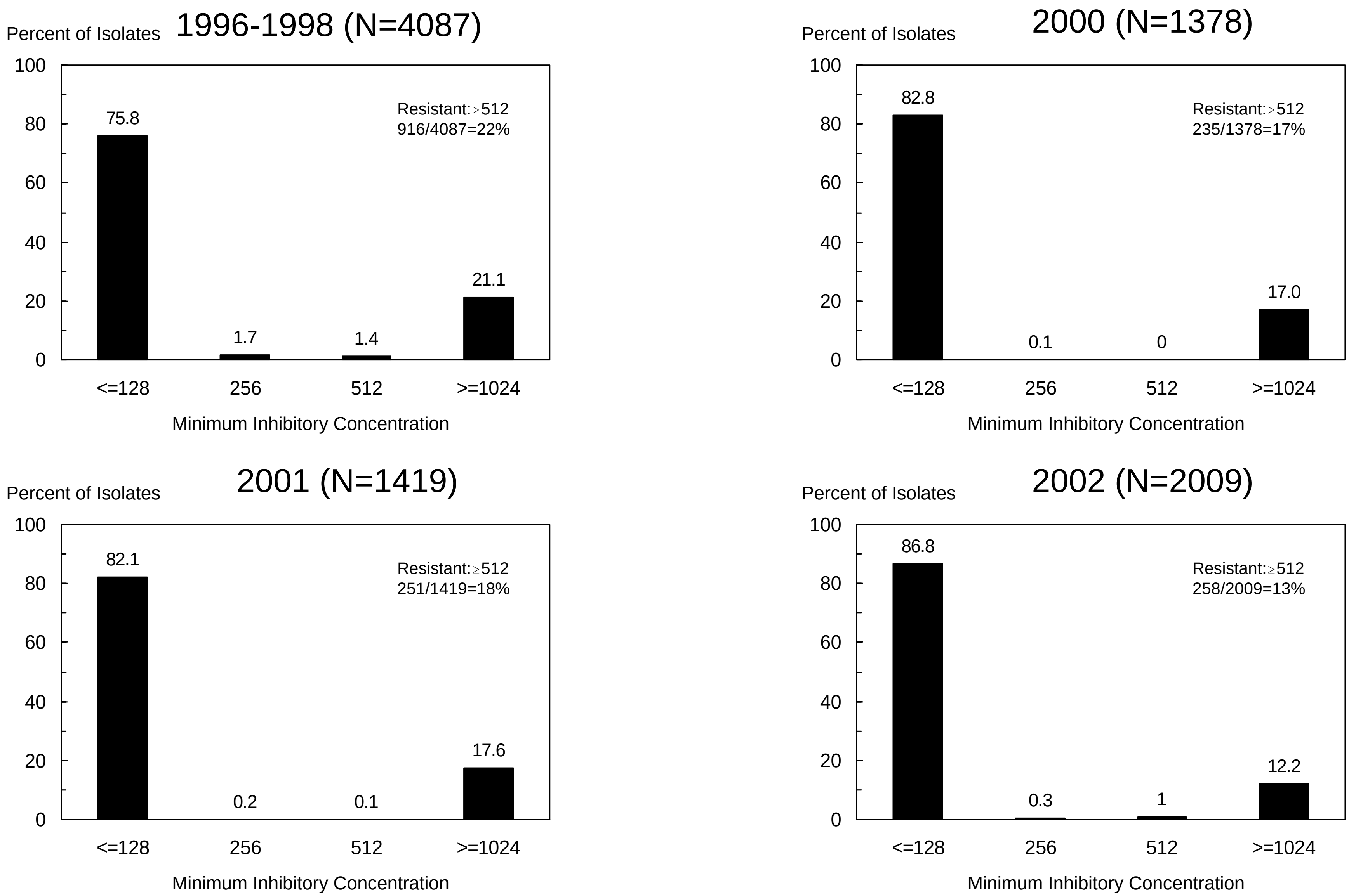
Figure 2n. MICs for sulfamethoxazole among non-Typhi *Salmonella* isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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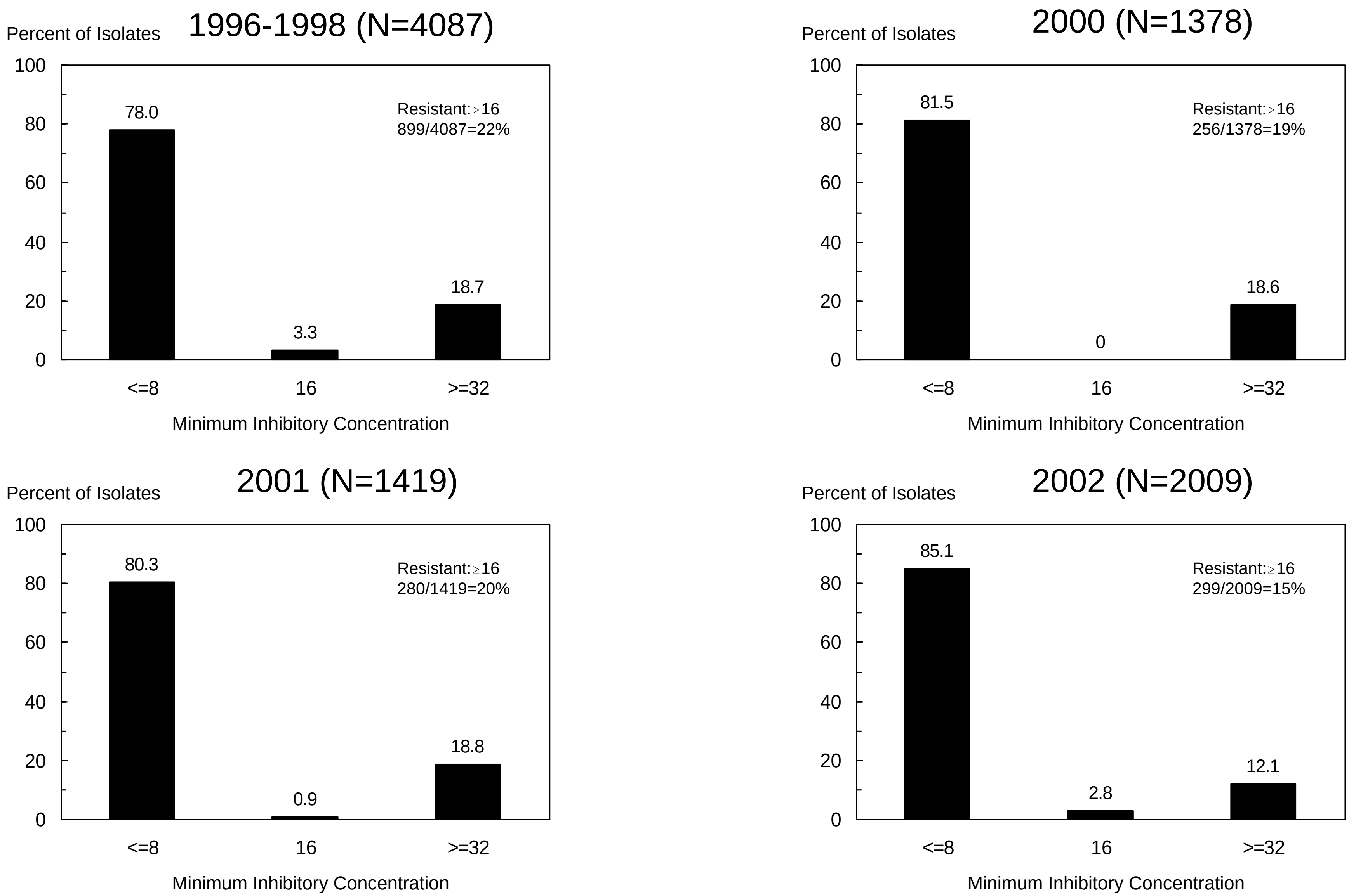
Figure 2o. MICs for tetracycline among non-Typhi *Salmonella* isolates 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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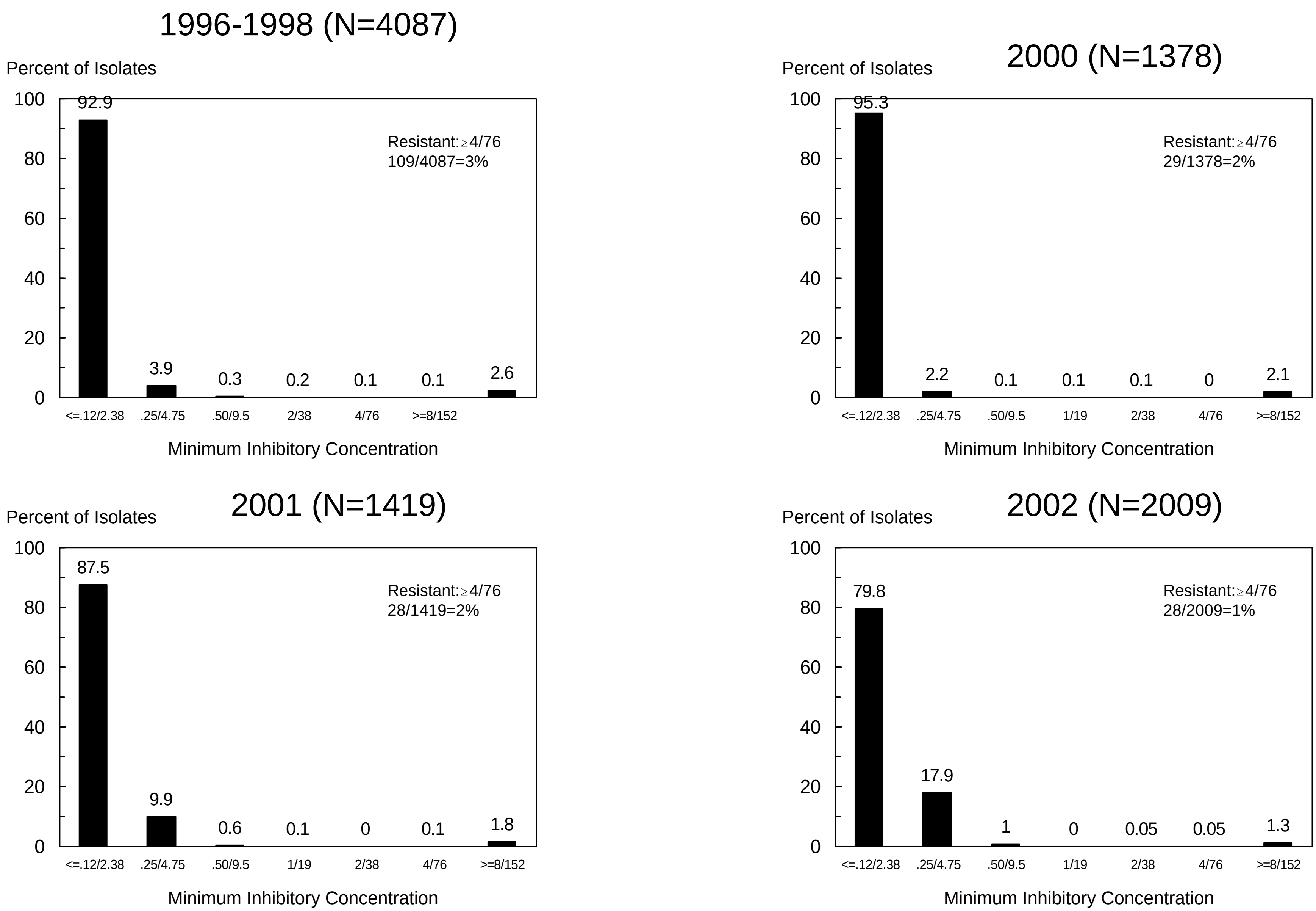
Figure 2p. MICs for trimethoprim-sulfamethoxazole among non-Typhi *Salmonella* isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

Figure 3. Percent of non-Typhi *Salmonella* isolates (N=2009) that were pansusceptible, and percent resistant to ≥1, ≥2, ≥5, and ≥8 of the 16 antimicrobial agents tested, 2002

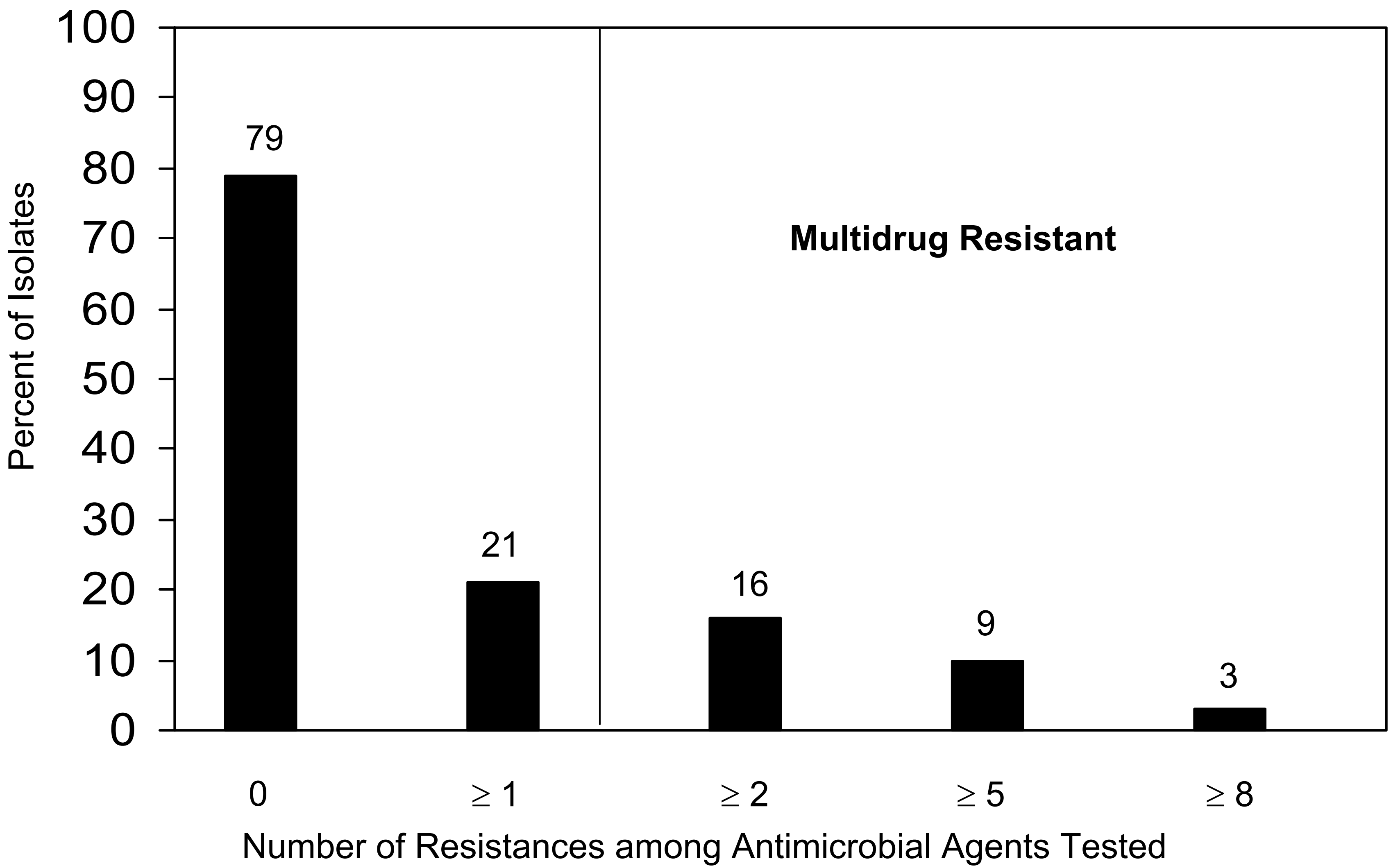


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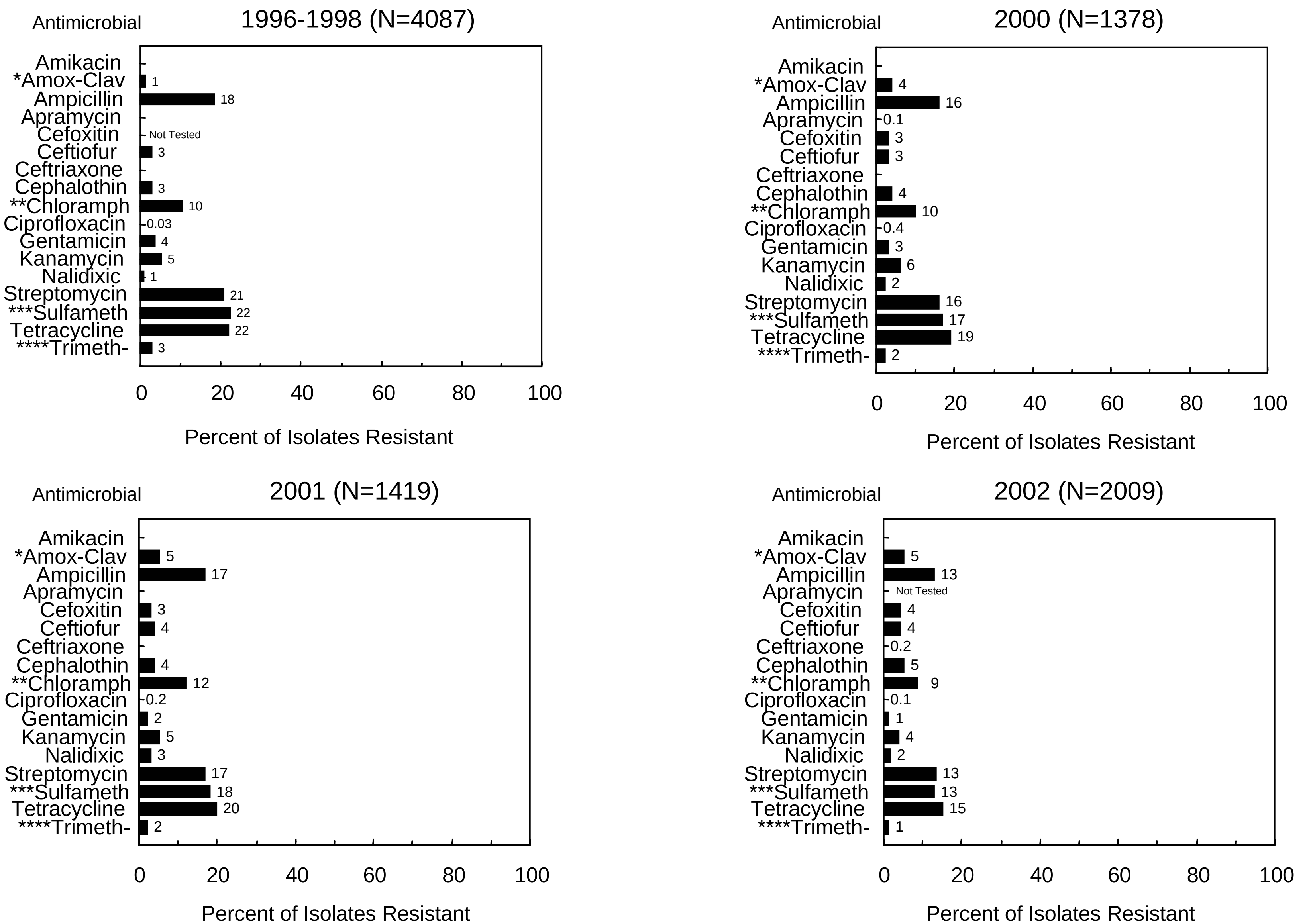
Figure 4. Resistance among non-Typhi *Salmonella* isolates 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.
*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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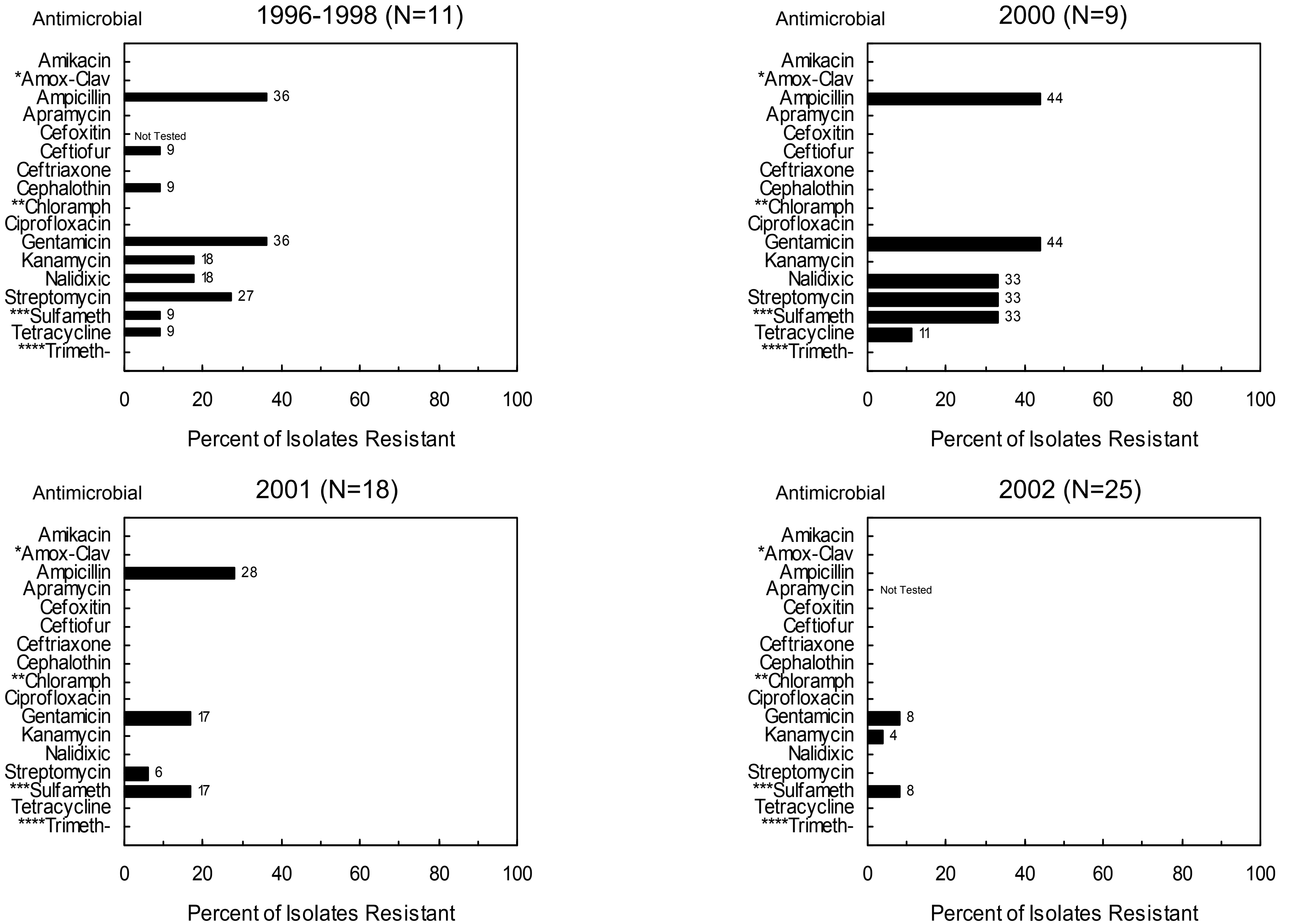
Figure 5a. Resistance among *Salmonella* serotype Berta isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.
*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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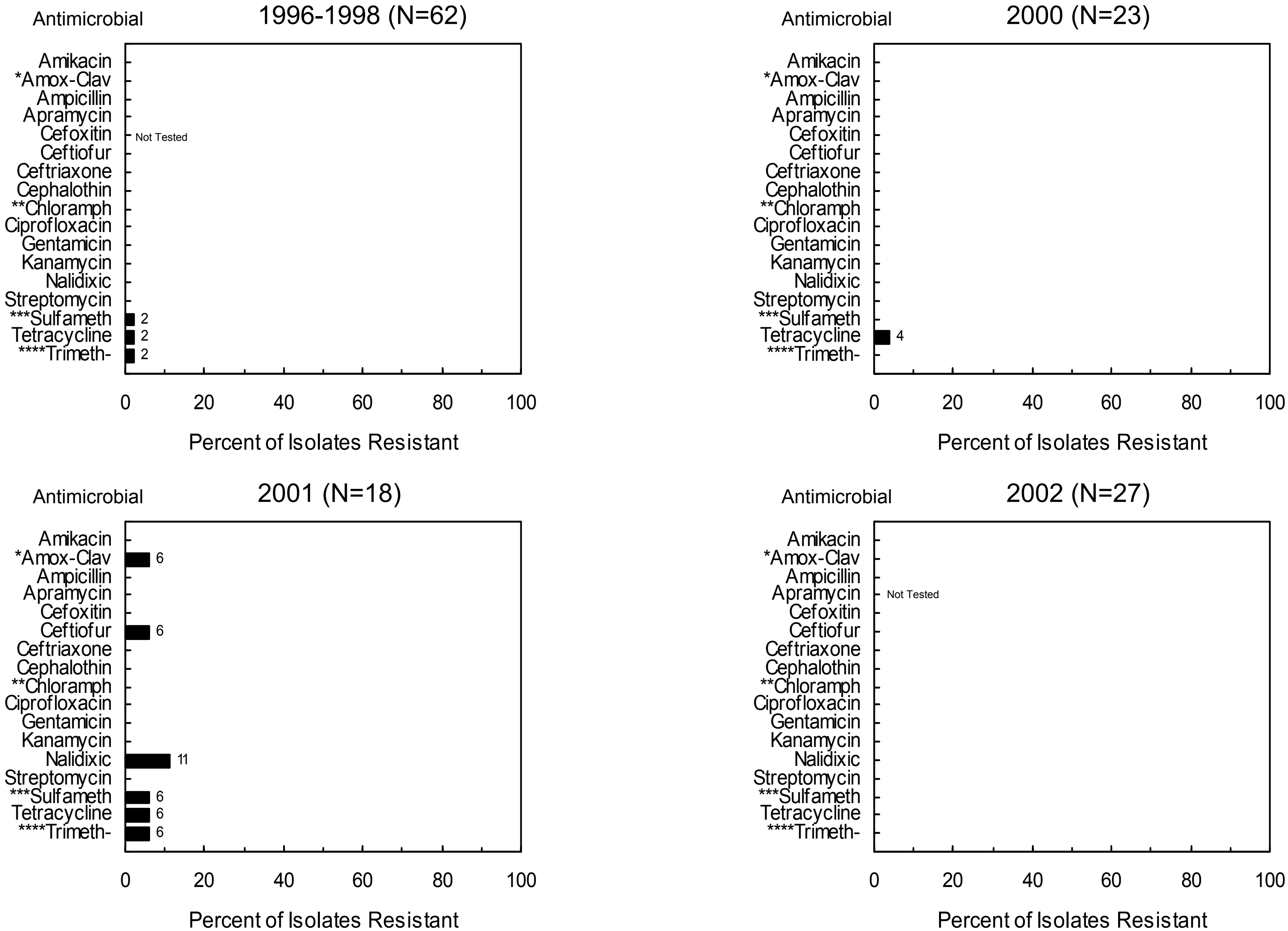
Figure 5b. Resistance among *Salmonella* serotype Braenderup isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.
*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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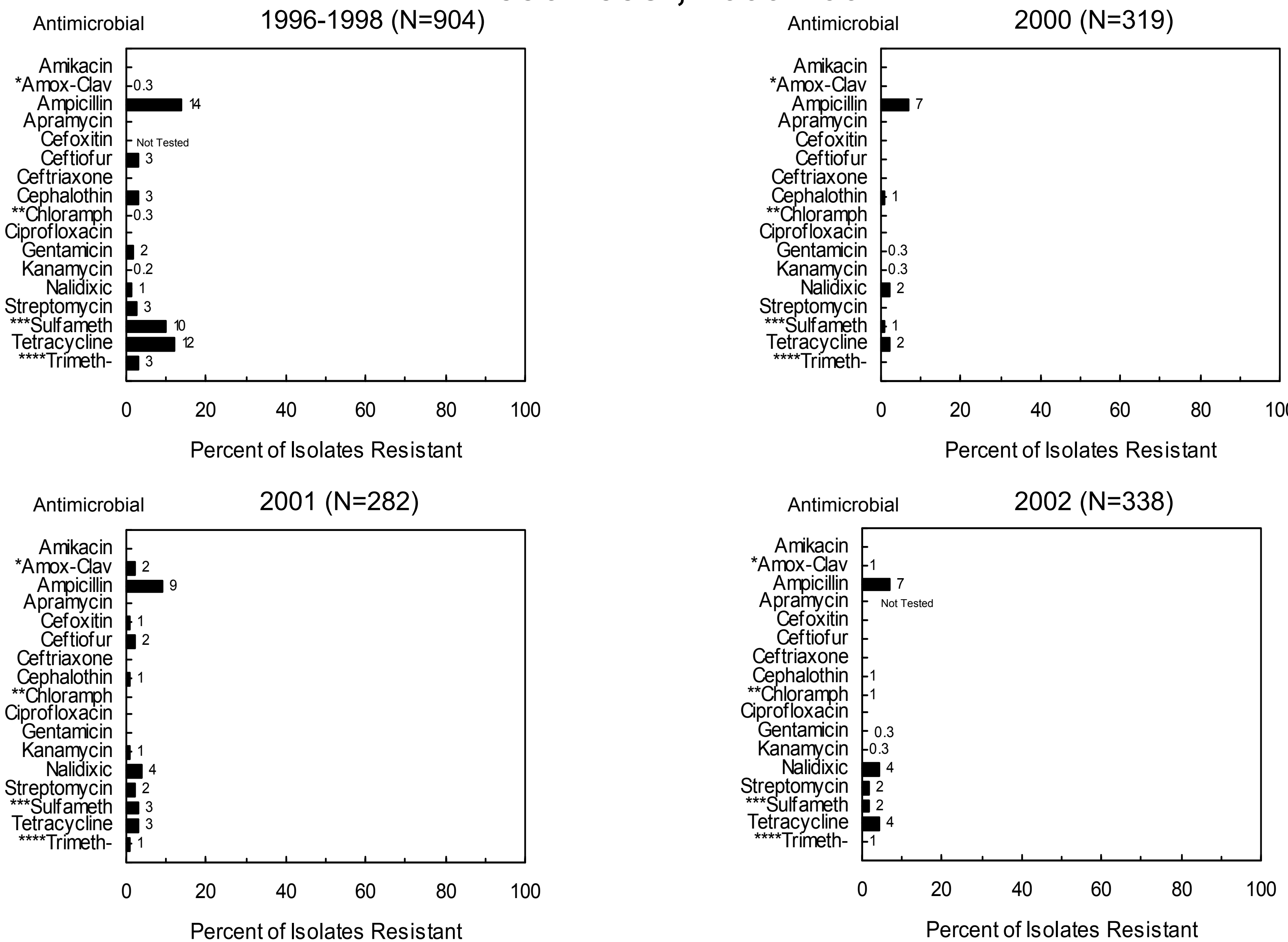
Figure 5c. Resistance among *Salmonella* serotype Enteritidis isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.

*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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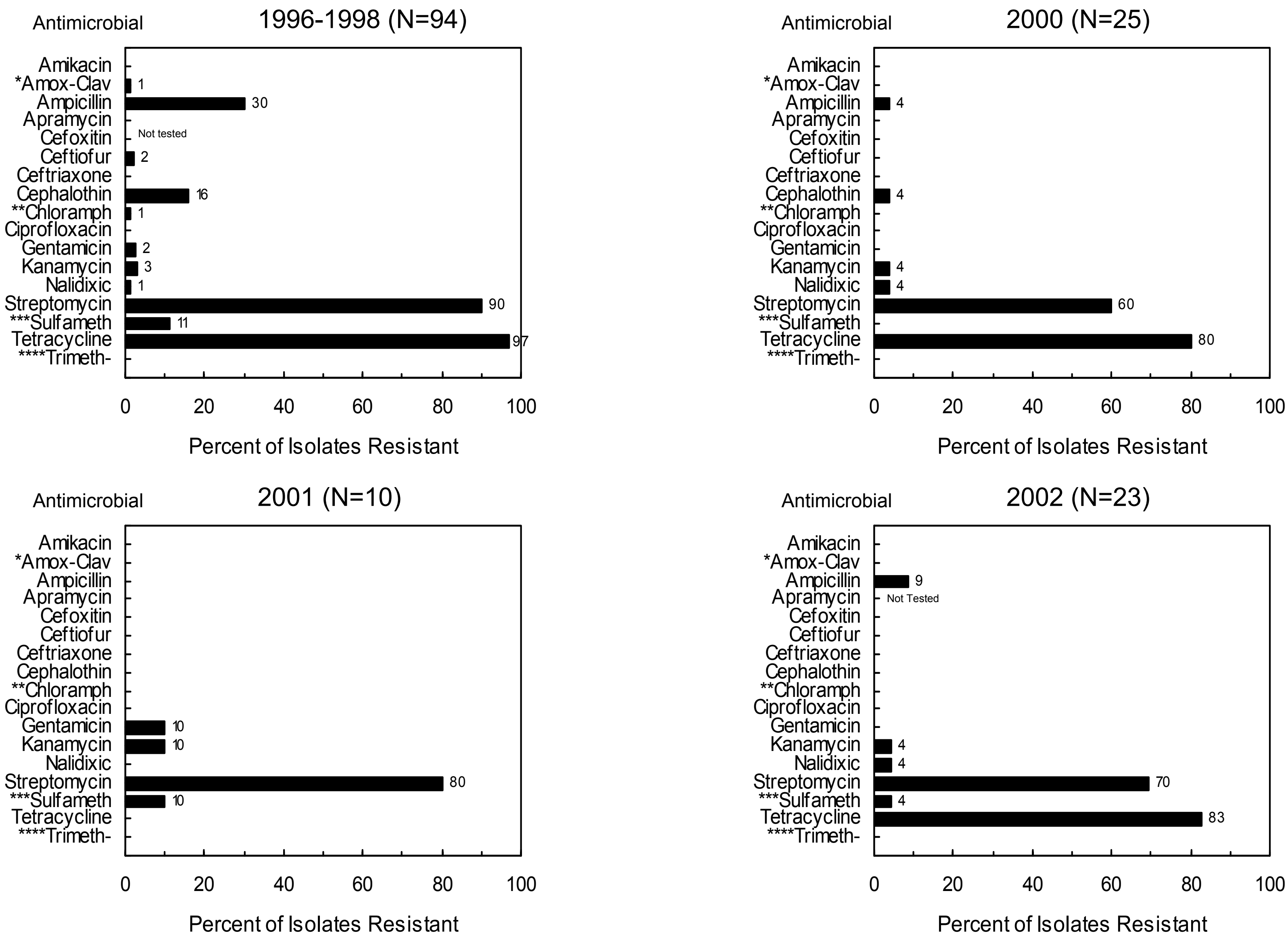
Figure 5d. Resistance among *Salmonella* serotype Hadar isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.
*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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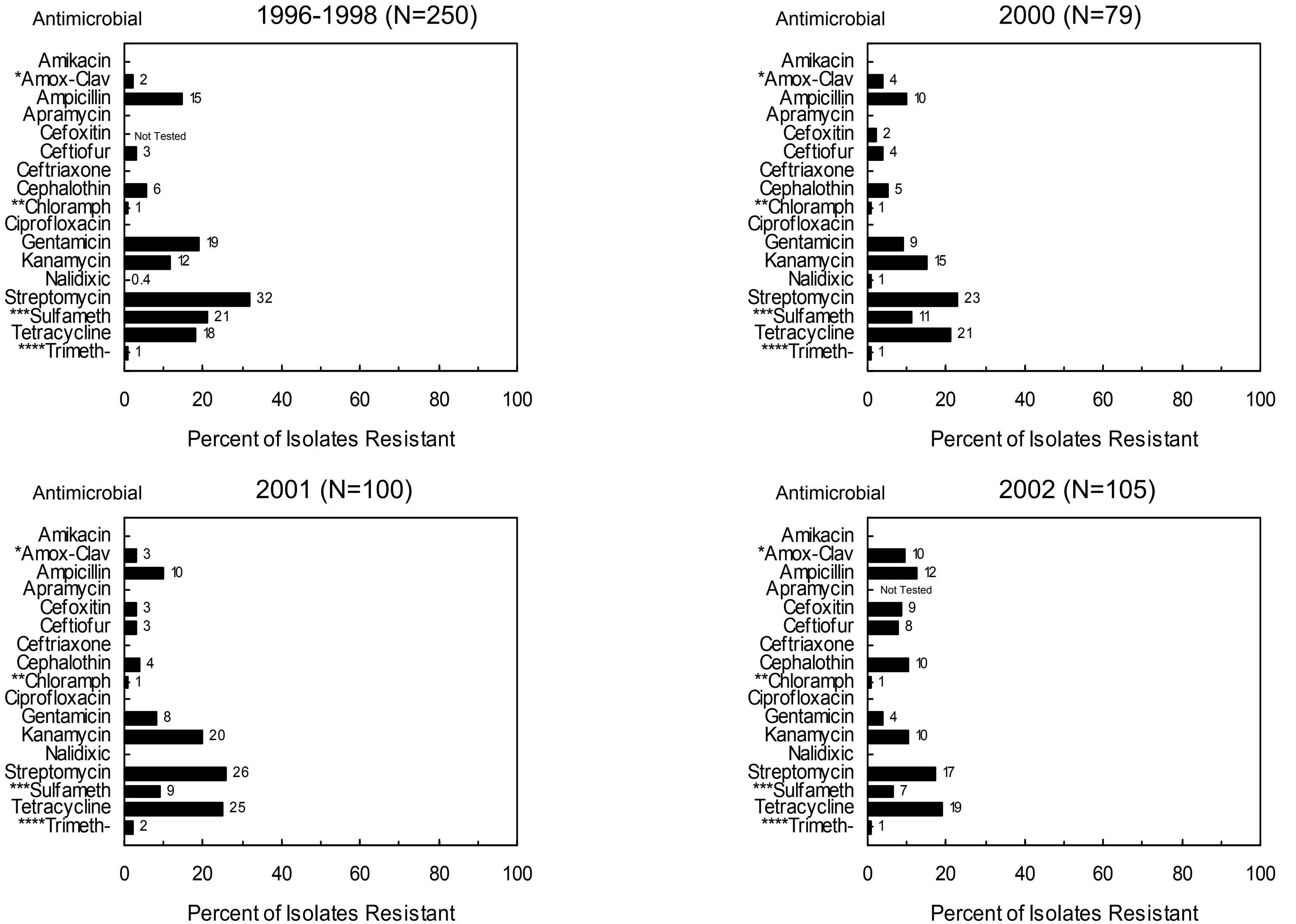
Figure 5e. Resistance among *Salmonella* serotype Heidelberg isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.

*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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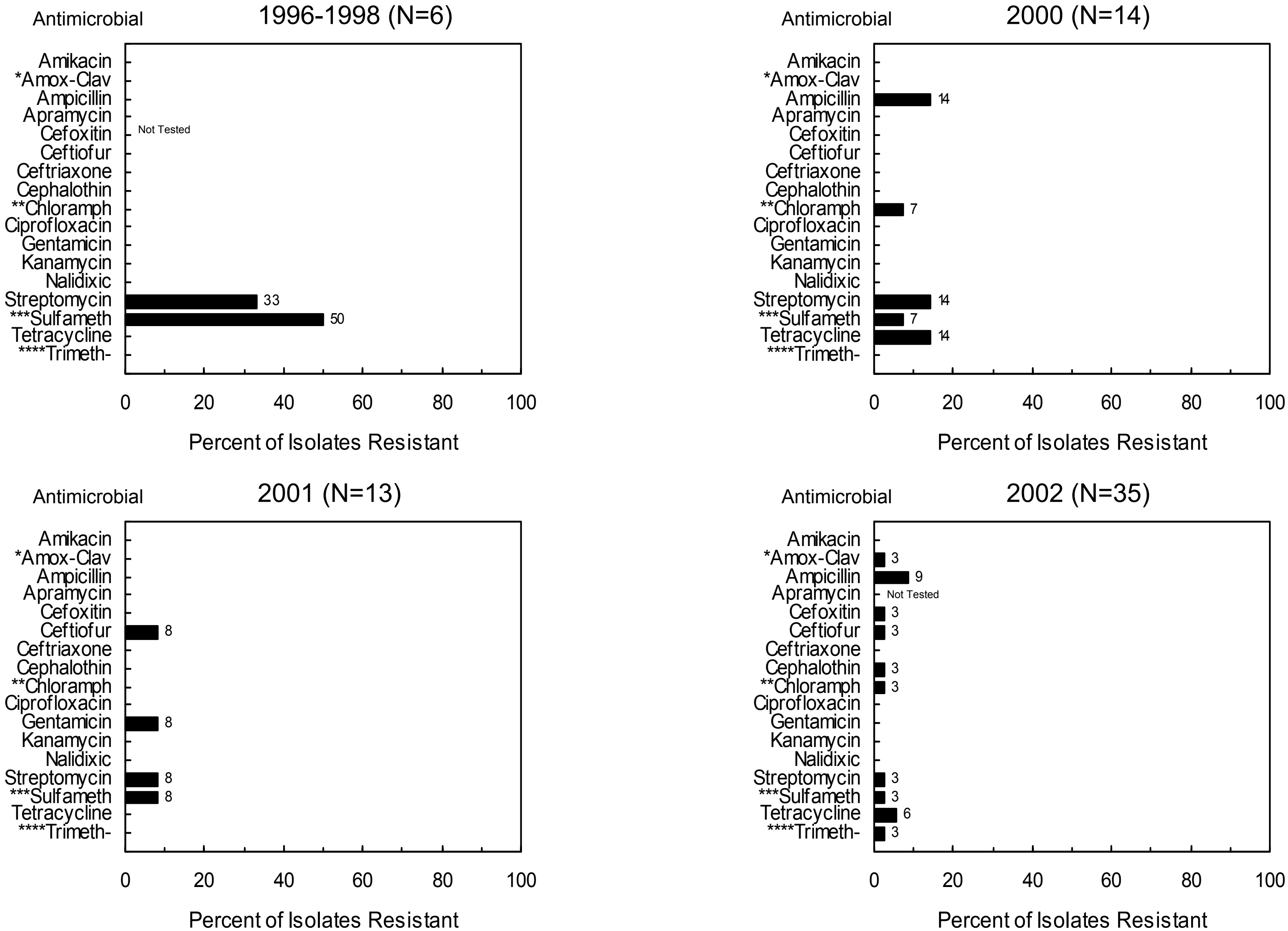
Figure 5f. Resistance among *Salmonella* serotype I 4,[5],12:i:- isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.
*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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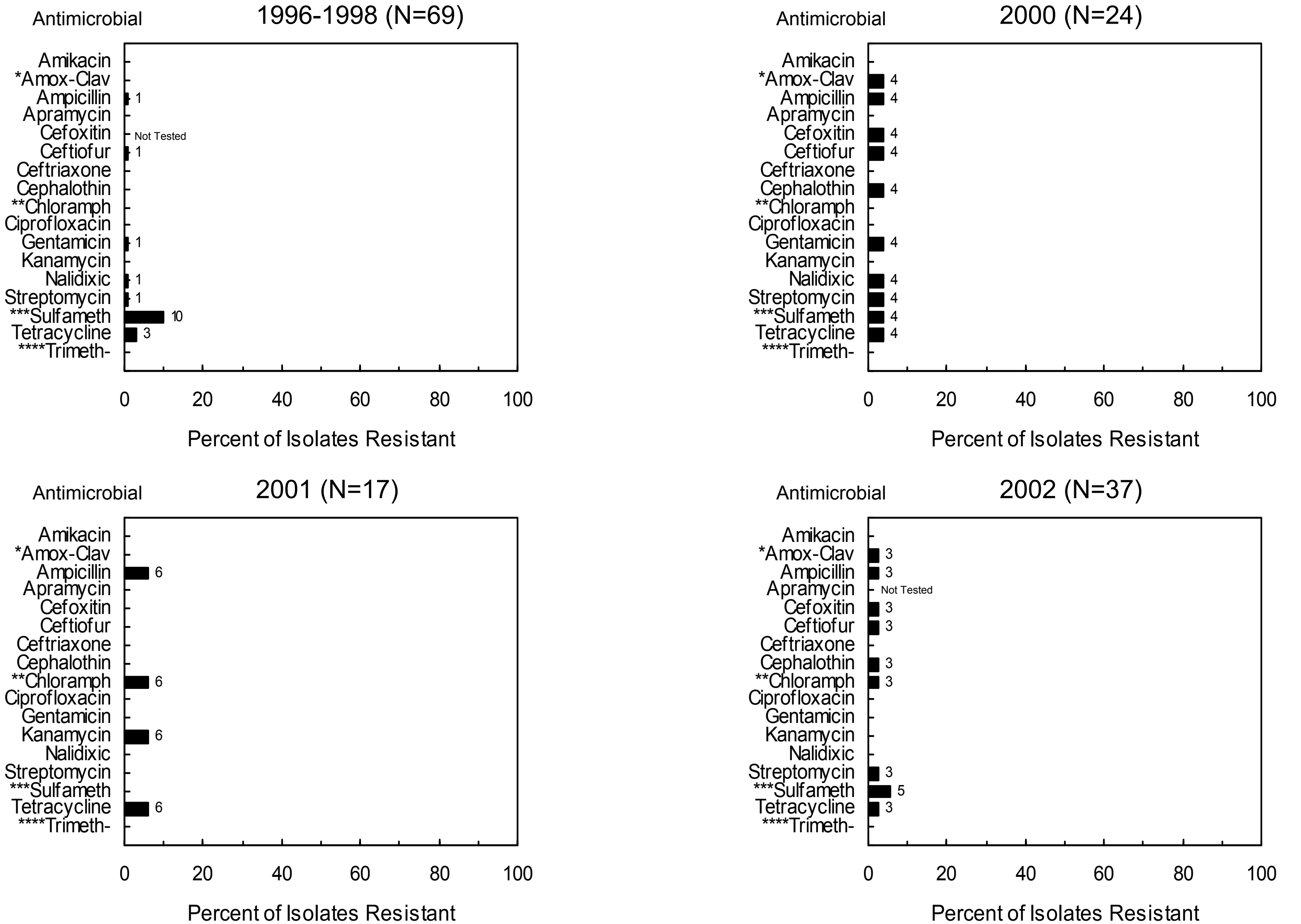
Figure 5g. Resistance among *Salmonella* serotype Infantis isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.
*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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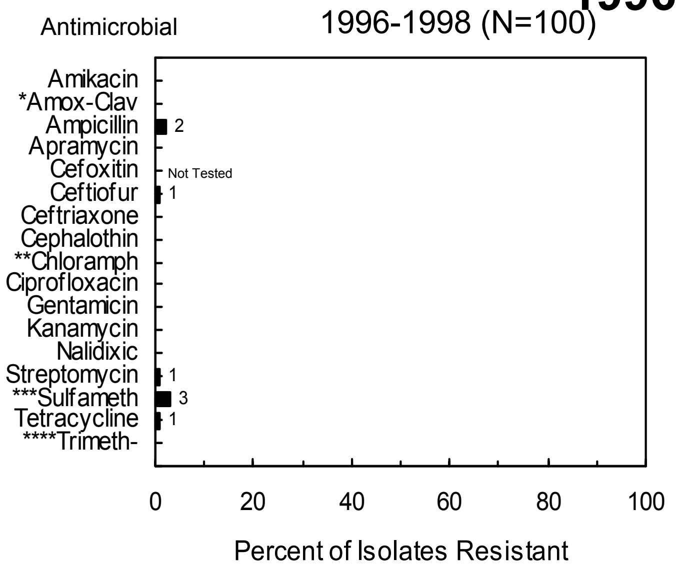
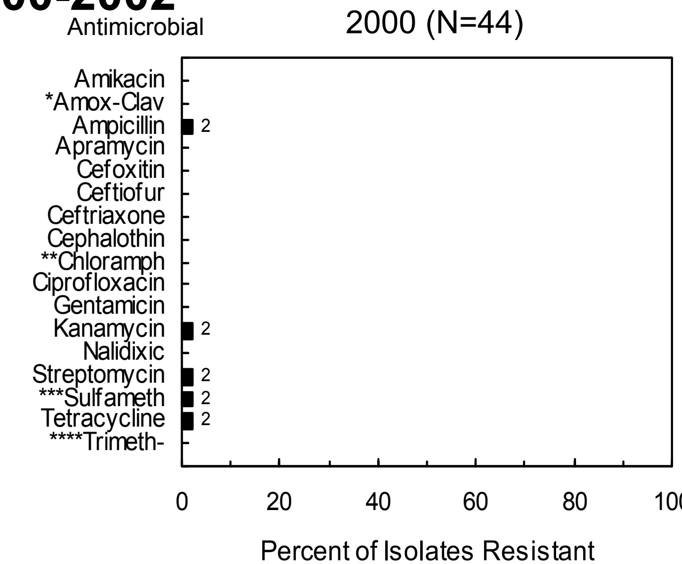
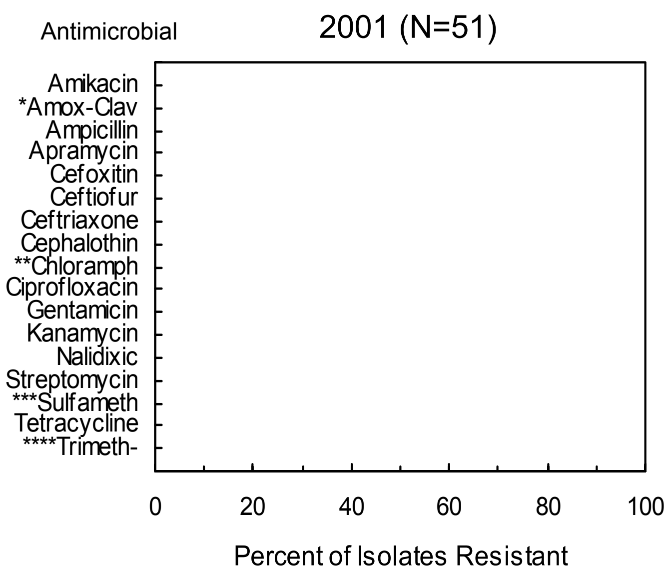
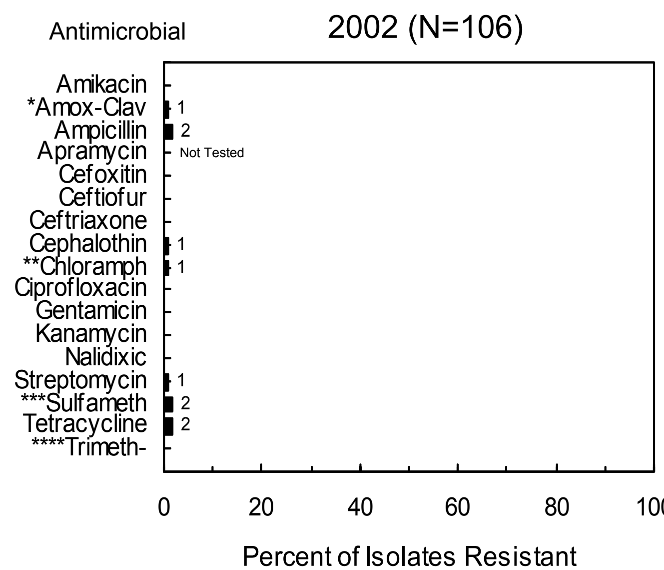
Figure 5h. Resistance among *Salmonella* serotype Javiana isolates, 1996-1998†, 2000-2002









†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.
*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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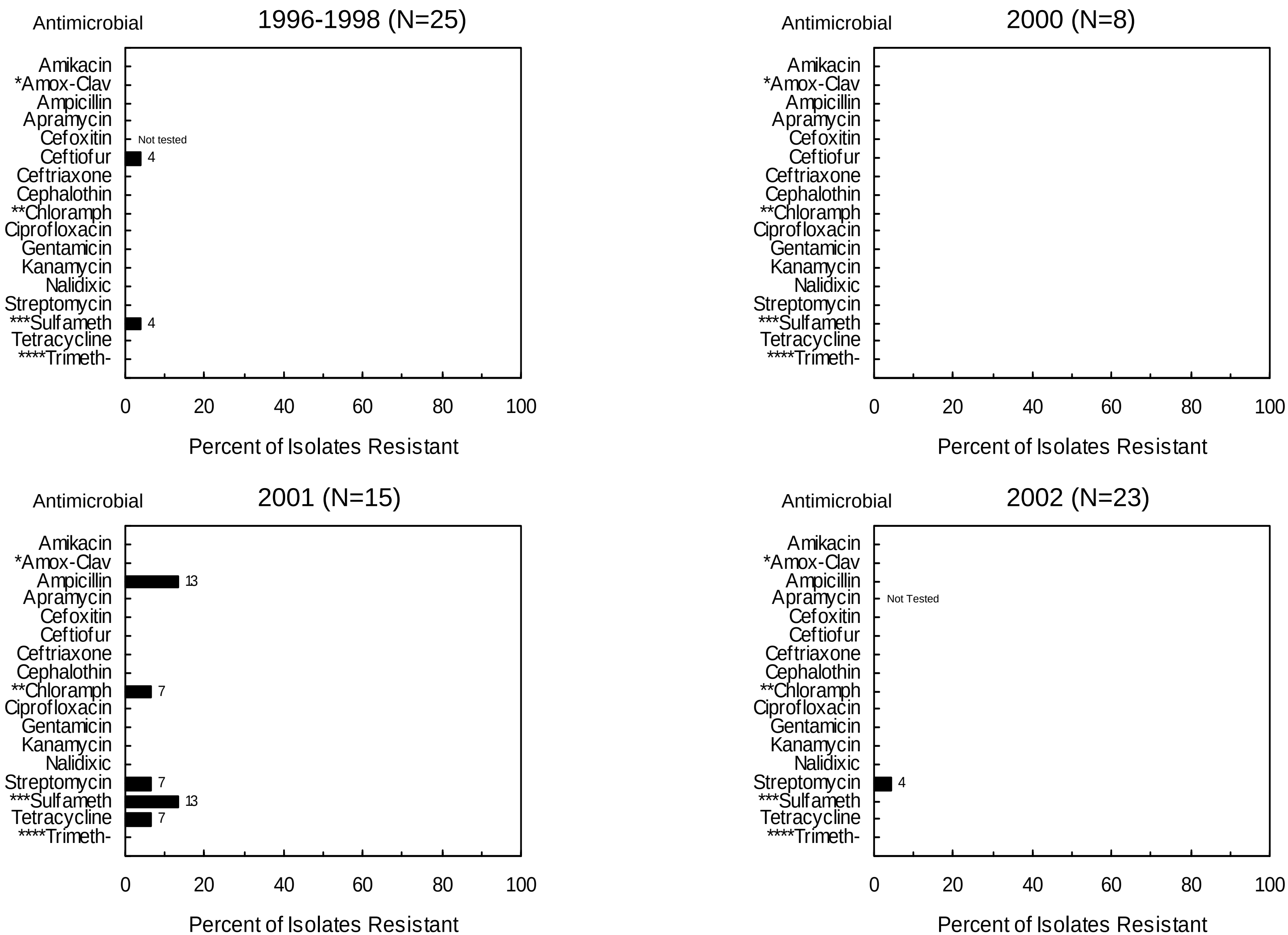
Figure 5i. Resistance among *Salmonella* serotype Mississipi isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.

*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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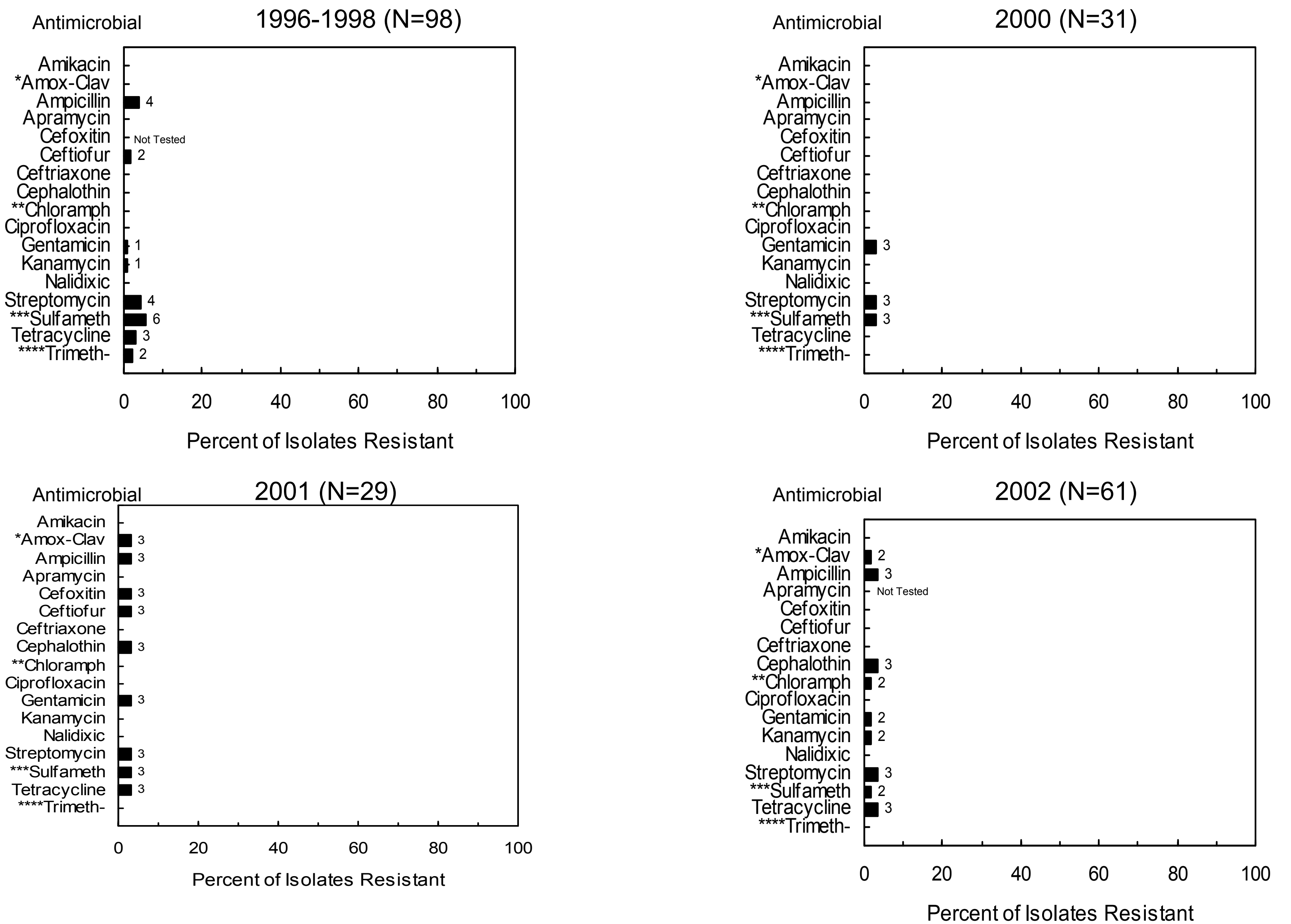
Figure 5j. Resistance among *Salmonella* serotype Montevideo isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.
*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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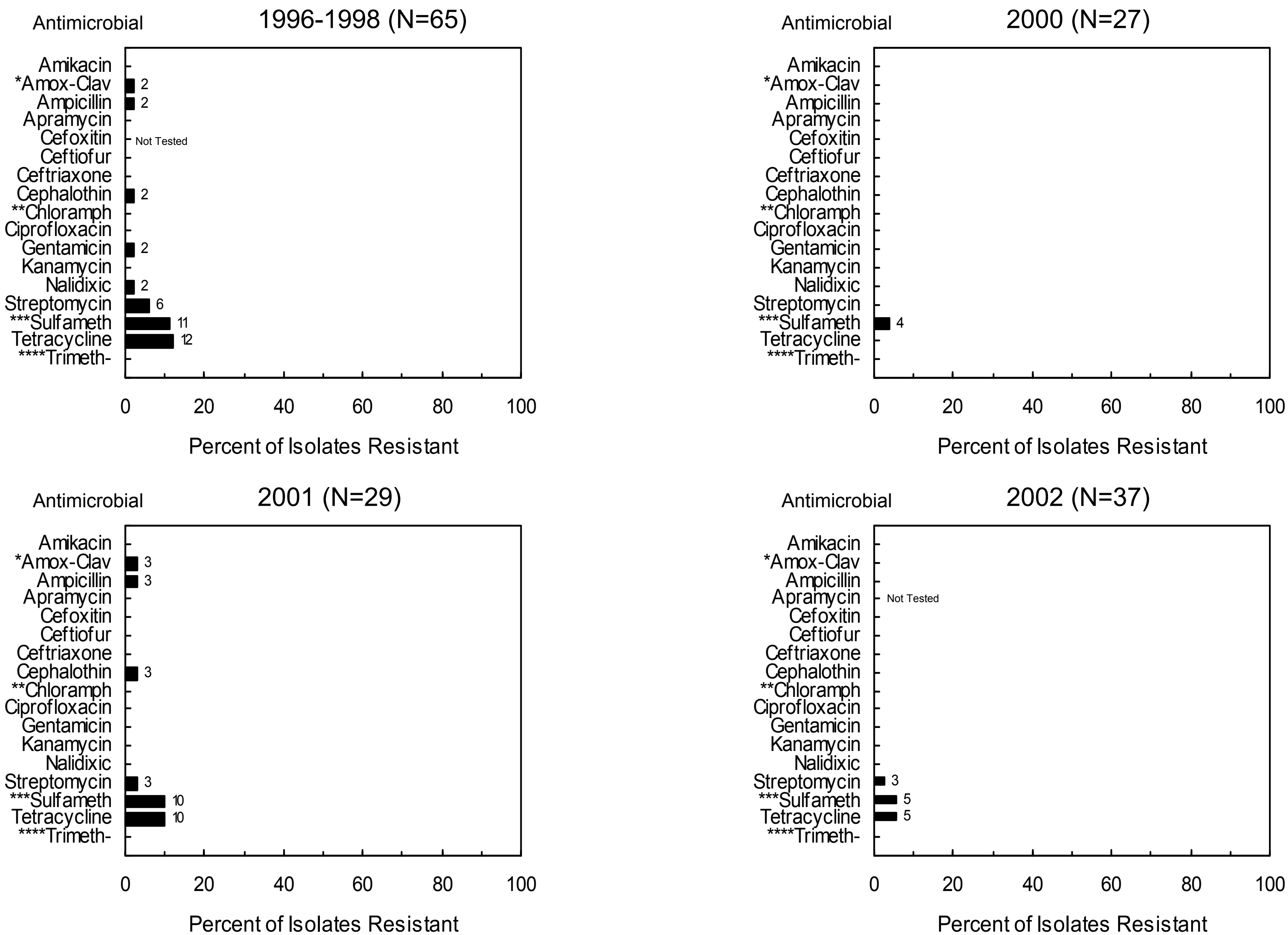
Figure 5k. Resistance among *Salmonella* serotype Muenchen isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.
*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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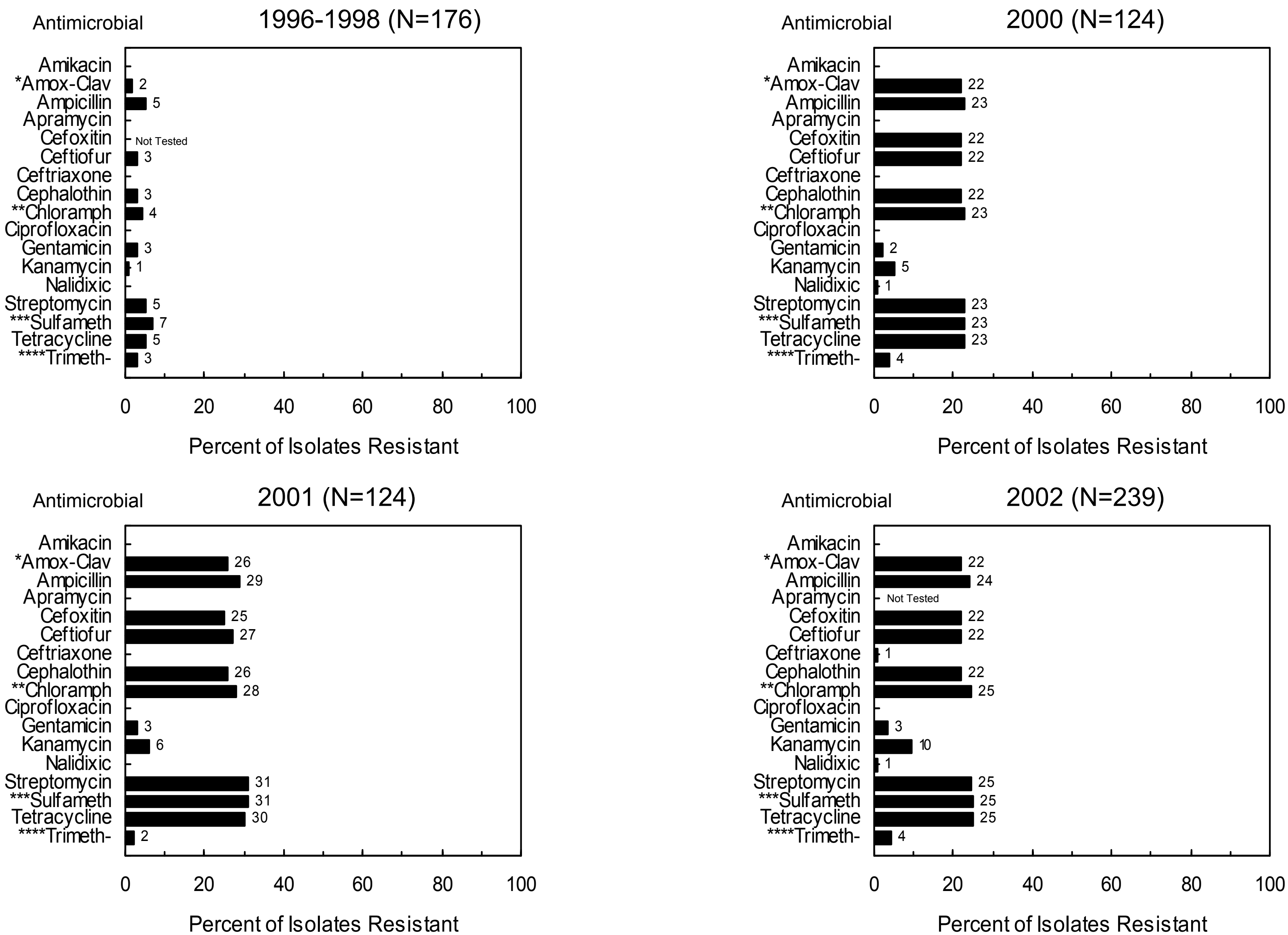
Figure 5I. Resistance among *Salmonella* serotype Newport isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.

*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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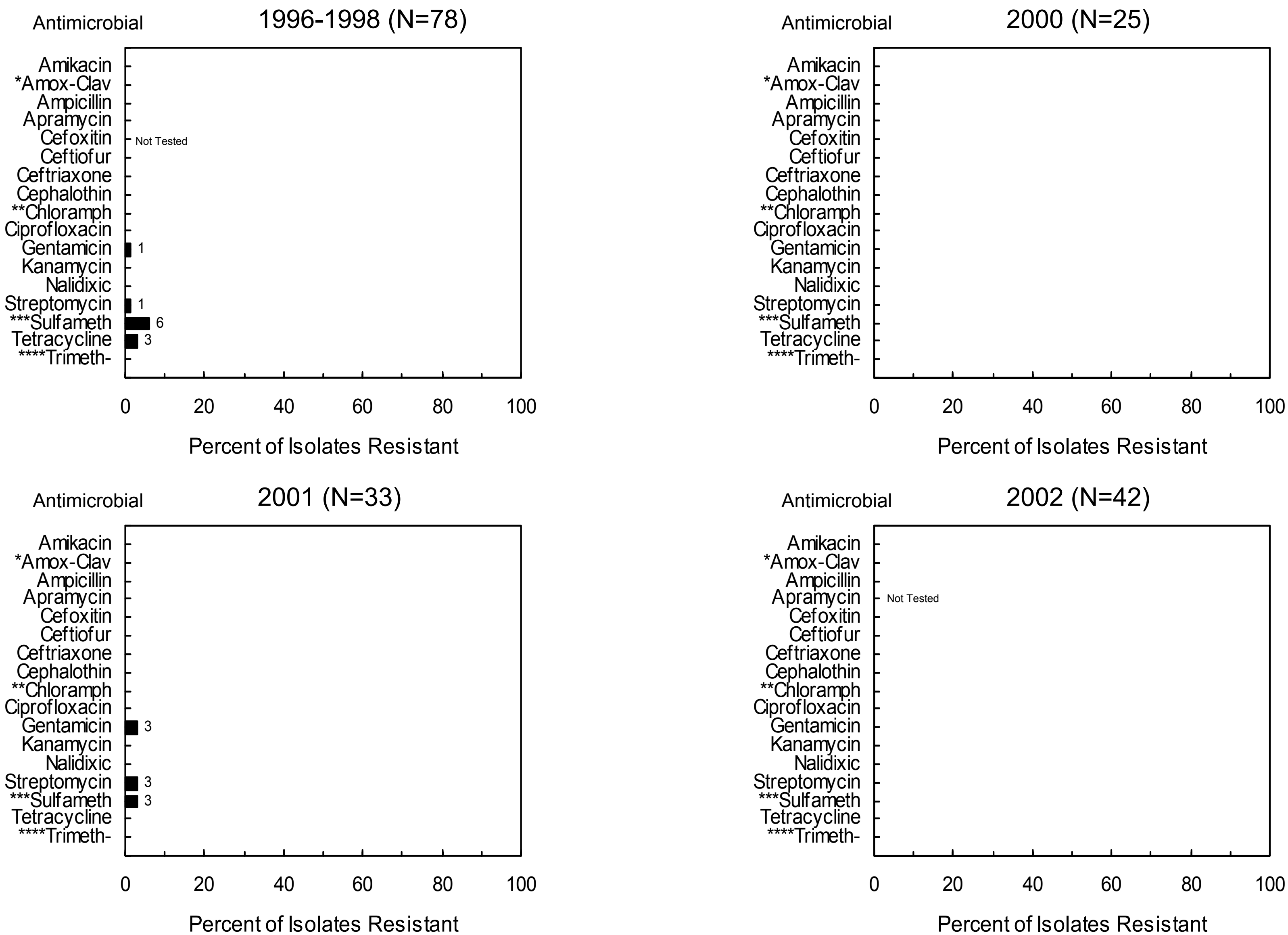
Figure 5m. Resistance among *Salmonella* serotype Oranienburg isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.
*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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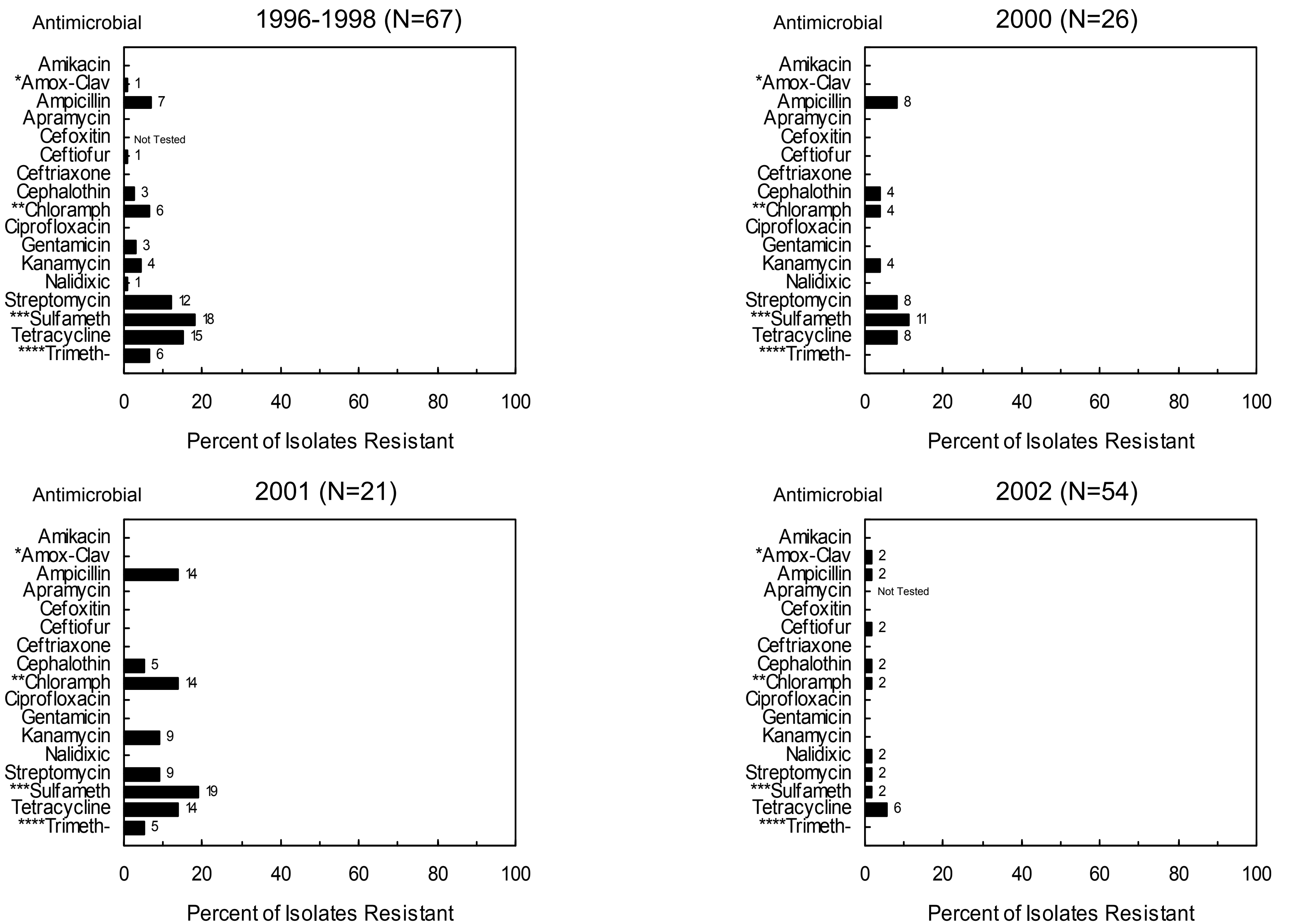
Figure 5n. Resistance among *Salmonella* serotype Saint Paul isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.
*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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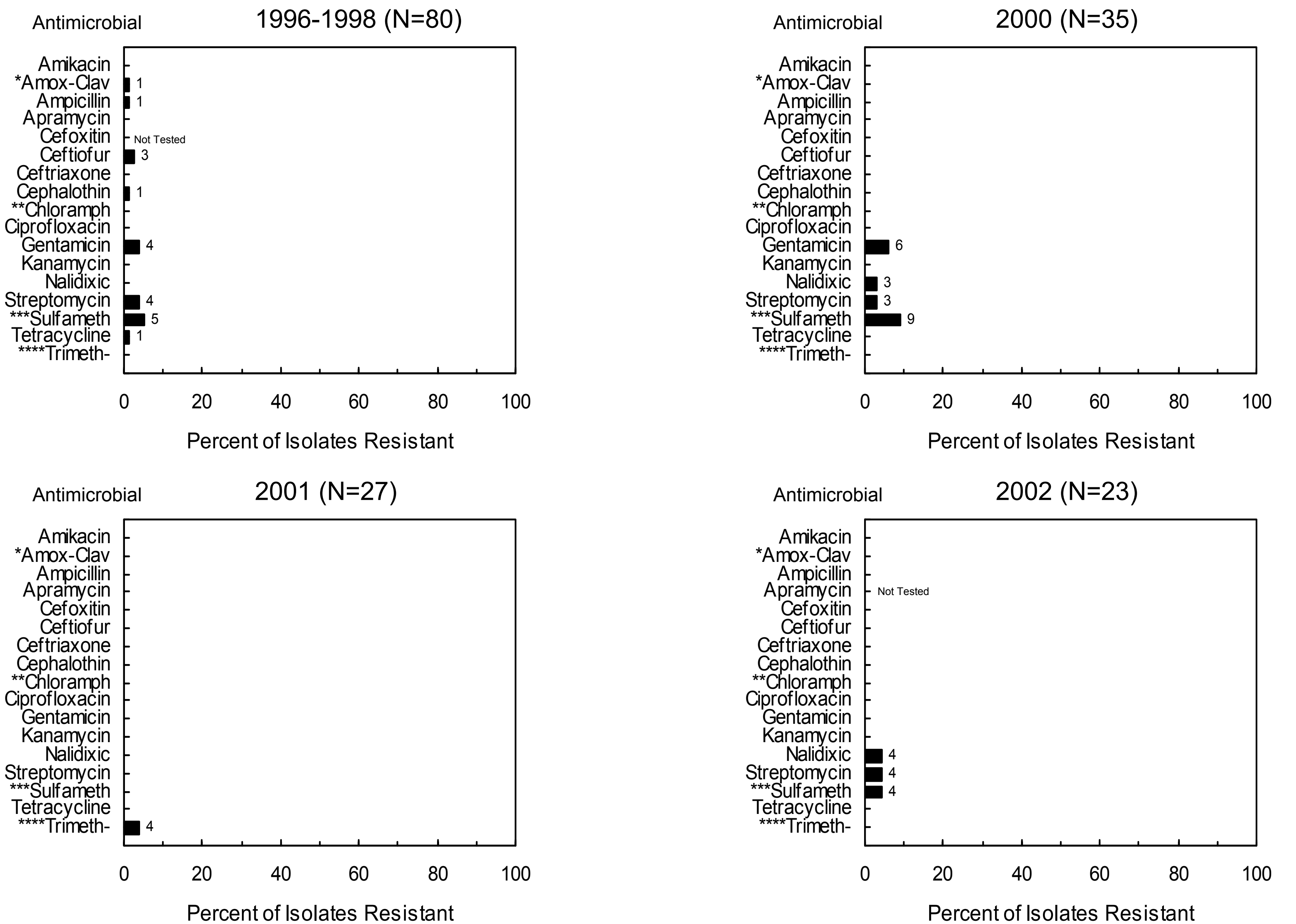
Figure 5o. Resistance among *Salmonella* serotype Thompson isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.

*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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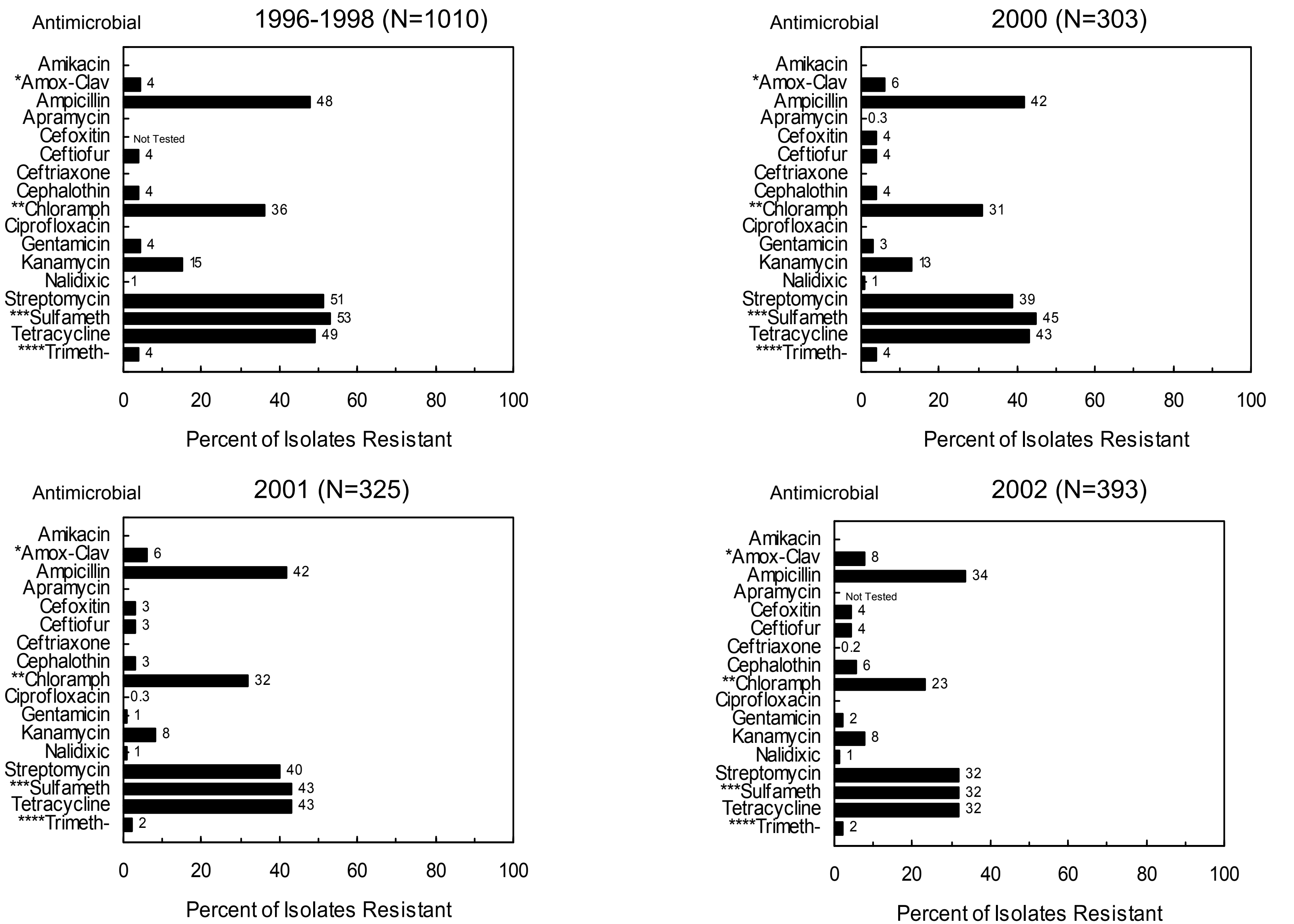
Figure 5p. Resistance among *Salmonella* serotype Typhimurium isolates, 1996-1998†, 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of resistant isolates for the three years.
*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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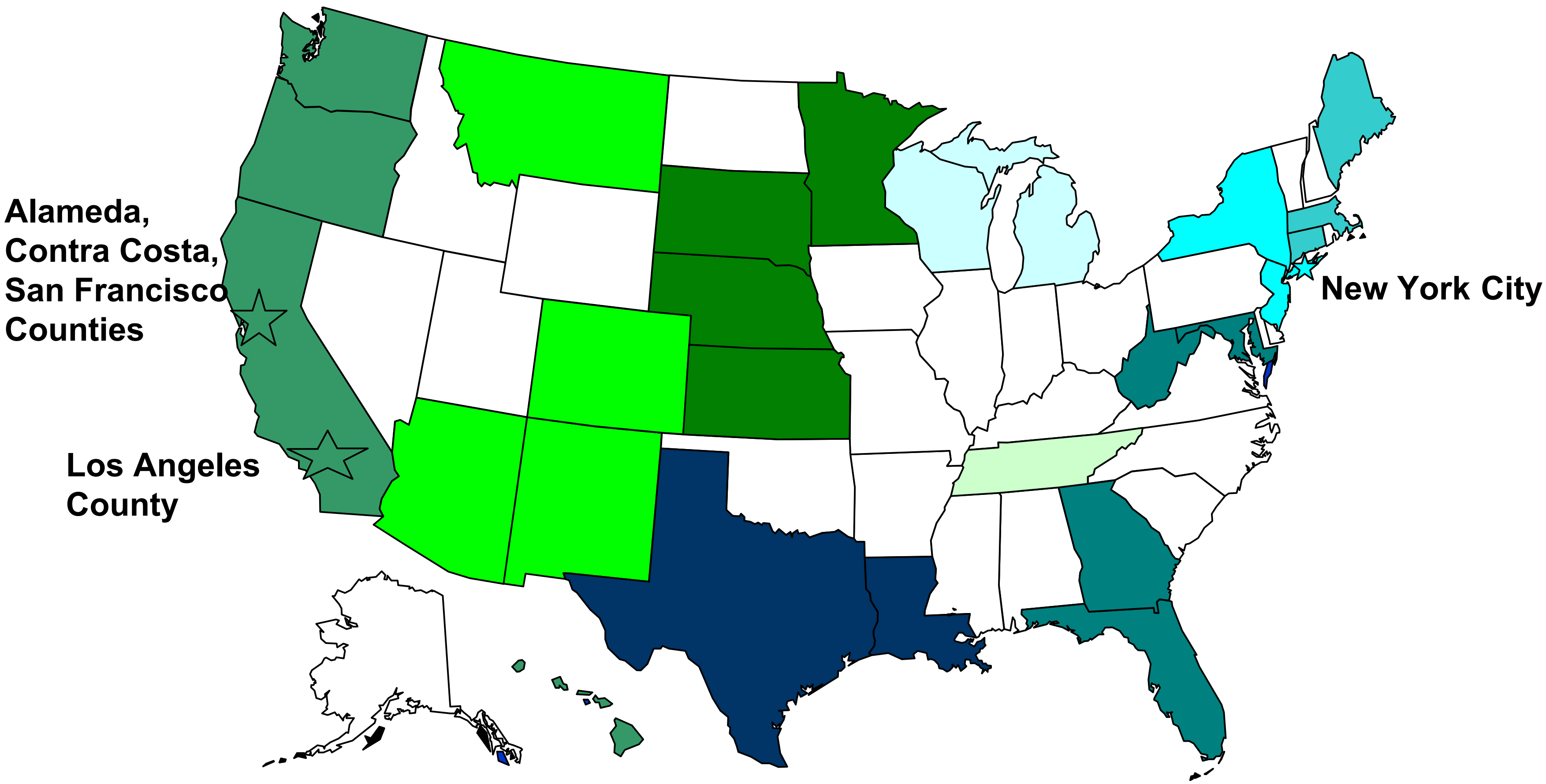
Figure 6. NARMS participating sites, by region, 2002: Population 188 million (65% of United States population)



- ENC: East North Central (MI, WI)
- ESC: East South Central (TN)
- MAT: Mid-Atlantic (NJ, NY, NY City)
- MTN: Mountain (AZ, CO, MT, NM)
- NEW: New England (CT, MA, ME)
- PAC: Pacific (CA, HI, LX, OR, WA)
- SAT: South Atlantic (FL, GA, MD, WV)
- WNC: West North Central (KS, MN, NE, SD)
- WSC: West South Central (LA, TX)

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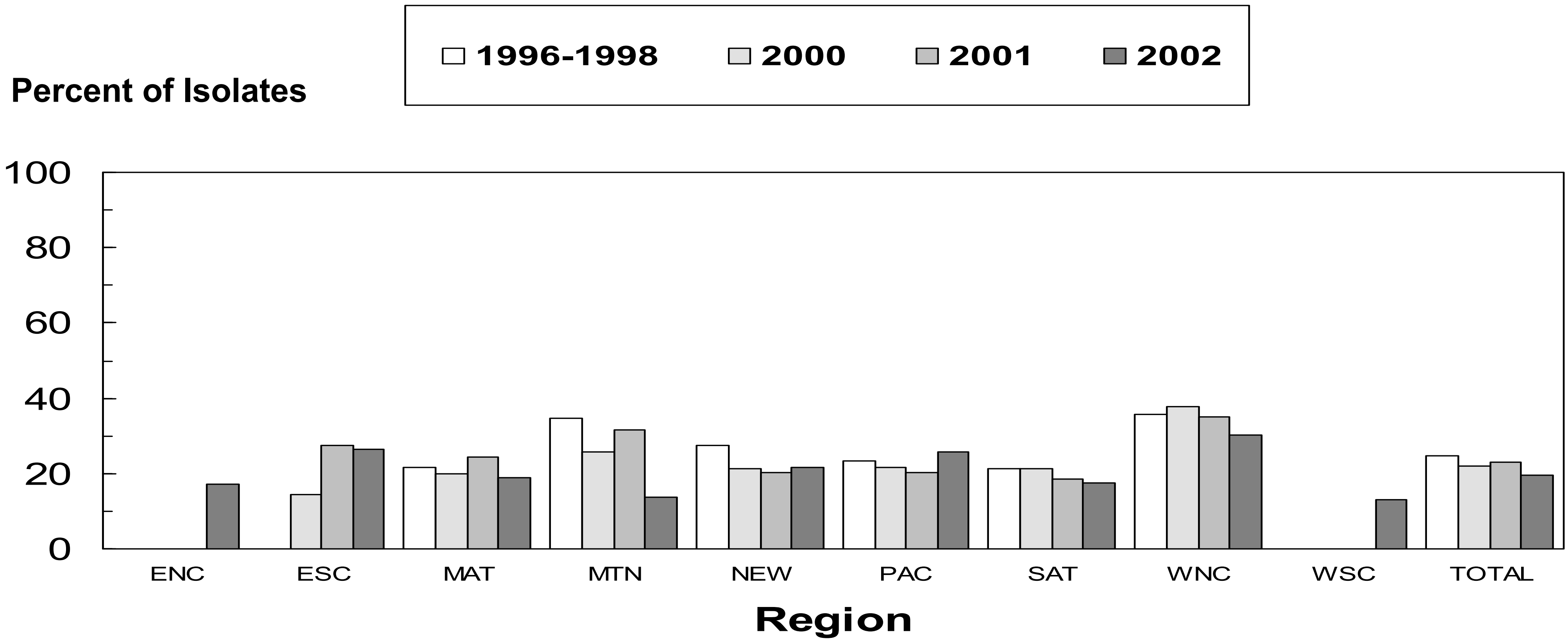
Figure 7. Percent of non-Typhi *Salmonella* isolates that are serotype Typhimurium, by region, 1996-2002



Percent Typhimurium for all sites:

1996-1998: 1010/4087 = 25%

2000: 303/1378 = 22%

2001: 325/1419 = 23%

2002: 393/2009 = 20%

ENC: East North Central (MI[4], WI[4])
ESC: East South Central (TN[3])
MAT: Mid-Atlantic (NJ, NY[2], NYC)
MTN: Mountain (AZ[4], CO, MT[4], NM[4])
NEW: New England (CT, MA, ME[4])
PAC: Pacific (CA, HI[4], LX, OR, WA)
SAT: South Atlantic (FL, GA, MD[1], WV)
WNC: West North Central (KS, MN, NE[4], SD[4])
WSC: West South Central (LA[4], TX[4])

CA= Alameda, Contra Costa, and San Francisco counties
LX=Los Angeles county
NY=Excluding New York city
NYC=New York city

1= Joined NARMS in 1997
2= Joined NARMS in 1998
3= Joined NARMS in 1999
4= Joined NARMS in 2002

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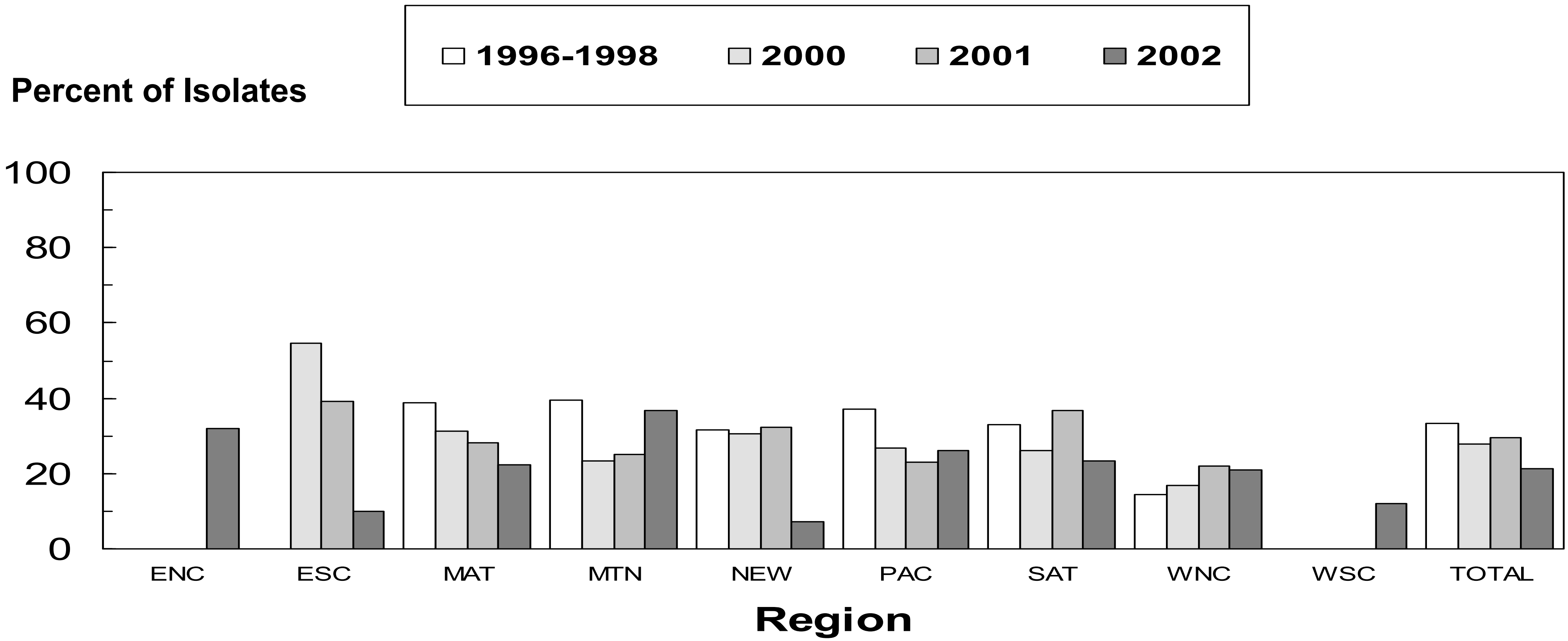
Figure 8. Percent of *Salmonella* Typhimurium isolates that are resistant to at least ampicillin, chloramphenicol, streptomycin, sulfamethoxazole, and tetracycline (R-type ACSSuT), by region, 1996-2002



Percent Typhimurium ACSSuT for all sites:

1996-1998: 338/1010 = 33%

2000: 84/303 = 28%

2001: 96/325 = 29%

2002: 84/393 = 21%

ENC: East North Central (MI[4], WI[4])
ESC: East South Central (TN[3])
MAT: Mid-Atlantic (NJ, NY[2], NYC)
MTN: Mountain (AZ[4], CO, MT[4], NM[4])
NEW: New England (CT, MA, ME[4])
PAC: Pacific (CA, HI[4], LX, OR, WA)
SAT: South Atlantic (FL, GA, MD[1], WV)
WNC: West North Central (KS, MN, NE[4], SD[4])
WSC: West South Central (LA[4], TX[4])

CA= Alameda, Contra Costa, and San Francisco counties
LX=Los Angeles county
NY=Excluding New York city
NYC=New York city

1= Joined NARMS in 1997
2= Joined NARMS in 1998
3= Joined NARMS in 1999
4= Joined NARMS in 2002

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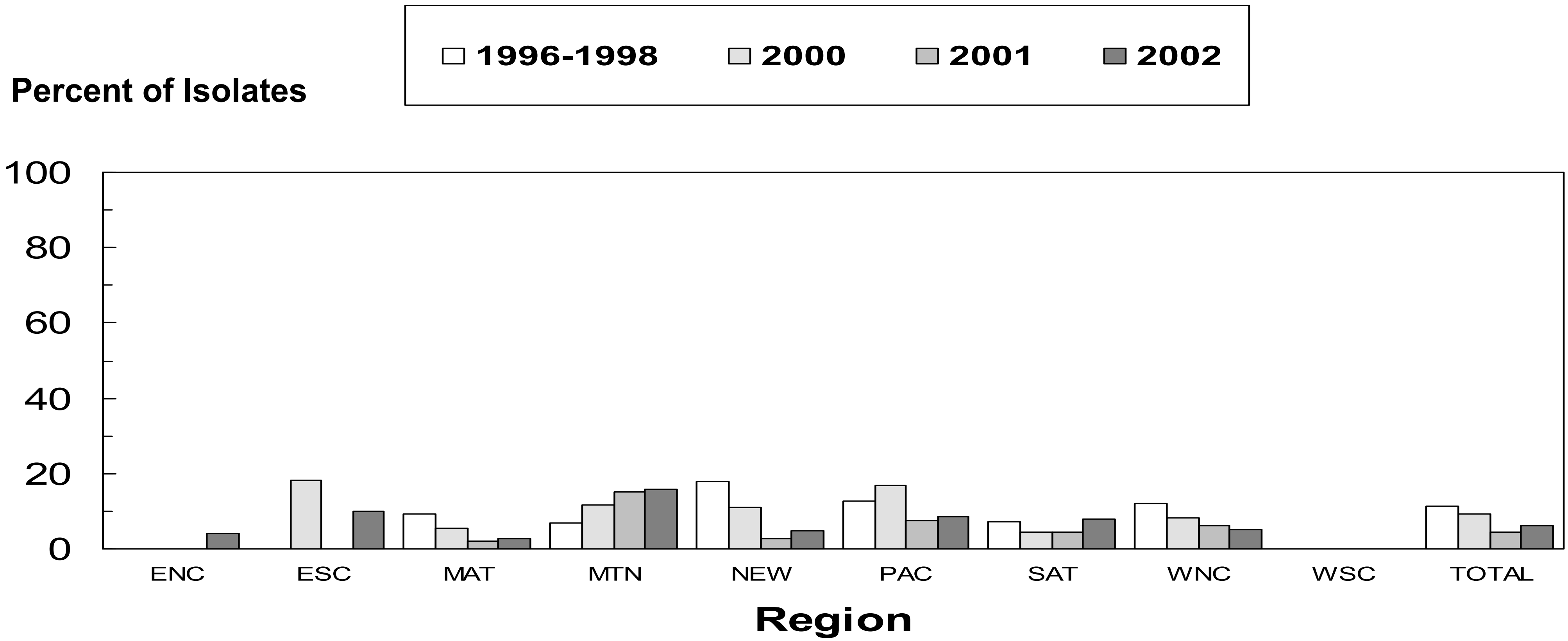
Figure 9. Percent of *Salmonella* Typhimurium isolates that are resistant to at least ampicillin, kanamycin, streptomycin, sulfamethoxazole, and tetracycline (R-type AKSSuT), by region, 1996-2002



Percent Typhimurium AKSSuT for all sites:

1996-1998: 115/1010 = 11%

2000: 28/303 = 9%

2001: 15/325 = 5%

2002: 24/393 = 6%

ENC: East North Central (MI[4], WI[4])
ESC: East South Central (TN[3])
MAT: Mid-Atlantic (NJ, NY[2], NYC)
MTN: Mountain (AZ[4], CO, MT[4], NM[4])
NEW: New England (CT, MA, ME[4])
PAC: Pacific (CA, HI[4], LX, OR, WA)
SAT: South Atlantic (FL, GA, MD[1], WV)
WNC: West North Central (KS, MN, NE[4], SD[4])
WSC: West South Central (LA[4], TX[4])

CA= Alameda, Contra Costa, and San Francisco counties
LX=Los Angeles county
NY=Excluding New York city
NYC=New York city

1= Joined NARMS in 1997
2= Joined NARMS in 1998
3= Joined NARMS in 1999
4= Joined NARMS in 2002

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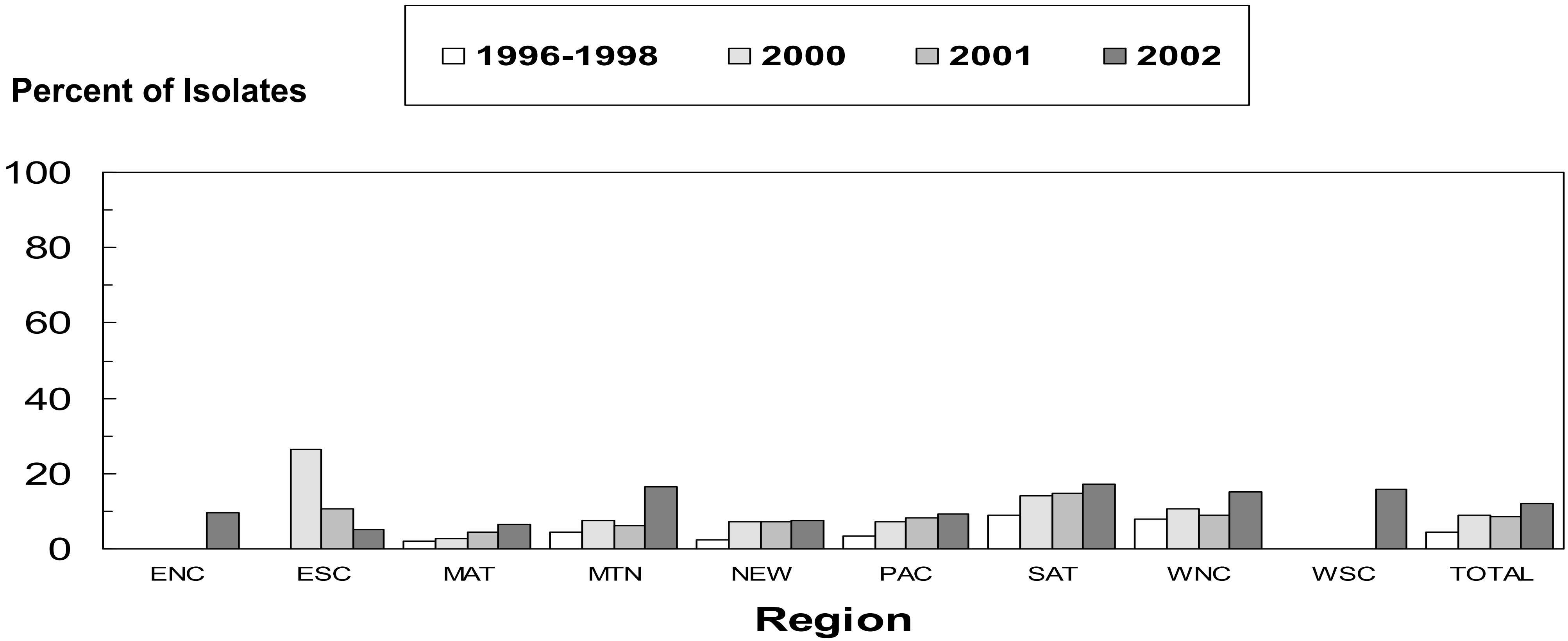
Figure 10. Percent of non-Typhi *Salmonella* isolates that are serotype Newport, by region, 1996-2002



Percent Newport for all sites:

1996-1998: 176/4087 = 4%

2000: 124/1378 = 9%

2001: 124/1419 = 9%

2002: 239/2009 = 12%

ENC: East North Central (MI[4], WI[4])
ESC: East South Central (TN[3])
MAT: Mid-Atlantic (NJ, NY[2], NYC)
MTN: Mountain (AZ[4], CO, MT[4], NM[4])
NEW: New England (CT, MA, ME[4])
PAC: Pacific (CA, HI[4], LX, OR, WA)
SAT: South Atlantic (FL, GA, MD[1], WV)
WNC: West North Central (KS, MN, NE[4], SD[4])
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NY=Excluding New York city
NYC=New York city

1= Joined NARMS in 1997
2= Joined NARMS in 1998
3= Joined NARMS in 1999
4= Joined NARMS in 2002

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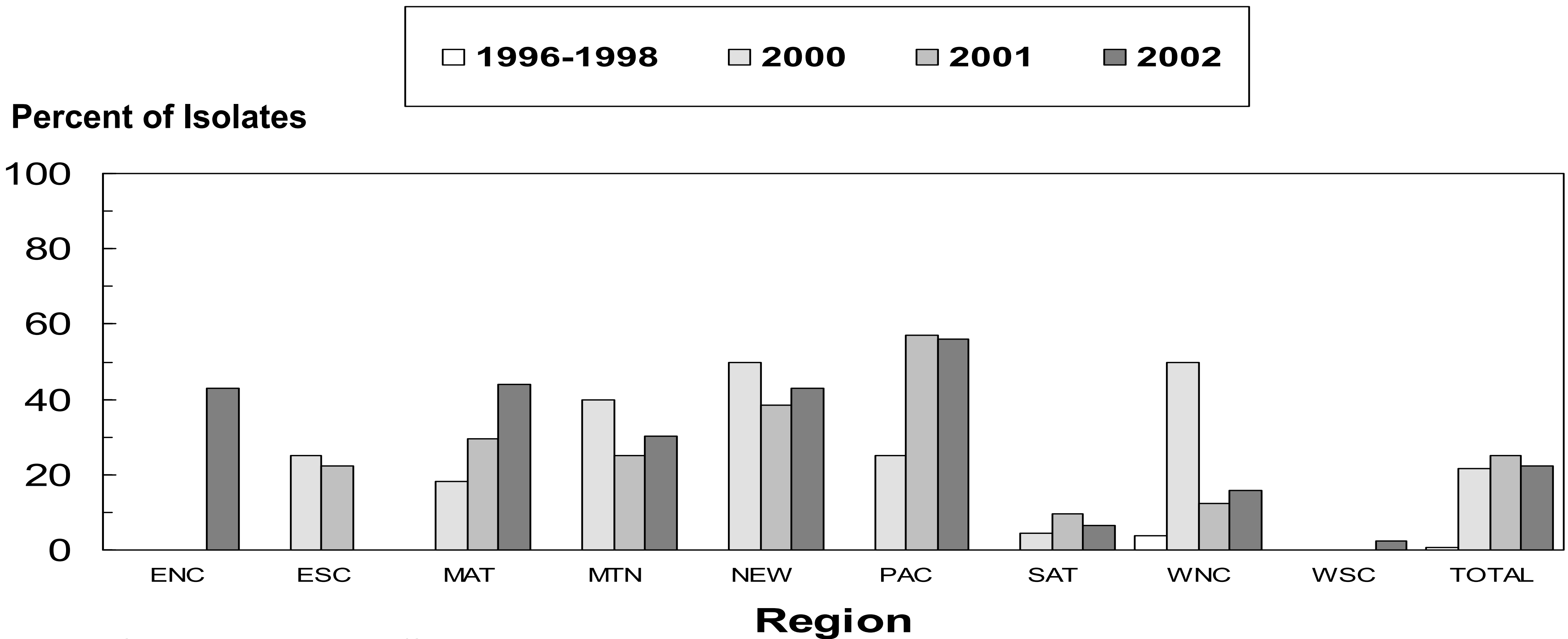
Figure 11. Percent of *Salmonella* Newport isolates that are at least MDR-AmpC ‡, by region, 1996-2002



‡MDR-AmpC=Resistance to Amoxicillin/Clavulanic Acid, Ampicillin, Cephalothin, Cefoxitin, Ceftiofur, Chloramphenicol, Sulfamethoxazole, Streptomycin and Tetracycline, and Decreased Susceptibility to Ceftriaxone (MIC ≥ 2 µg/ml)

Percent Newport with MDR-AmpC pattern for all sites:

1996-1998: 1/176 = 1%

2000: 27/124 = 22%

2001: 31/124 = 25%

2002: 53/239 = 22%

ENC: East North Central (MI[4], WI[4])
ESC: East South Central (TN[3])
MAT: Mid-Atlantic (NJ, NY[2], NYC)
MTN: Mountain (AZ[4], CO, MT[4], NM[4])
NEW: New England (CT, MA, ME[4])
PAC: Pacific (CA, HI[4], LX, OR, WA)
SAT: South Atlantic (FL, GA, MD[1], WV)
WNC: West North Central (KS, MN, NE[4], SD[4])
WSC: West South Central (LA[4], TX[4])

CA= Alameda, Contra Costa, and San Francisco counties
LX=Los Angeles county
NY=Excluding New York city
NYC=New York city

1= Joined NARMS in 1997
2= Joined NARMS in 1998
3= Joined NARMS in 1999
4= Joined NARMS in 2002

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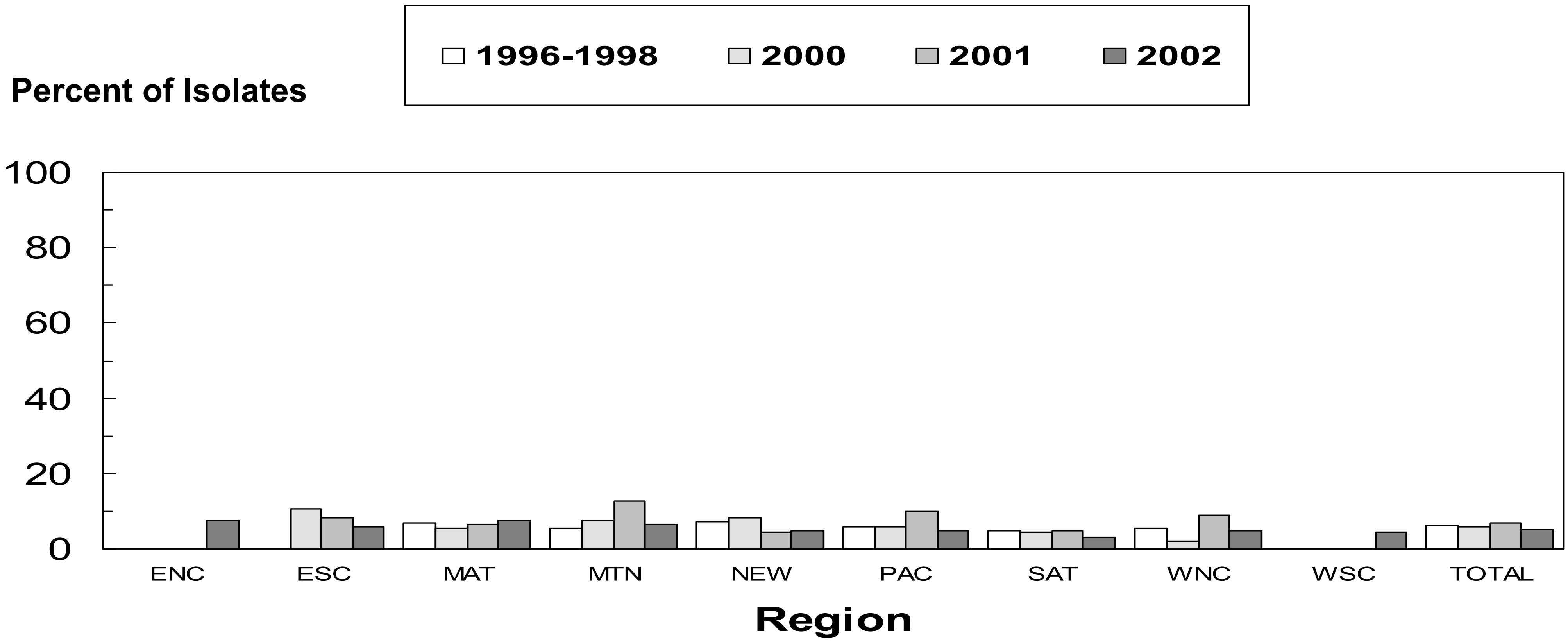
Figure 12. Percent of non-Typhi *Salmonella* isolates that are serotype Heidelberg, by region, 1996-2002



Percent Heidelberg for all sites:

1996-1998: 250/4087 = 6%

2000: 79/1378 = 6%

2001: 100/1419 = 7%

2002: 105/2009 = 5%

ENC: East North Central (MI[4], WI[4])
ESC: East South Central (TN[3])
MAT: Mid-Atlantic (NJ, NY[2], NYC)
MTN: Mountain (AZ[4], CO, MT[4], NM[4])
NEW: New England (CT, MA, ME[4])
PAC: Pacific (CA, HI[4], LX, OR, WA)
SAT: South Atlantic (FL, GA, MD[1], WV)
WNC: West North Central (KS, MN, NE[4], SD[4])
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CA= Alameda, Contra Costa, and San Francisco counties
LX=Los Angeles county
NY=Excluding New York city
NYC=New York city

1= Joined NARMS in 1997
2= Joined NARMS in 1998
3= Joined NARMS in 1999
4= Joined NARMS in 2002

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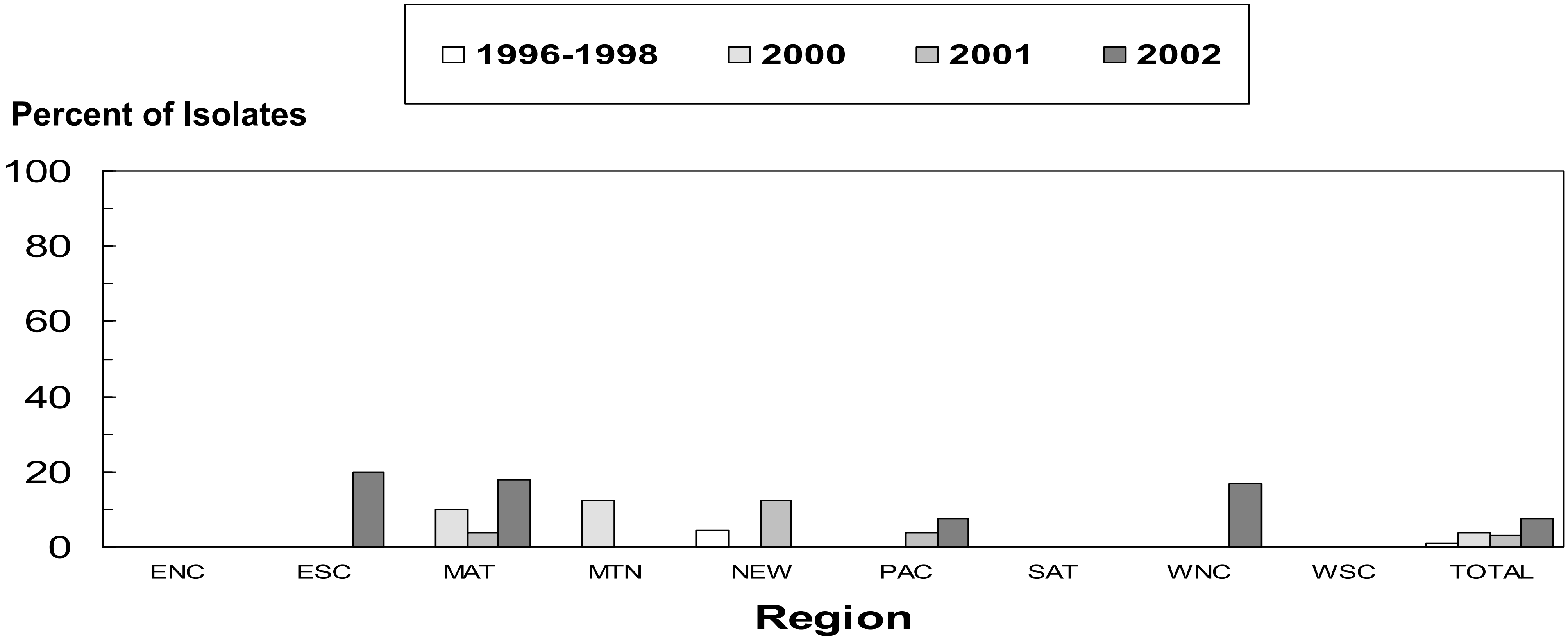
Figure 13. Percent of *Salmonella* Heidelberg isolates that are resistant to at least ampicillin, amoxicillin-clavulanic acid, ceftiofur, and cephalothin (R-type ACICfCp), by region, 1996-2002



Percent Heidelberg R-type ACICfCp
for all sites:
1996-1998: 2/250 = 1%
2000: 3/79 = 4%
2001: 3/100 = 3%
2002: 8/105 = 8%

ENC: East North Central (MI[4], WI[4])
ESC: East South Central (TN[3])
MAT: Mid-Atlantic (NJ, NY[2], NYC)
MTN: Mountain (AZ[4], CO, MT[4], NM[4])
NEW: New England (CT, MA, ME[4])
PAC: Pacific (CA, HI[4], LX, OR, WA)
SAT: South Atlantic (FL, GA, MD[1], WV)
WNC: West North Central (KS, MN, NE[4], SD[4])
WSC: West South Central (LA[4], TX[4])

CA= Alameda, Contra Costa, and San Francisco counties
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1= Joined NARMS in 1997
2= Joined NARMS in 1998
3= Joined NARMS in 1999
4= Joined NARMS in 2002

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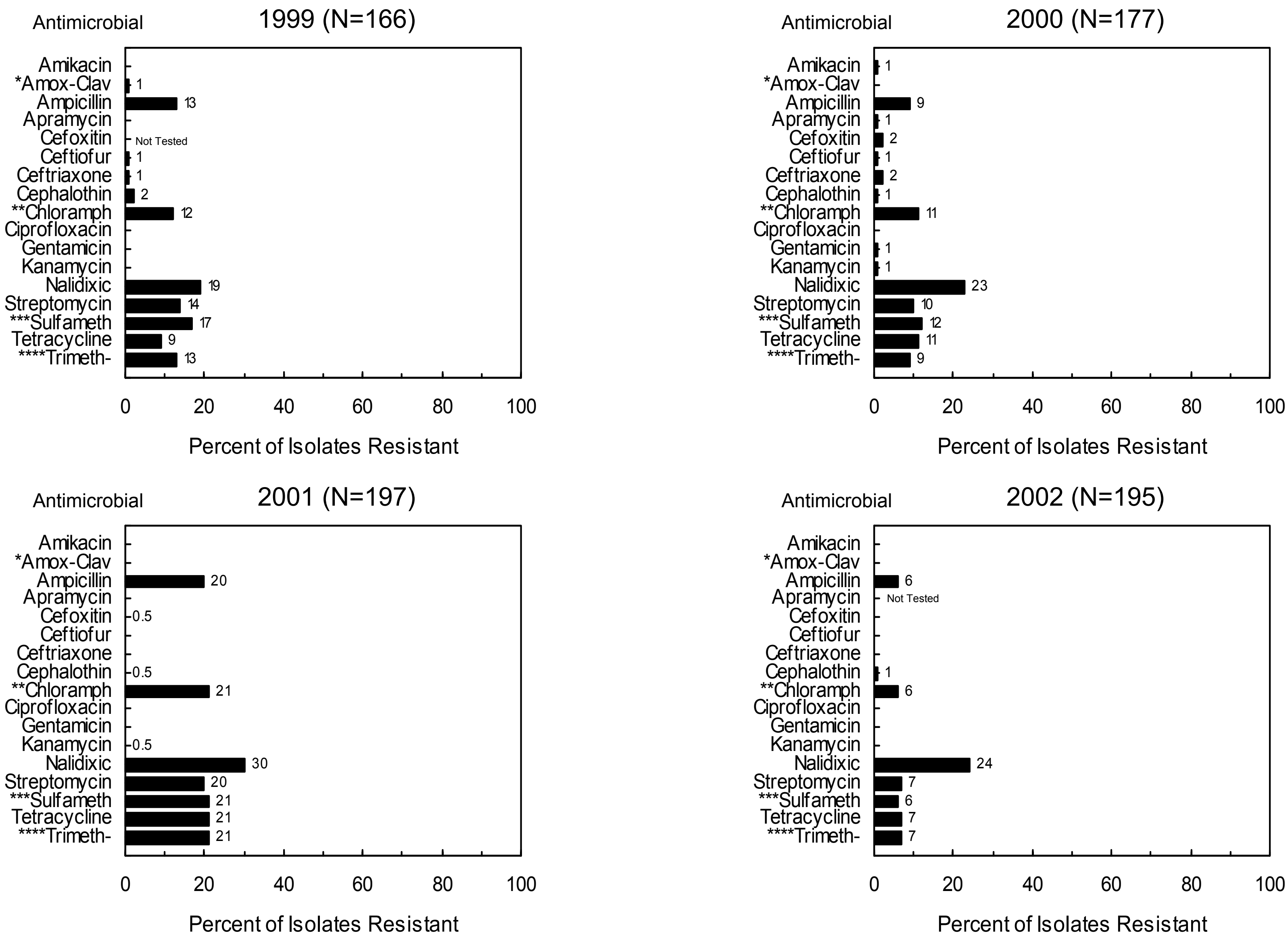
Figure 14. Resistance among *Salmonella* Typhi isolates, 1999-2002



*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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Figure 15a. MICs for amikacin among *Salmonella* Typhi isolates, 1999-2002

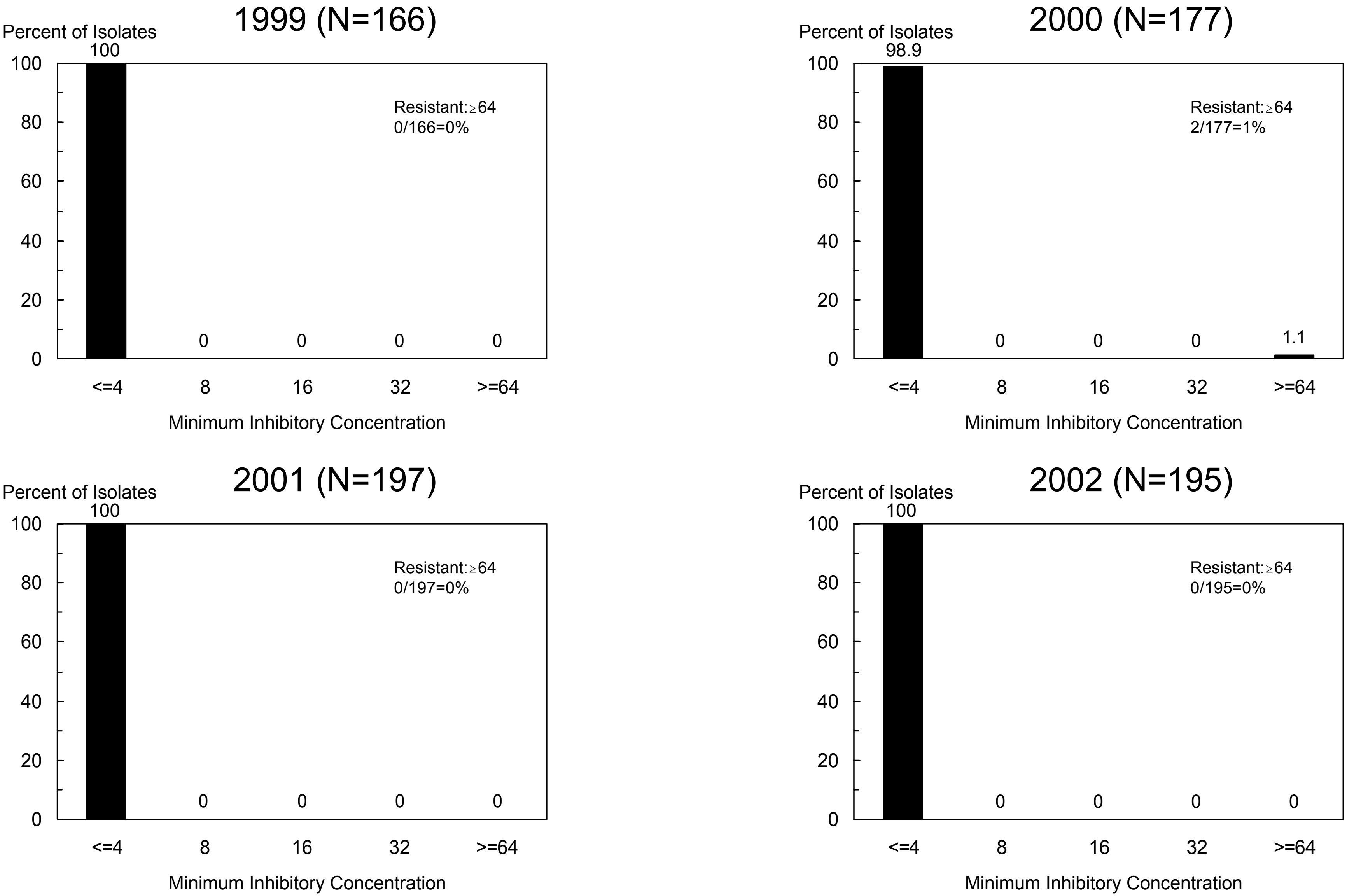

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Figure 15b. MICs for amoxicillin-clavulanic acid among *Salmonella* Typhi isolates, 1999-2002

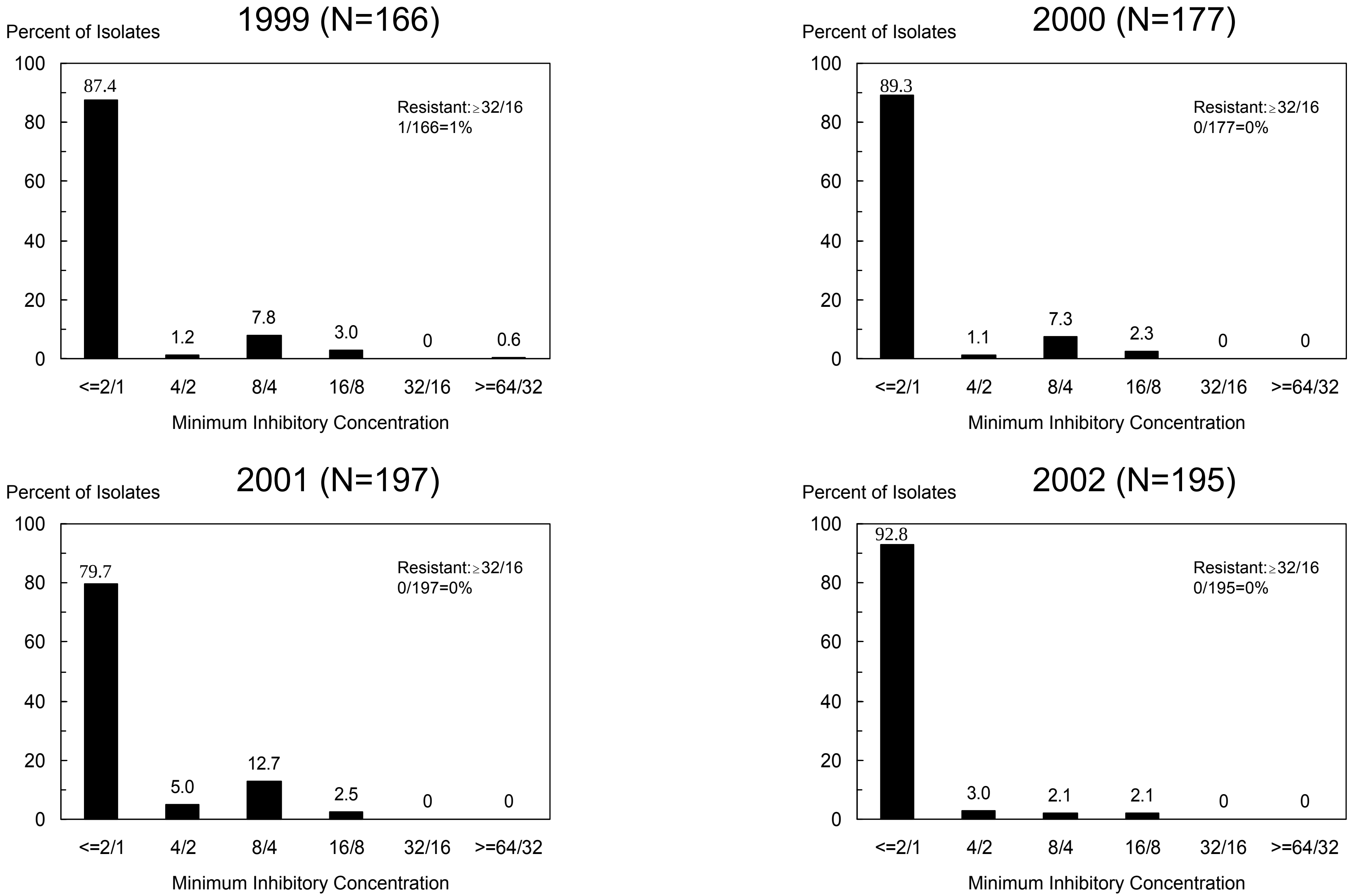

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Figure 15c. MICs for ampicillin among *Salmonella* Typhi isolates, 1999-2002

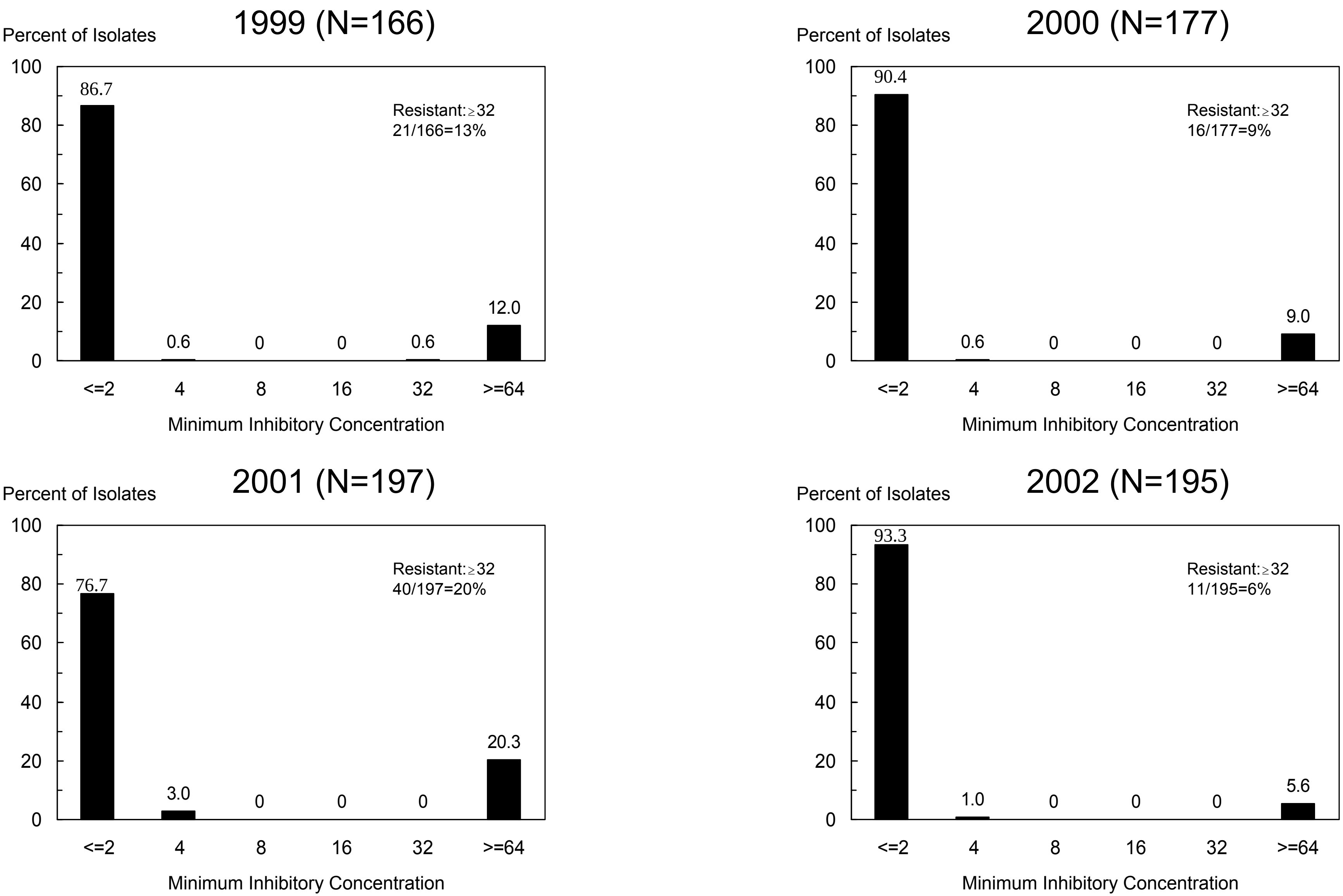

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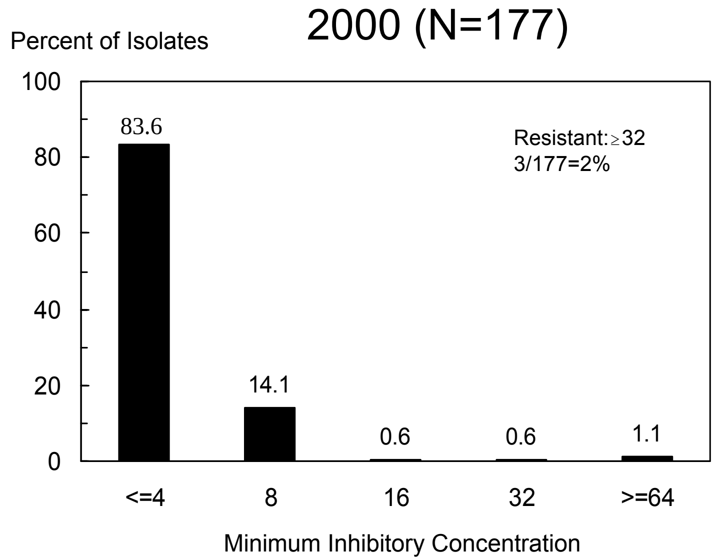
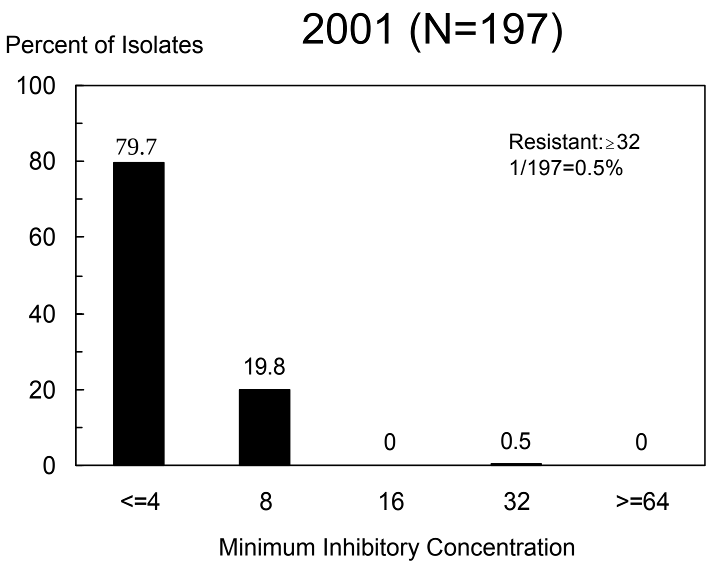
Figure 15d. MICs for cefoxitin among *Salmonella* Typhi isolates, 1999-2002

Not Tested in 1999





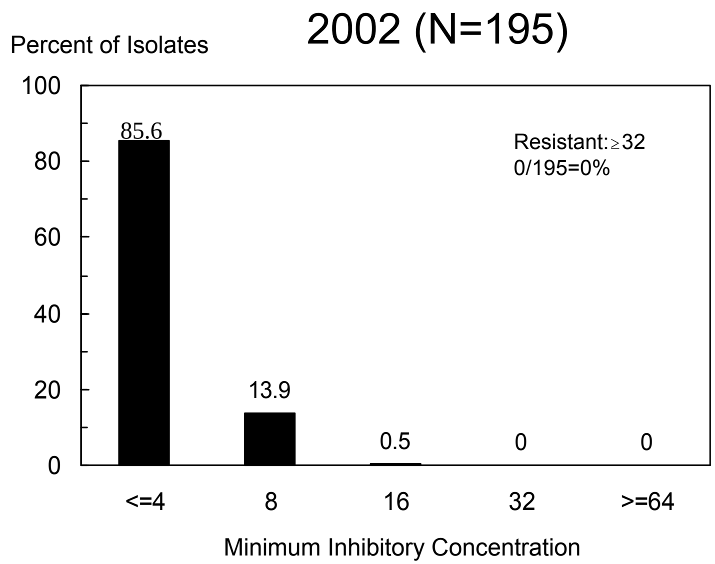


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Figure 15e. MICs for ceftiofur among *Salmonella* Typhi isolates, 1999-2002

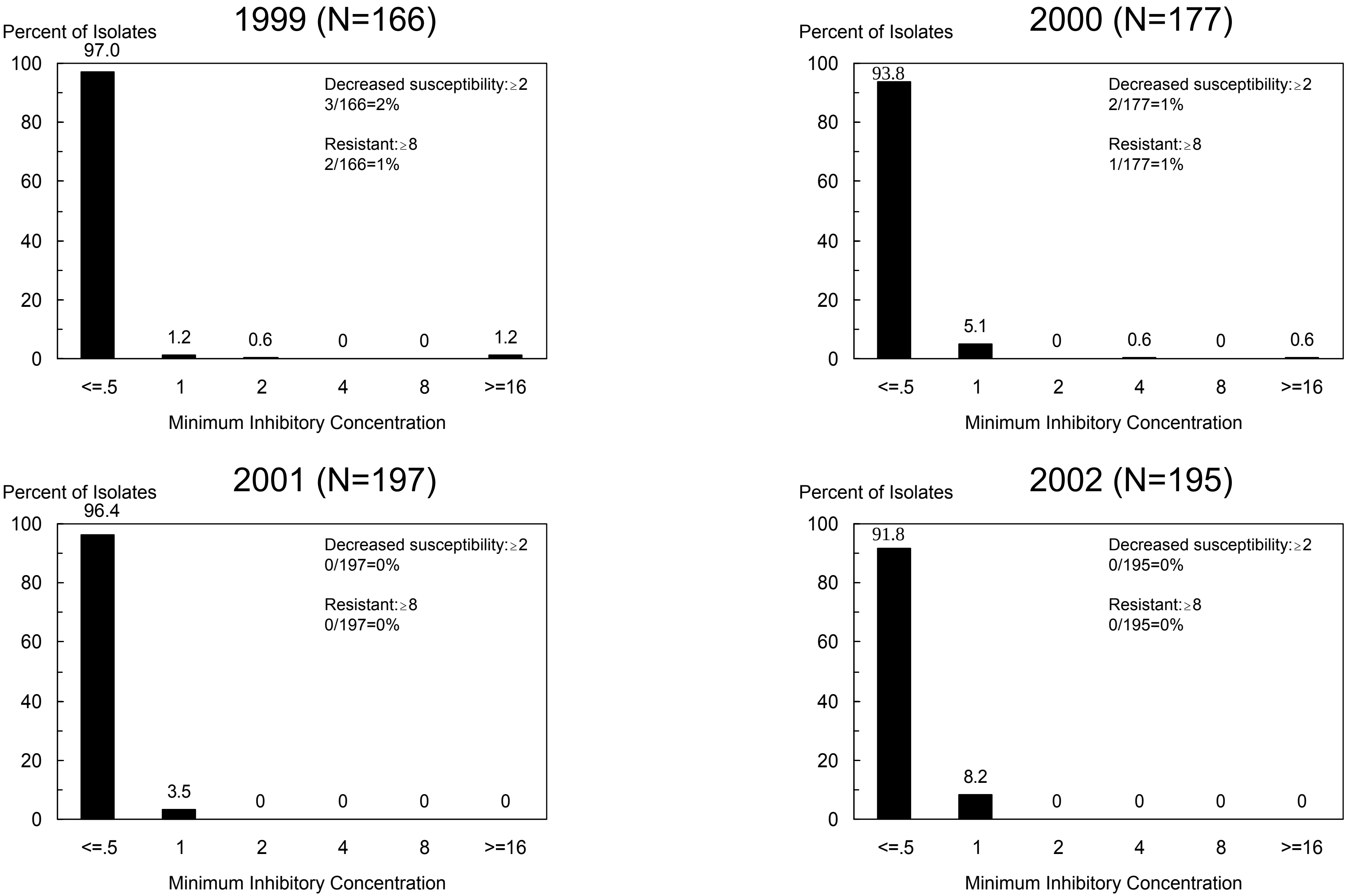

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Figure 15f. MICs for ceftriaxone among *Salmonella* Typhi isolates, 1999-2002

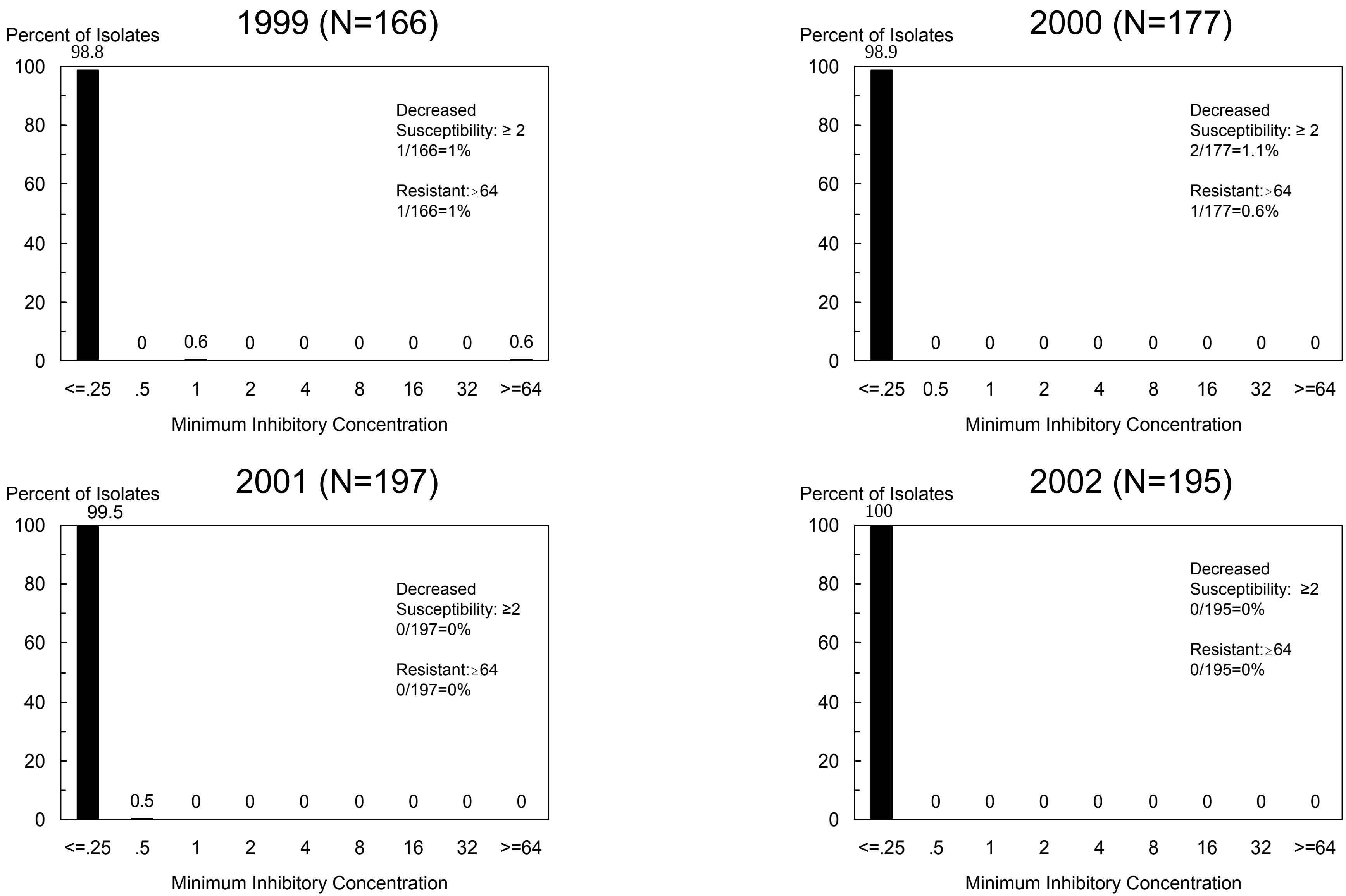

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Figure 15g. MICs for cephalothin among *Salmonella* Typhi isolates, 1999-2002

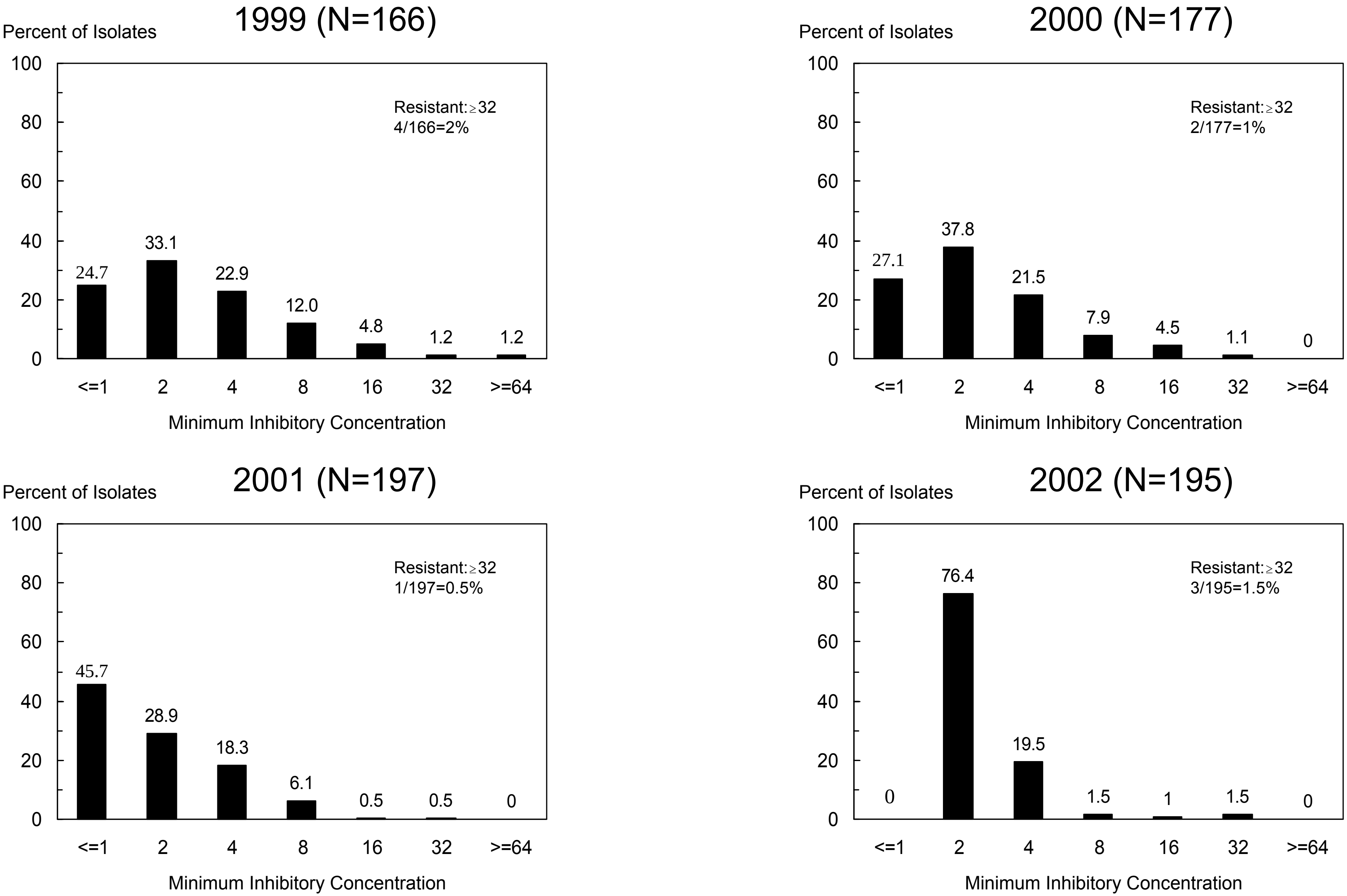

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Figure 15h. MICs for chloramphenicol among *Salmonella* Typhi Isolates, 1999-2002

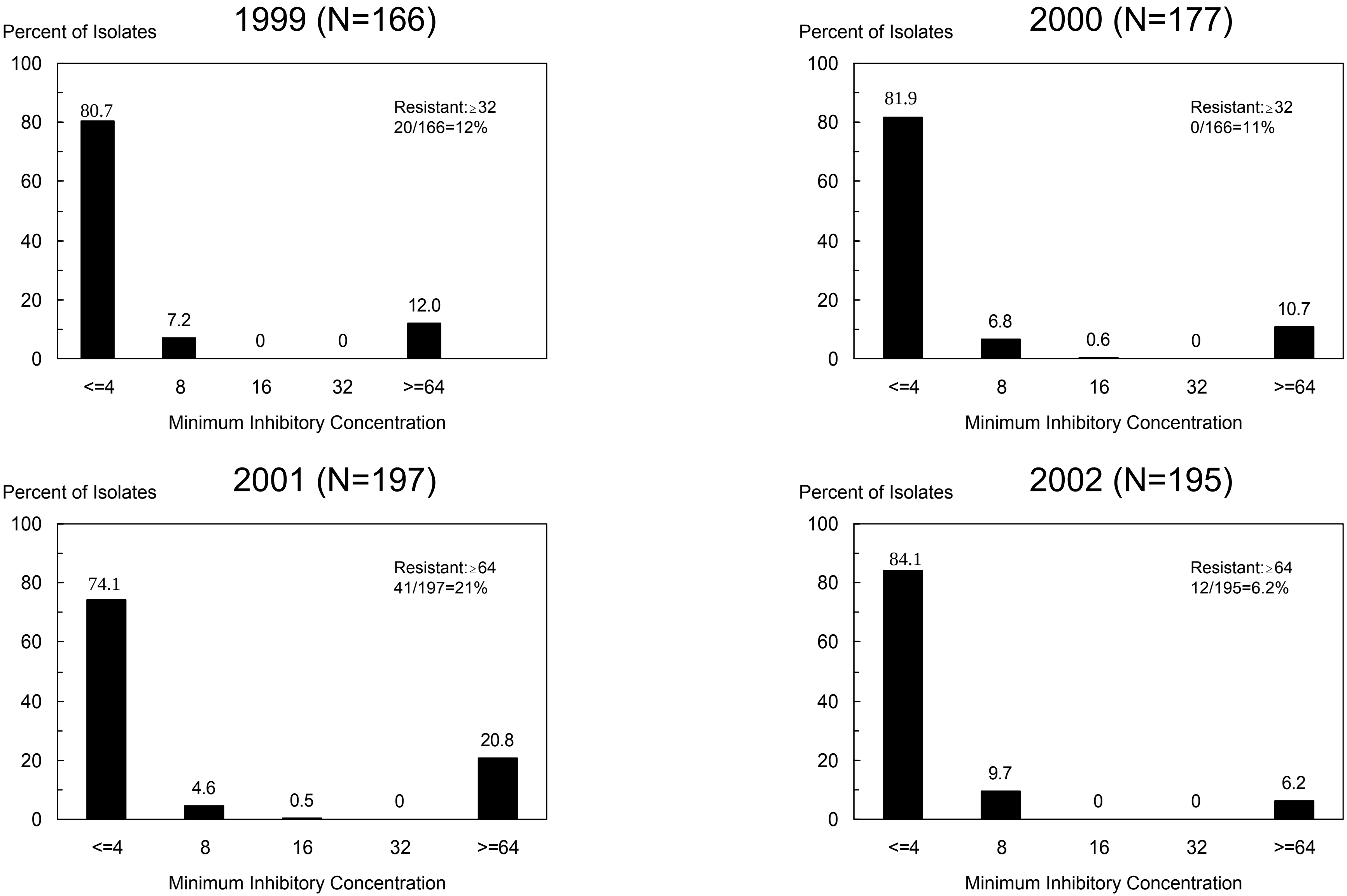

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Figure 15i. MICs for ciprofloxacin among *Salmonella* Typhi isolates, 1999-2002

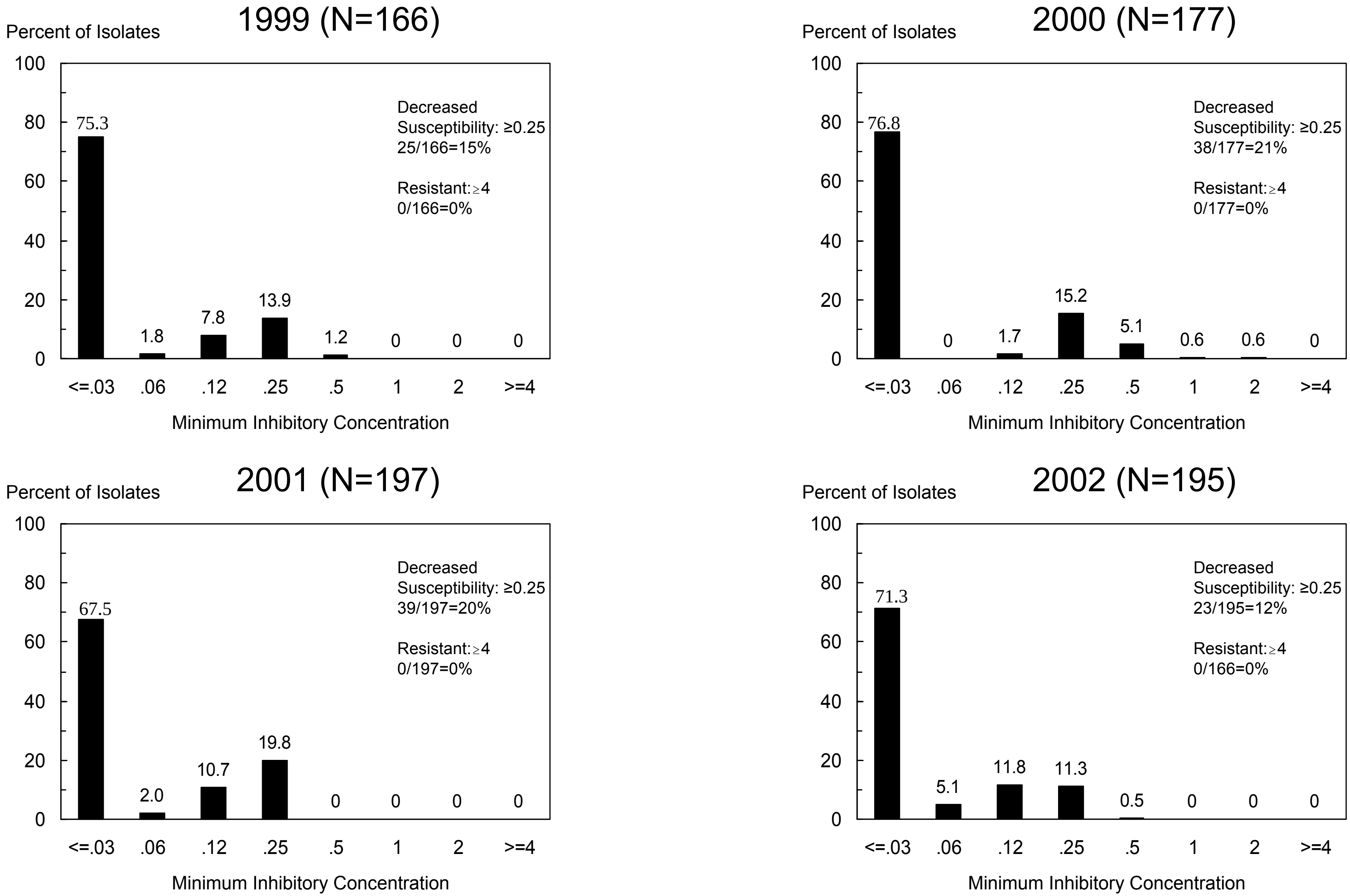

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Figure 15j. MICs for gentamicin among *Salmonella* Typhi isolates, 1999-2002

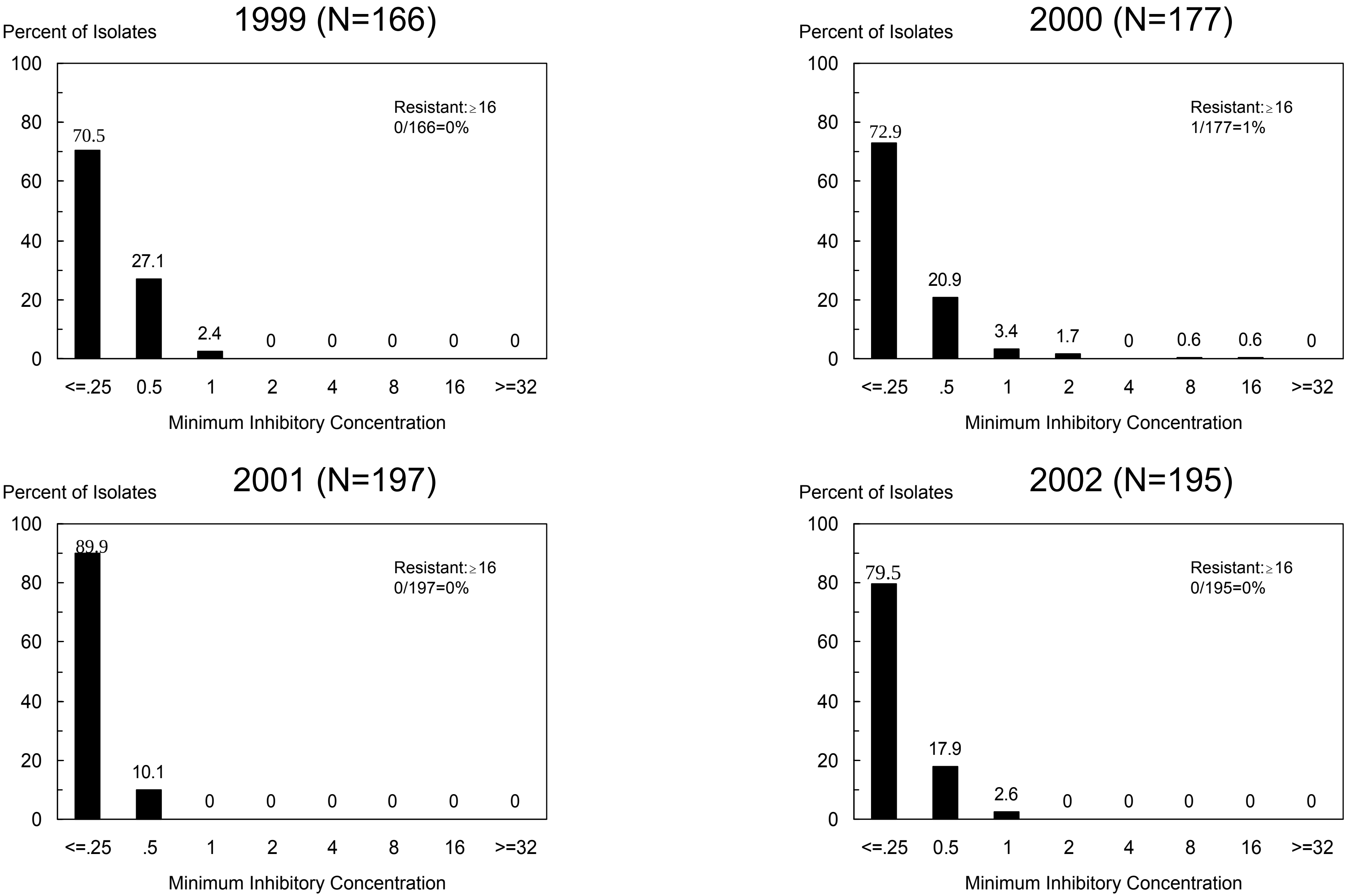

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Figure 15k. MICs for kanamycin among *Salmonella* Typhi isolates, 1999-2002

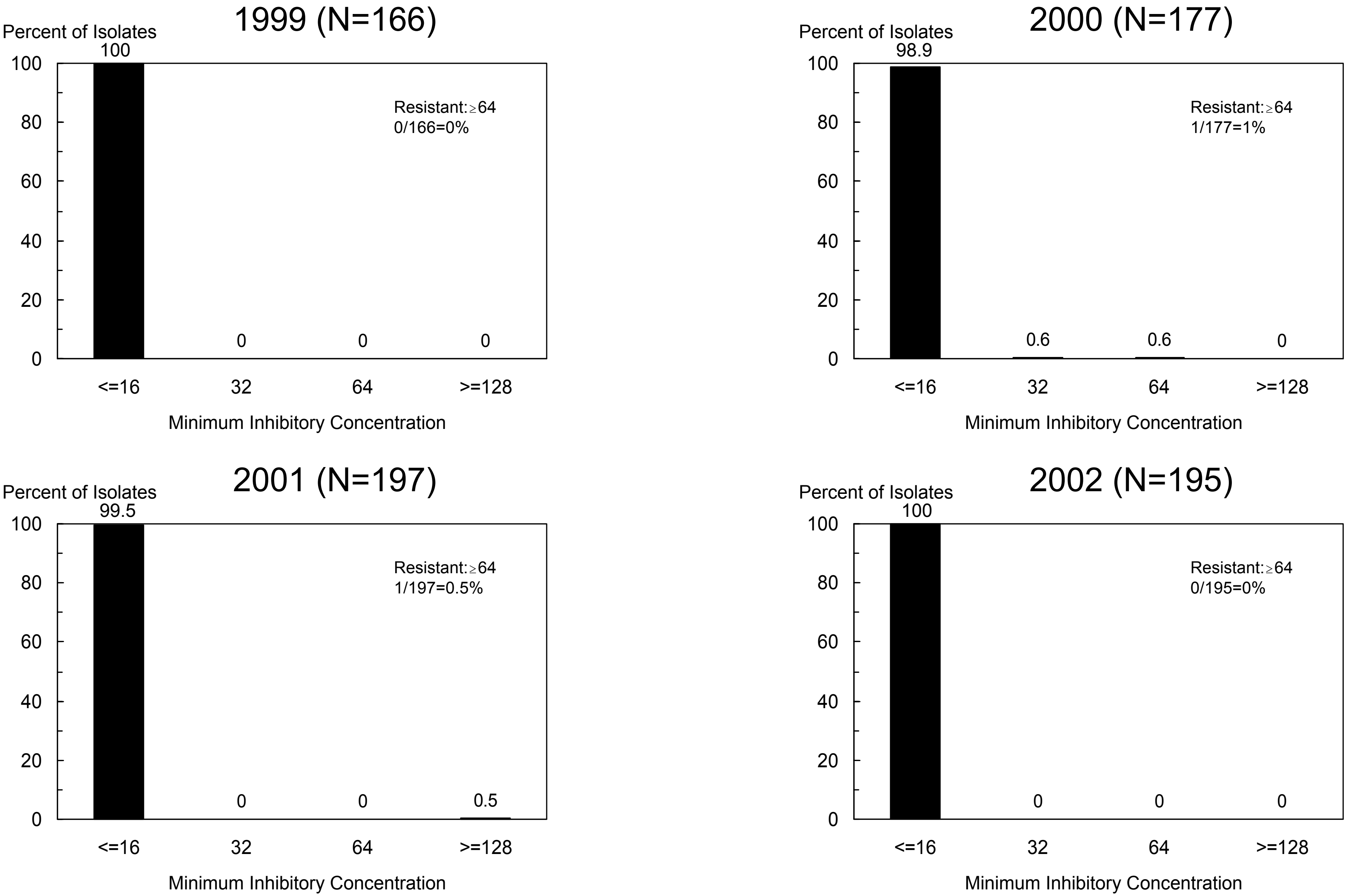

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Figure 15I. MICs for nalidixic acid among *Salmonella* Typhi isolates, 1999-2002

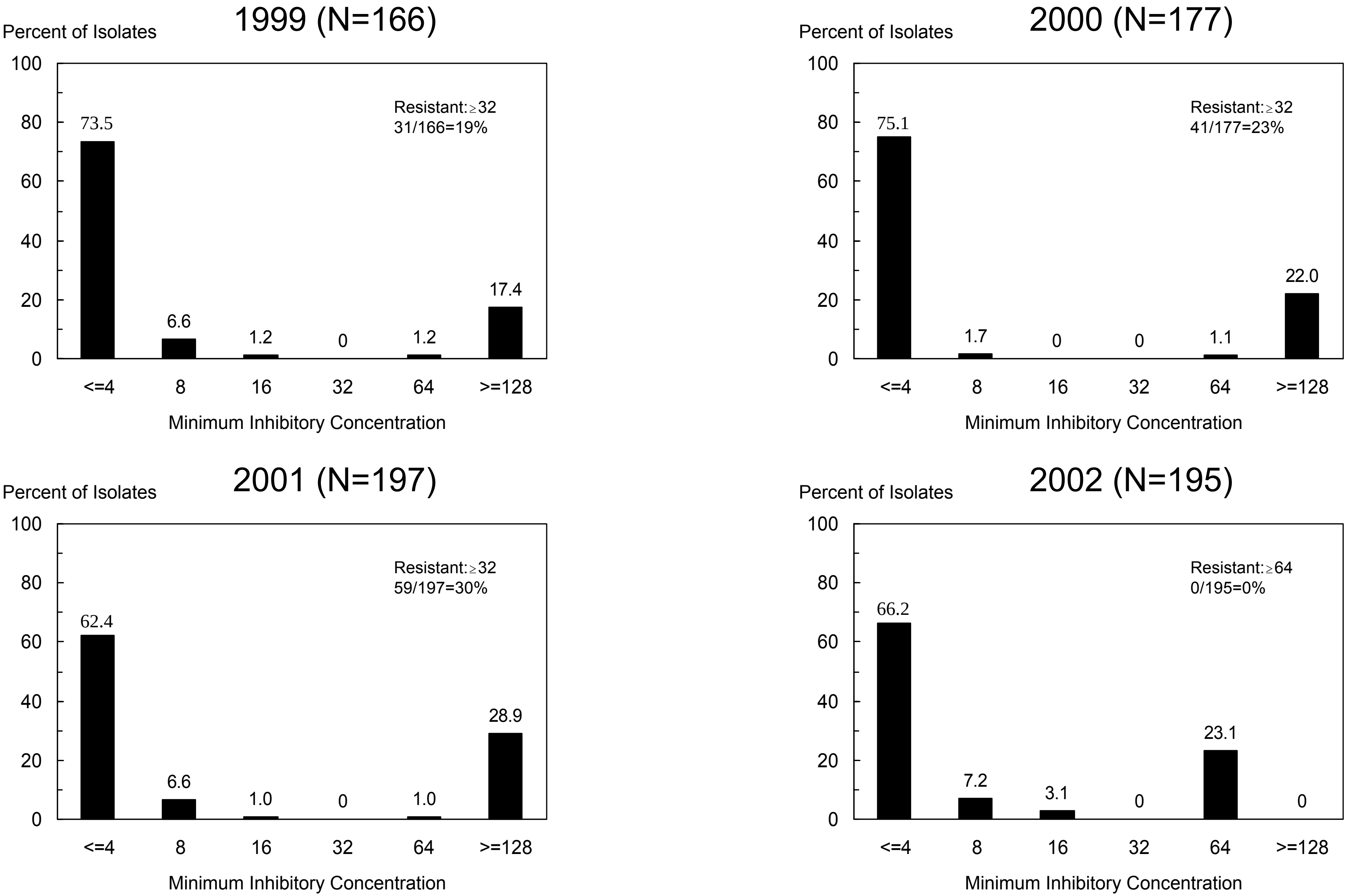

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Figure 15m. MICs for streptomycin among *Salmonella* Typhi isolates, 1999-2002

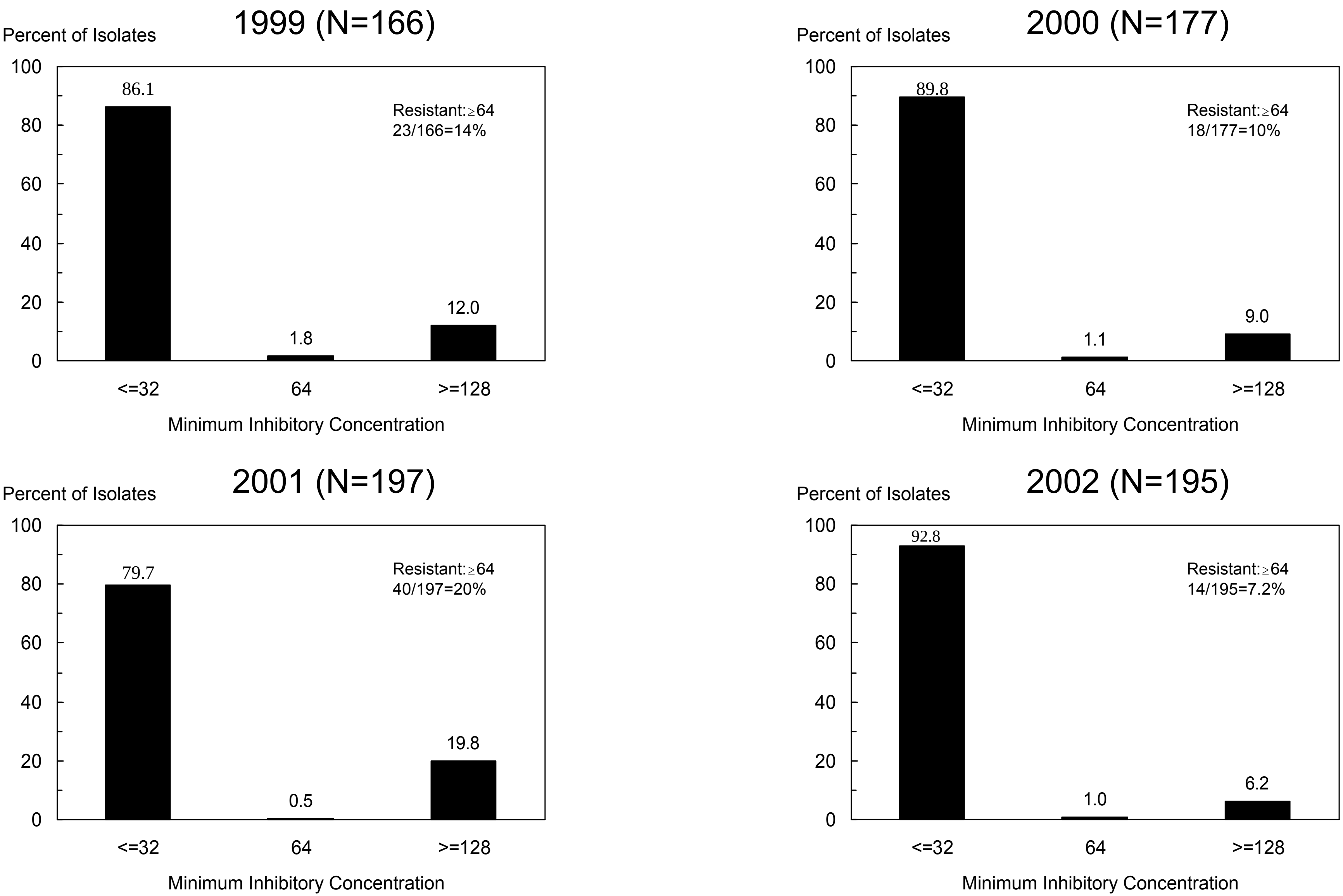

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Figure 15n. MICs for sulfamethoxazole among *Salmonella* Typhi isolates, 1999-2002

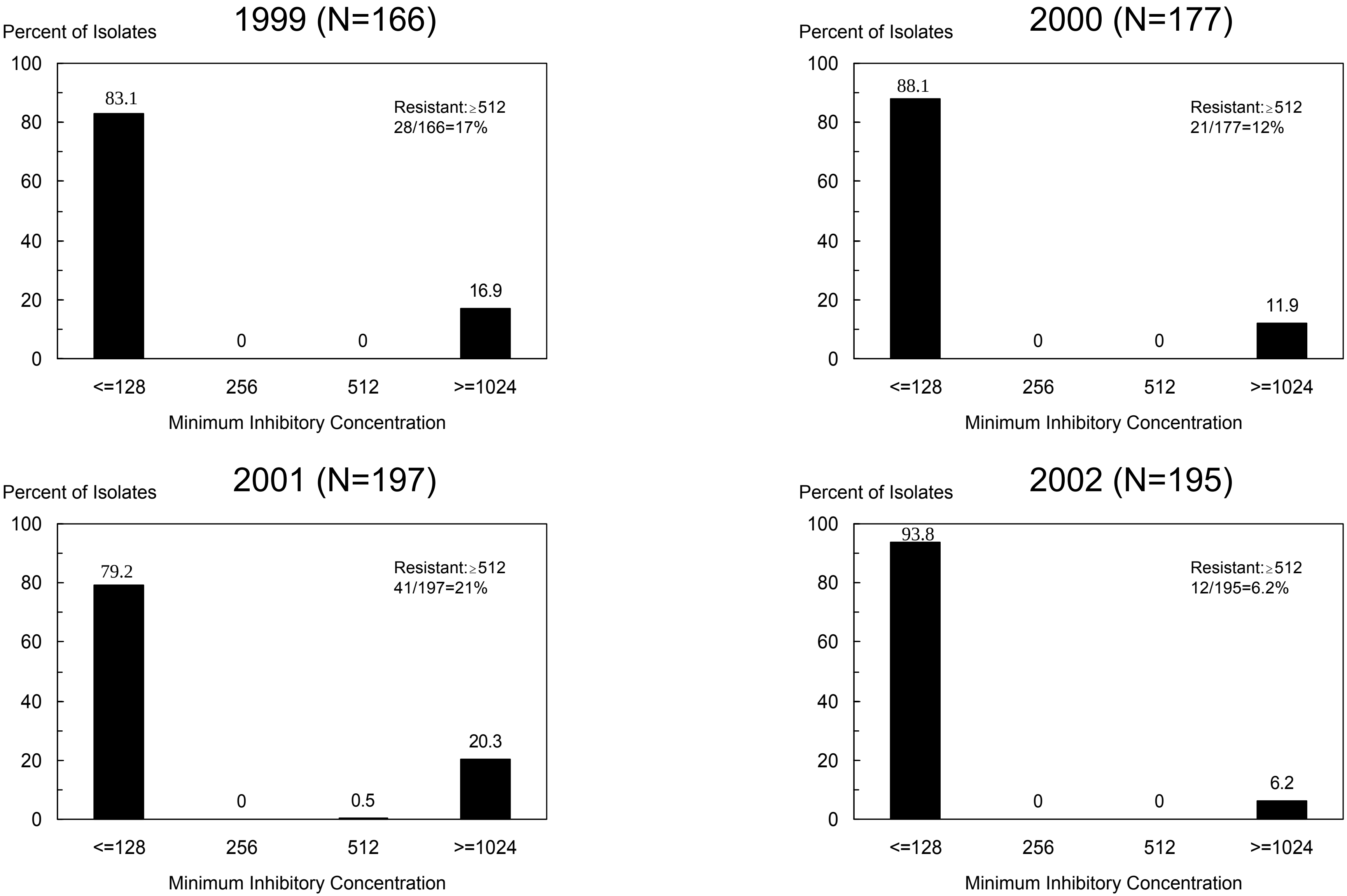

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Figure 15o. MICs for tetracycline among *Salmonella* Typhi isolates, 1999-2002

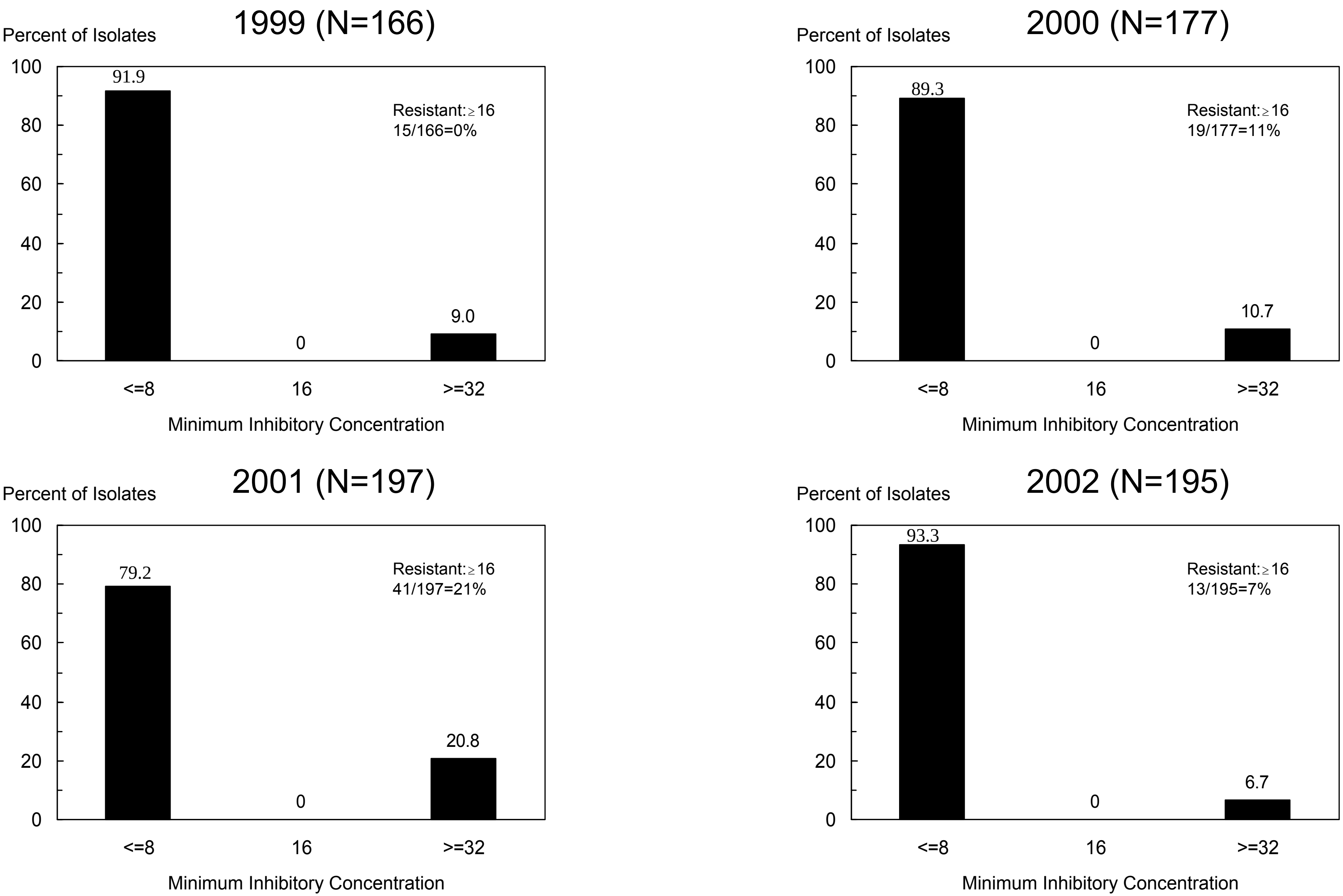

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Figure 15p. MICs for trimethoprim-sulfamethoxazole among *Salmonella* Typhi isolates, 1999 - 2002

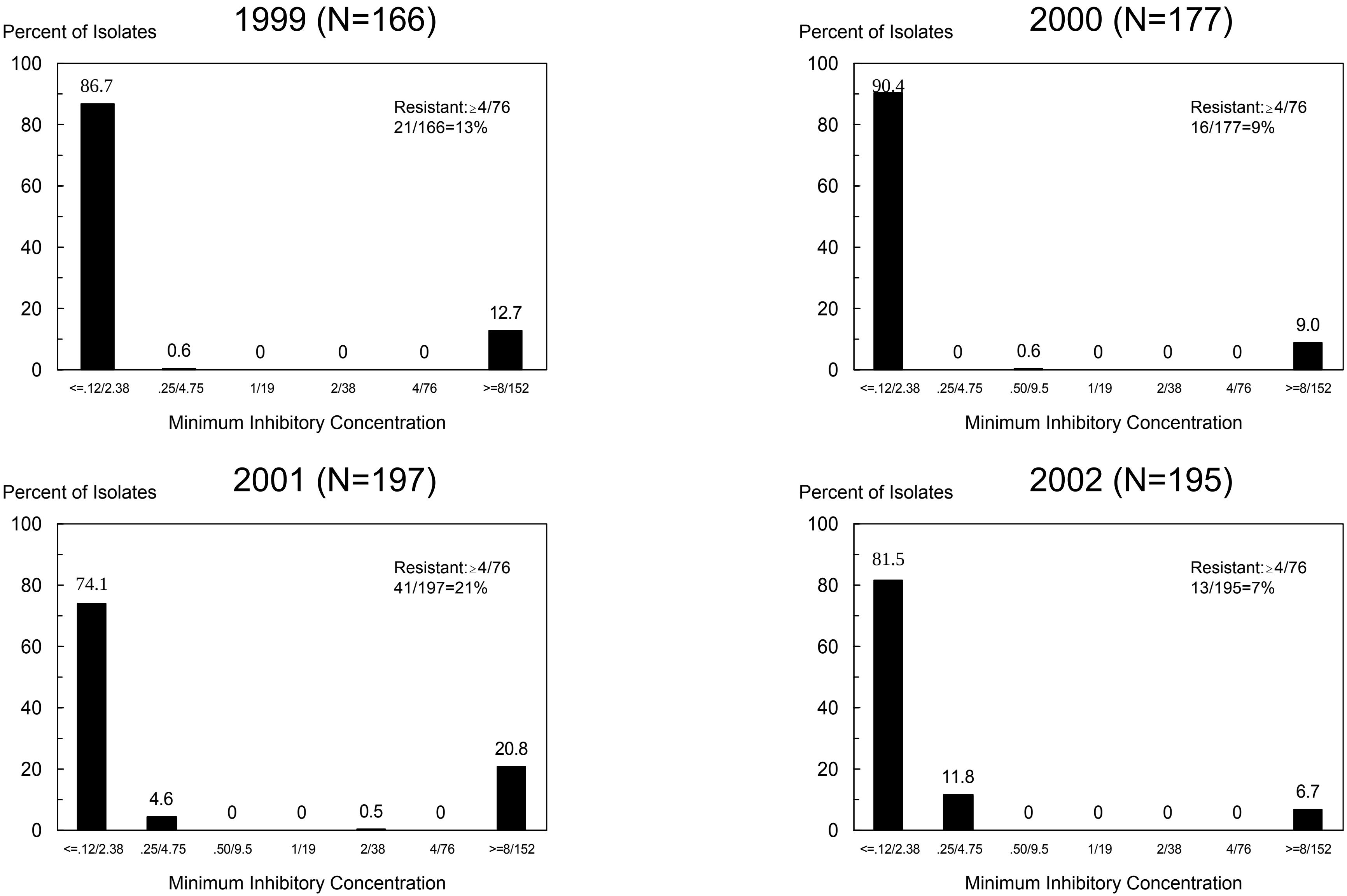

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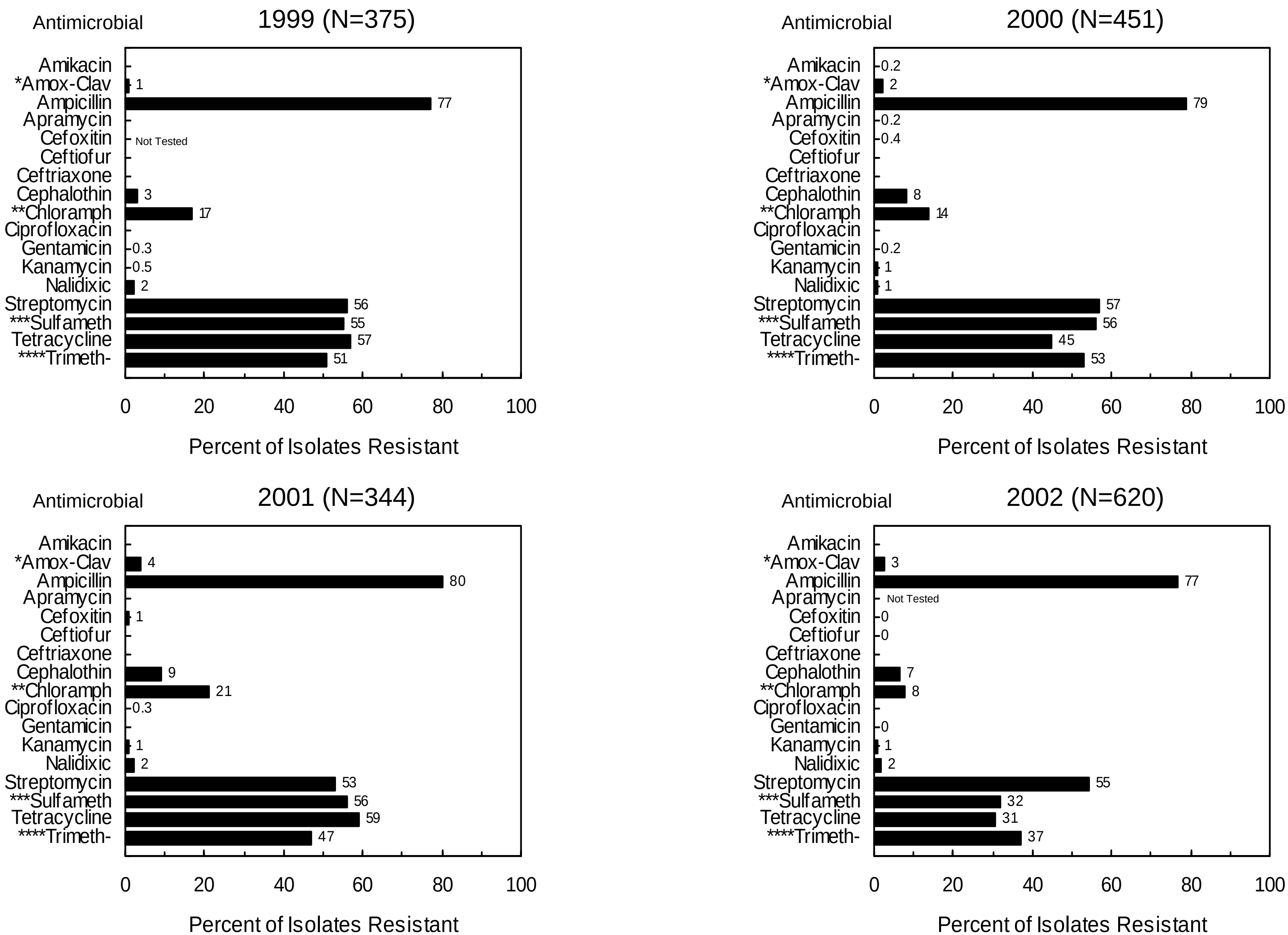
Figure 16. Resistance among *Shigella* isolates, 1999-2002



*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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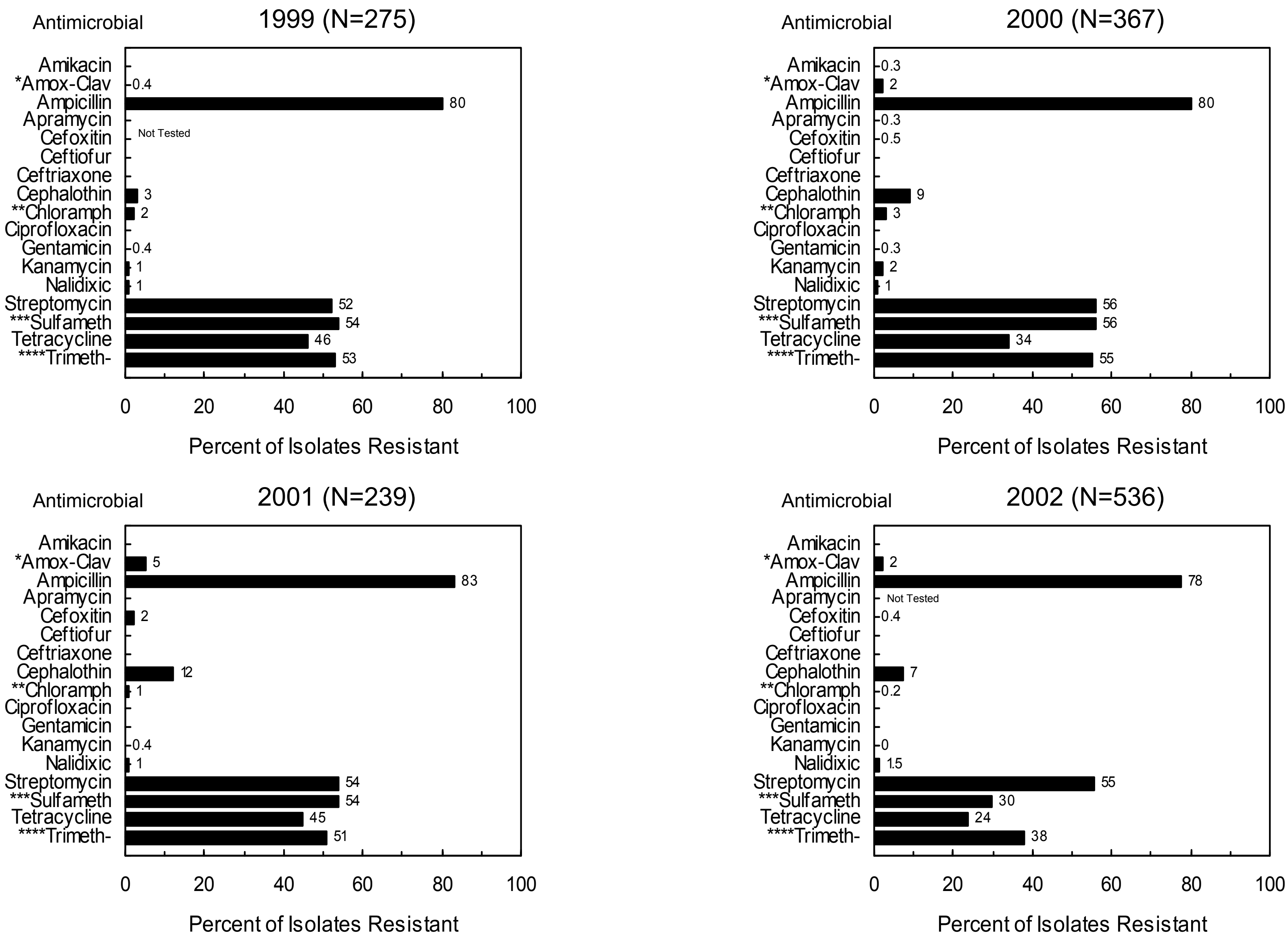
Figure 17a. Resistance among *Shigella sonnei* isolates, 1999-2002



*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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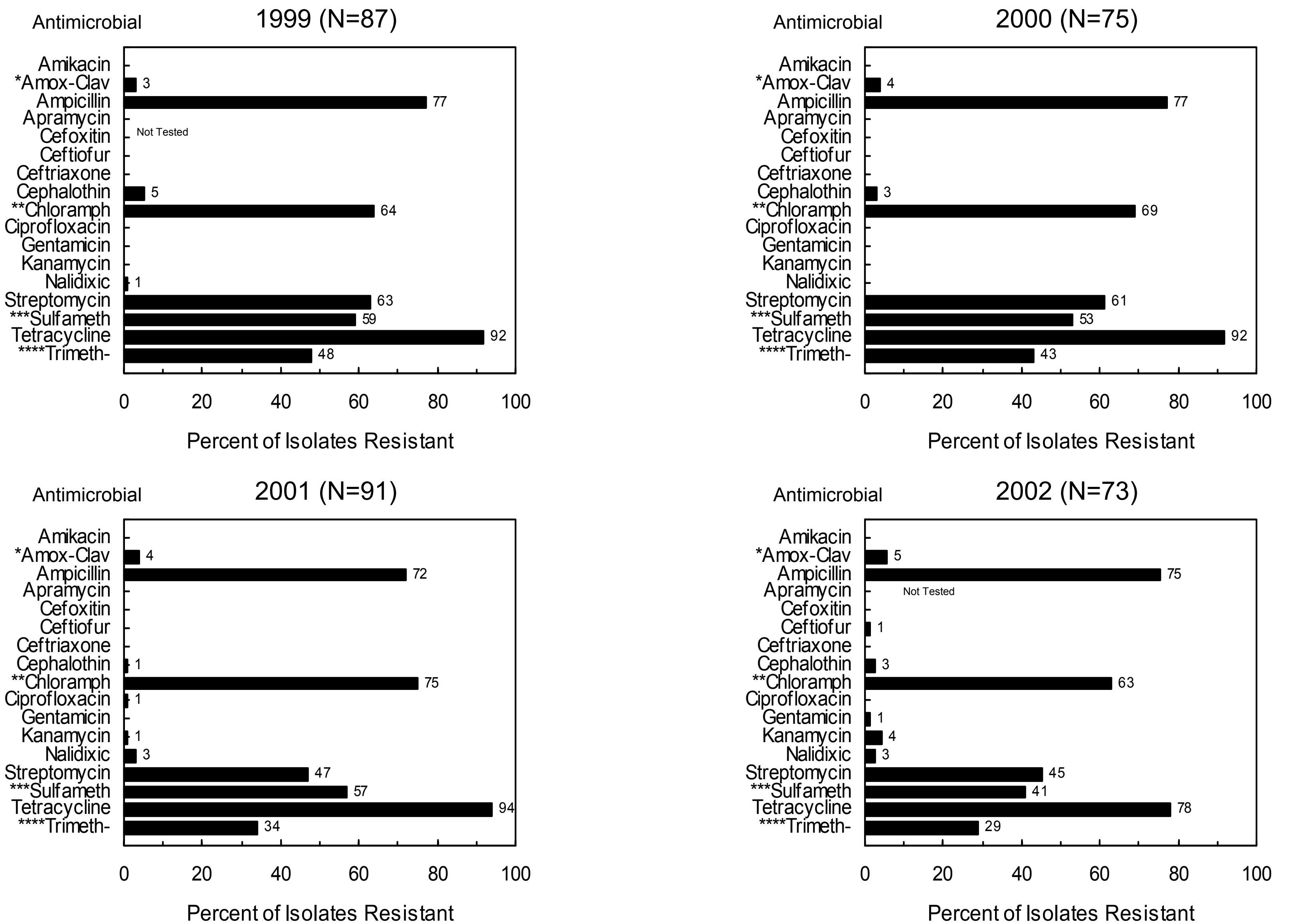
Figure 17b. Resistance among *Shigella flexneri* isolates, 1999-2002



*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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Figure 18a. MICs for amikacin among *Shigella sonnei* isolates, 1999-2002

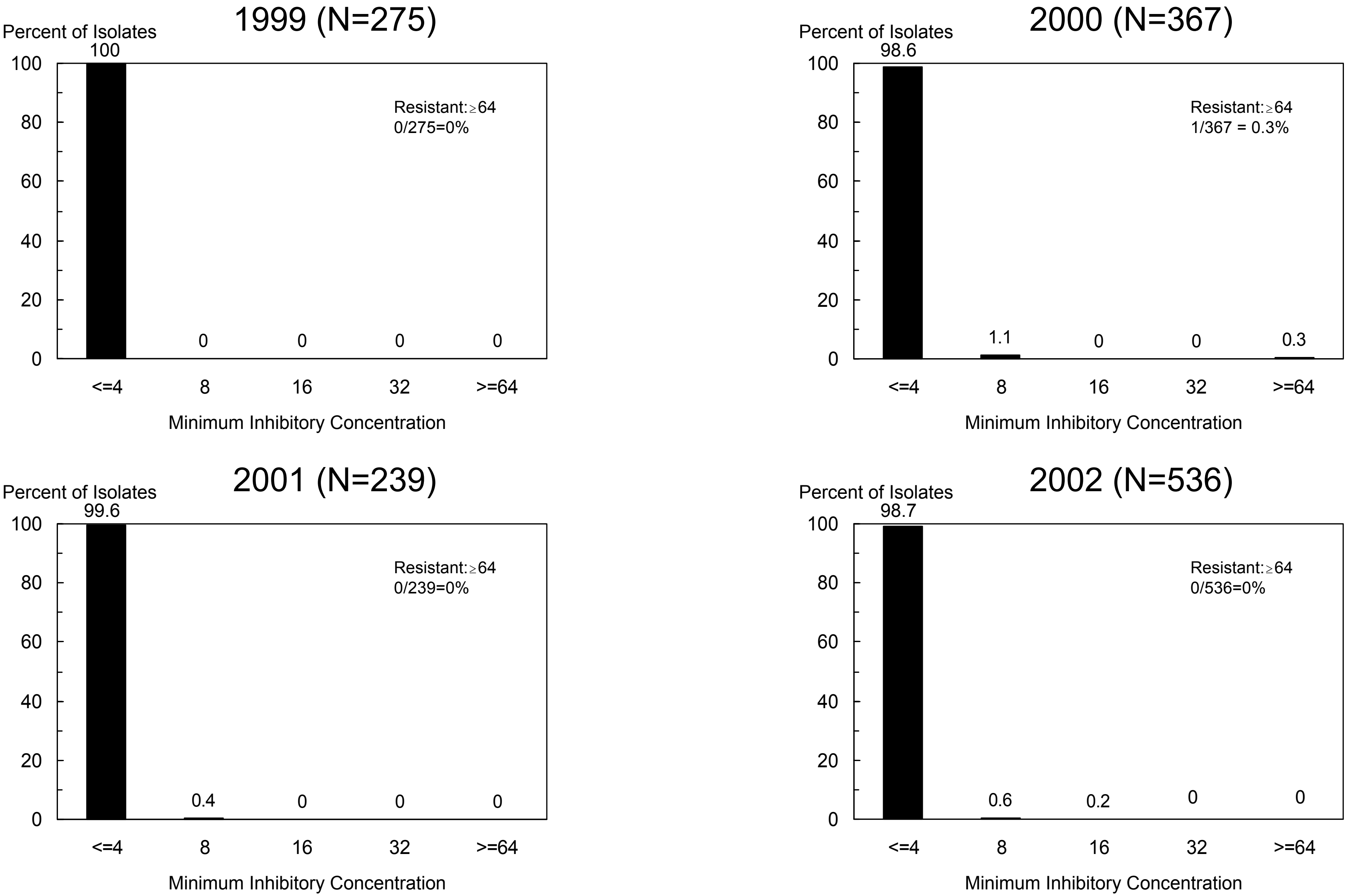

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Figure 18b. MICs for amoxicillin-clavulanic acid among *Shigella sonnei* isolates, 1999-2002

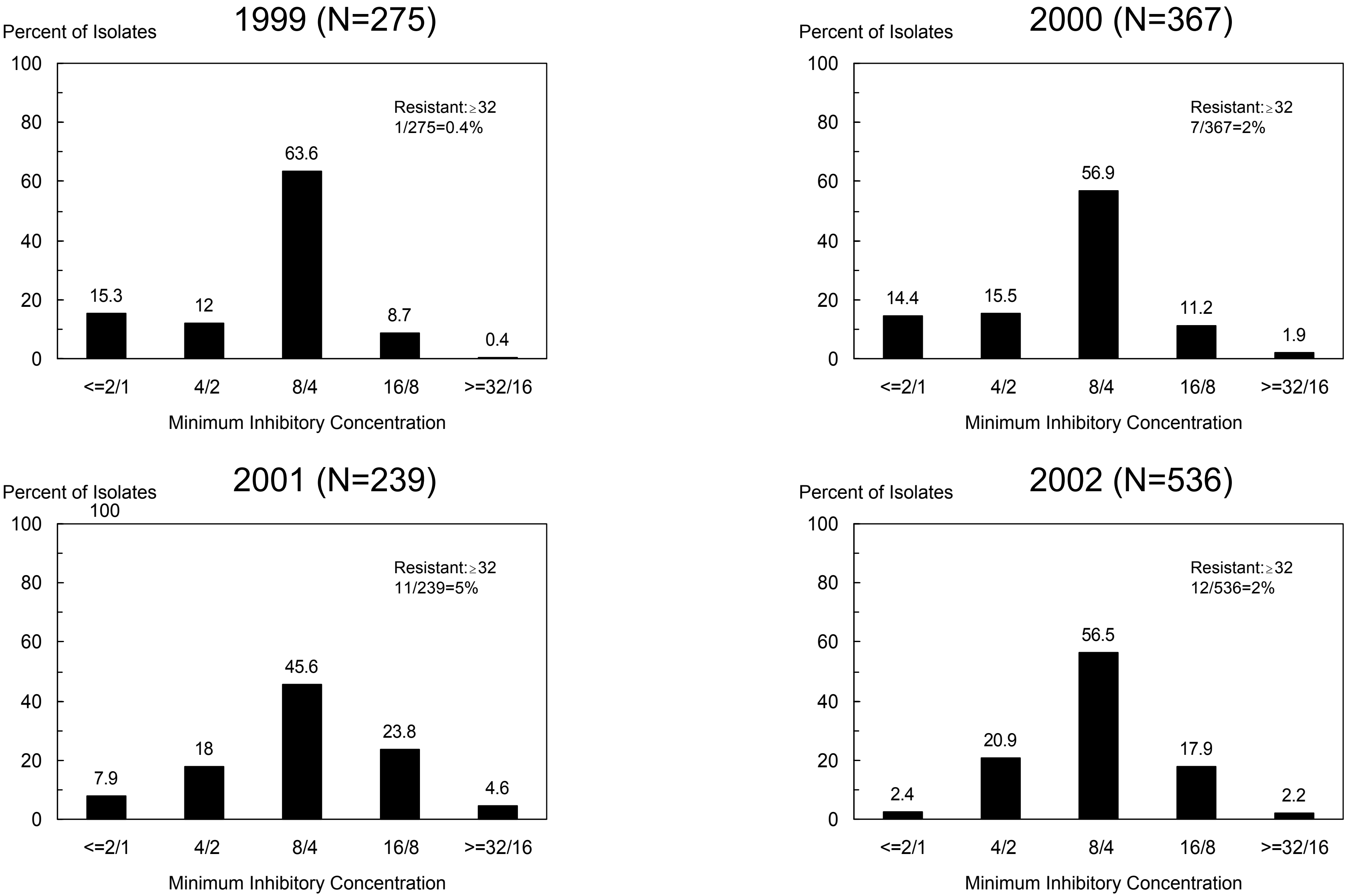

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Figure 18c. MICs for ampicillin among *Shigella sonnei* isolates, 1999-2002

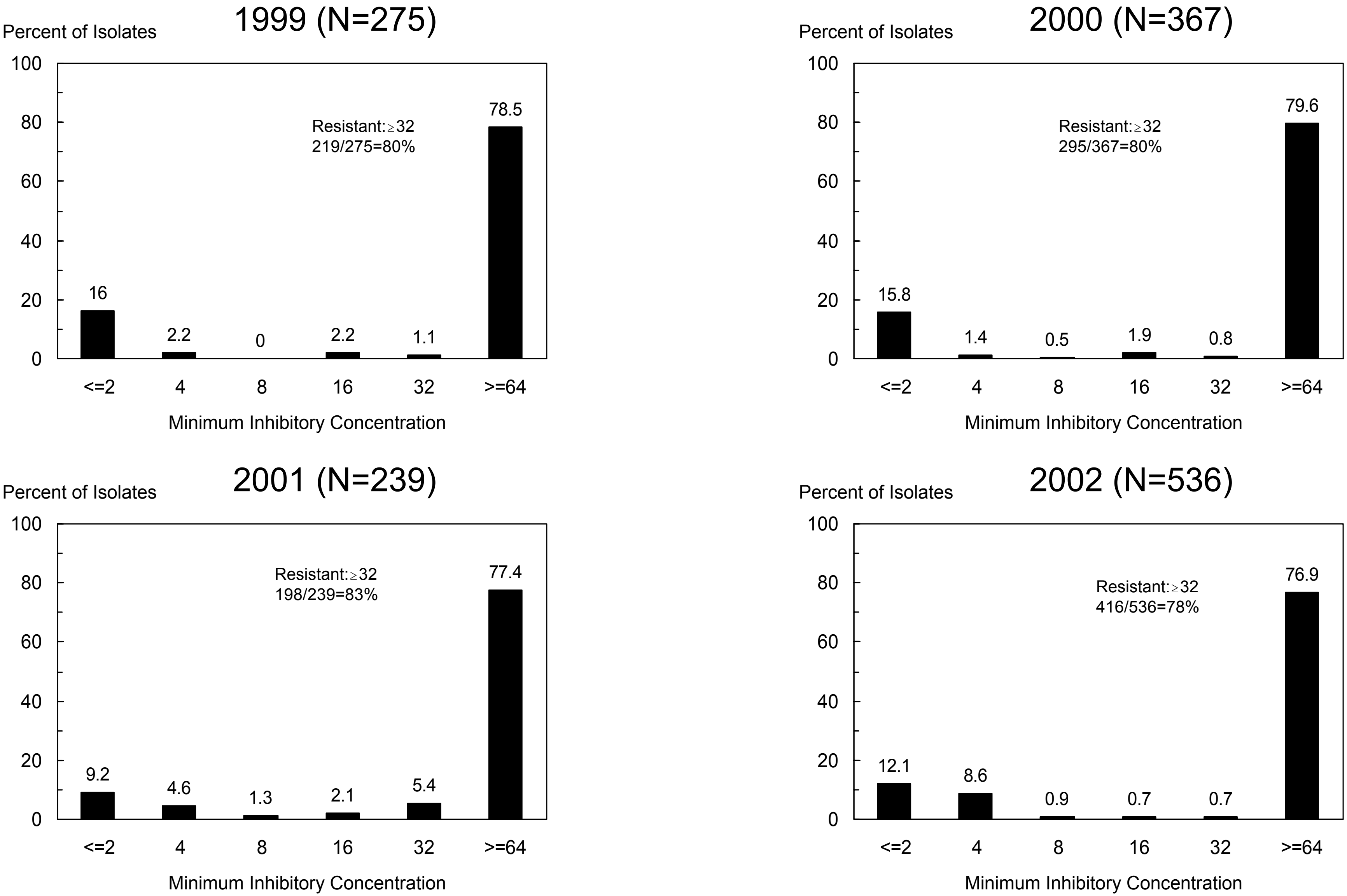

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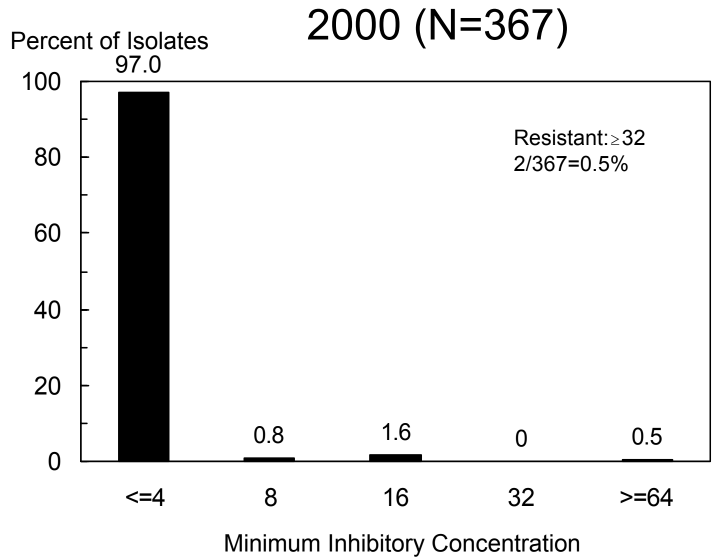
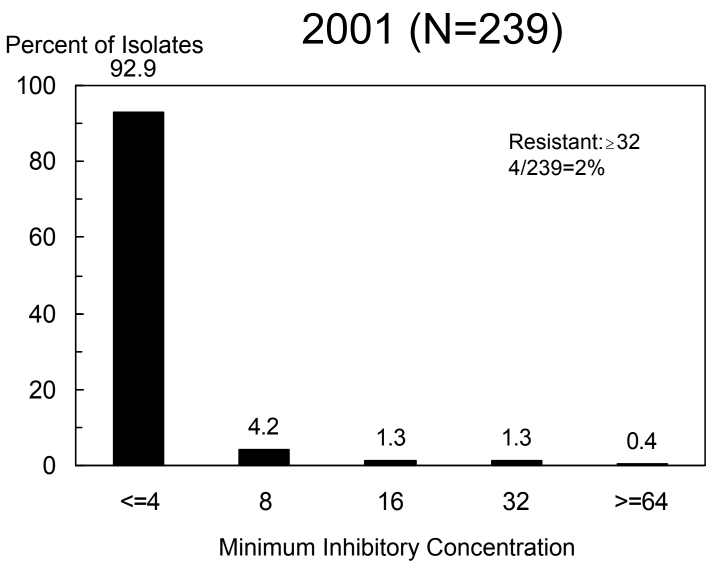
Figure 18d. MICs for cefoxitin among *Shigella sonnei* isolates, 1999-2002

Not Tested in 1999





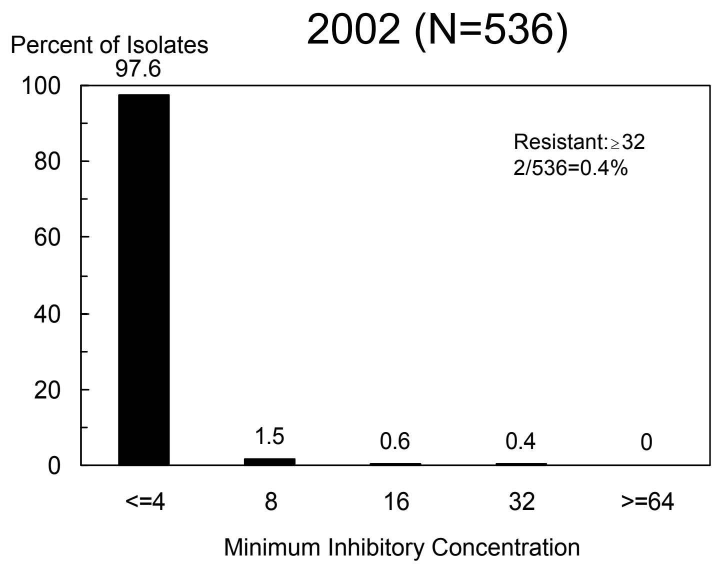


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Figure 18e. MICs for ceftiofur among *Shigella sonnei* isolates, 1999-2002

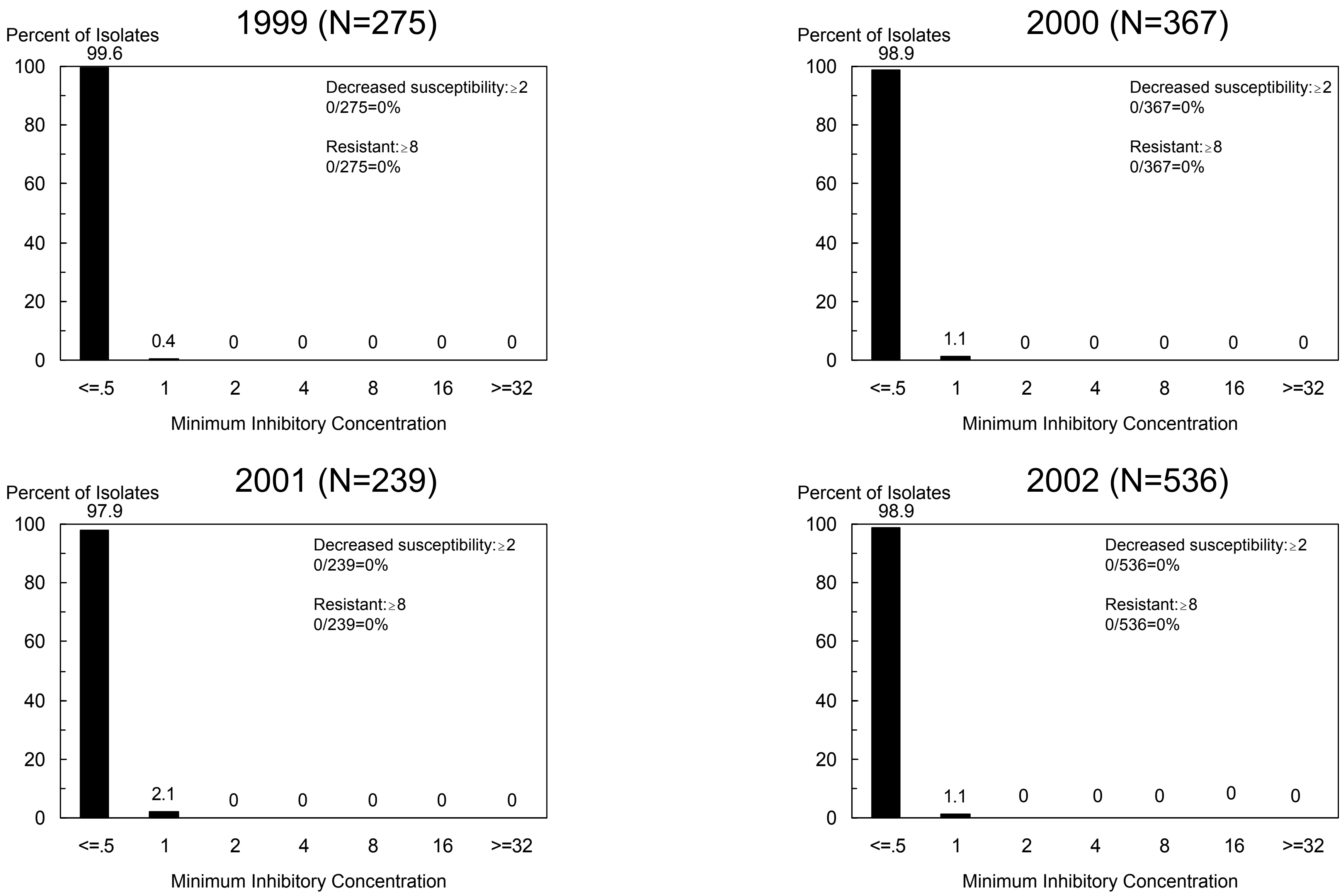

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Figure 18f. MICs for ceftriaxone among *Shigella sonnei* isolates, 1999-2002

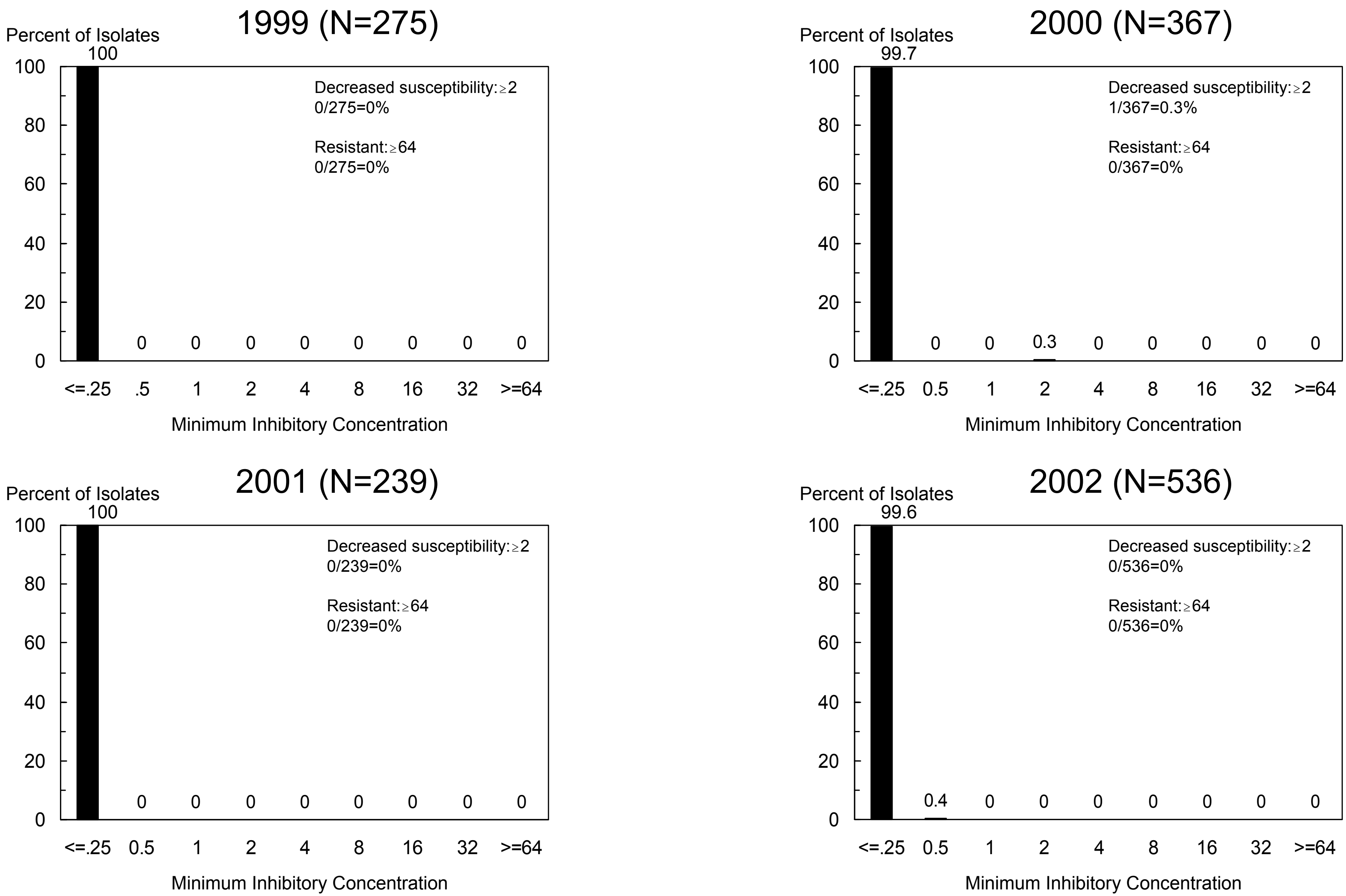

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Figure 18g. MICs for cephalothin among *Shigella sonnei* isolates, 1999-2002

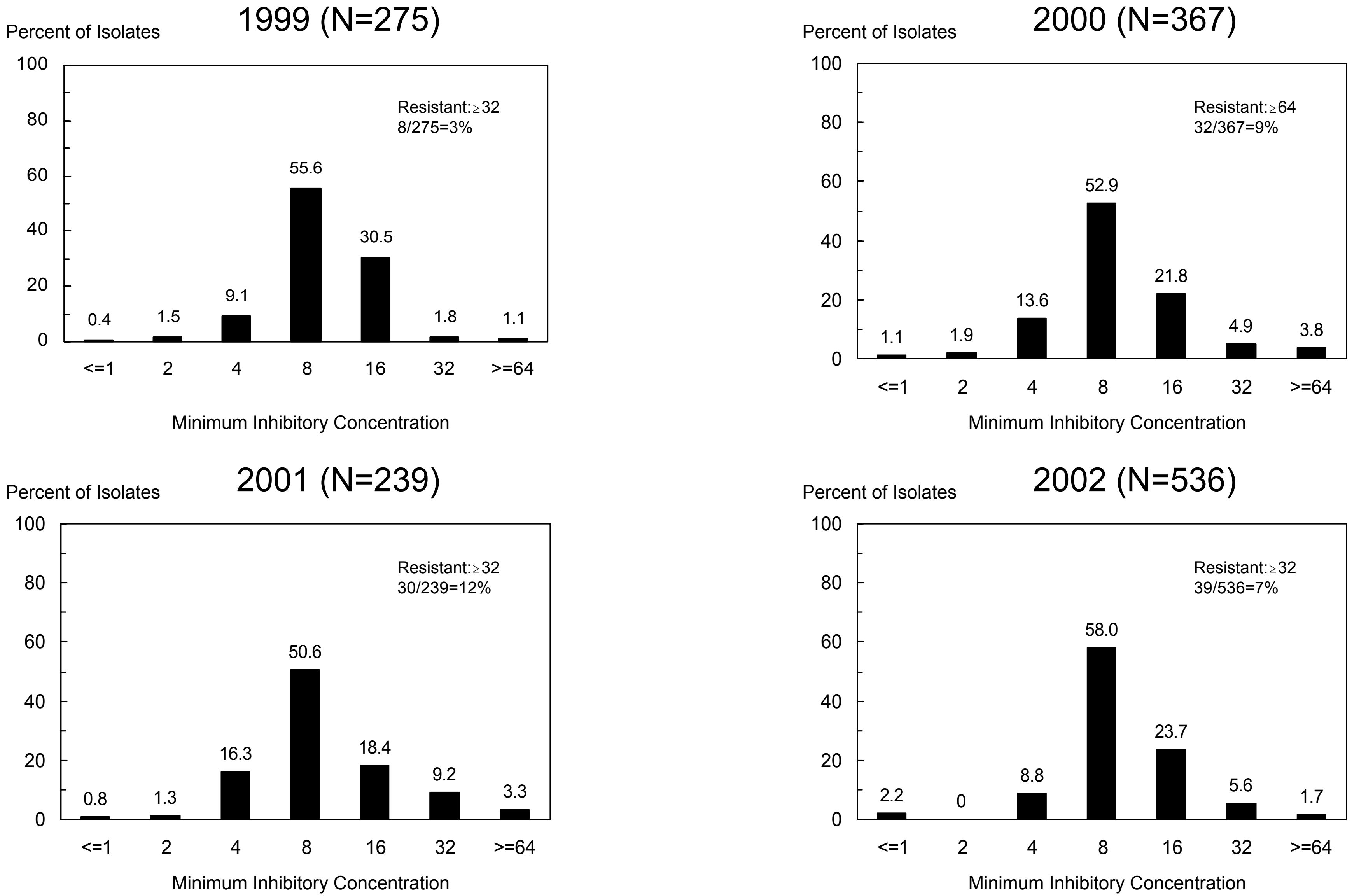

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Figure 18h. MICs for chloramphenicol among *Shigella sonnei* isolates, 1999-2002

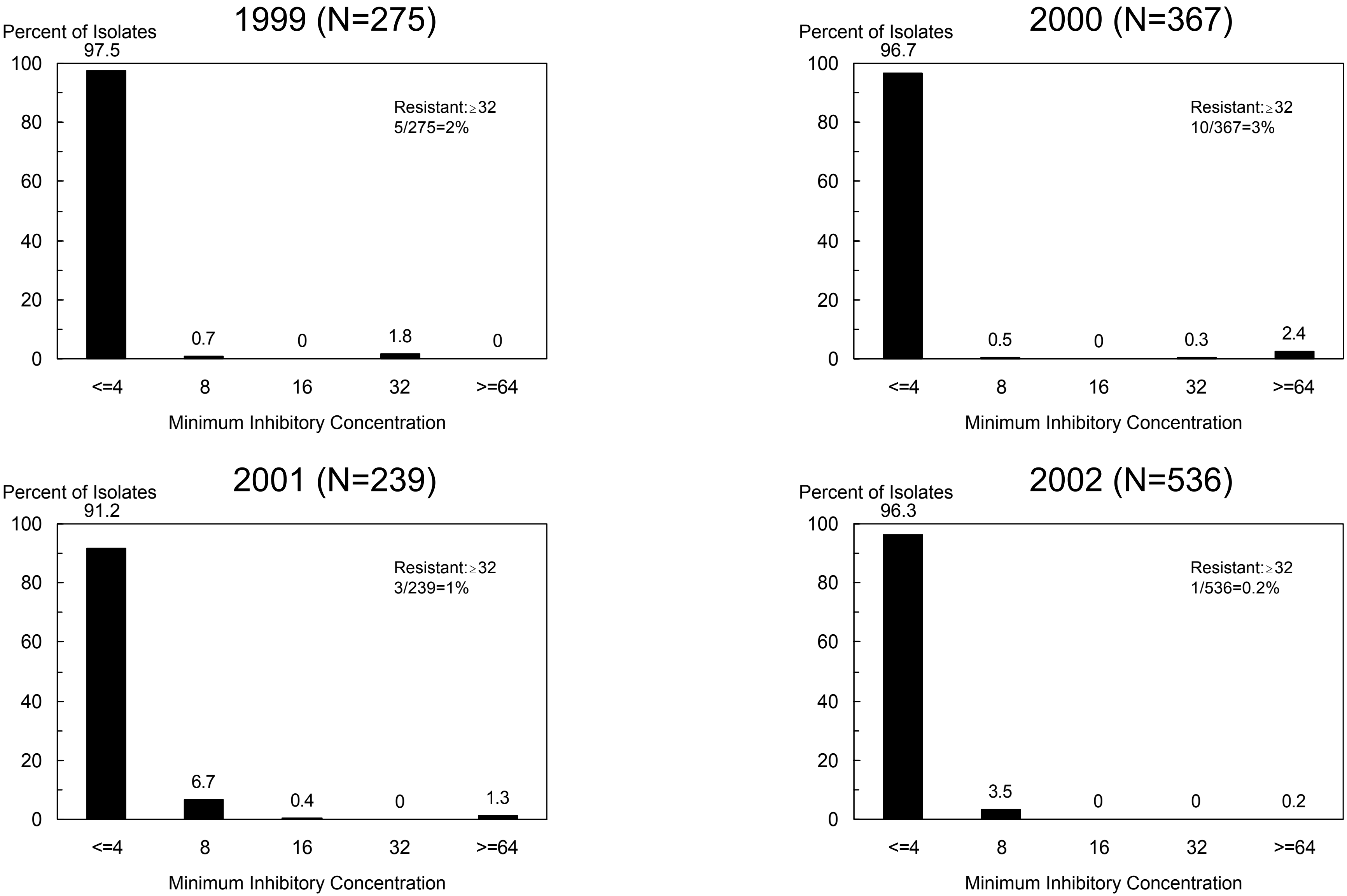

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Figure 18i. MICs for ciprofloxacin among *Shigella sonnei* isolates, 1999-2002

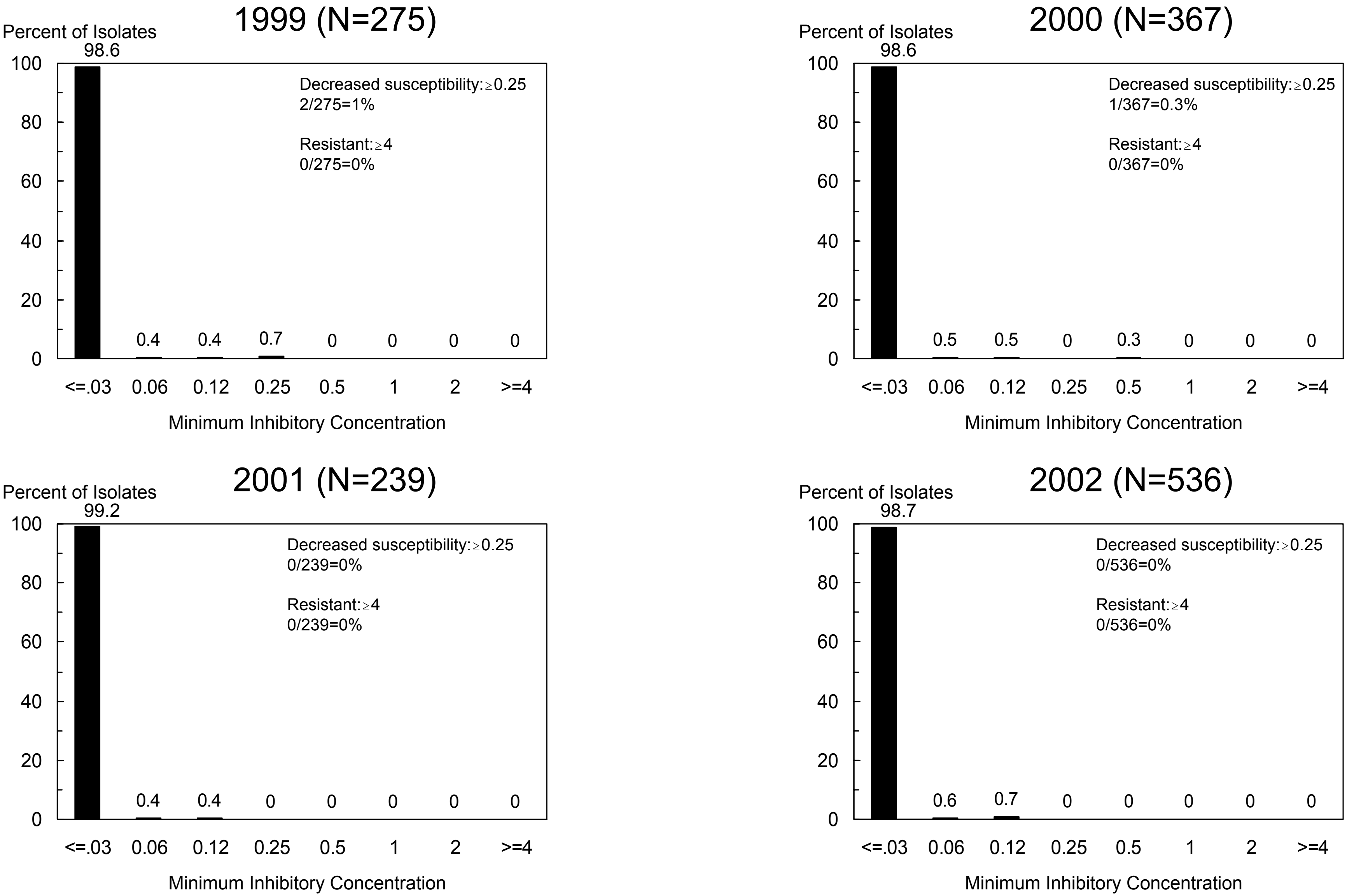

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Figure 18j. MICs for gentamicin among *Shigella sonnei* isolates, 1999-2002

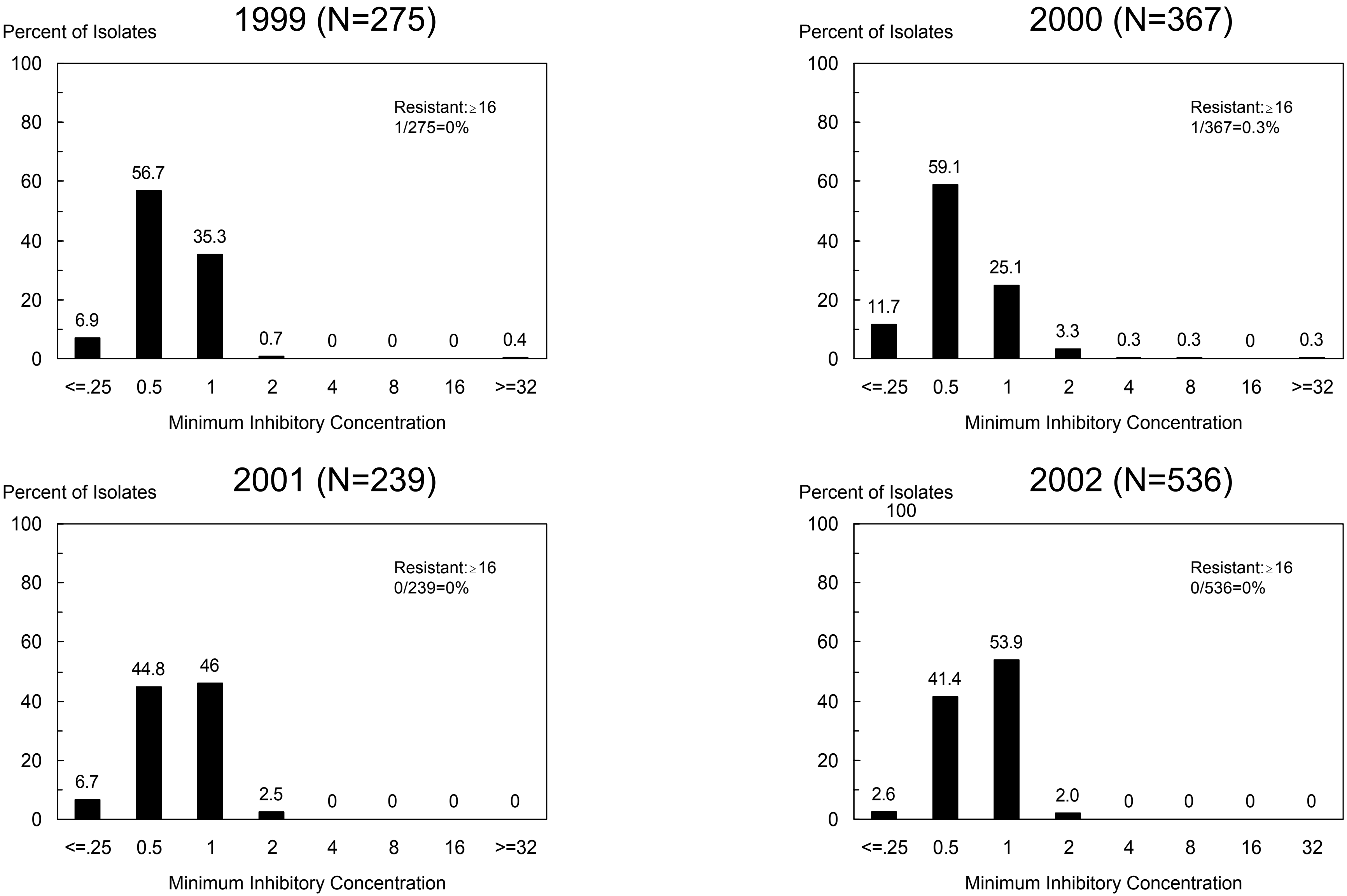

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Figure 18k. MICs for kanamycin among *Shigella sonnei* isolates, 1999-2002

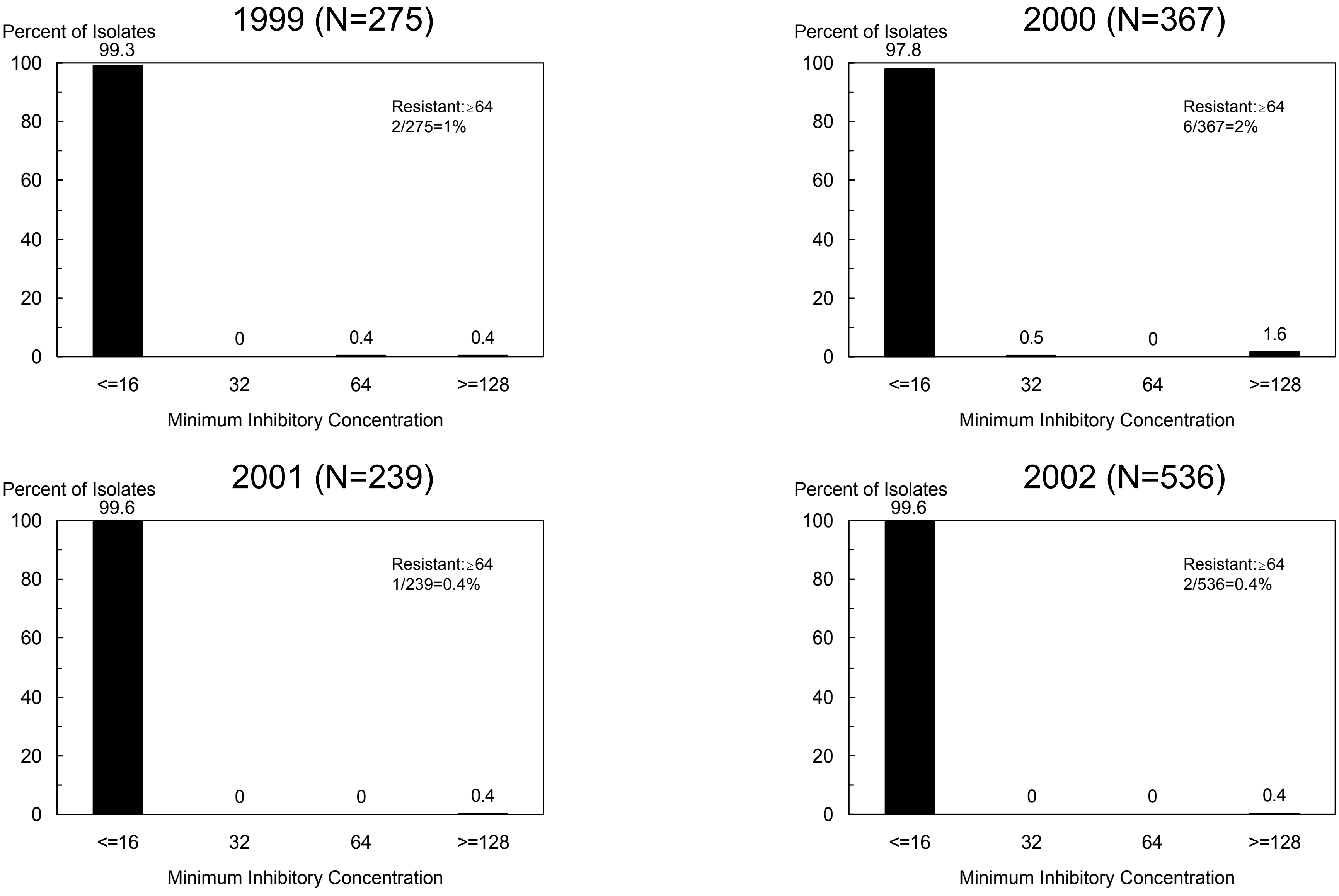

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Figure 18I. MICs for nalidixic acid among *Shigella sonnei* isolates, 1999-2002

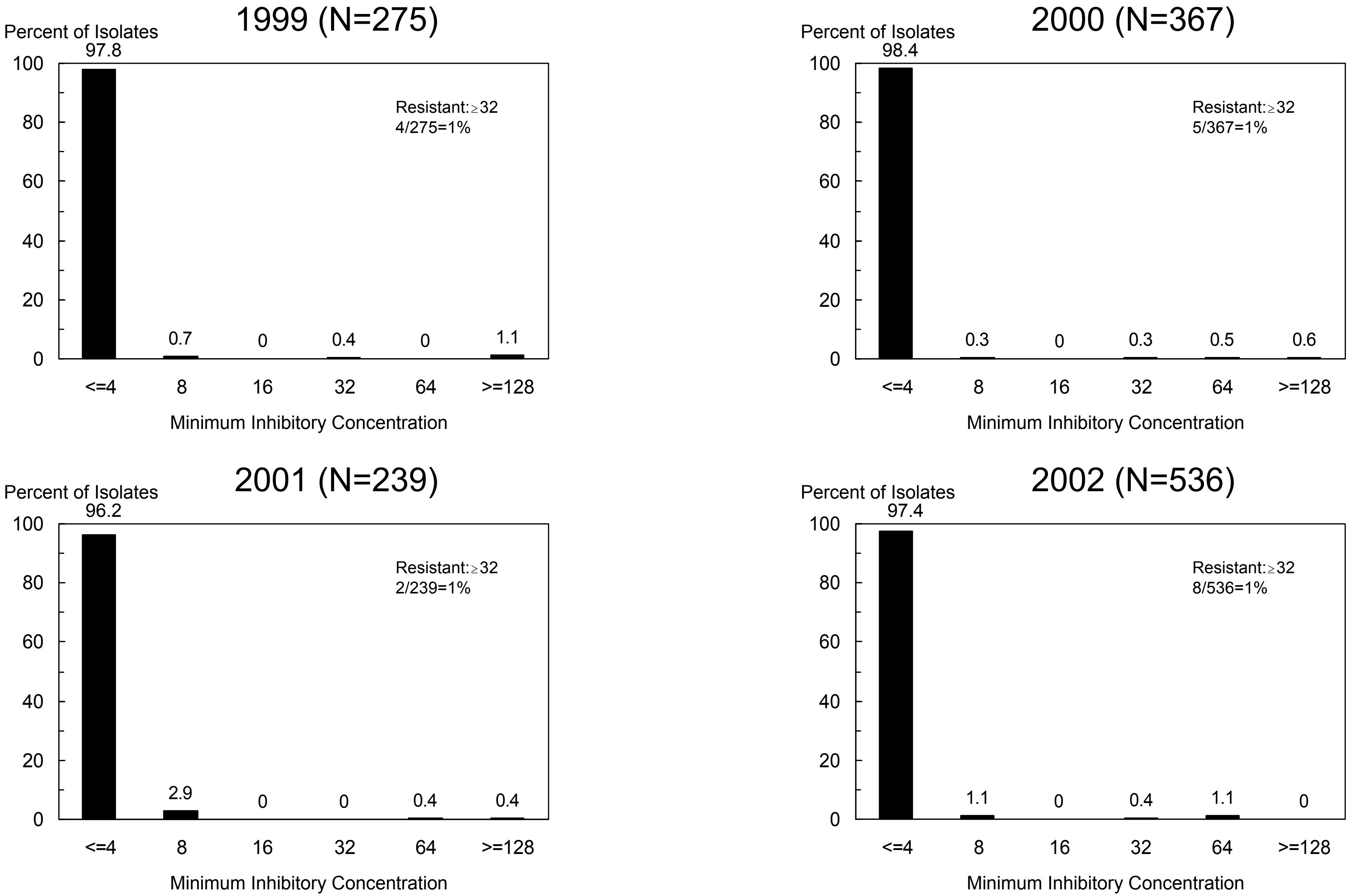

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Figure 18m. MICs for streptomycin among *Shigella sonnei* isolates, 1999-2002

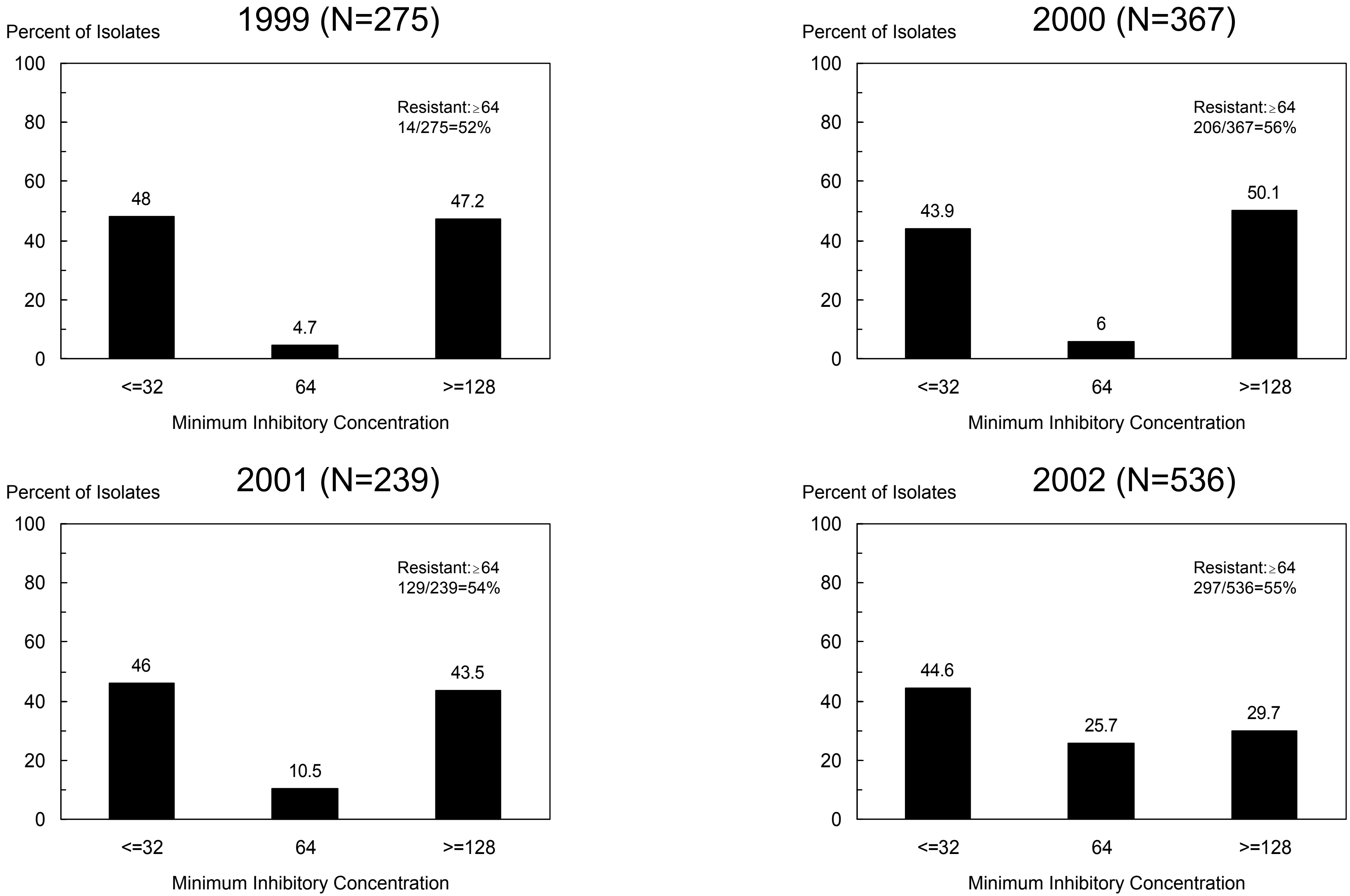

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Figure 18n. MICs for sulfamethoxazole among *Shigella sonnei* isolates, 1999-2002

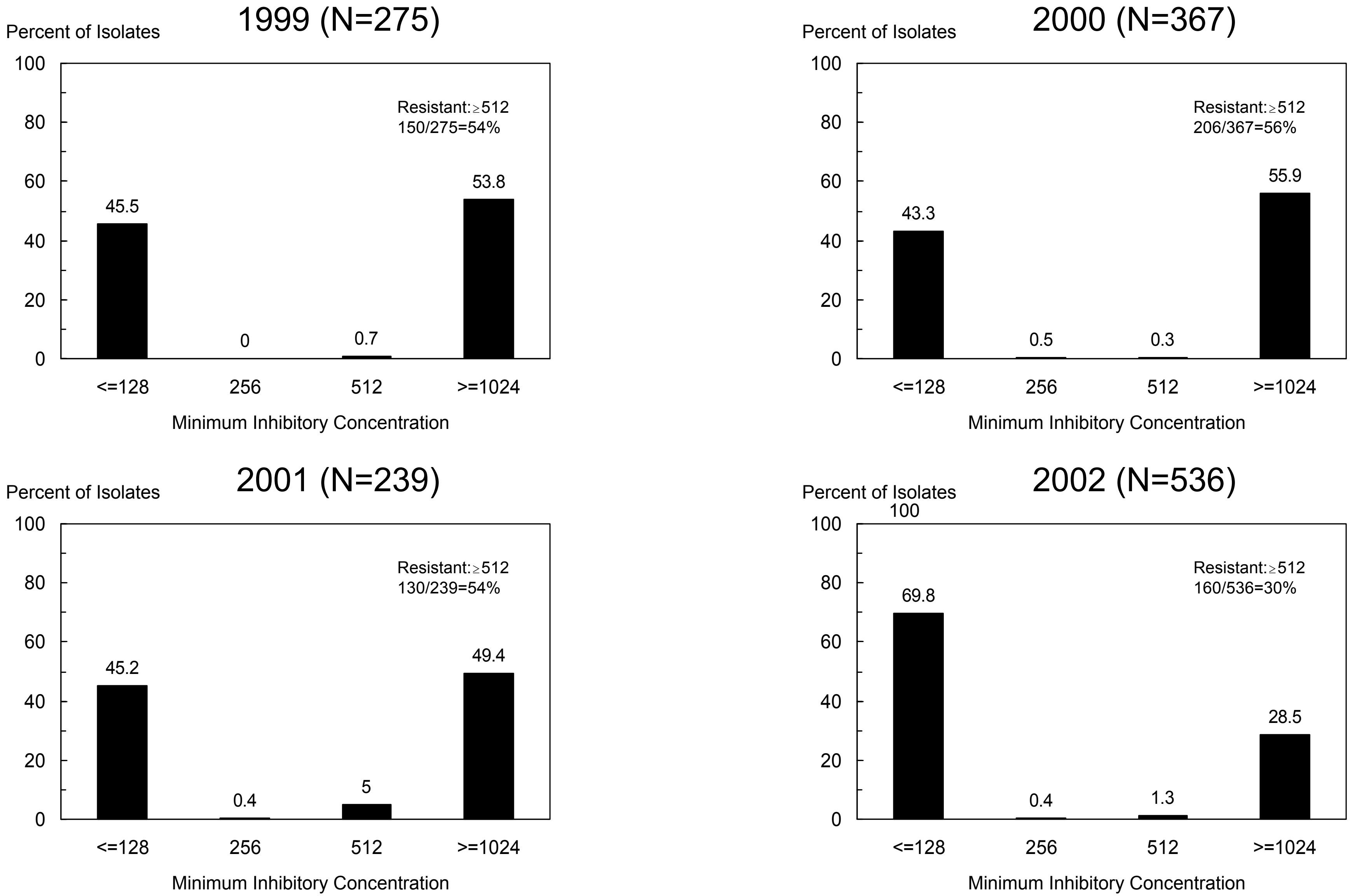

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Figure 18o. MICs for tetracycline among *Shigella sonnei* isolates, 1999-2002

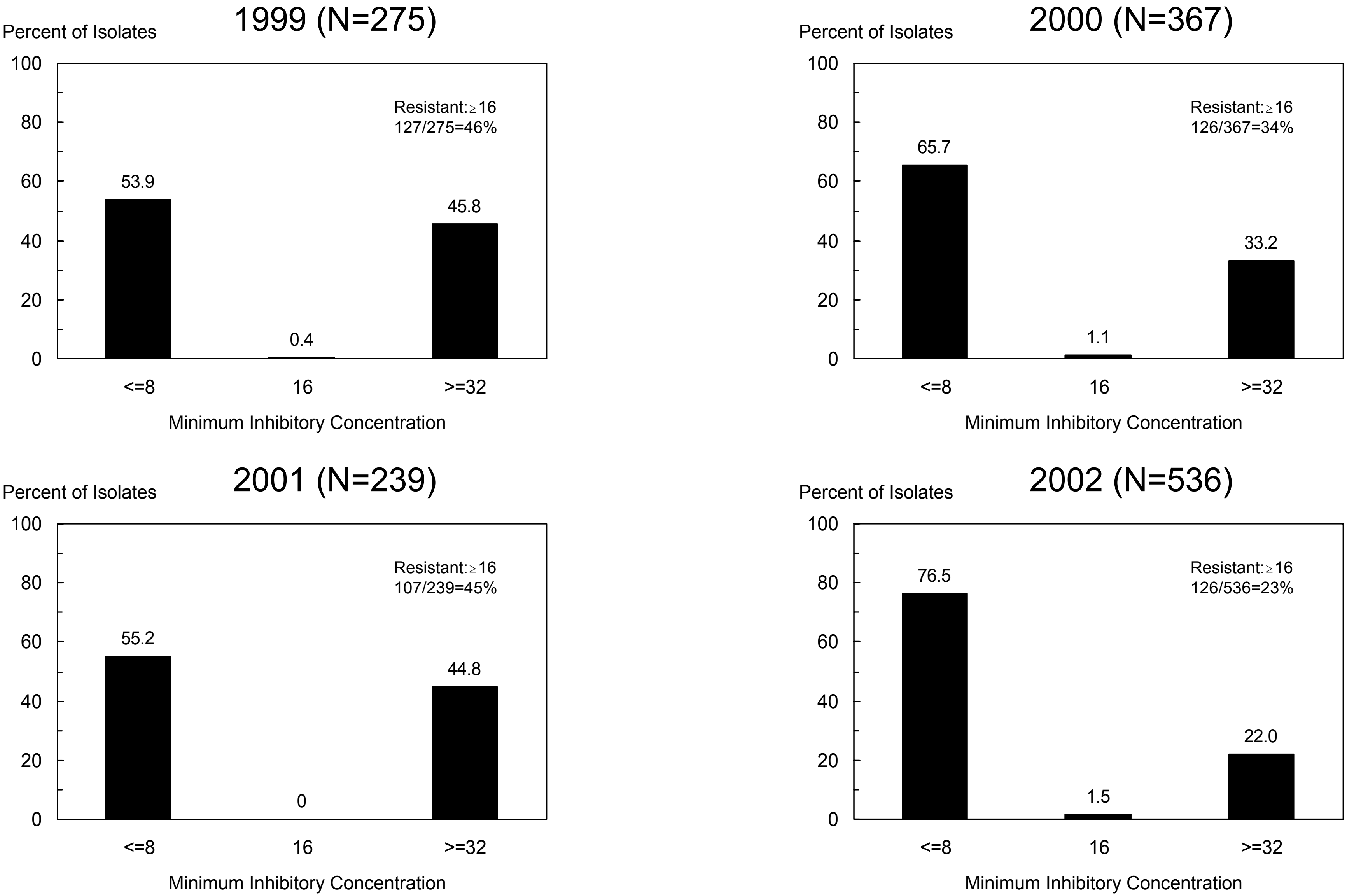

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Figure 18p. MICs for trimethoprim-sulfamethoxazole among *Shigella sonnei* isolates, 1999-2002

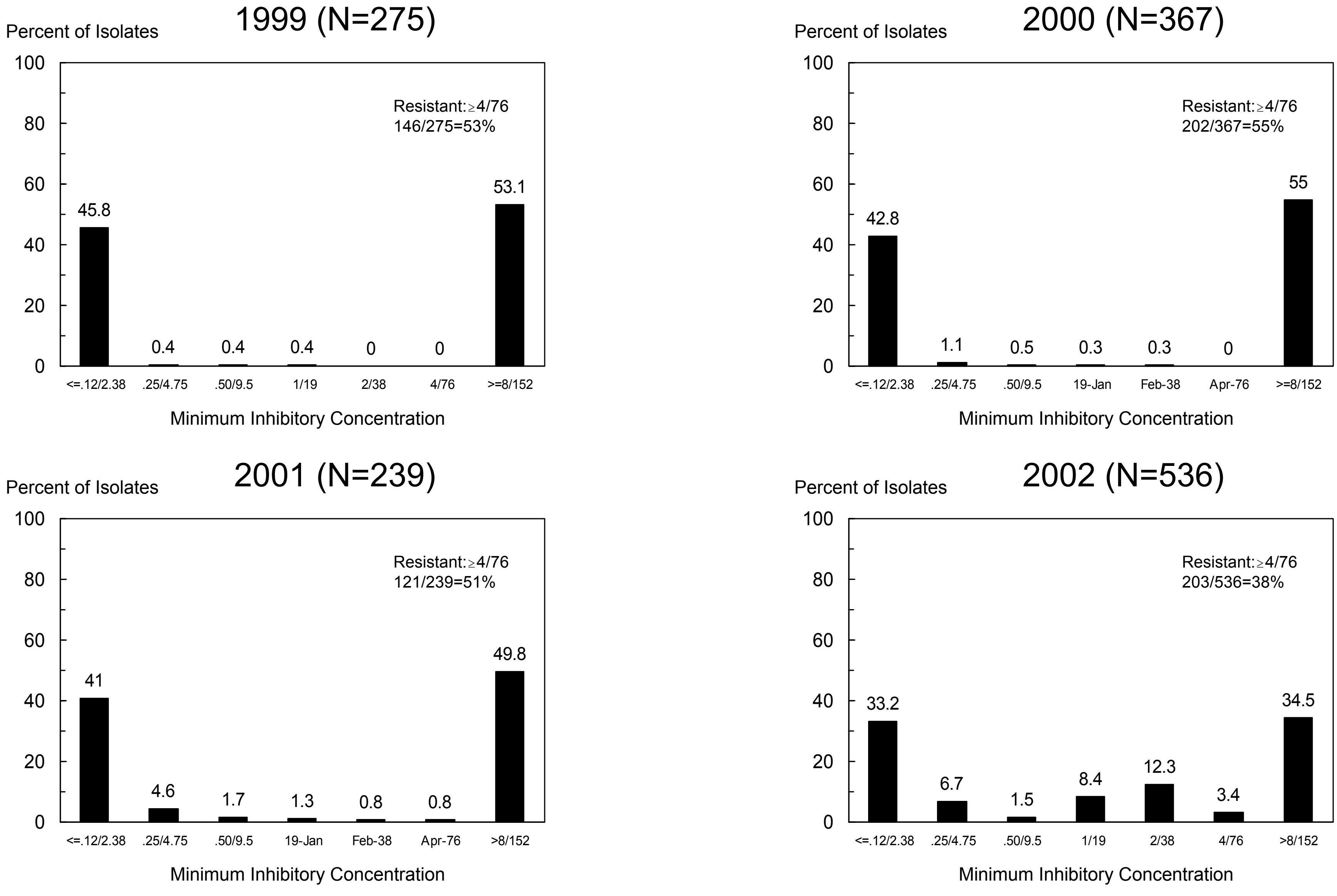

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Figure 19a. MICs for amikacin among *Shigella flexneri* isolates, 1999-2002

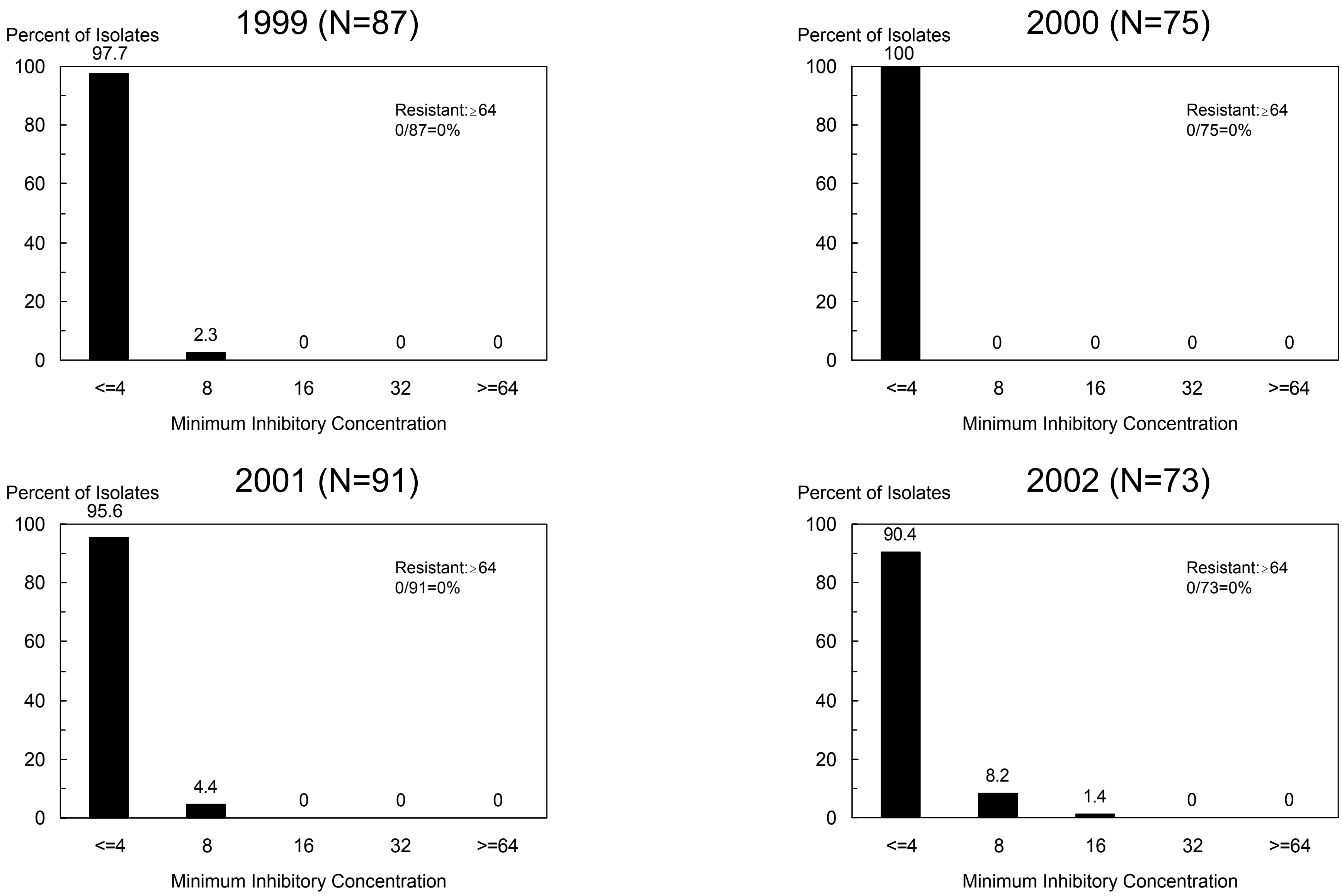

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Figure 19b. MICs for amoxicillin-clavulanic acid among *Shigella flexneri* isolates, 1999-2002

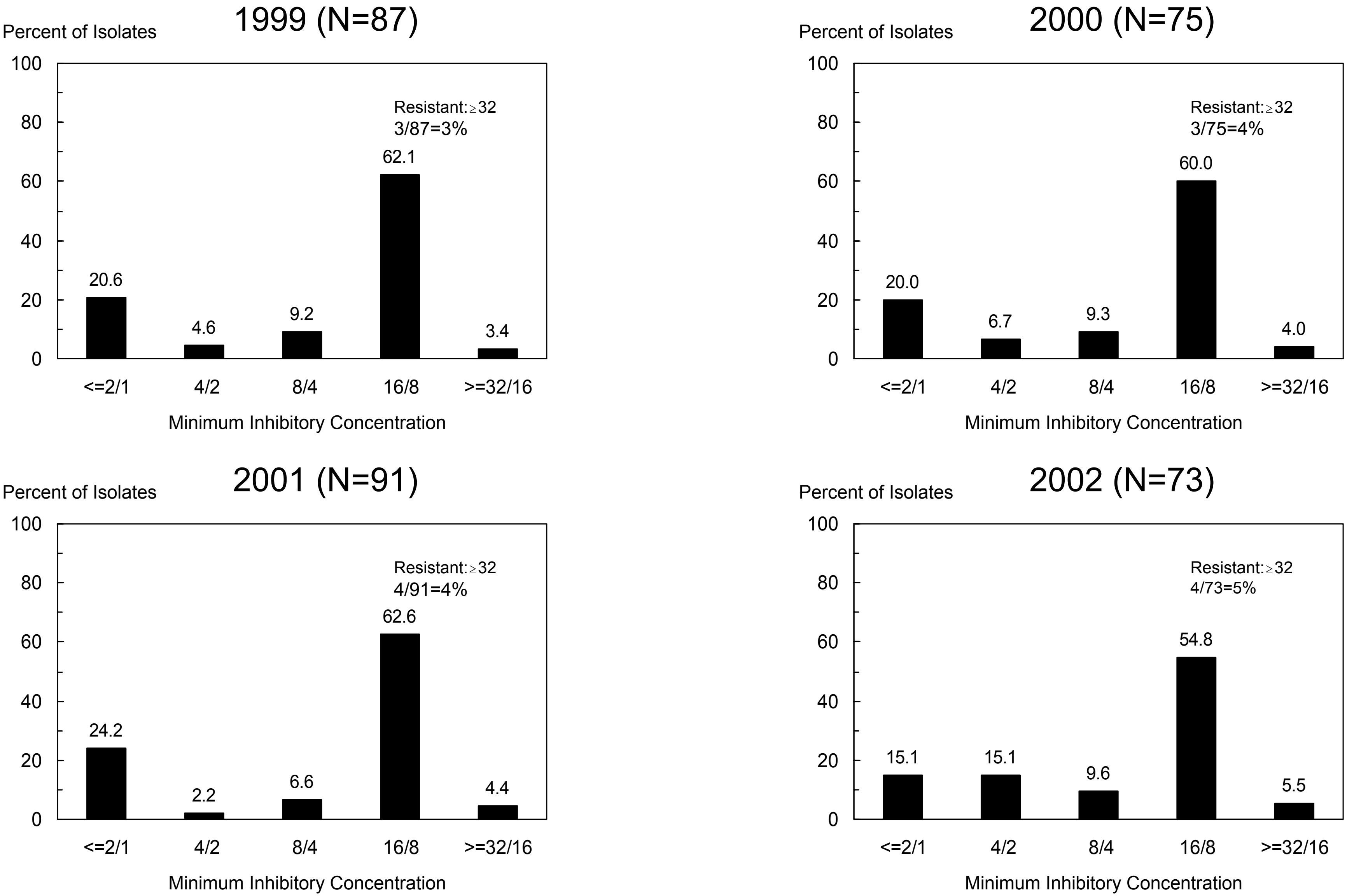

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Figure 19c. MICs for ampicillin among *Shigella flexneri* isolates, 1999-2002

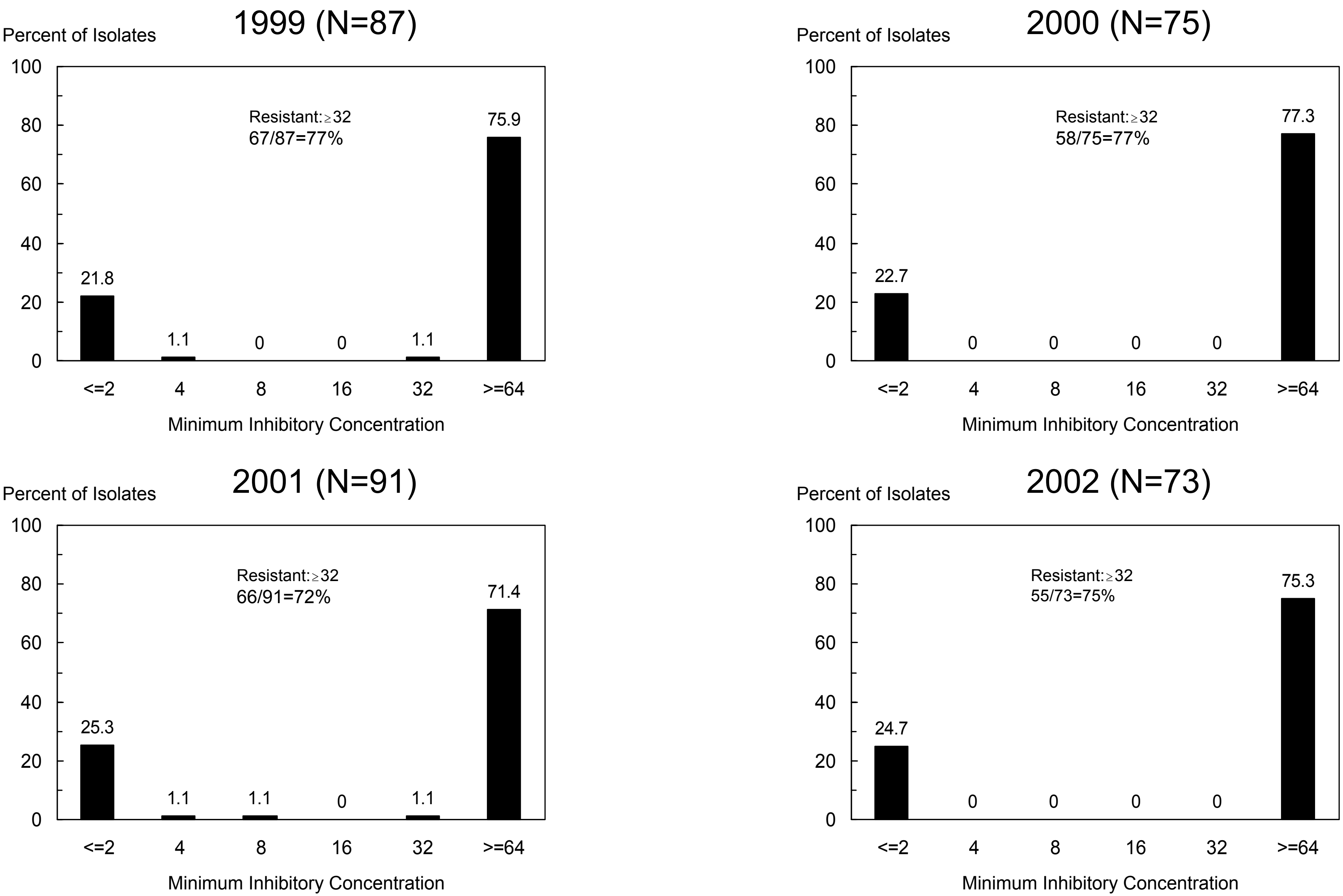

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Figure 19d. MICs for cefoxitin among *Shigella flexneri* isolates, 1999-2002

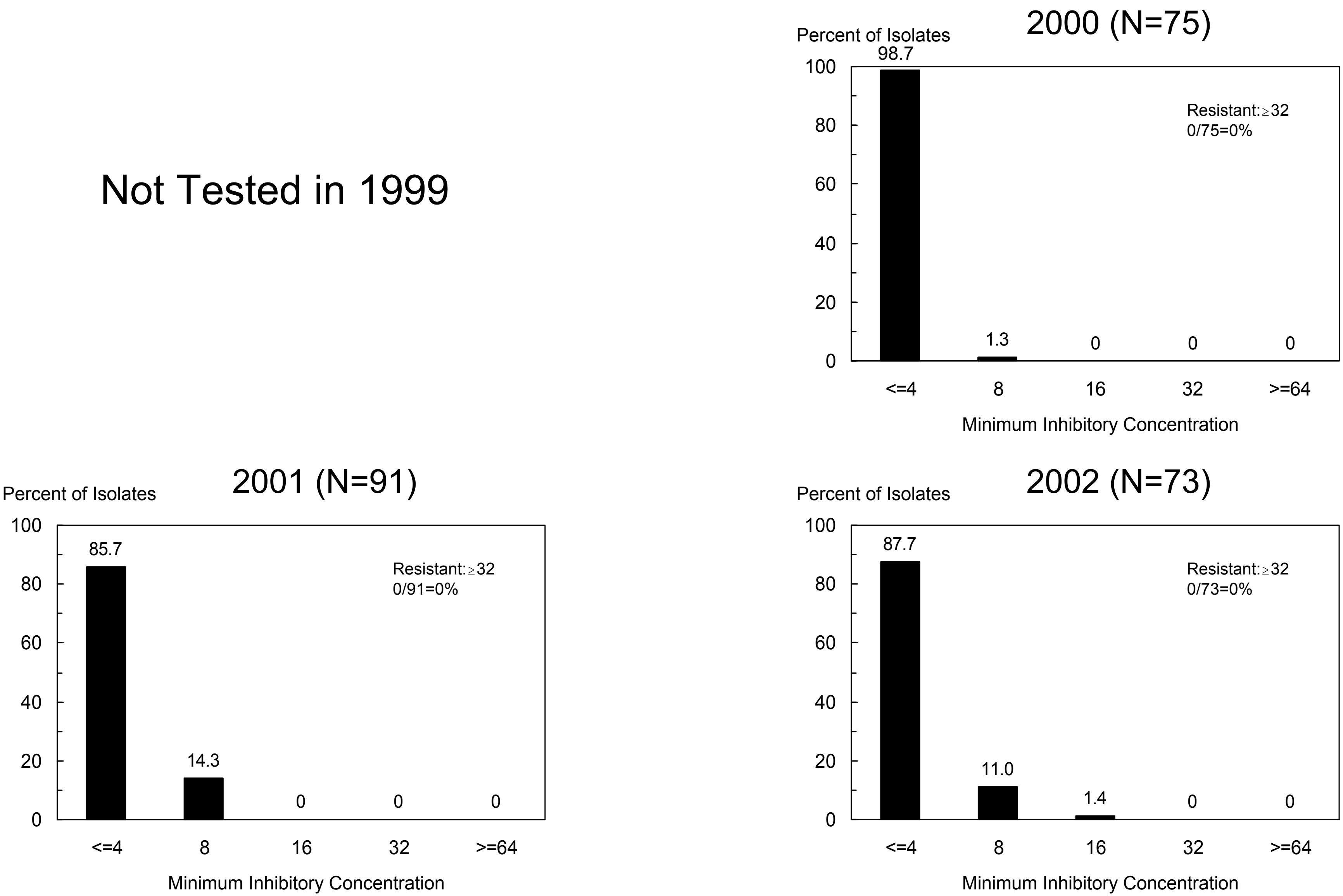

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Figure 19e. MICs for ceftiofur among *Shigella flexneri* isolates, 1999-2002

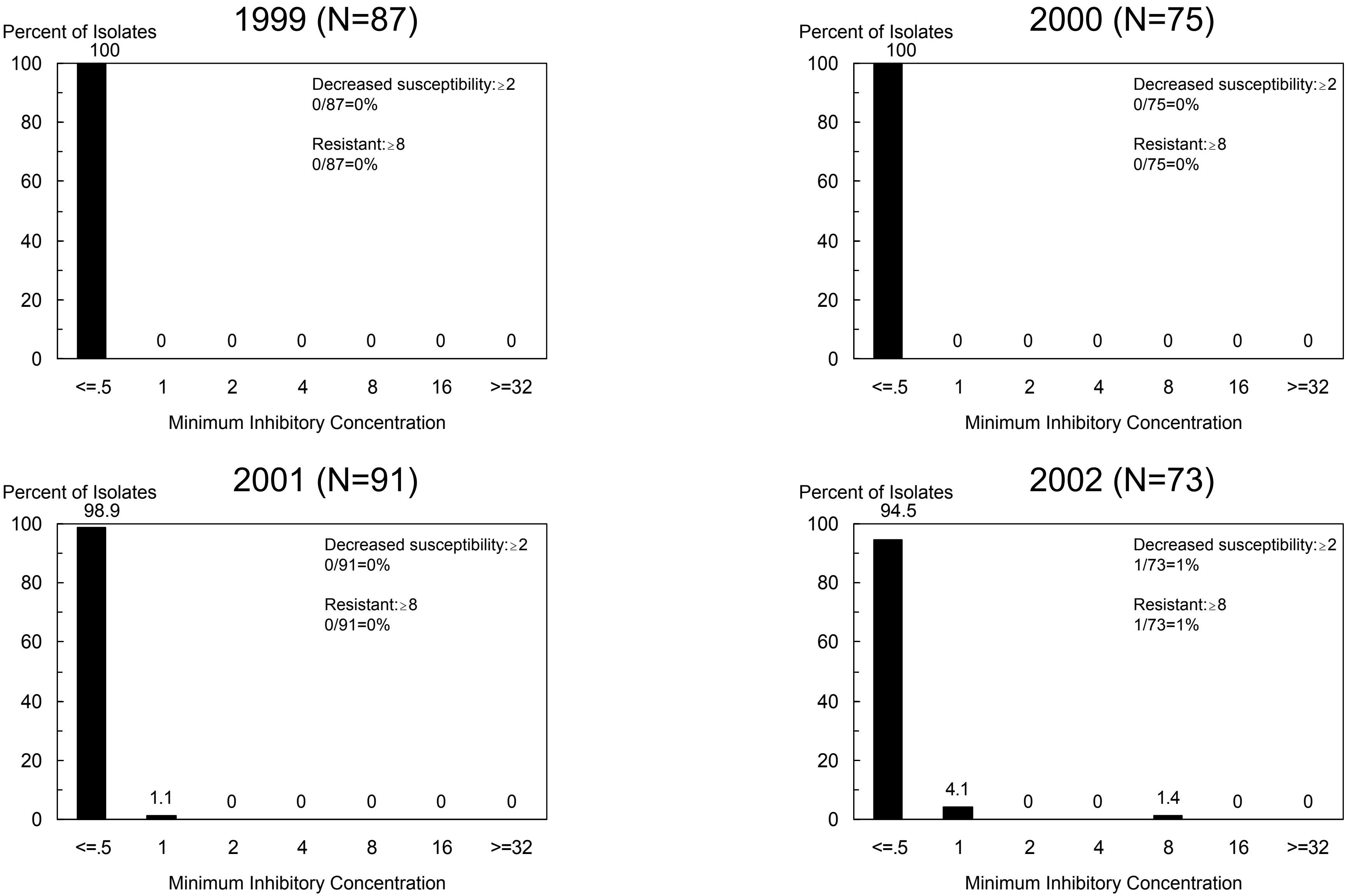

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Figure 19f. MICs for ceftriaxone among *Shigella flexneri* isolates, 1999-2002

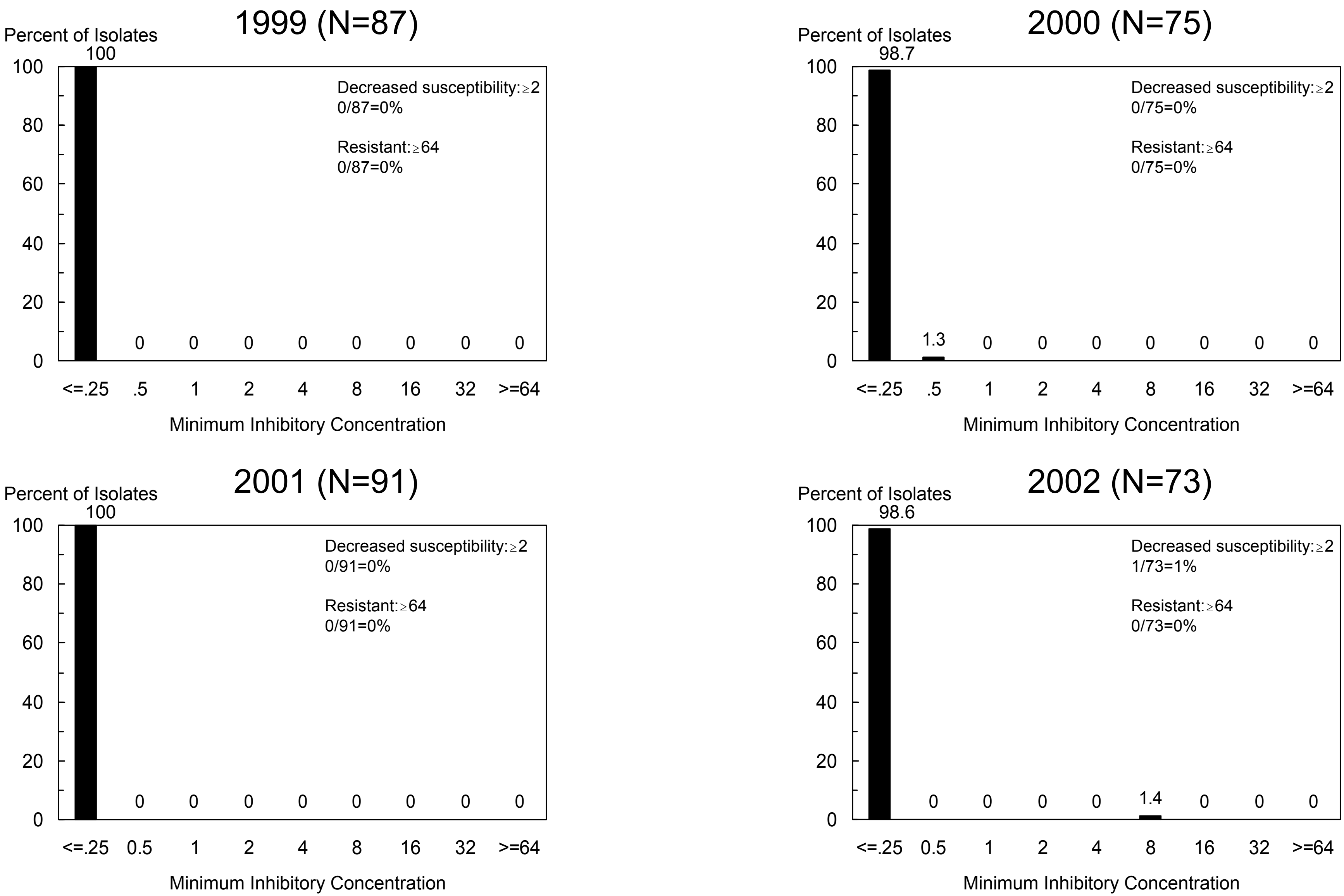

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Figure 19g. MICs for cephalothin among *Shigella flexneri* isolates, 1999-2002

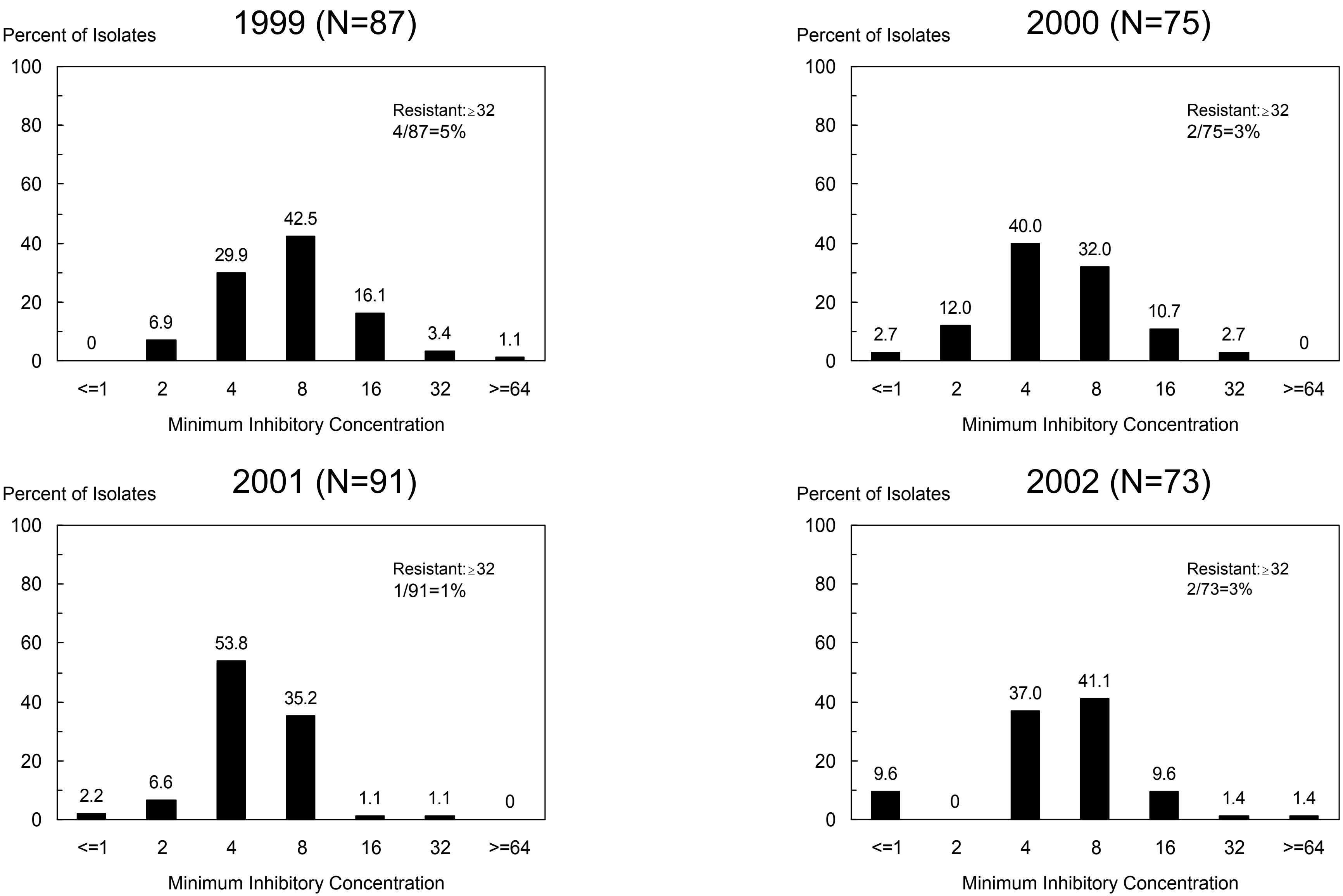

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Figure 19h. MICs for chloramphenicol among *Shigella flexneri* isolates, 1999-2002

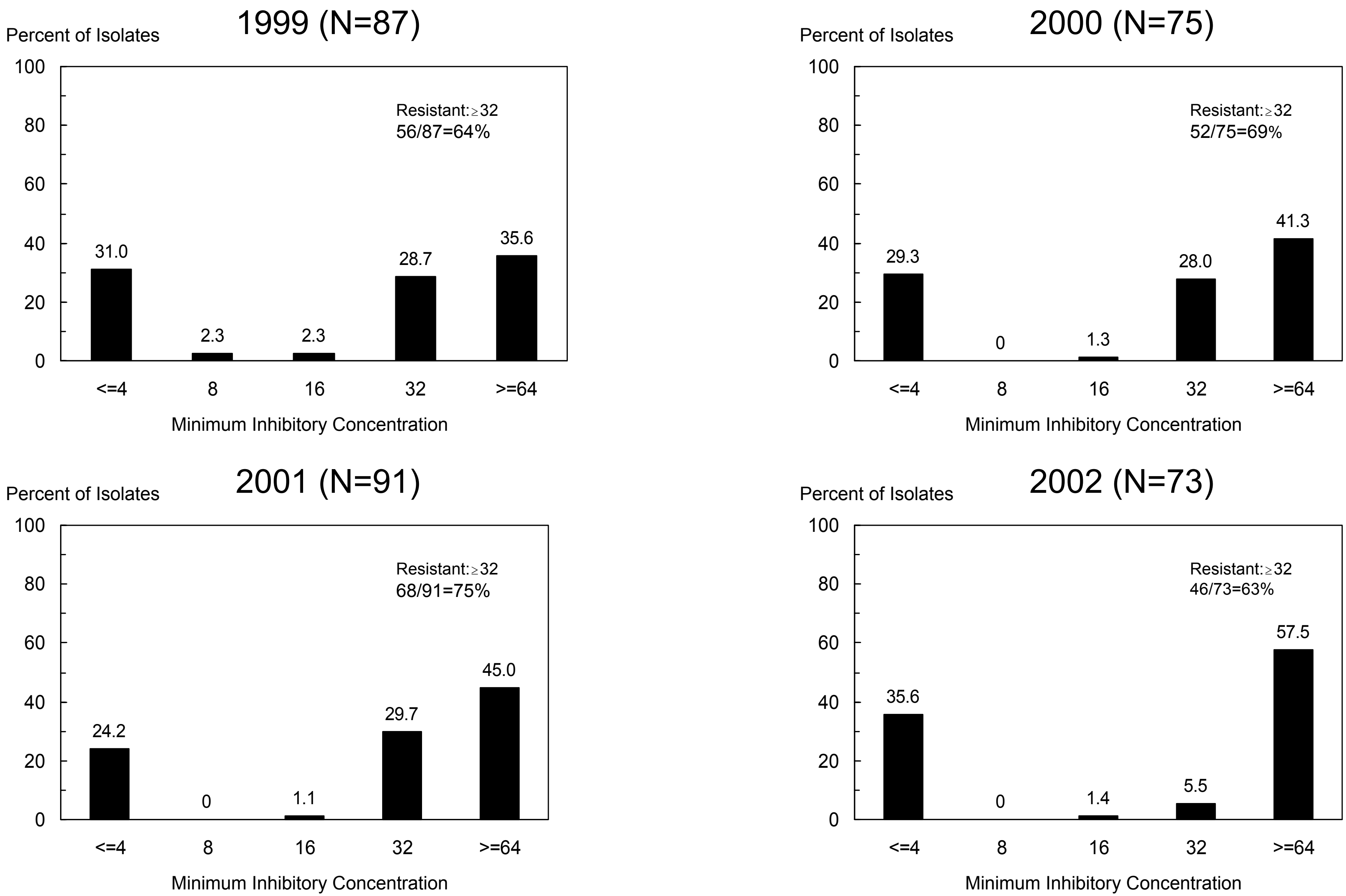

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Figure 19i. MICs for ciprofloxacin among *Shigella flexneri* isolates, 1999-2002

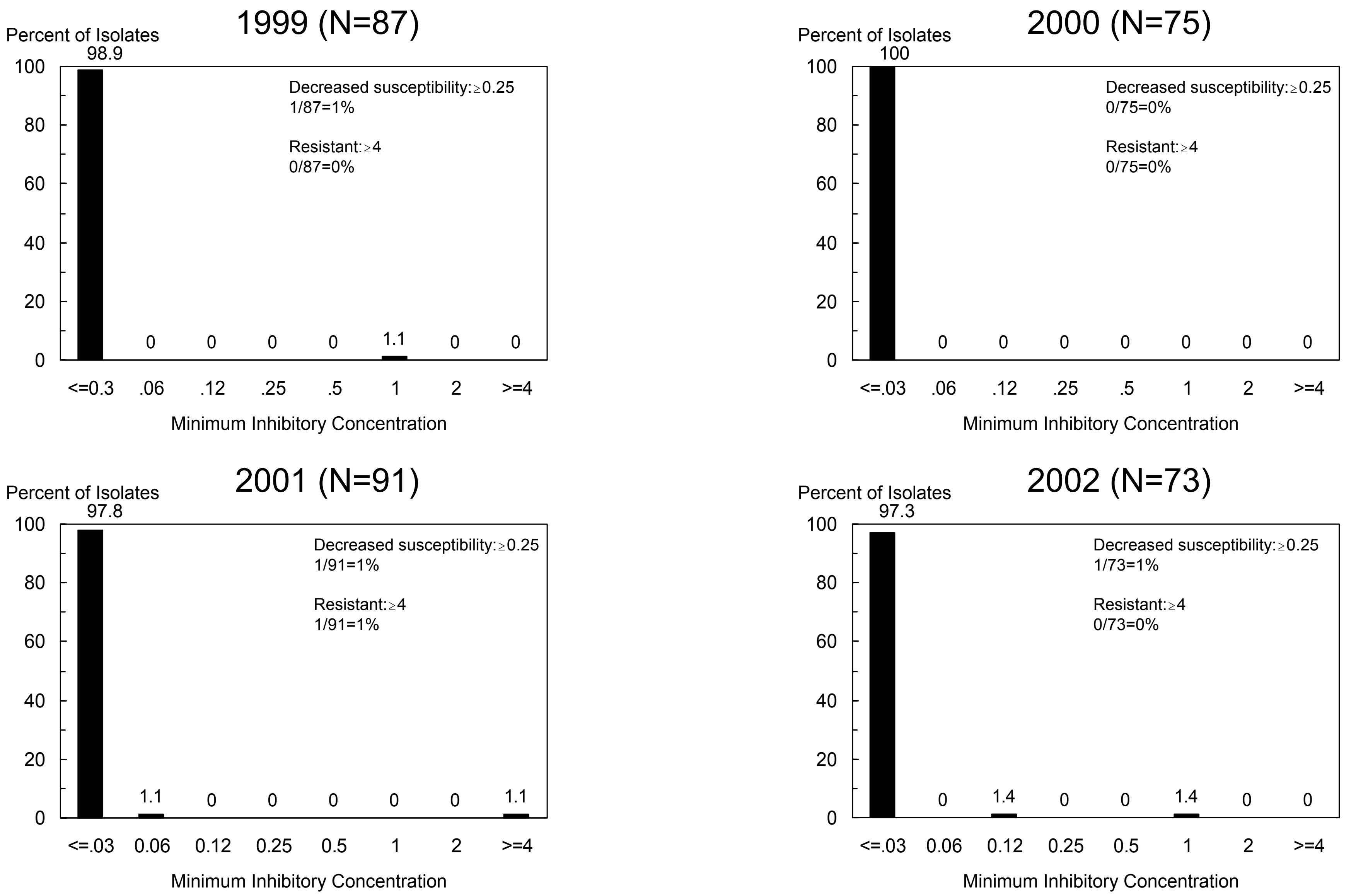

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Figure 19j. MICs for gentamicin among *Shigella flexneri* isolates, 1999-2002

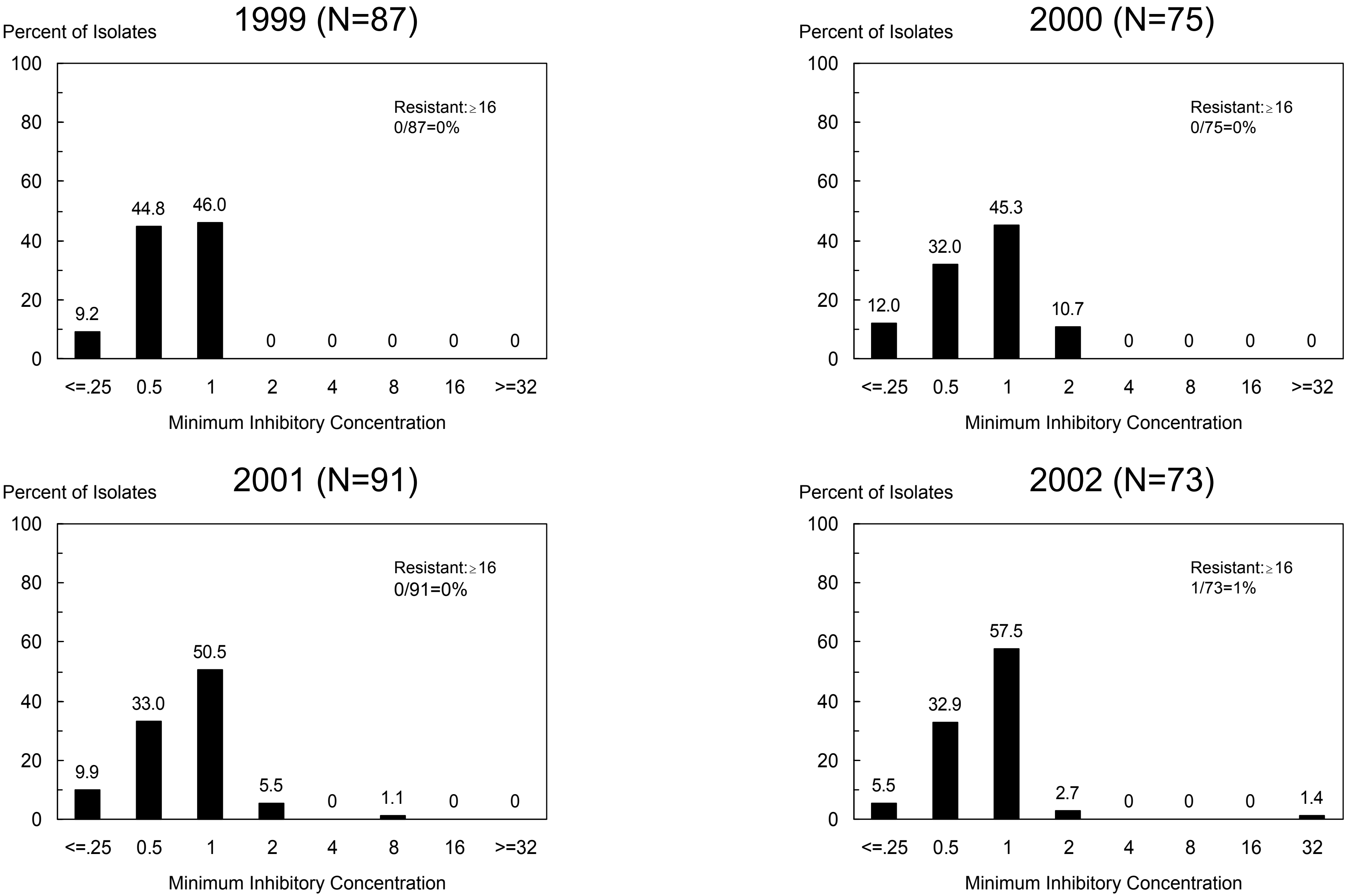

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Figure 19k. MICs for kanamycin among *Shigella flexneri* isolates, 1999-2002

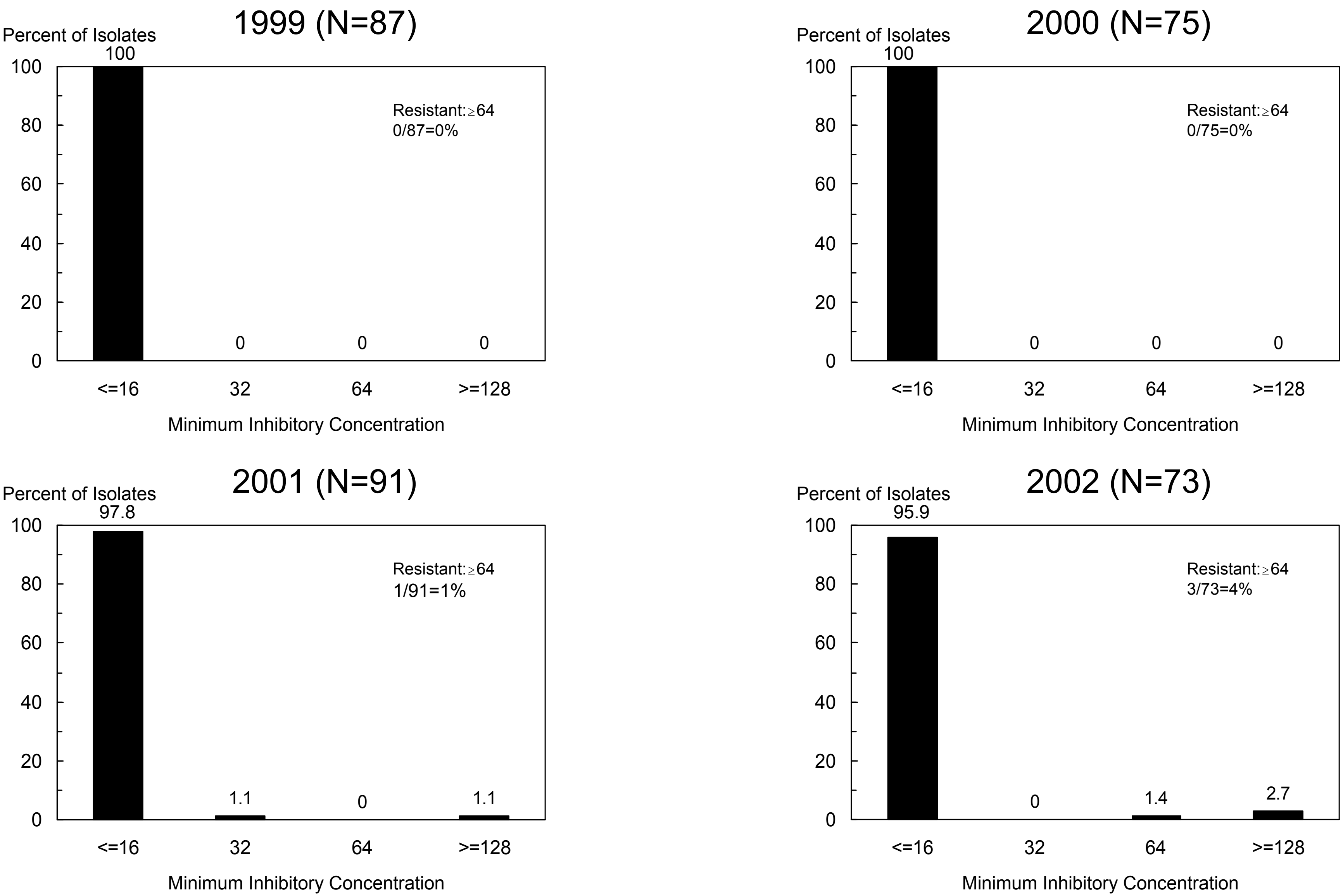

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Figure 19I. MICs for nalidixic acid among *Shigella flexneri* isolates, 1999-2002

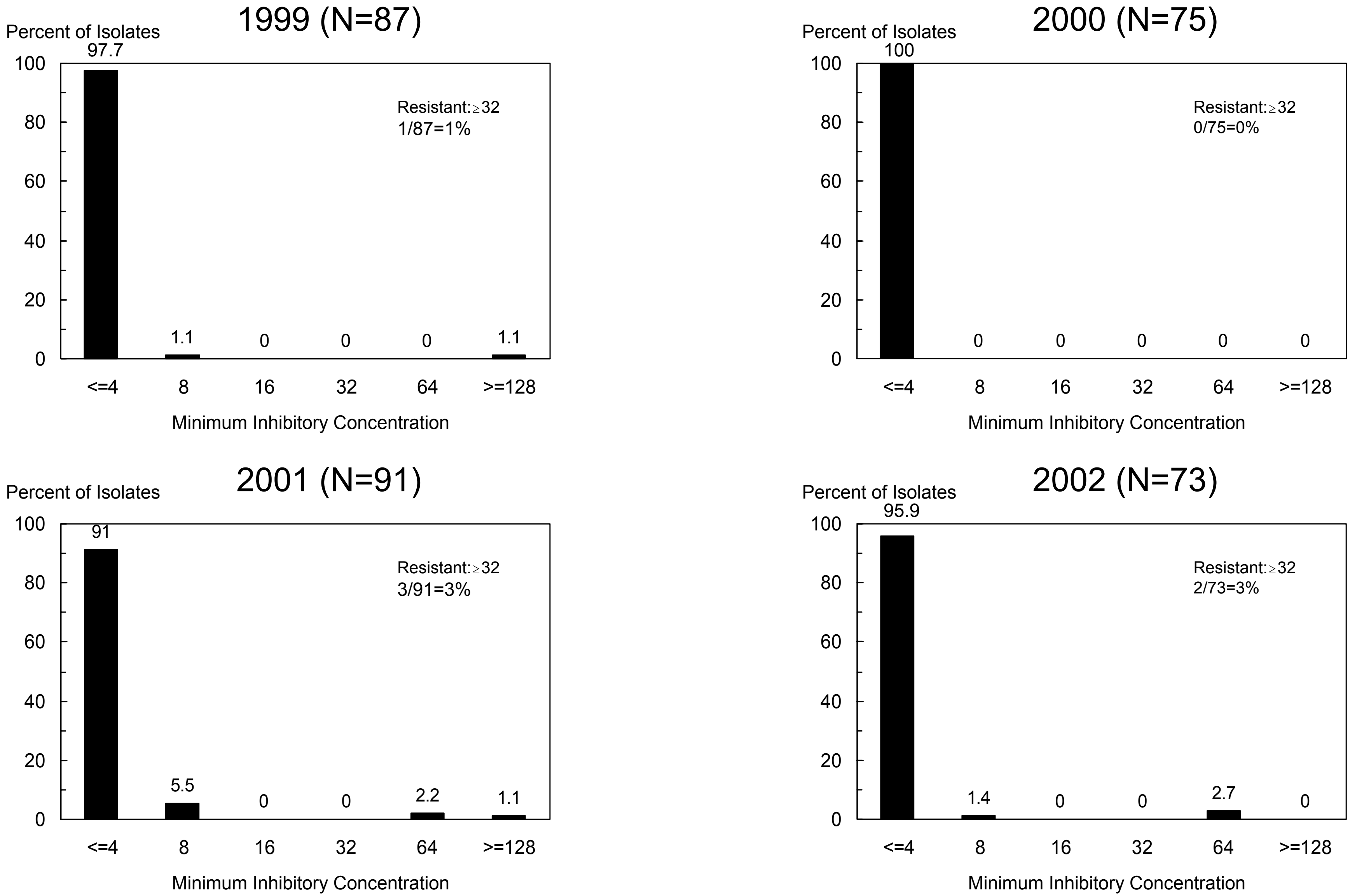

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Figure 19m. MICs for streptomycin among *Shigella flexneri* isolates, 1999-2002

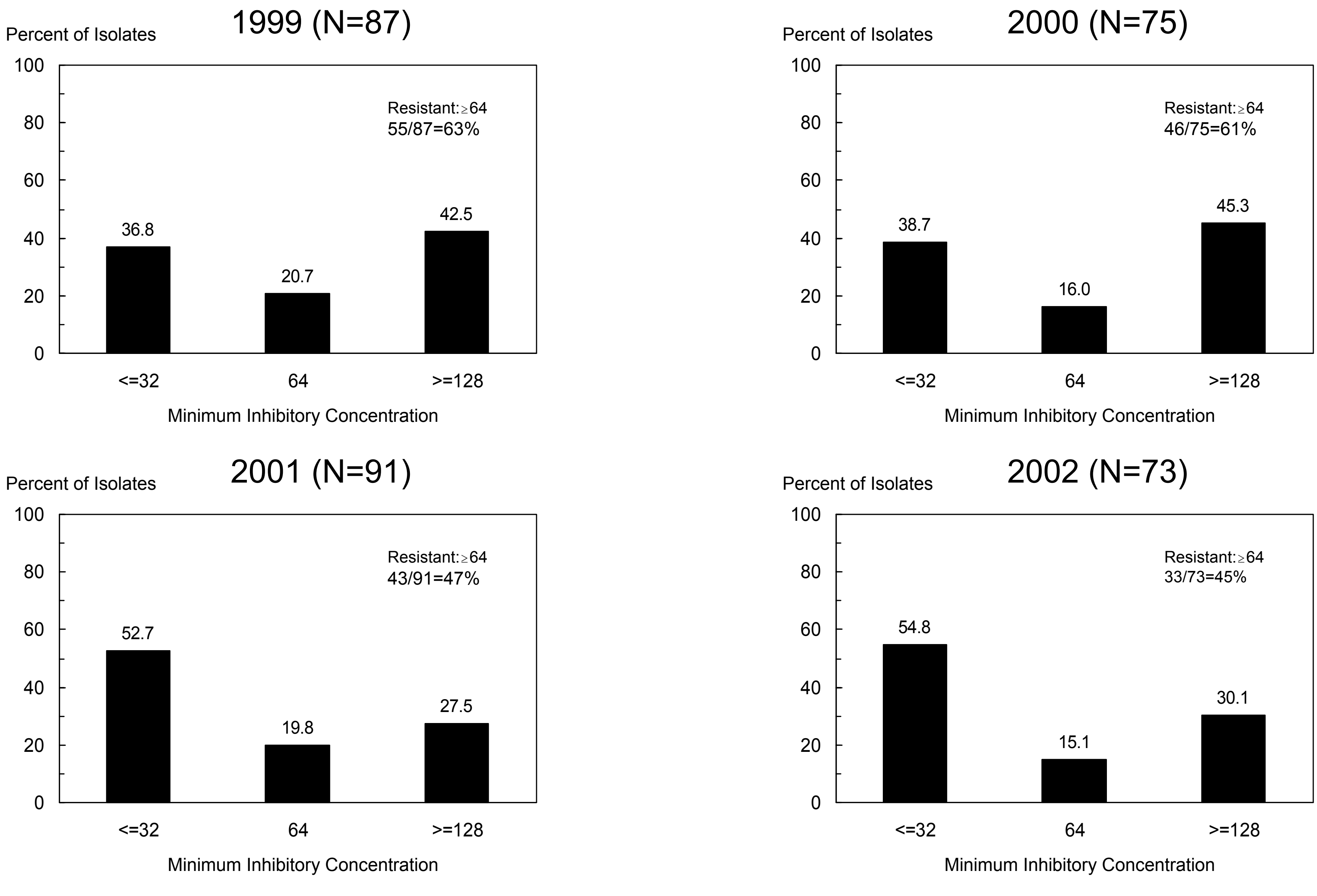

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Figure 19n. MICs for sulfamethoxazole among *Shigella flexneri* isolates, 1999-2002

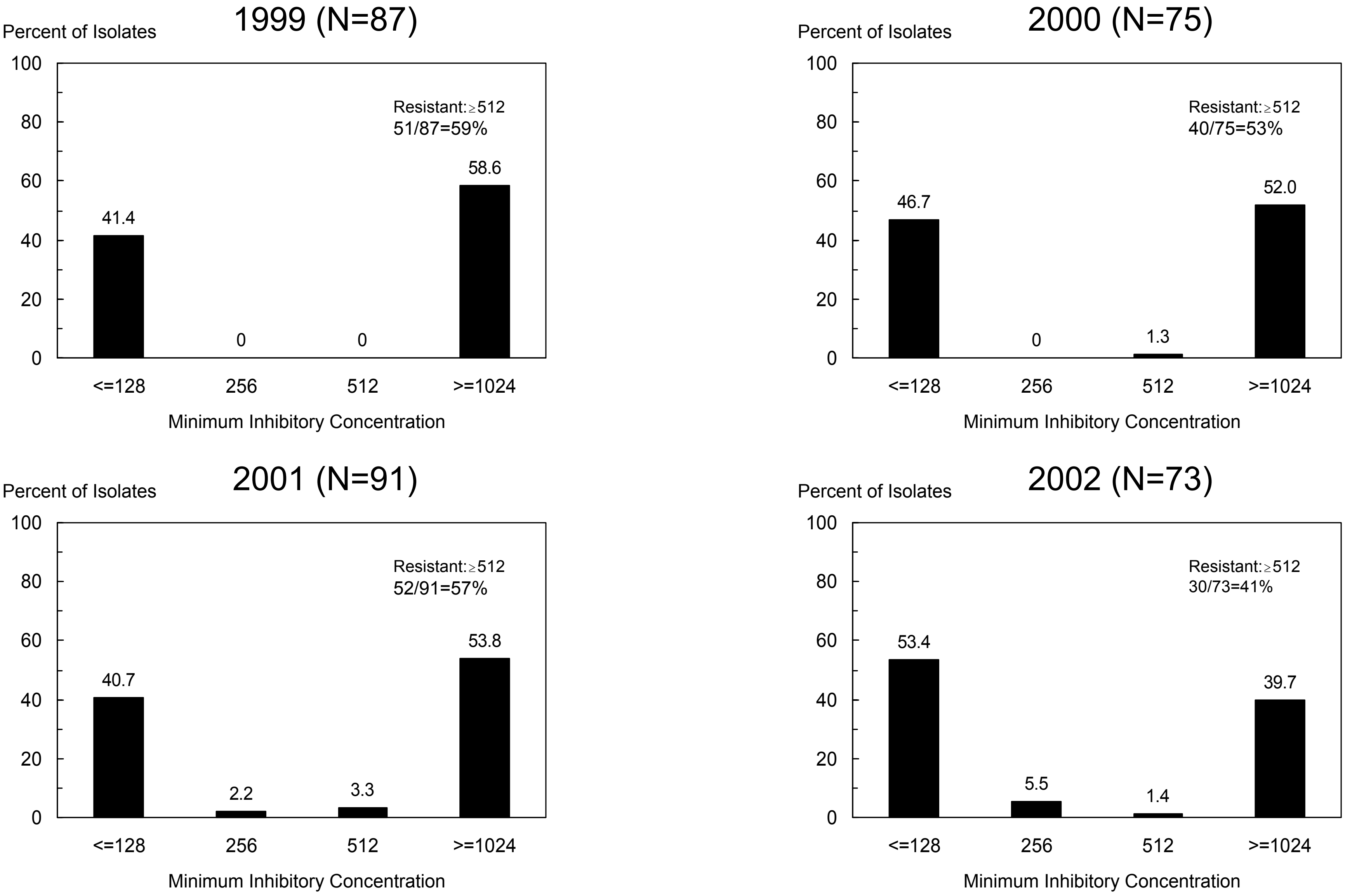

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Figure 19o. MICs for tetracycline among *Shigella flexneri* isolates, 1999-2002

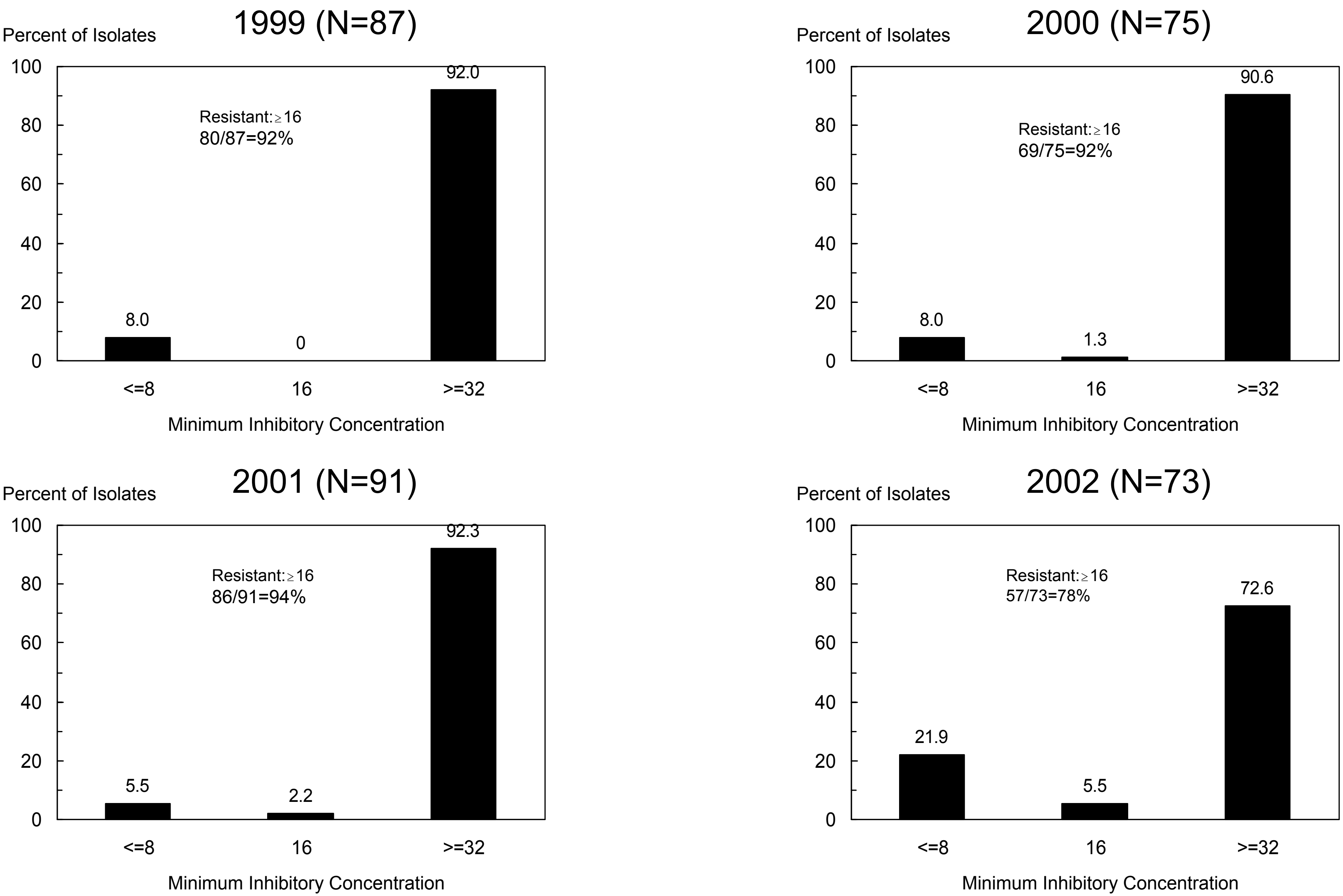

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Figure 19p. MICs for trimethoprim-sulfamethoxazole among *Shigella flexneri* isolates, 1999-2002

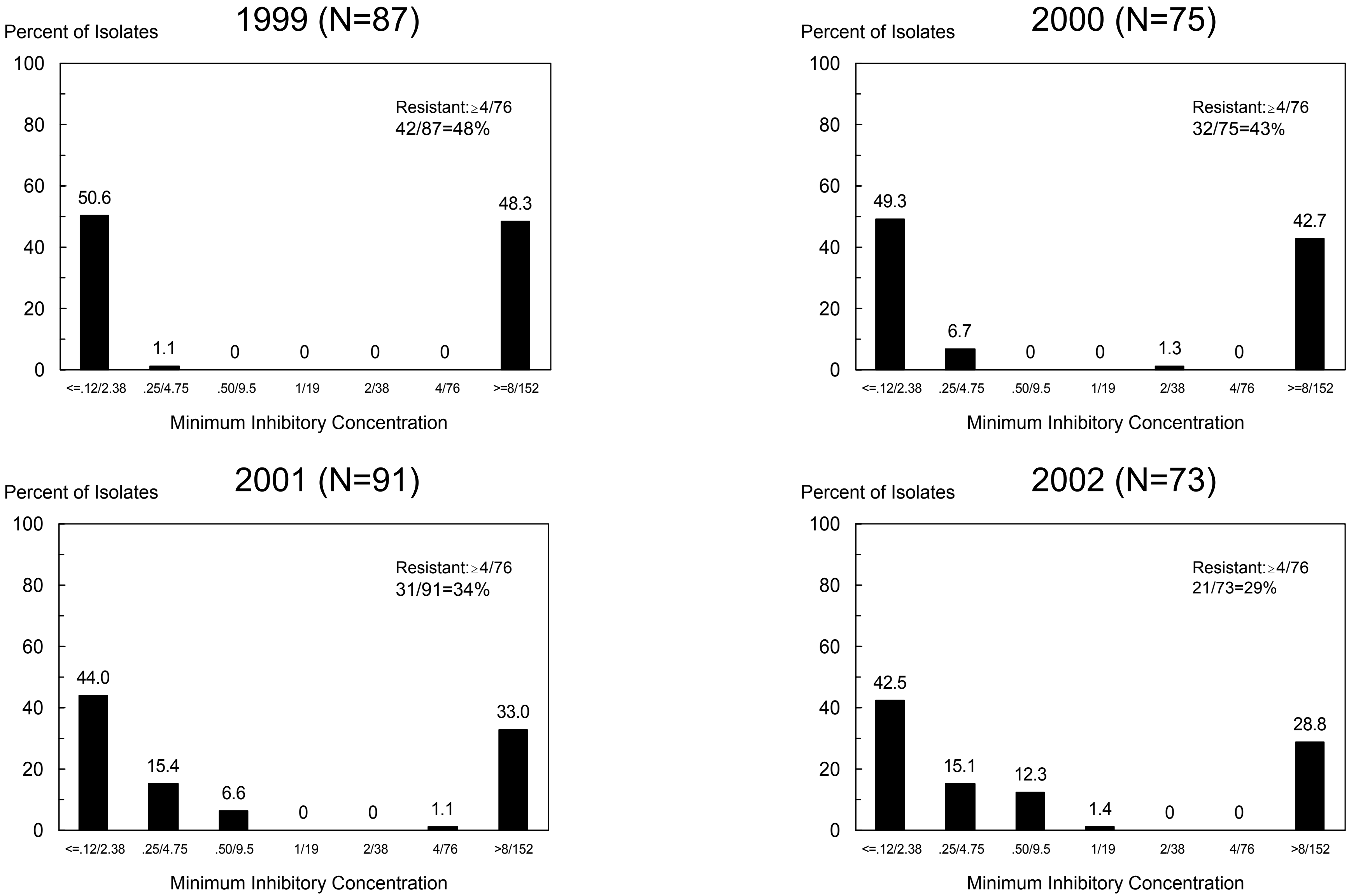

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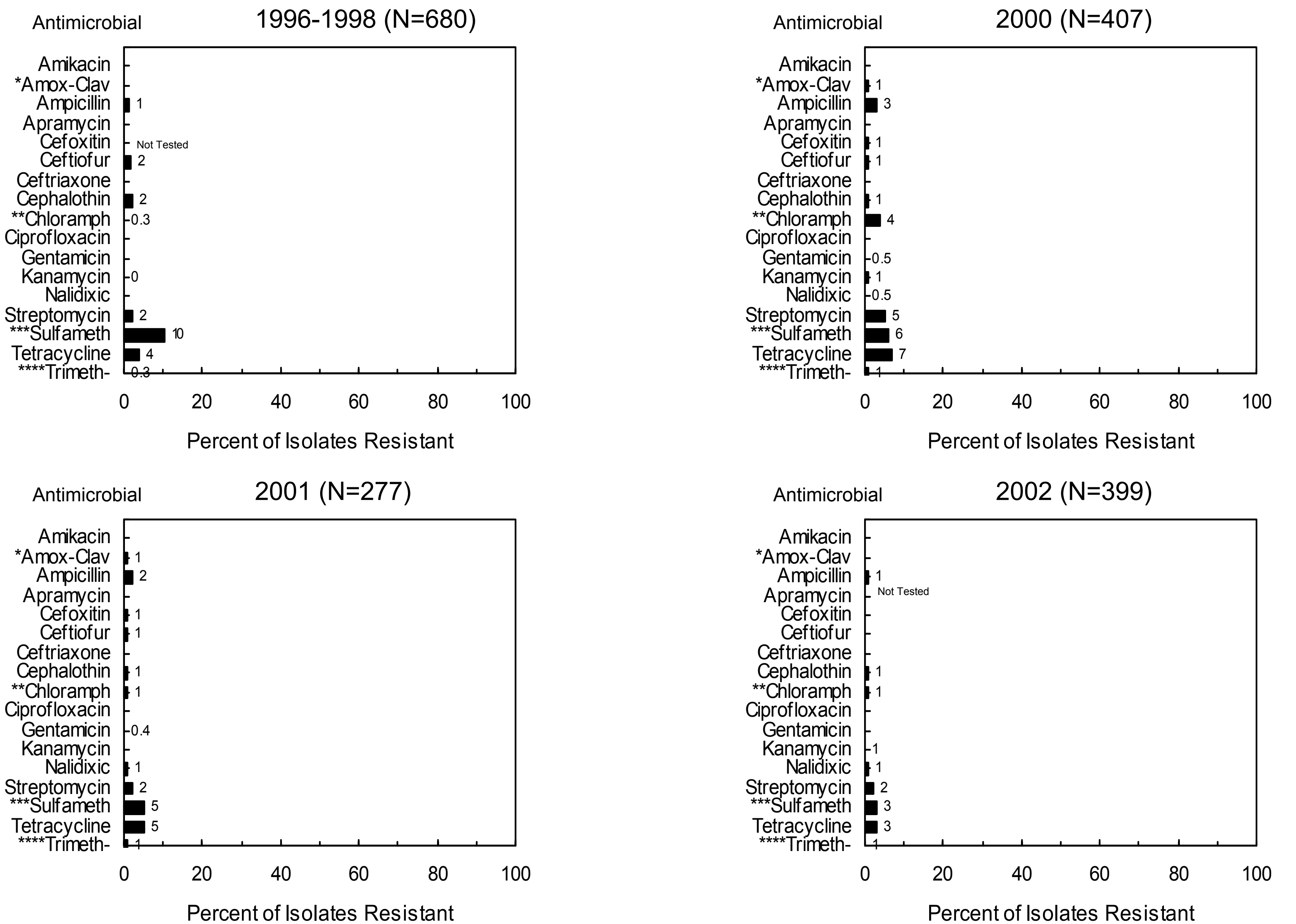
Figure 20. Resistance among *E. coli* O157 isolates, 1996-1998† and 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

*Amox-Clav=Amoxicillin-Clavulanic Acid **Chloramph=Chloramphenicol ***Sulfameth=Sulfamethoxazole ****Trimeth-=Trimethoprim-Sulfamethoxazole

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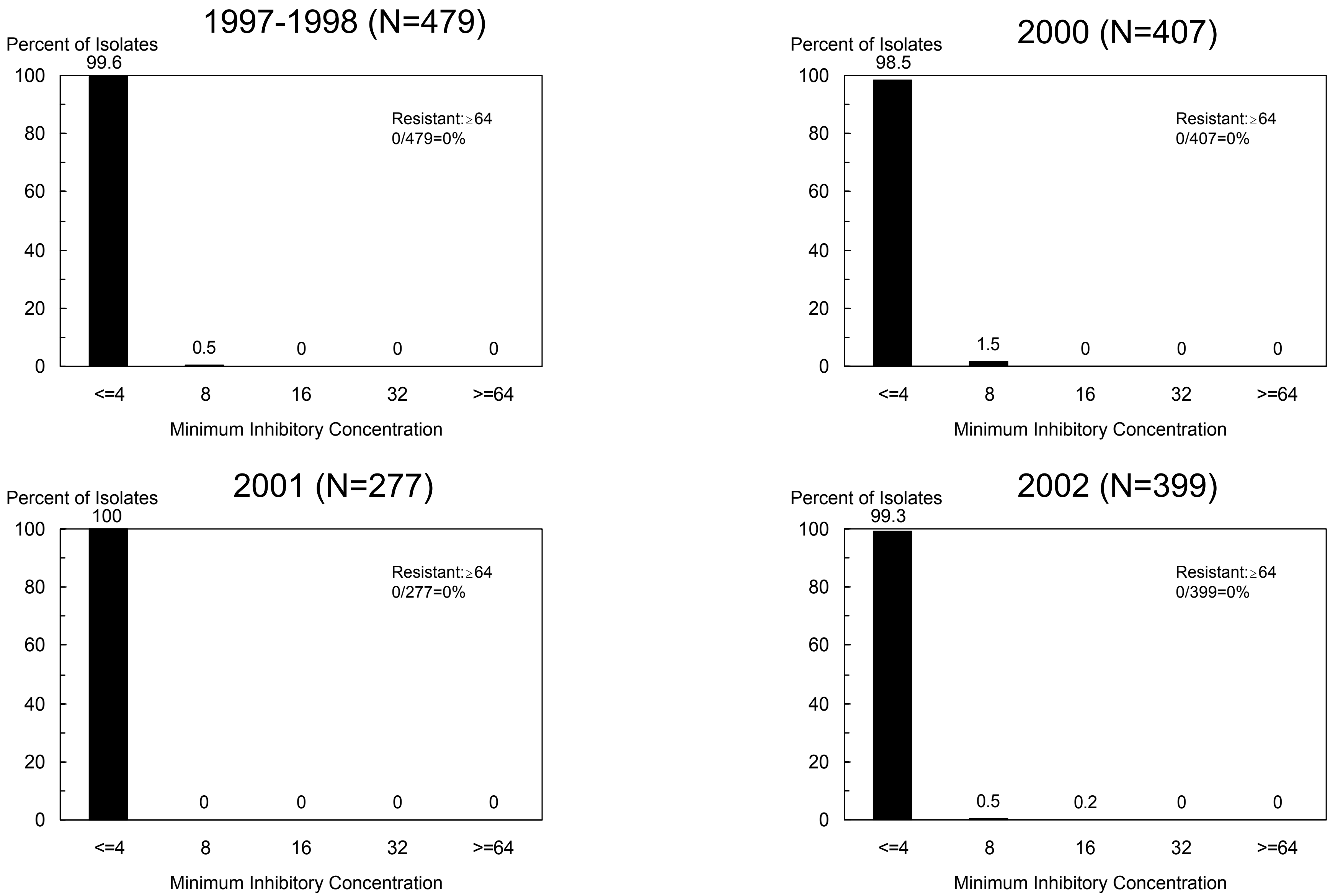
Figure 21a. MICs for amikacin among *E. coli* O157 isolates, 1997-98 and 2000-2002



†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

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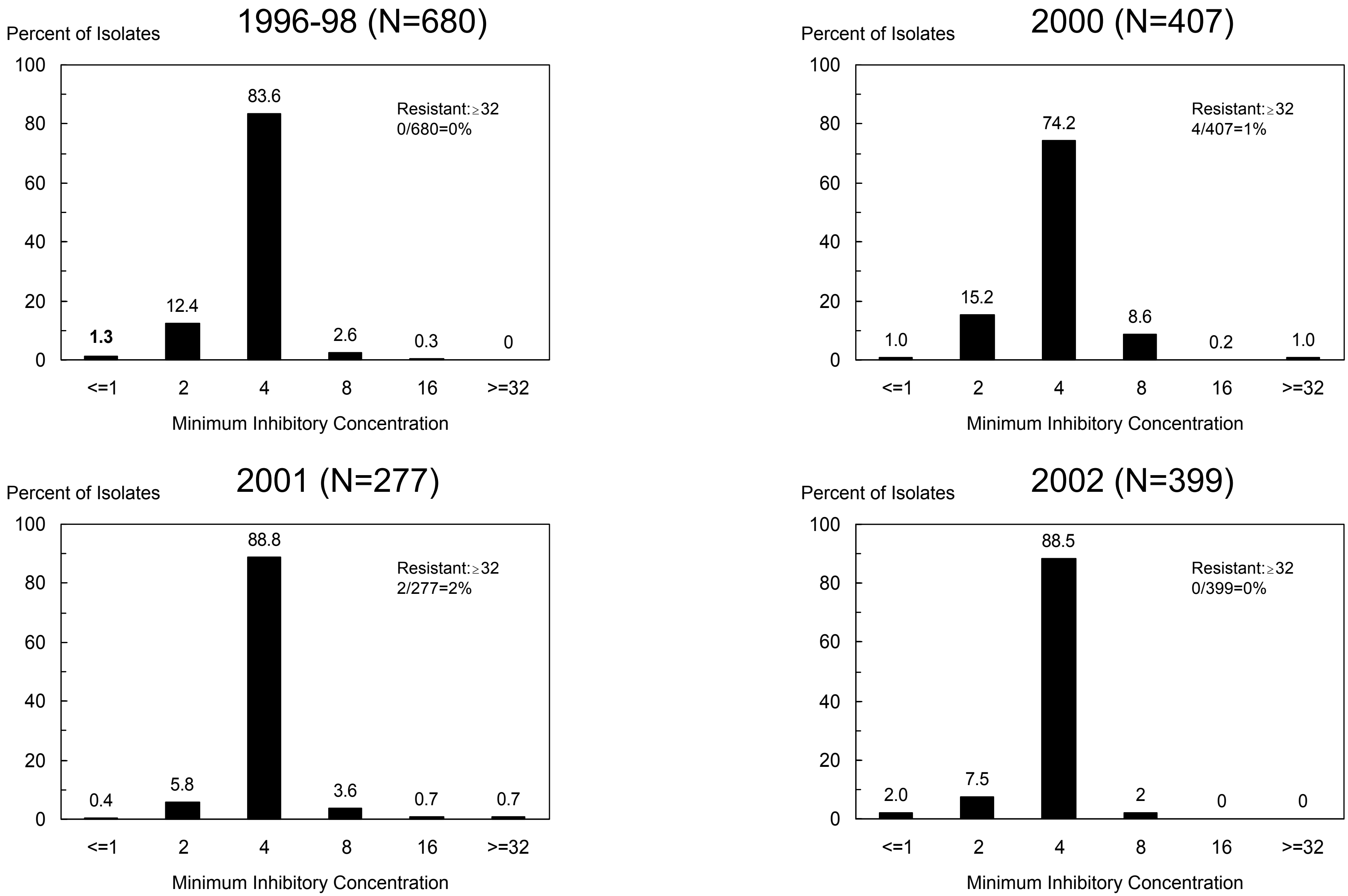
Figure 21b. MICs for amoxicillin-clavulanic acid among *E. coli* O157 isolates, 1996-1998† and 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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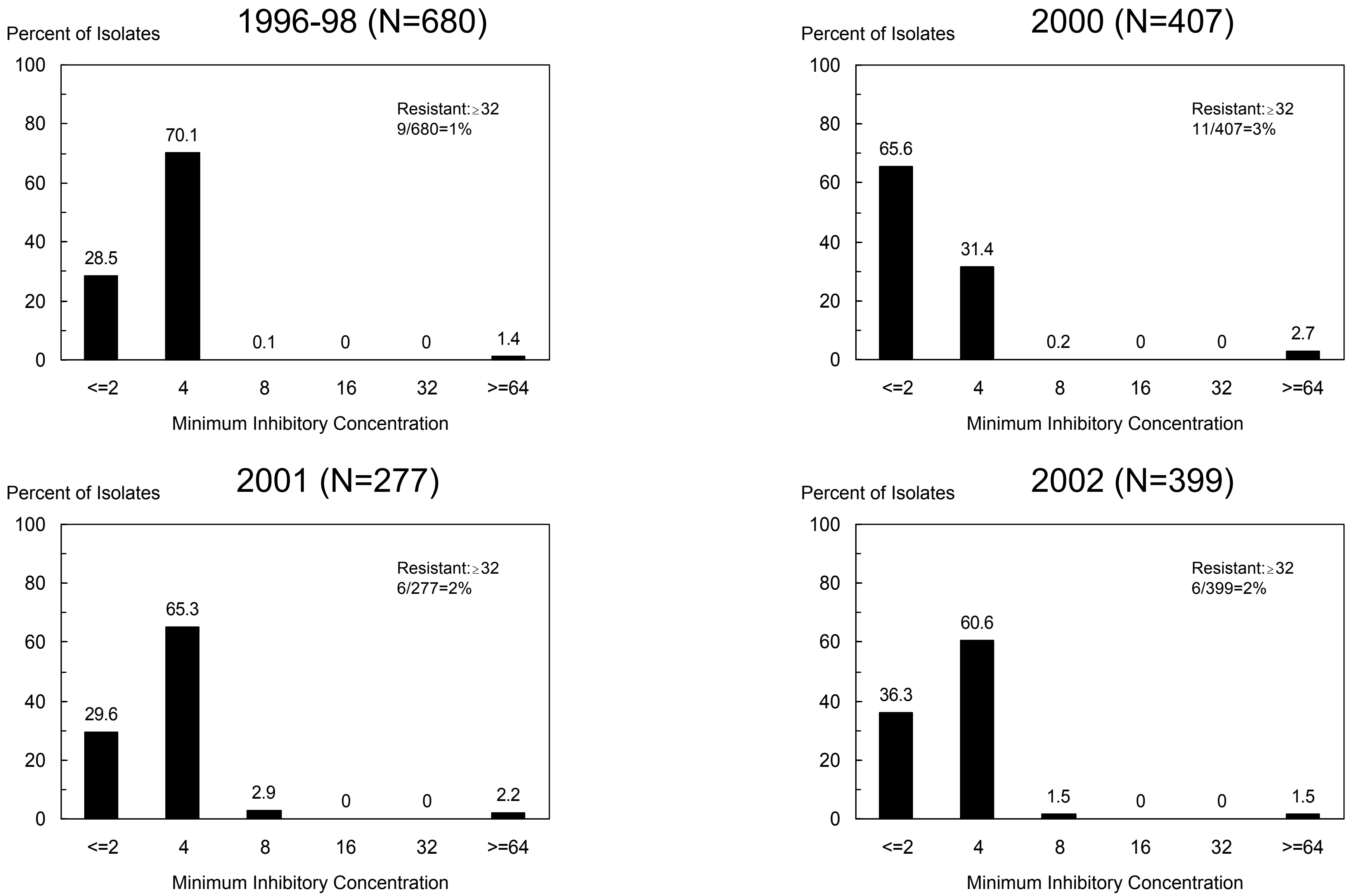
Figure 21c. MICs for ampicillin among *E. coli* O157 isolates, 1996-1998† and 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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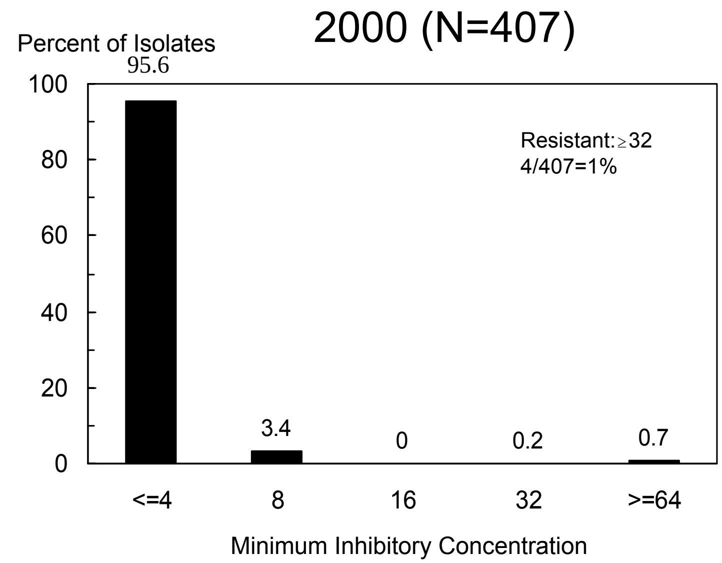
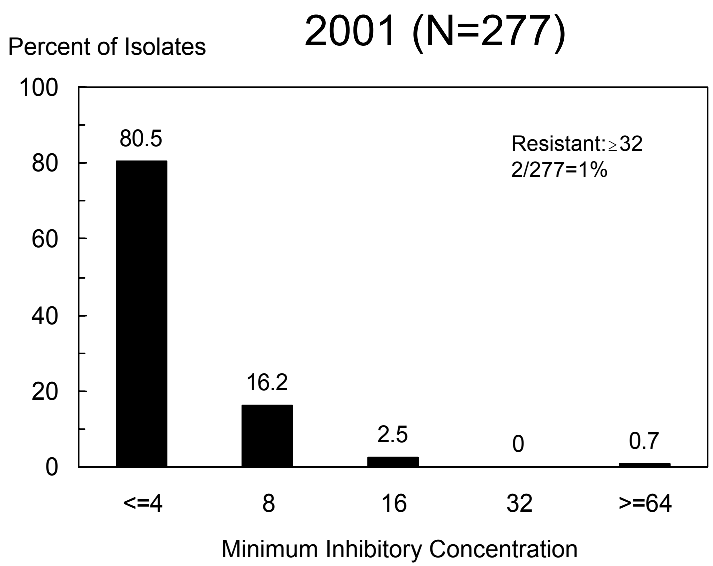
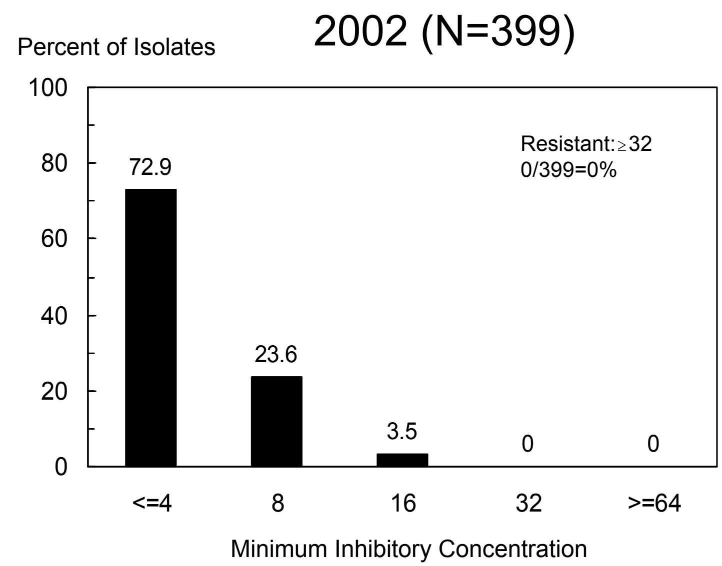
Figure 21d. MICs for cefoxitin among *E. coli* O157 isolates, 1996-1998† and 2000-2002

Not Tested in 1996-1998







†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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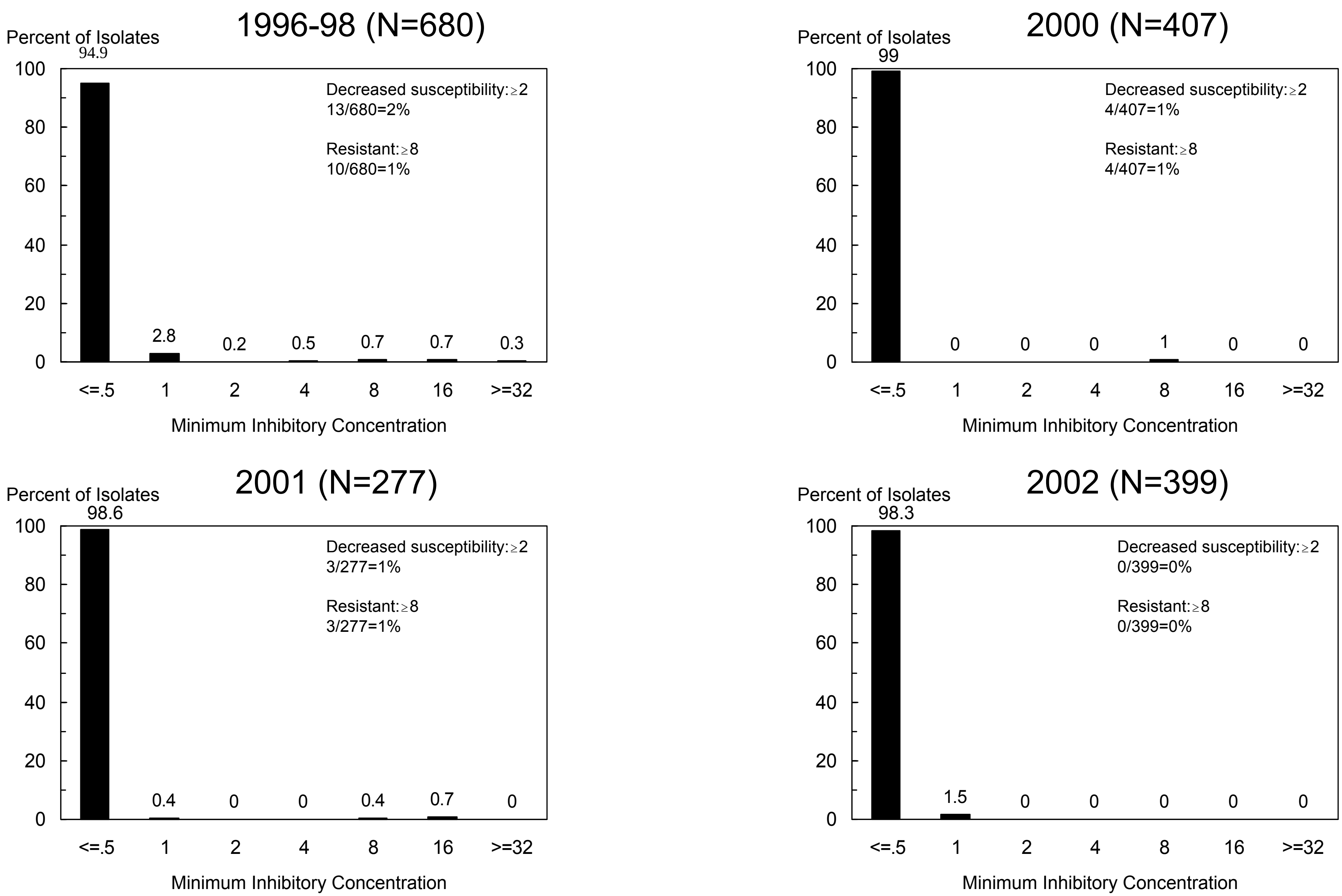
Figure 21e. MICs for ceftiofur among *E. coli* O157 isolates, 1996-1998† and 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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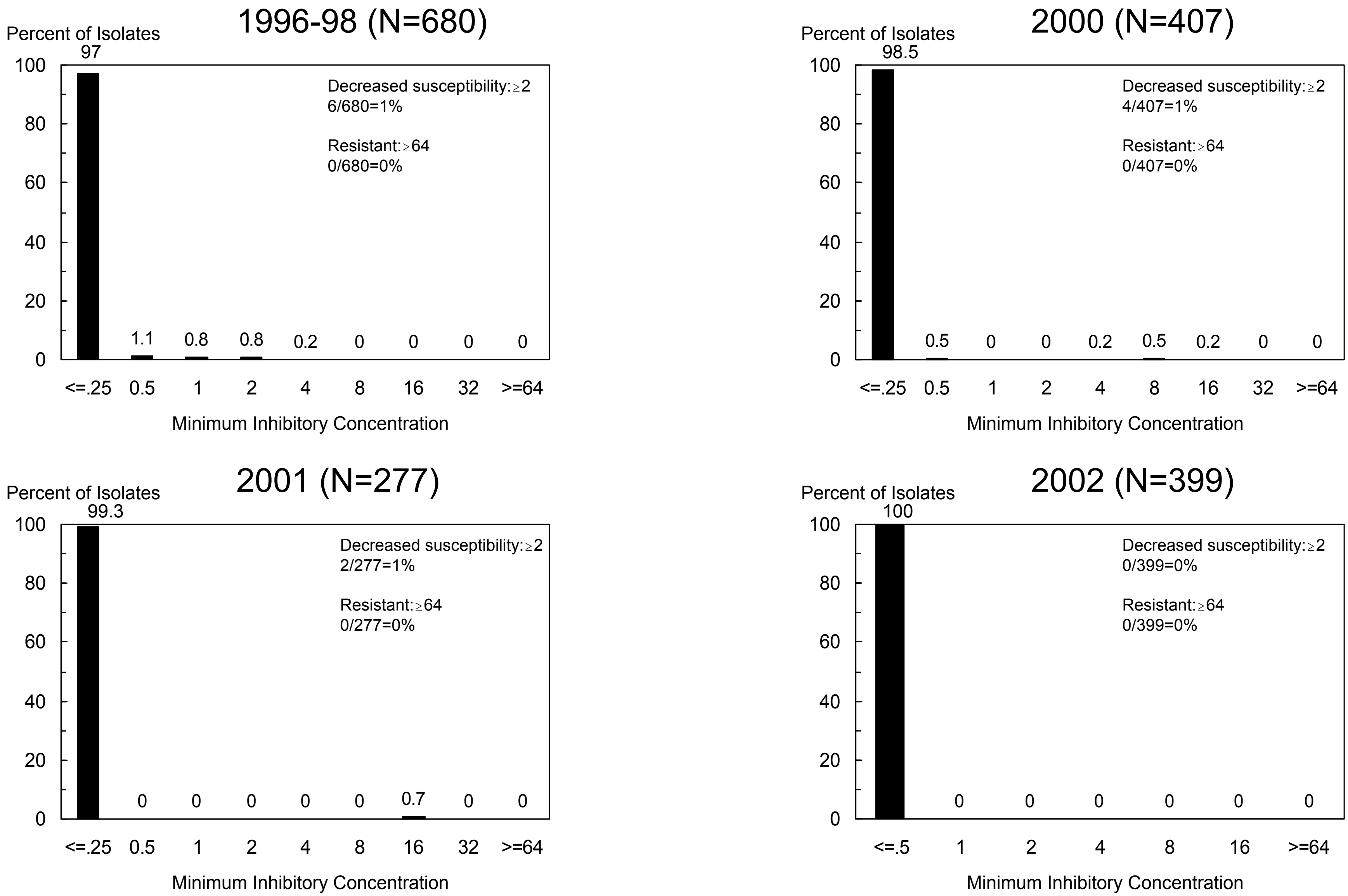
Figure 21f. MICs for ceftriaxone among *E. coli* O157 isolates, 1996-1998† and 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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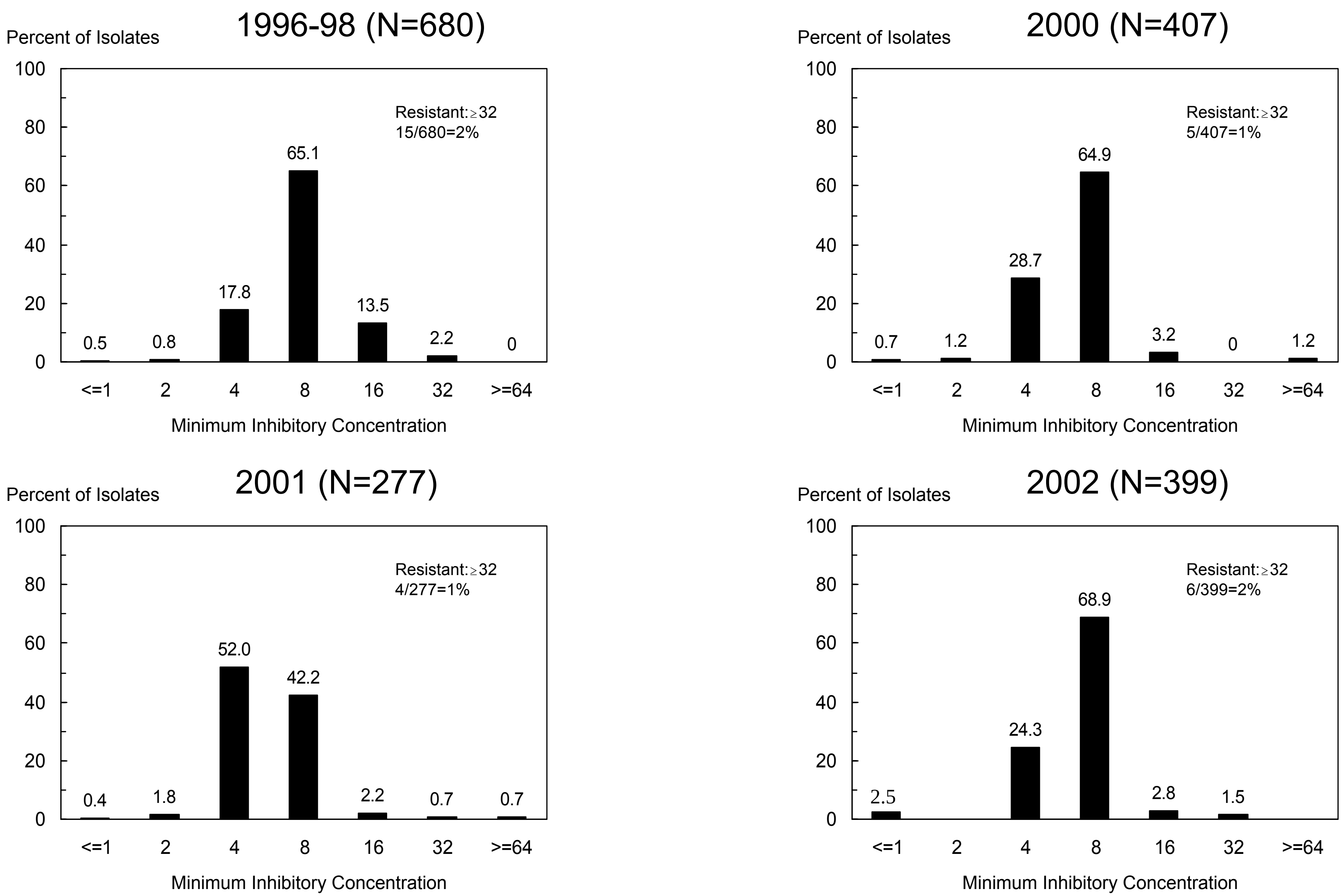
Figure 21g. MICs for cephalothin among *E. coli* O157 isolates, 1996-1998† and 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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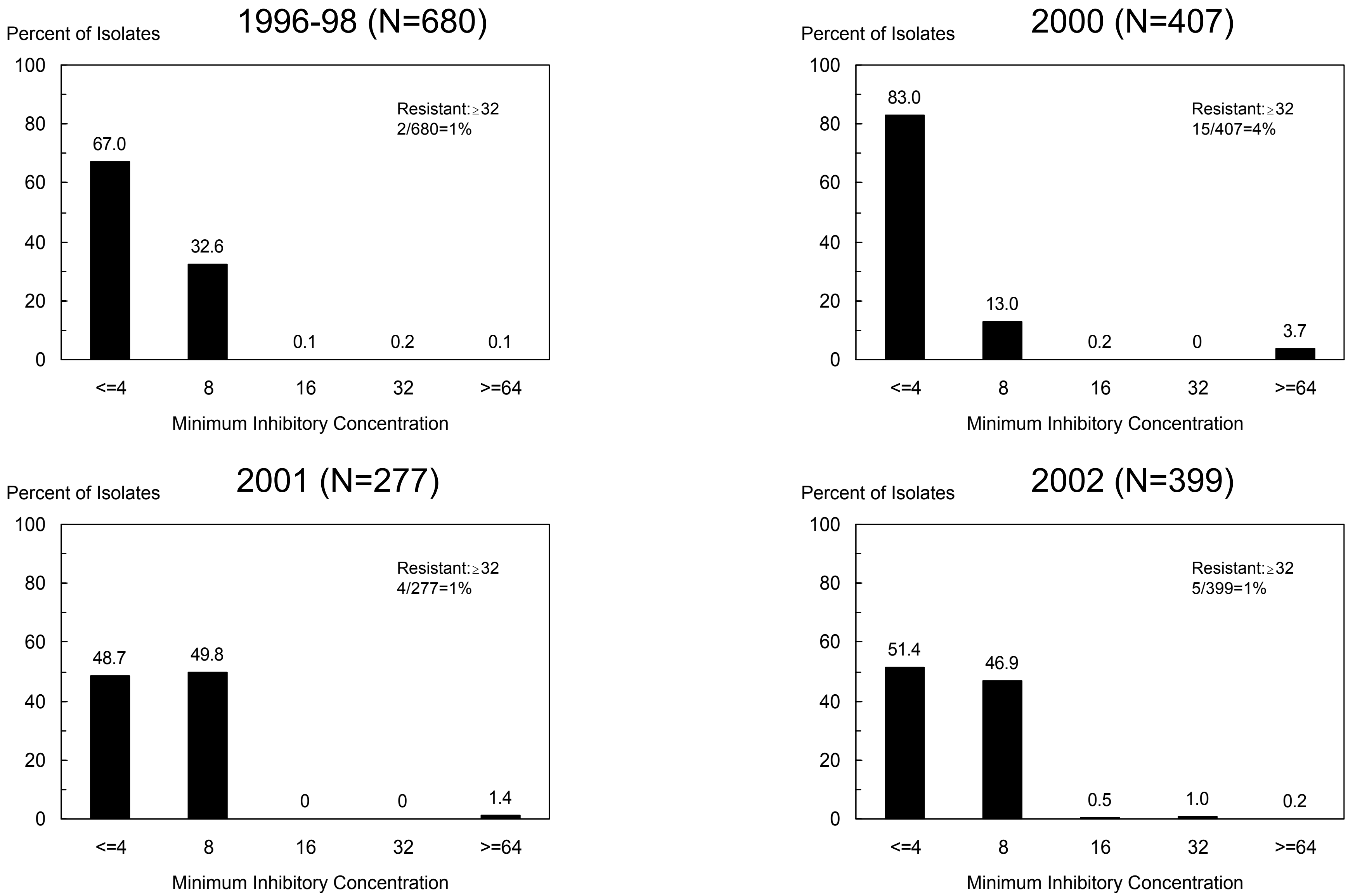
Figure 21h. MICs for chloramphenicol among *E. coli* O157 isolates, 1996-1998† and 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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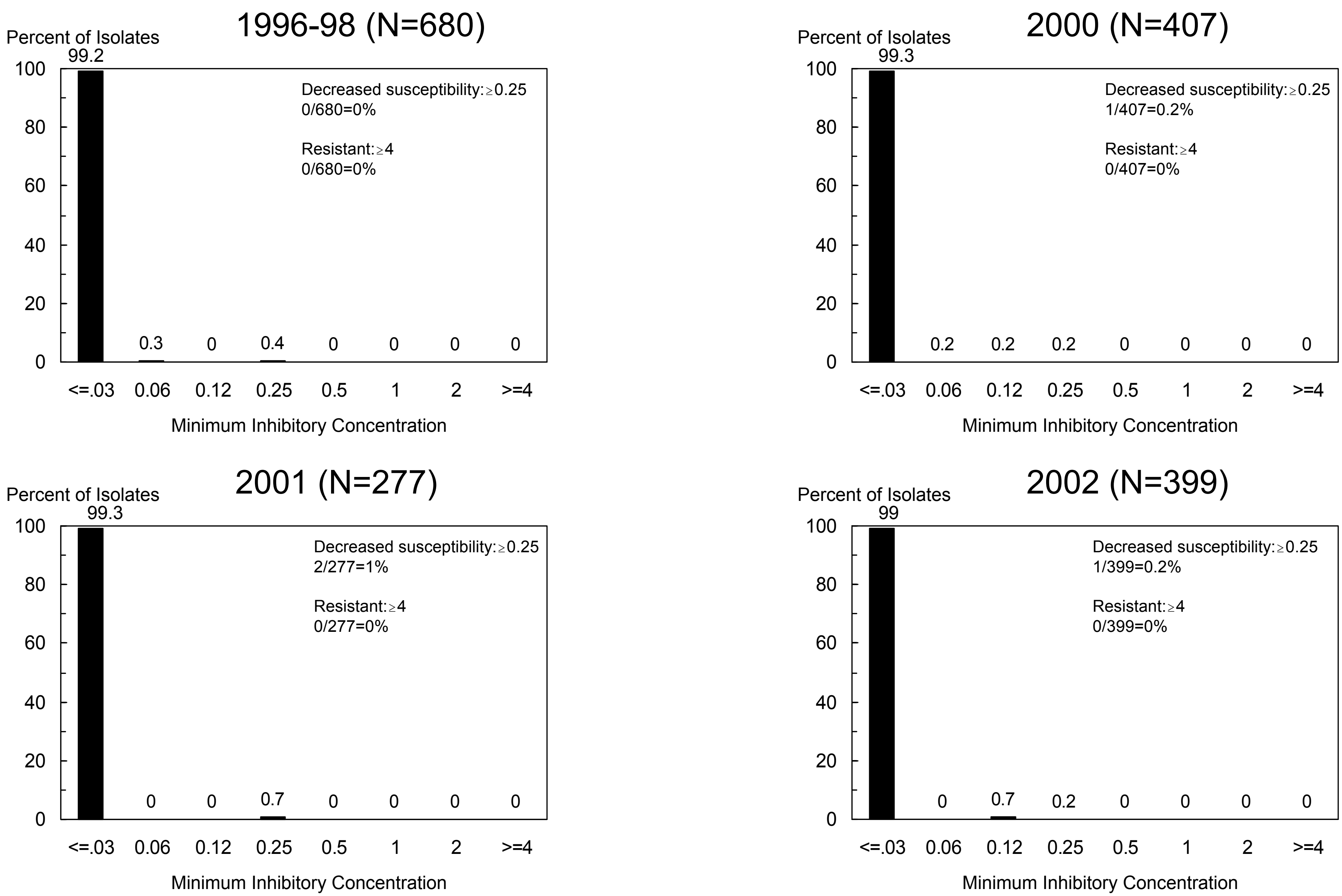
Figure 21i. MICs for ciprofloxacin among *E. coli* O157 isolates, 1996-1998† and 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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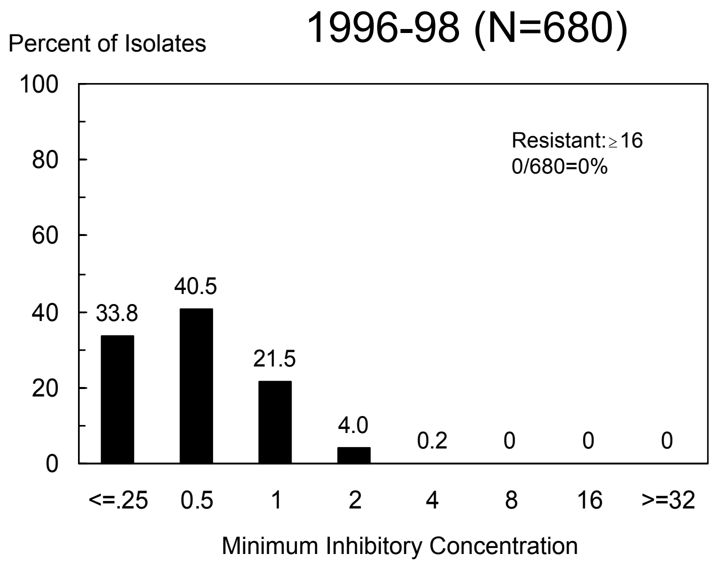
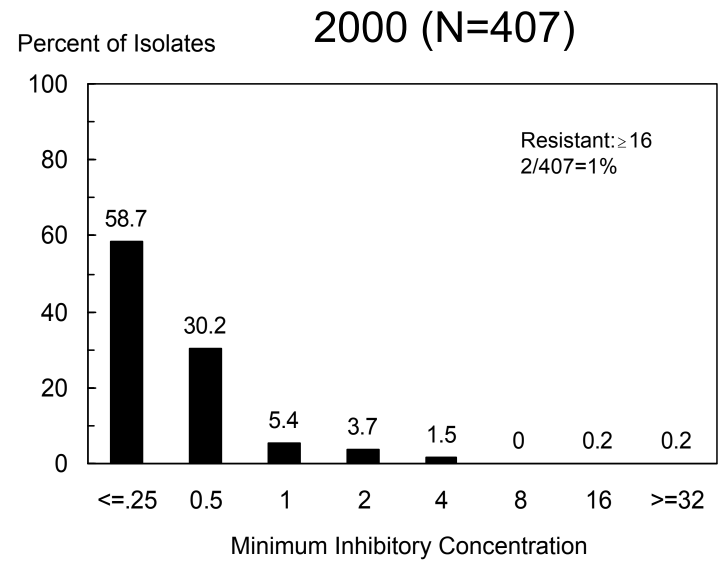
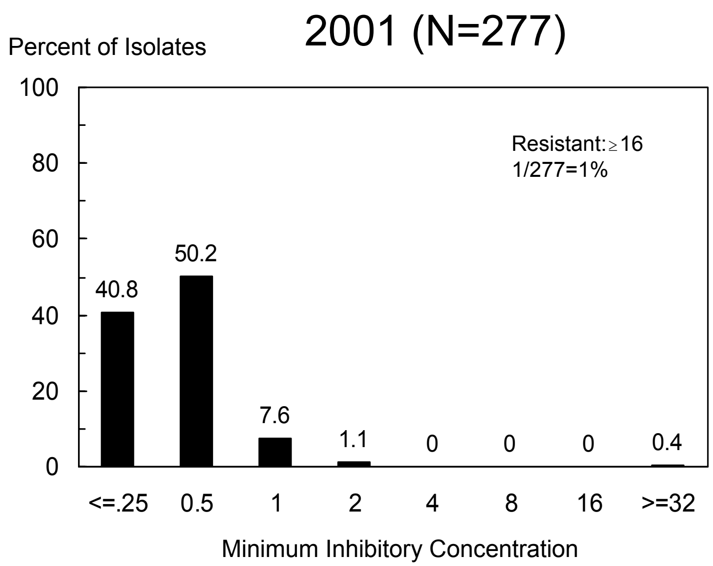
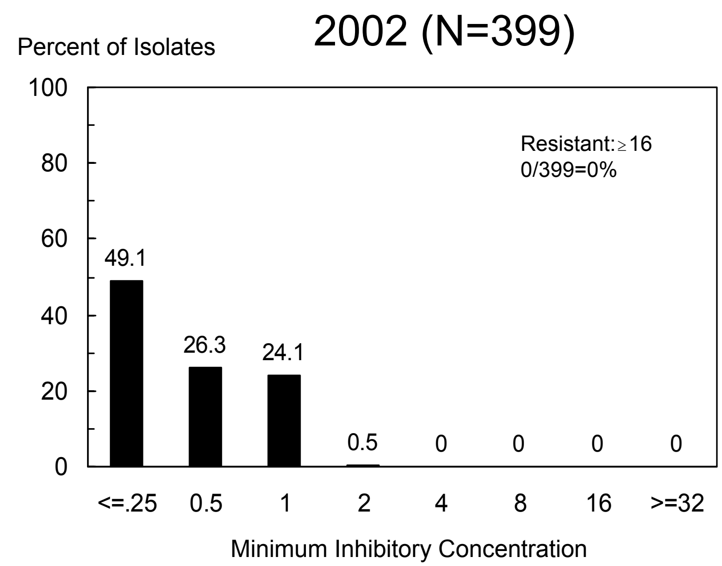
Figure 21j. MICs for gentamicin among *E. coli* O157 isolates, 1996-1998† and 2000-2002









†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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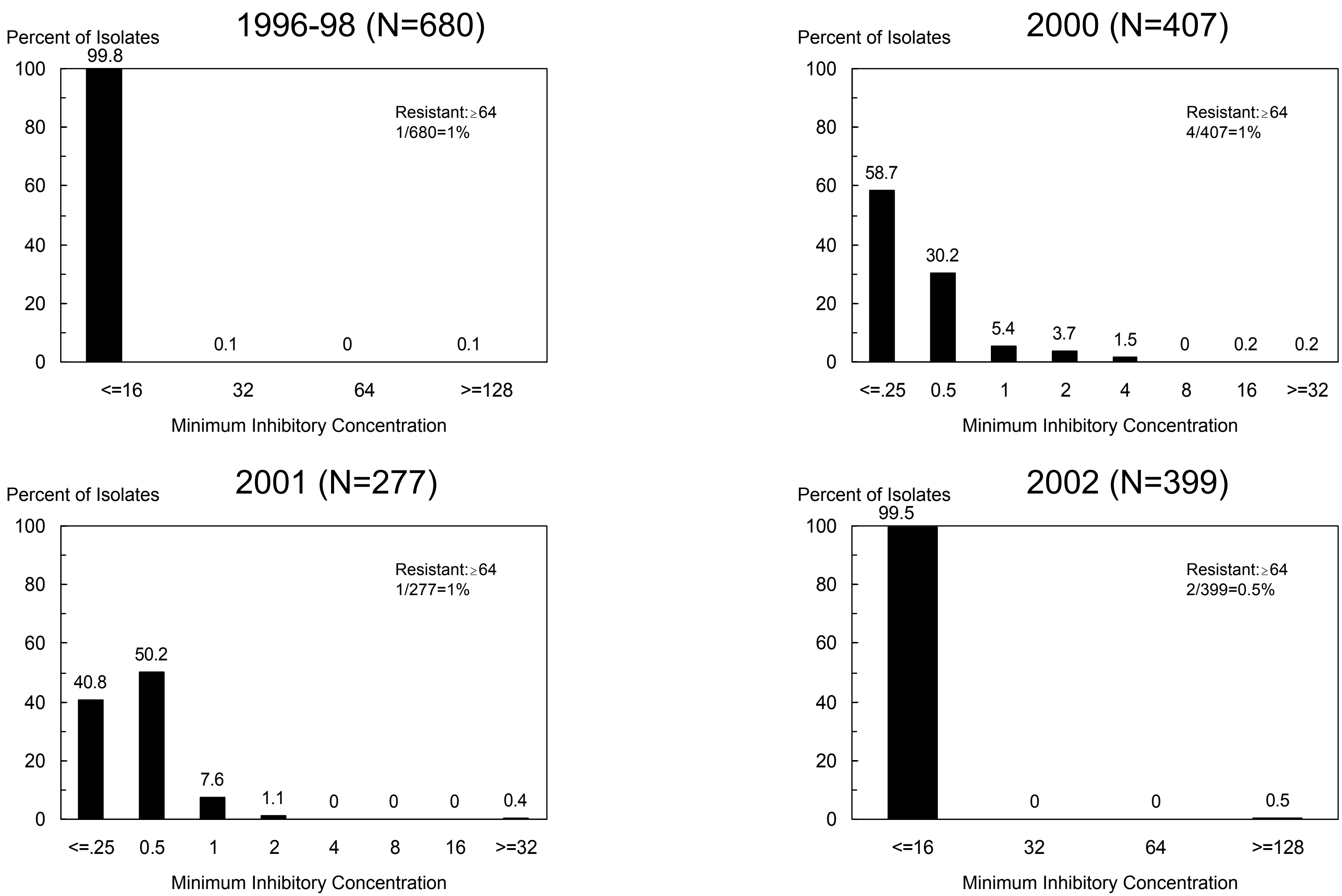
Figure 21k. MICs for kanamycin among *E. coli* O157 isolates, 1996-1998† and 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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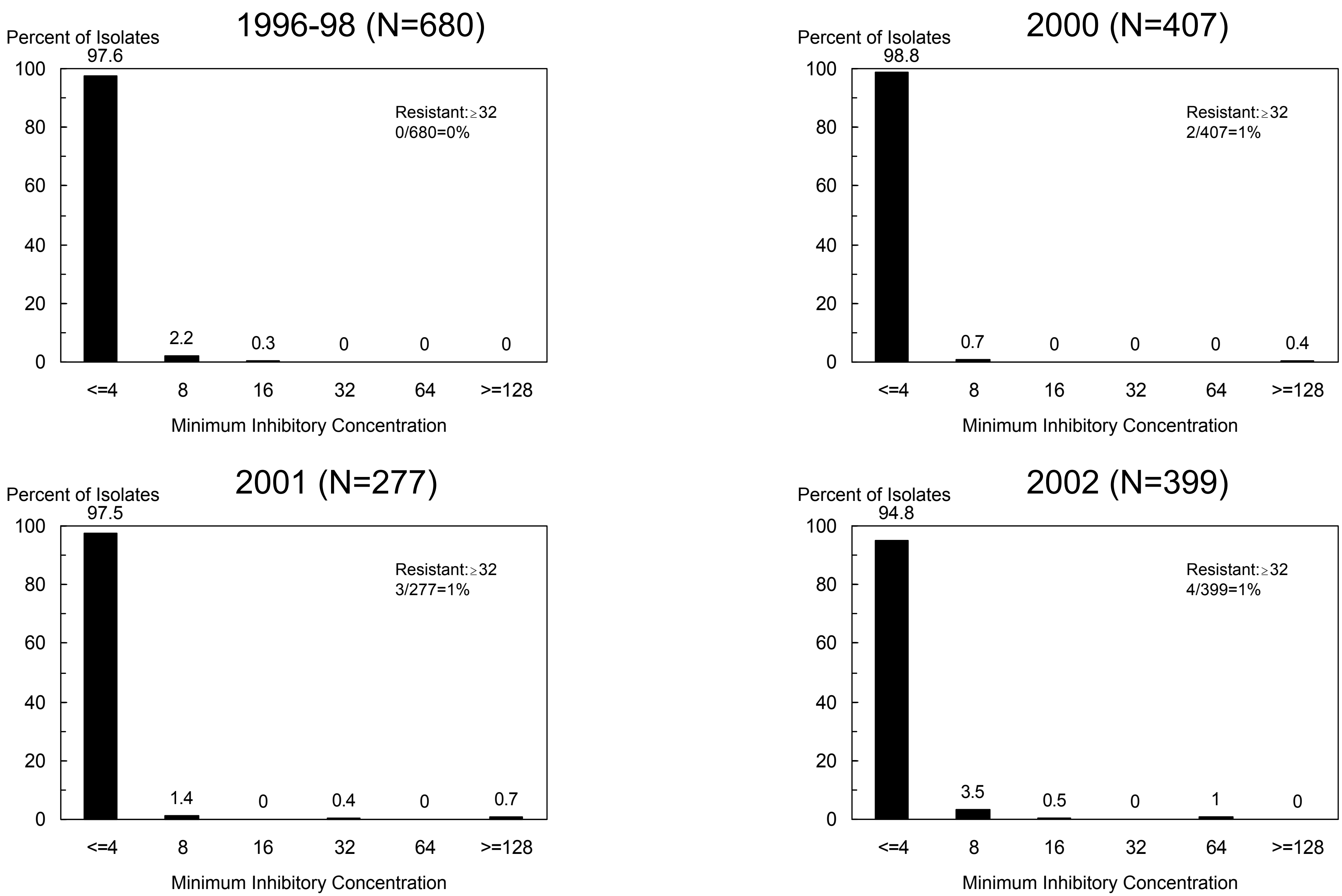
Figure 21I. MICs for nalidixic acid among *E. coli* O157 isolates, 1996-1998† and 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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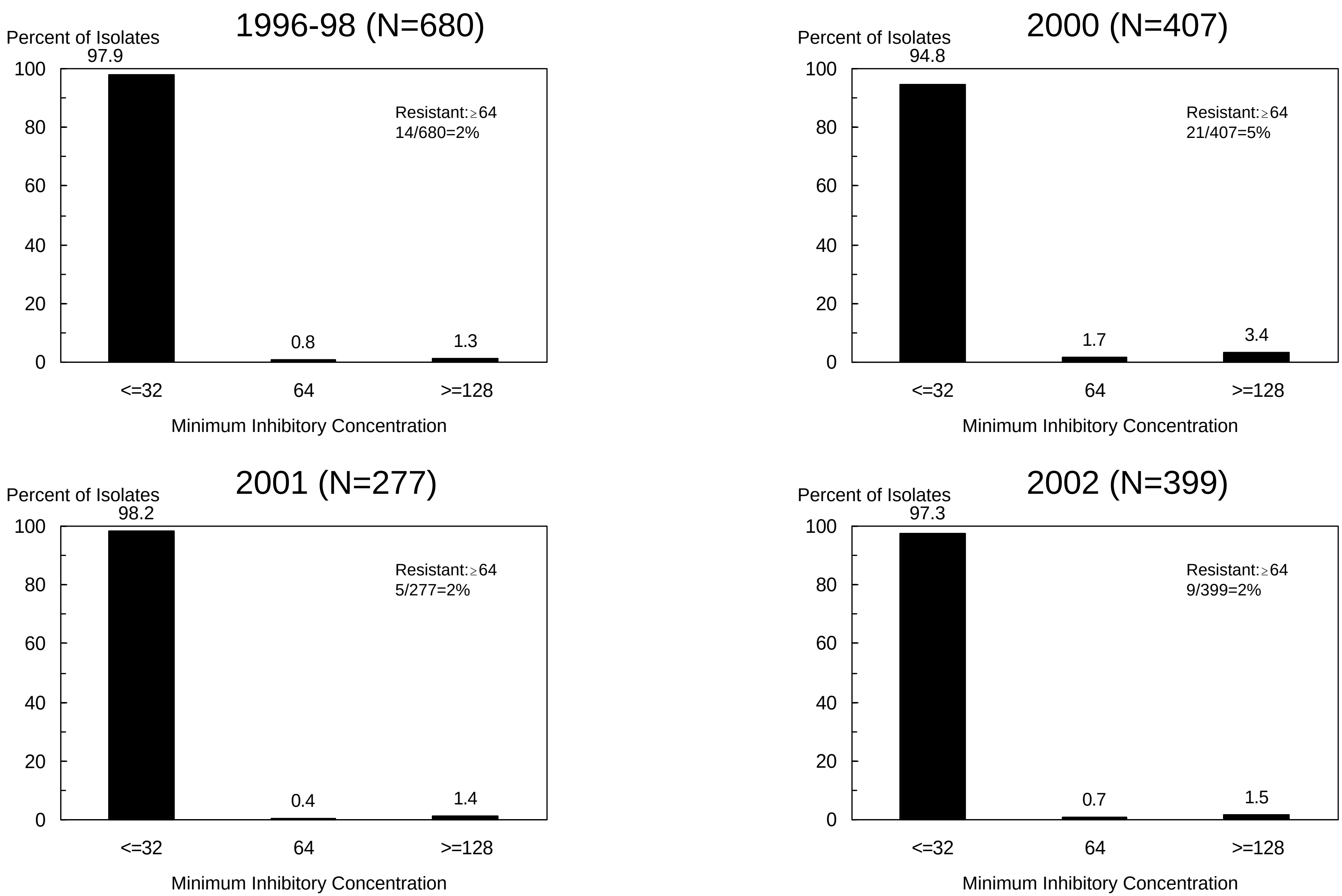
Figure 21m. MICs for streptomycin among *E. coli* O157 isolates, 1996-1998† and 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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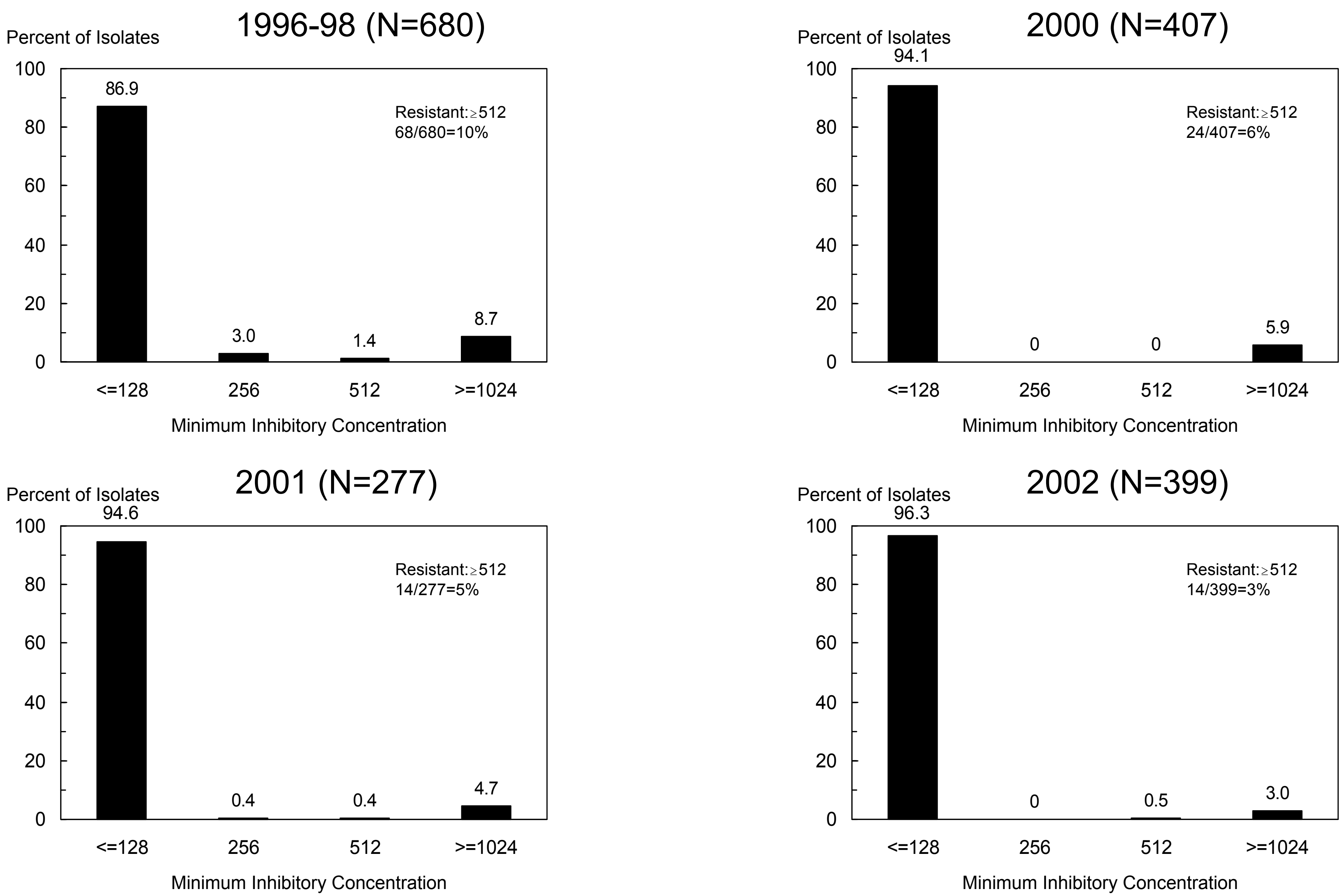
Figure 21n. MICs for sulfamethoxazole among *E. coli* O157 isolates, 1996-1998† and 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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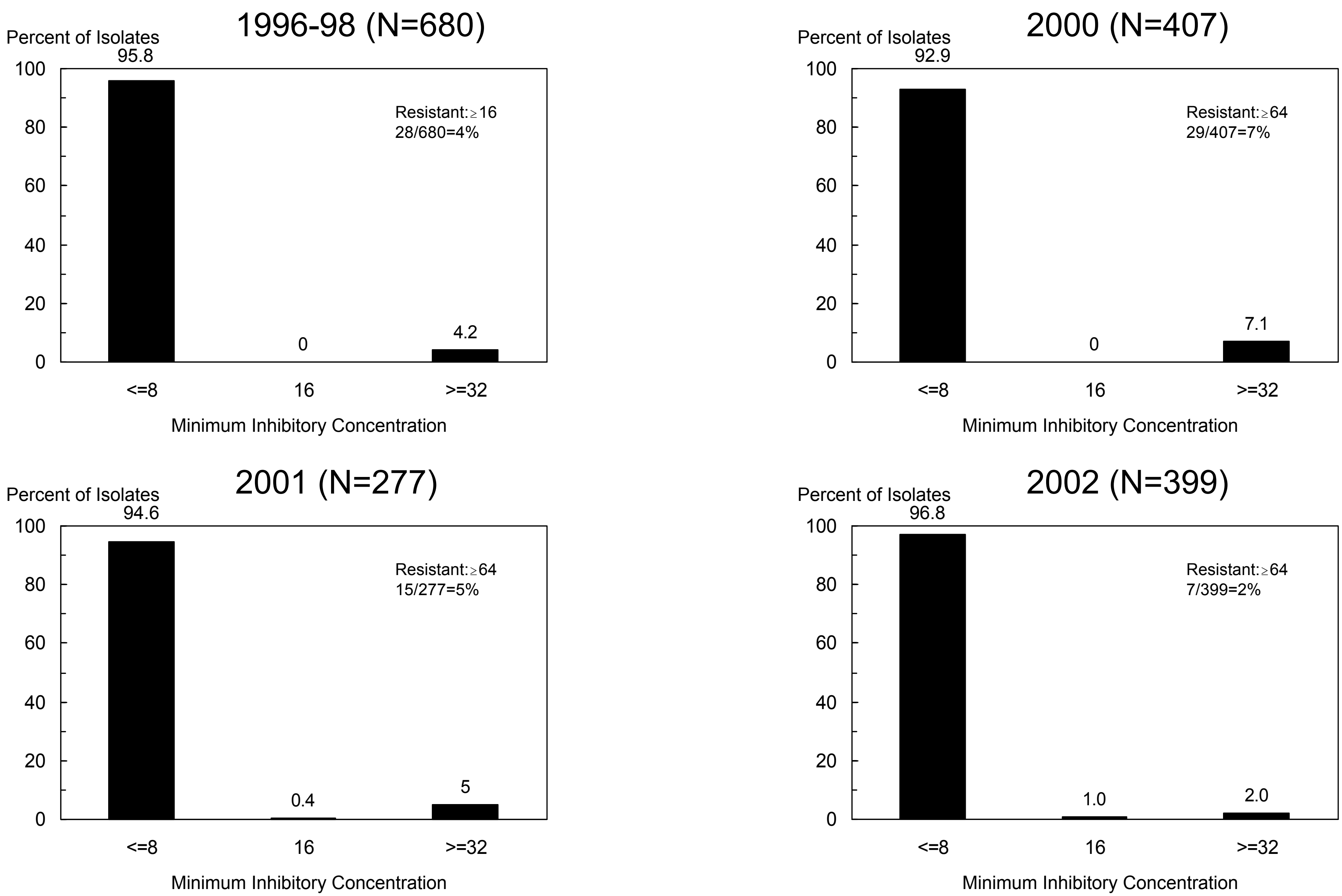
Figure 21o. MICs for tetracycline among *E. coli* O157 isolates, 1996-1998† and 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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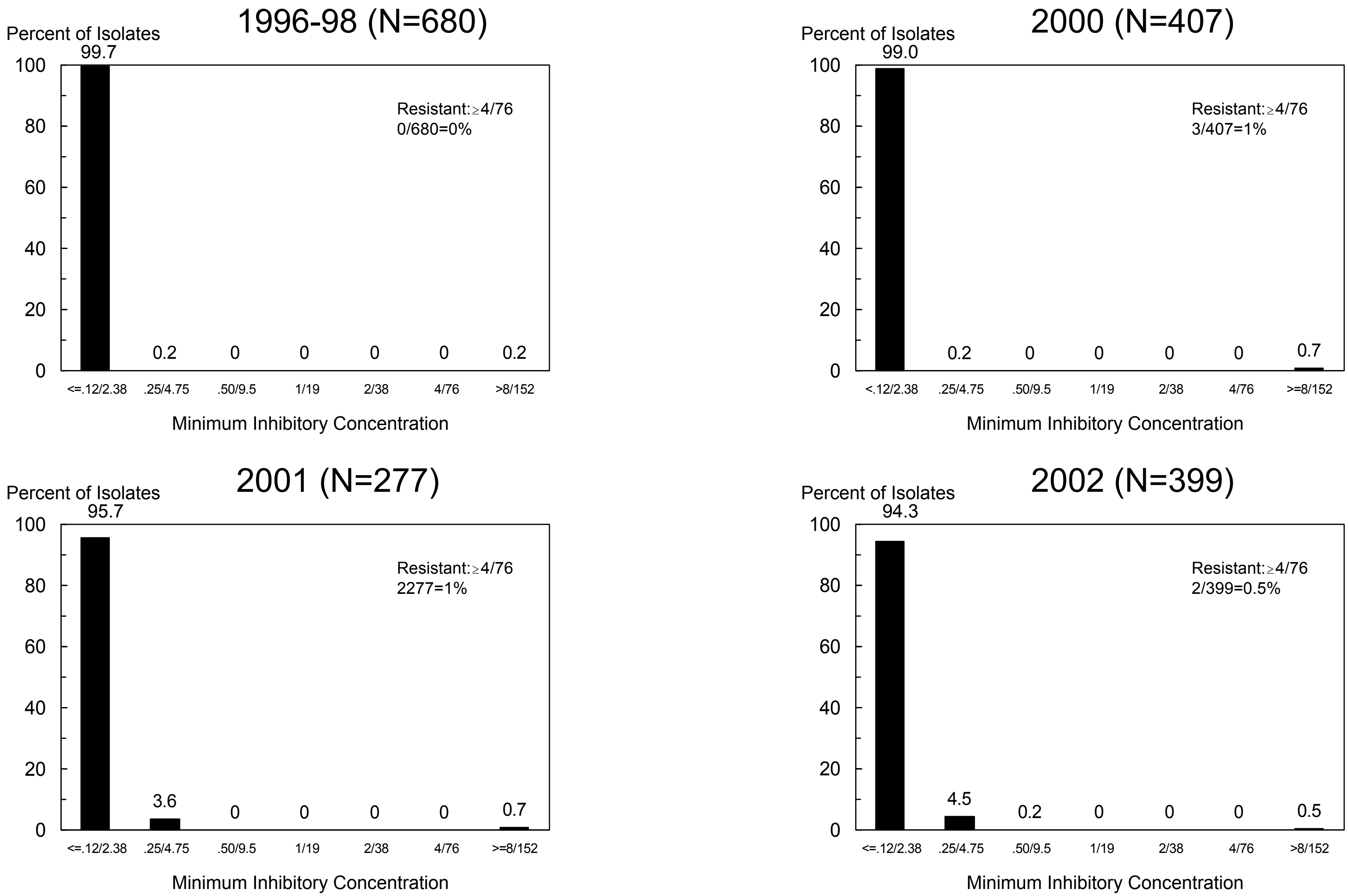
Figure 21p. MICs for trimethoprim-sulfamethoxazole among *E. coli* O157 isolates, 1996-1998† and 2000-2002



†1996-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the three years.

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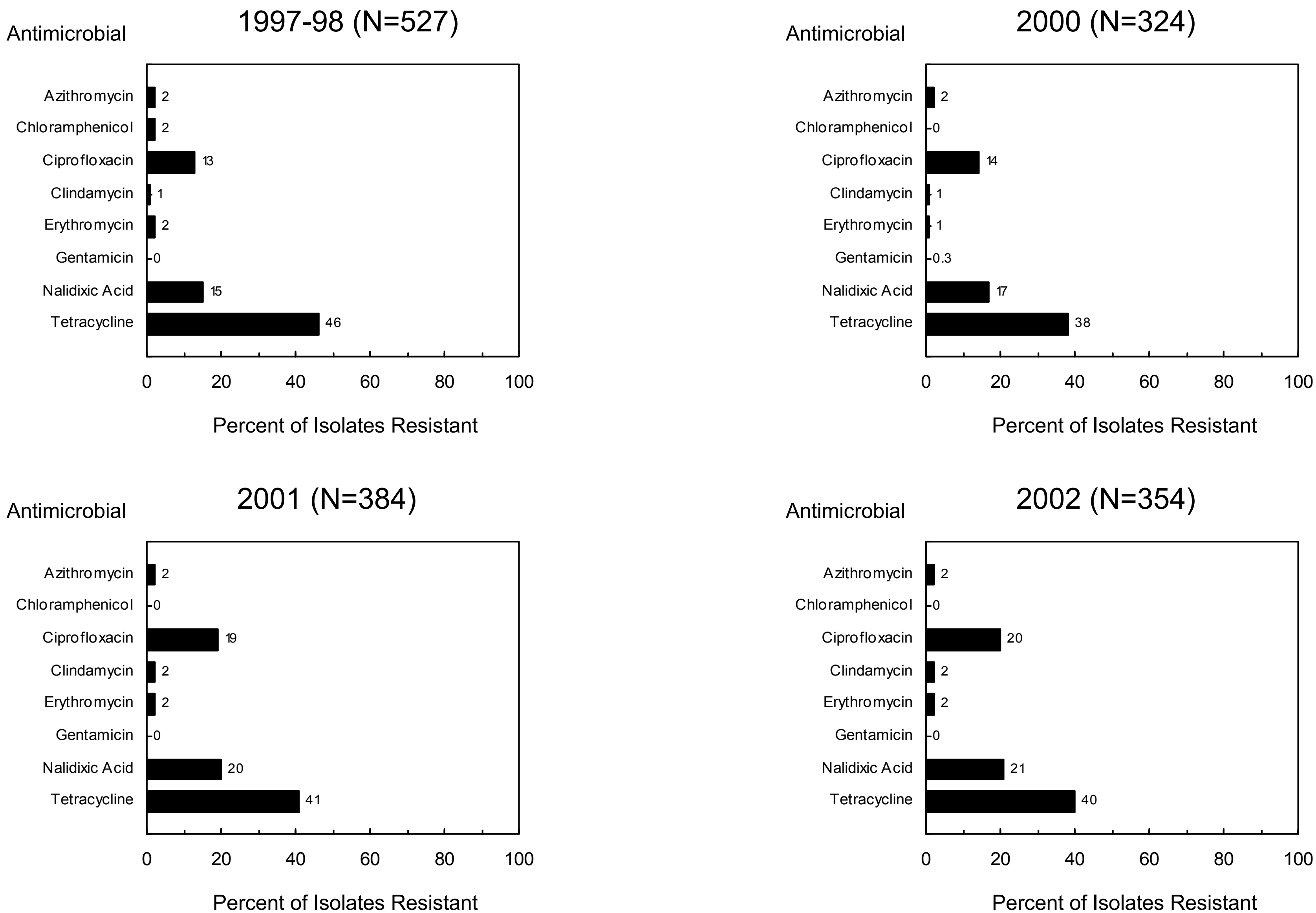
Figure 22. Resistance among *Campylobacter* isolates, 1997-98† and 2000-2002



†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

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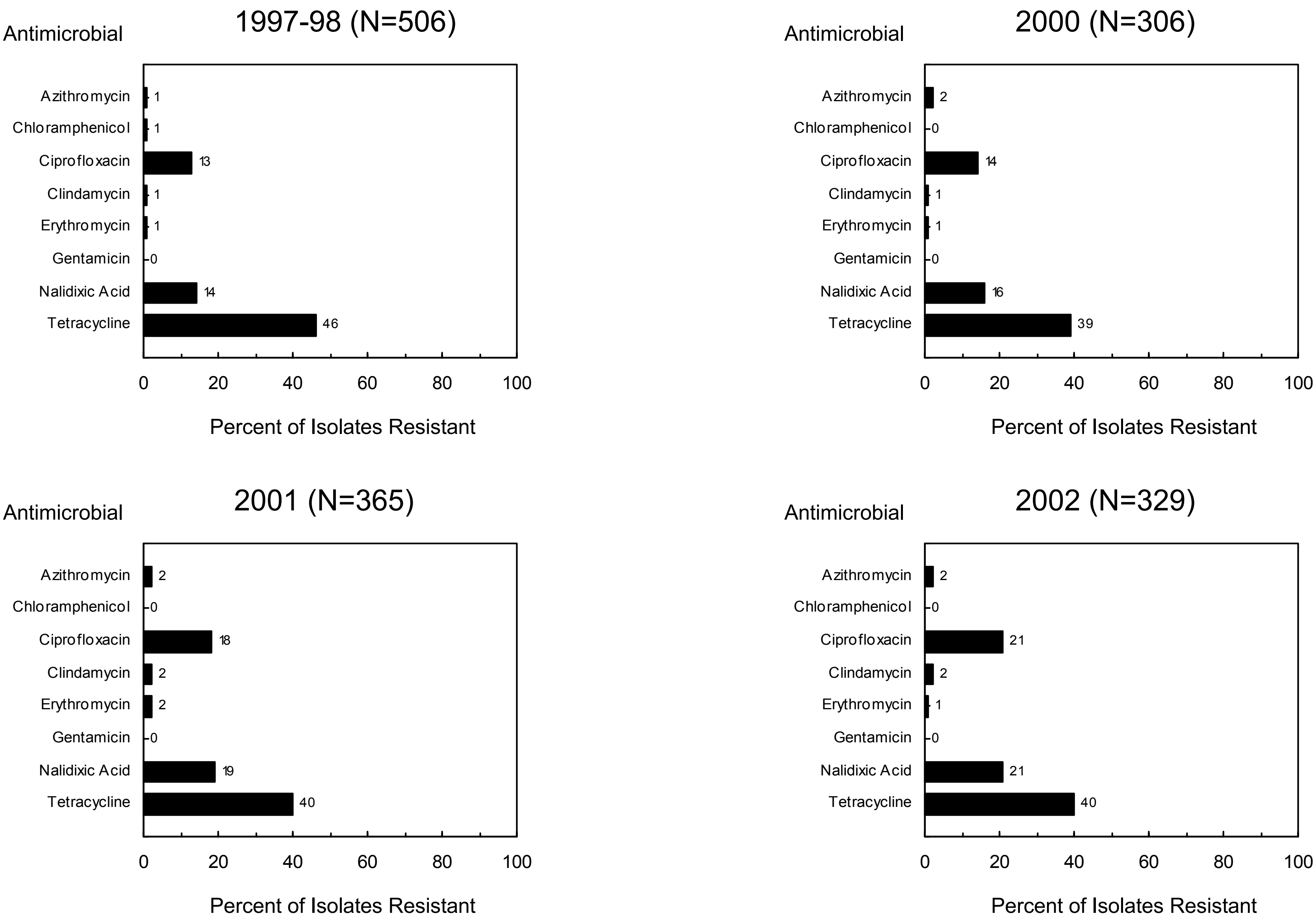
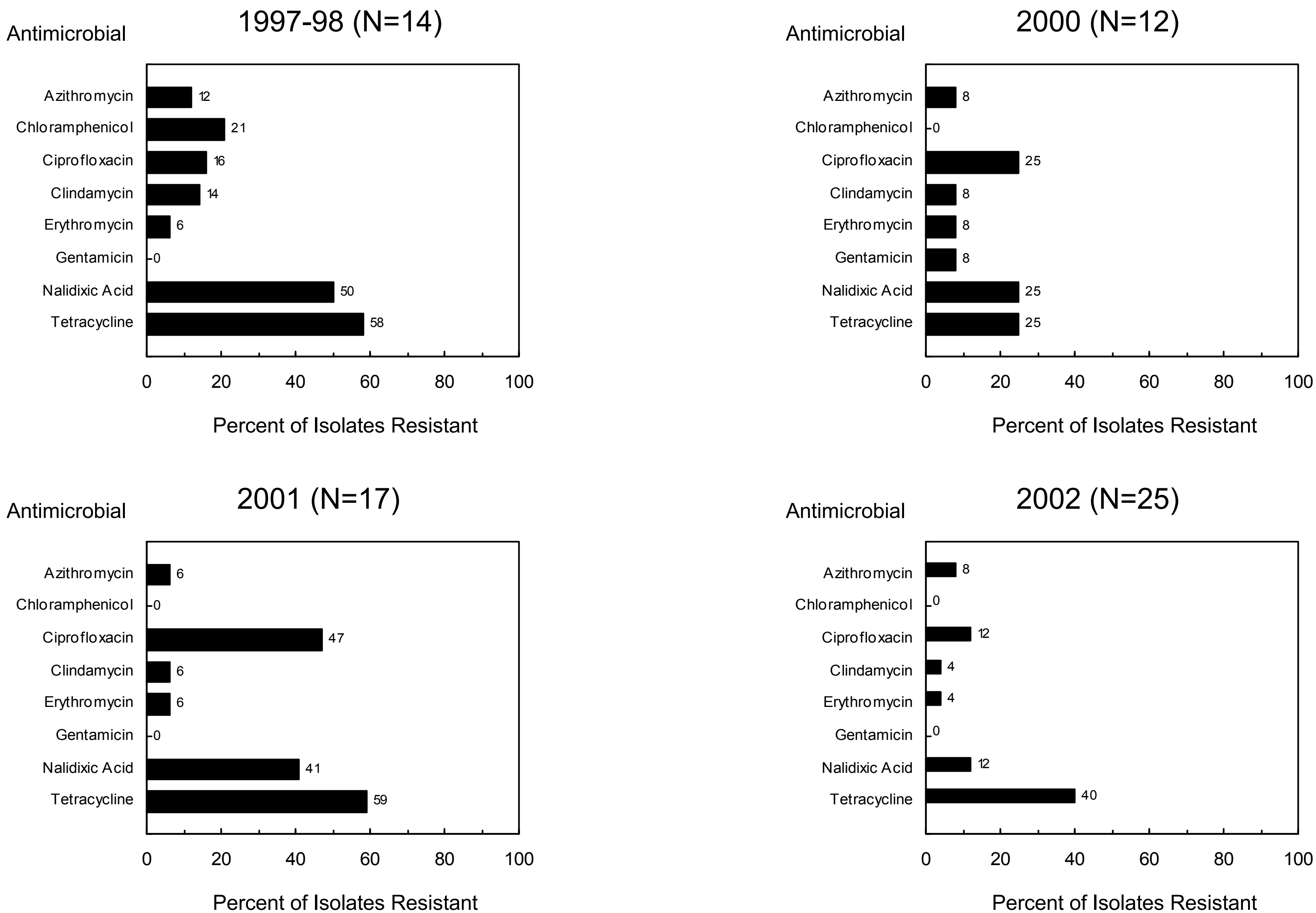
Figure 23a. Resistance among *Campylobacter jejuni* isolates, 1997-98† and 2000-2002



†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

Figure 23b. Resistance among *Campylobacter coli* isolates, 1997-98† and 2000-2002



†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

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Figure 24a. MICs for azithromycin among *Campylobacter jejuni* isolates, 1998 and 2000-2002

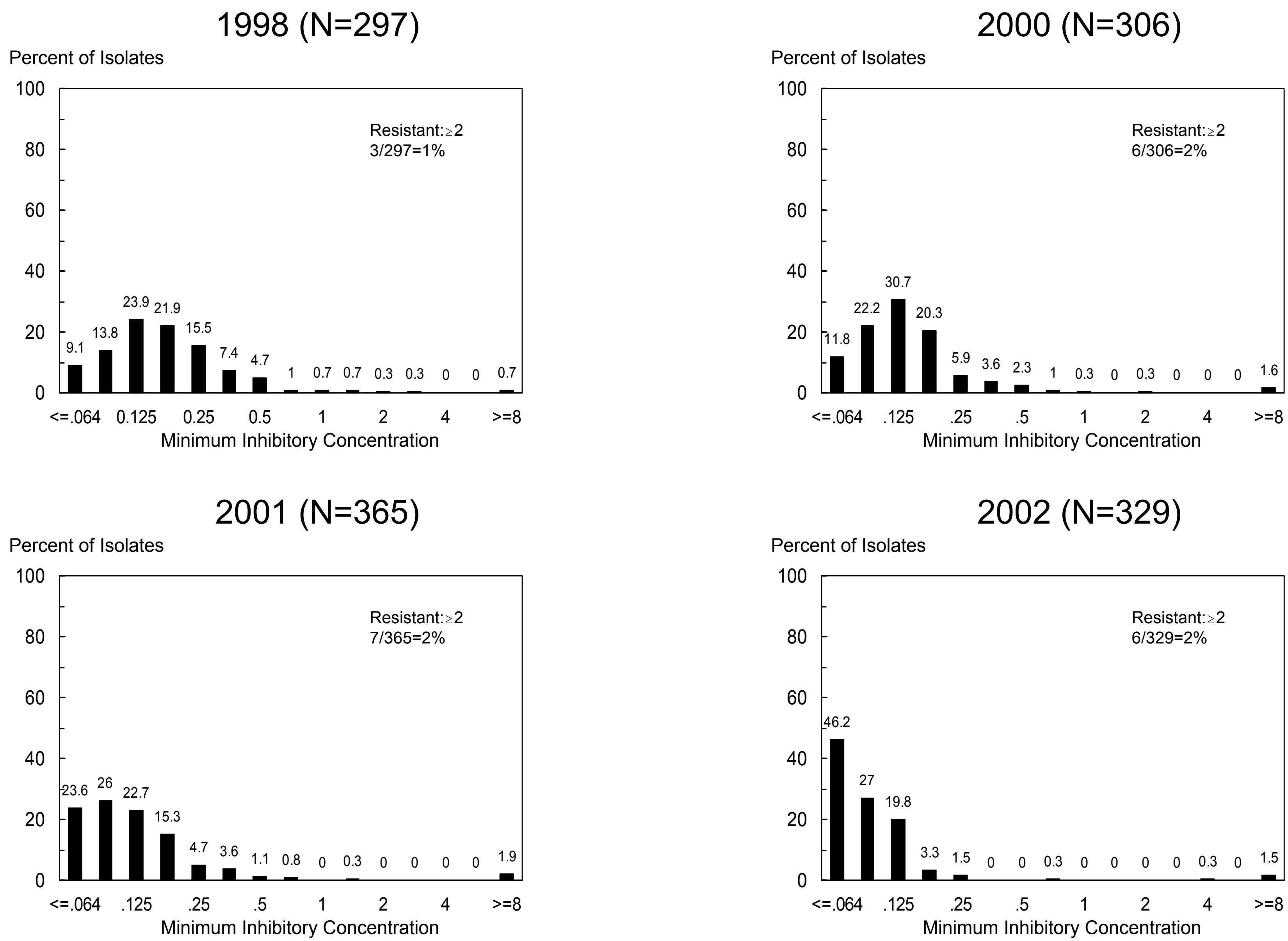

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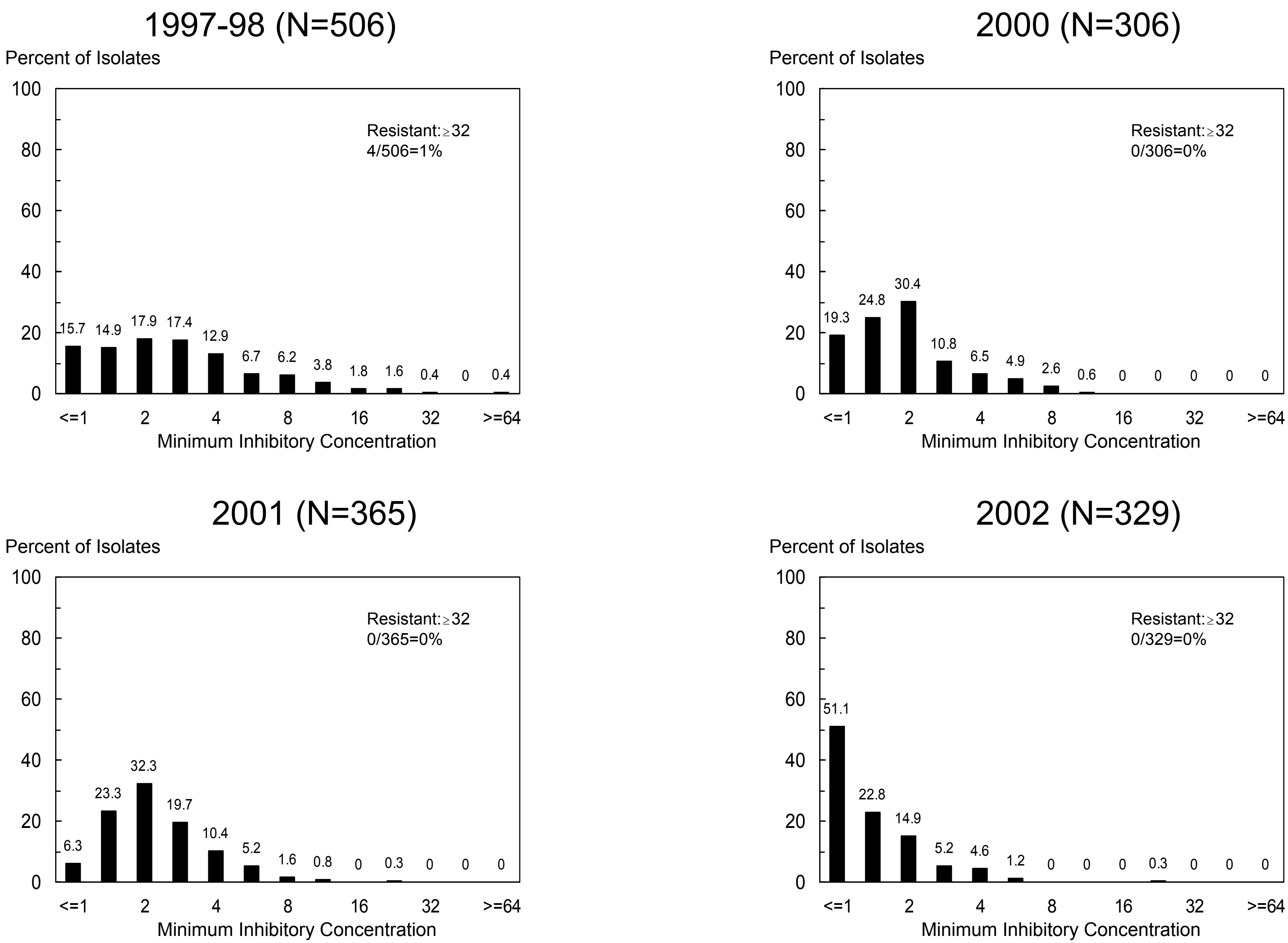
Figure 24b. MICs for chloramphenicol among *Campylobacter jejuni* isolates, 1997-98† and 2000-2002



†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

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Figure 24c. MICs for ciprofloxacin among *Campylobacter jejuni* isolates, 1997-98† and 1999-2002

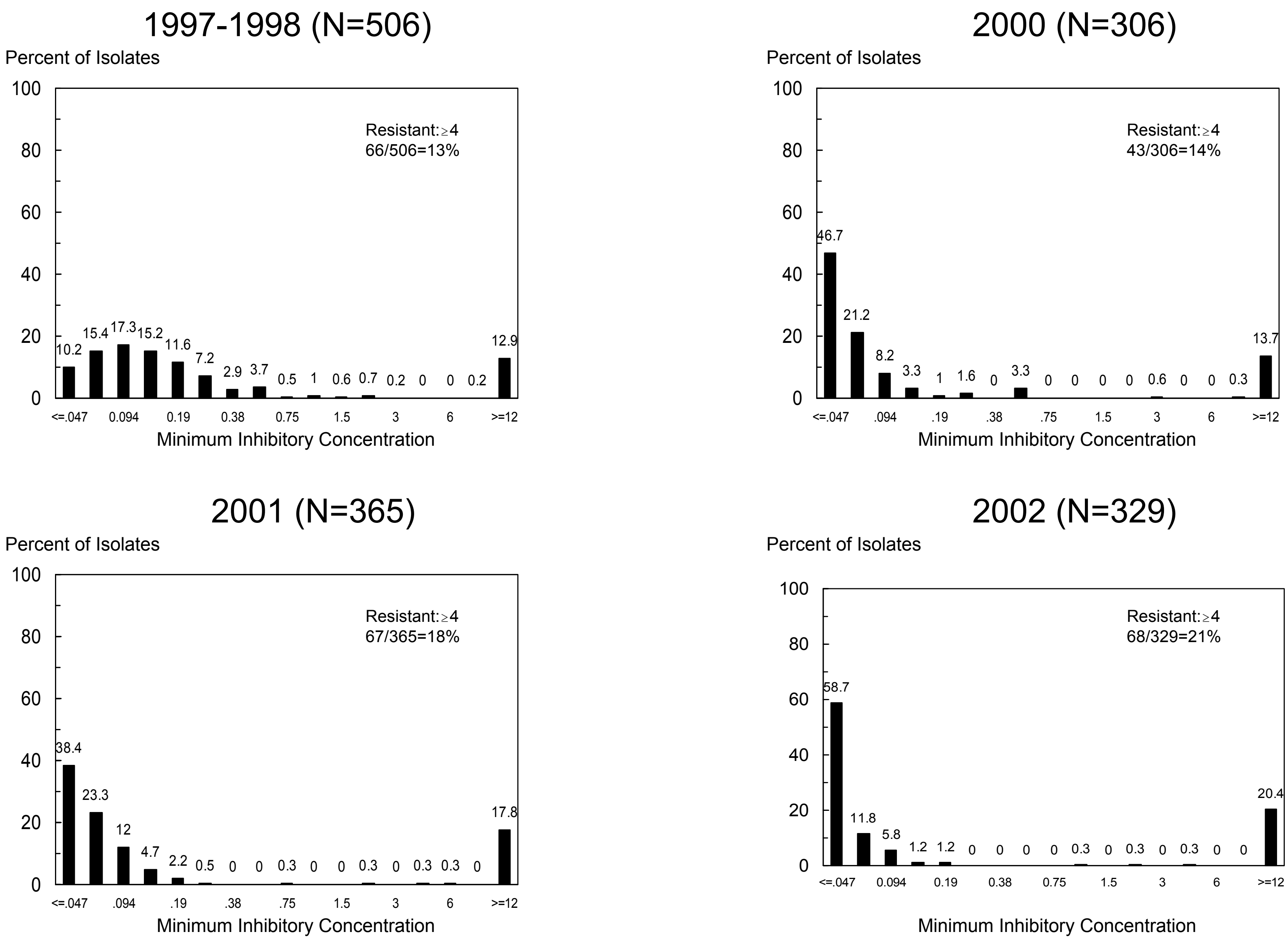

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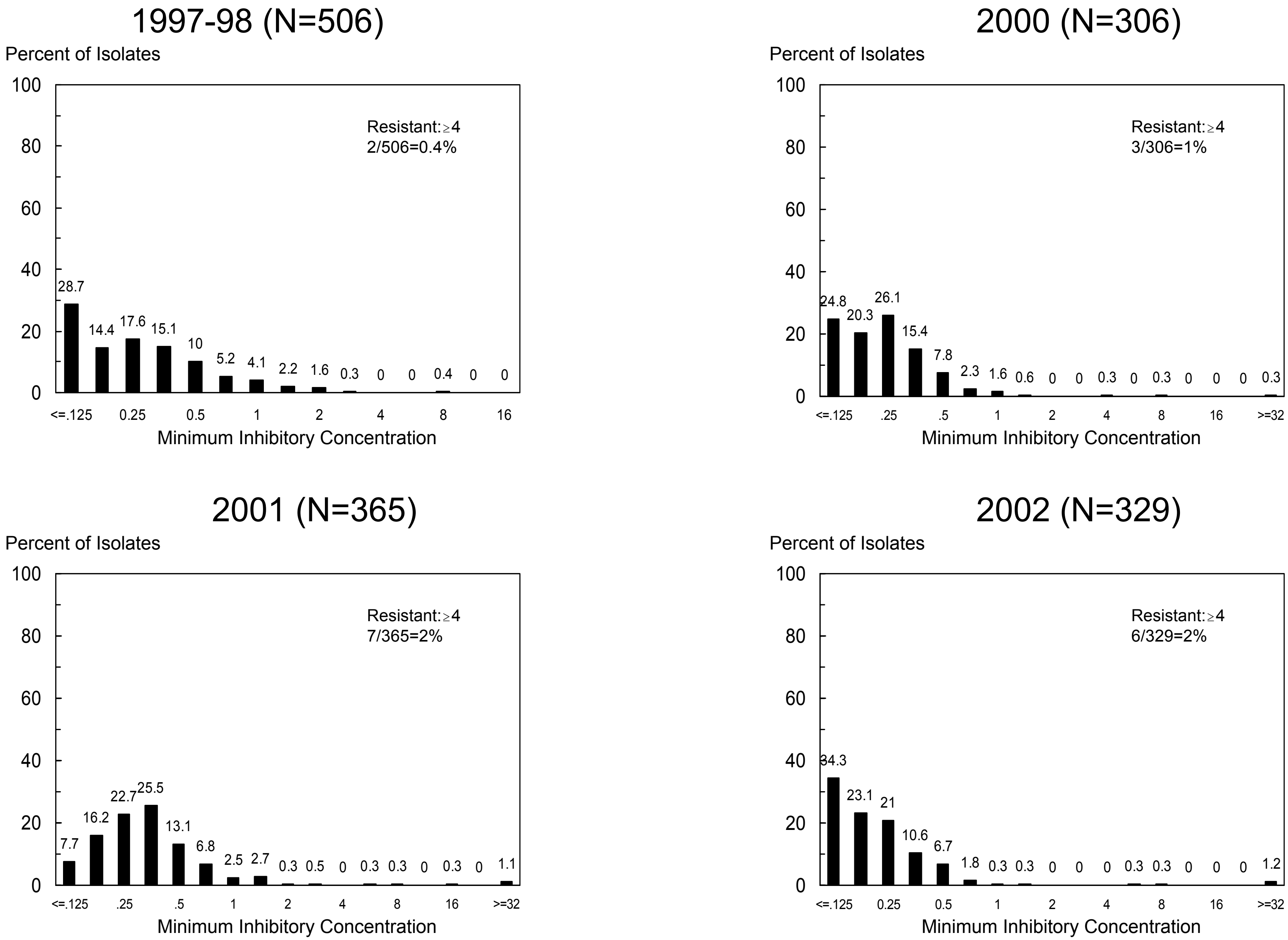
Figure 24d. MICs for clindamycin among *Campylobacter jejuni* isolates, 1997-98 and 2000-2002



†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

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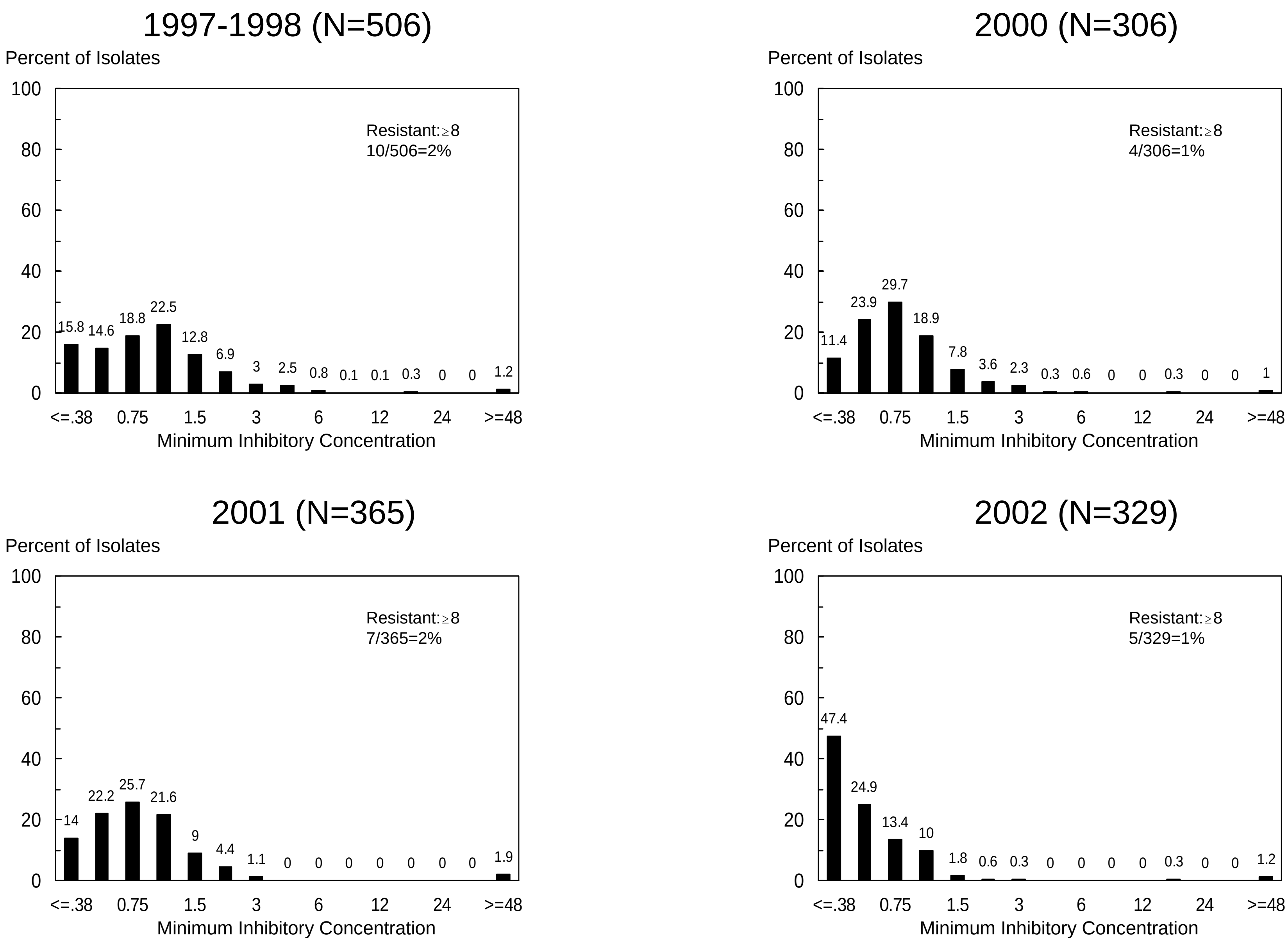
Figure 24e. MICs for erythromycin among *Campylobacter jejuni* isolates, 1997-98† and 1999-2002



†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

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Figure 24f. MICs for gentamicin among *Campylobacter jejuni* isolates, 1998 and 1999-2002

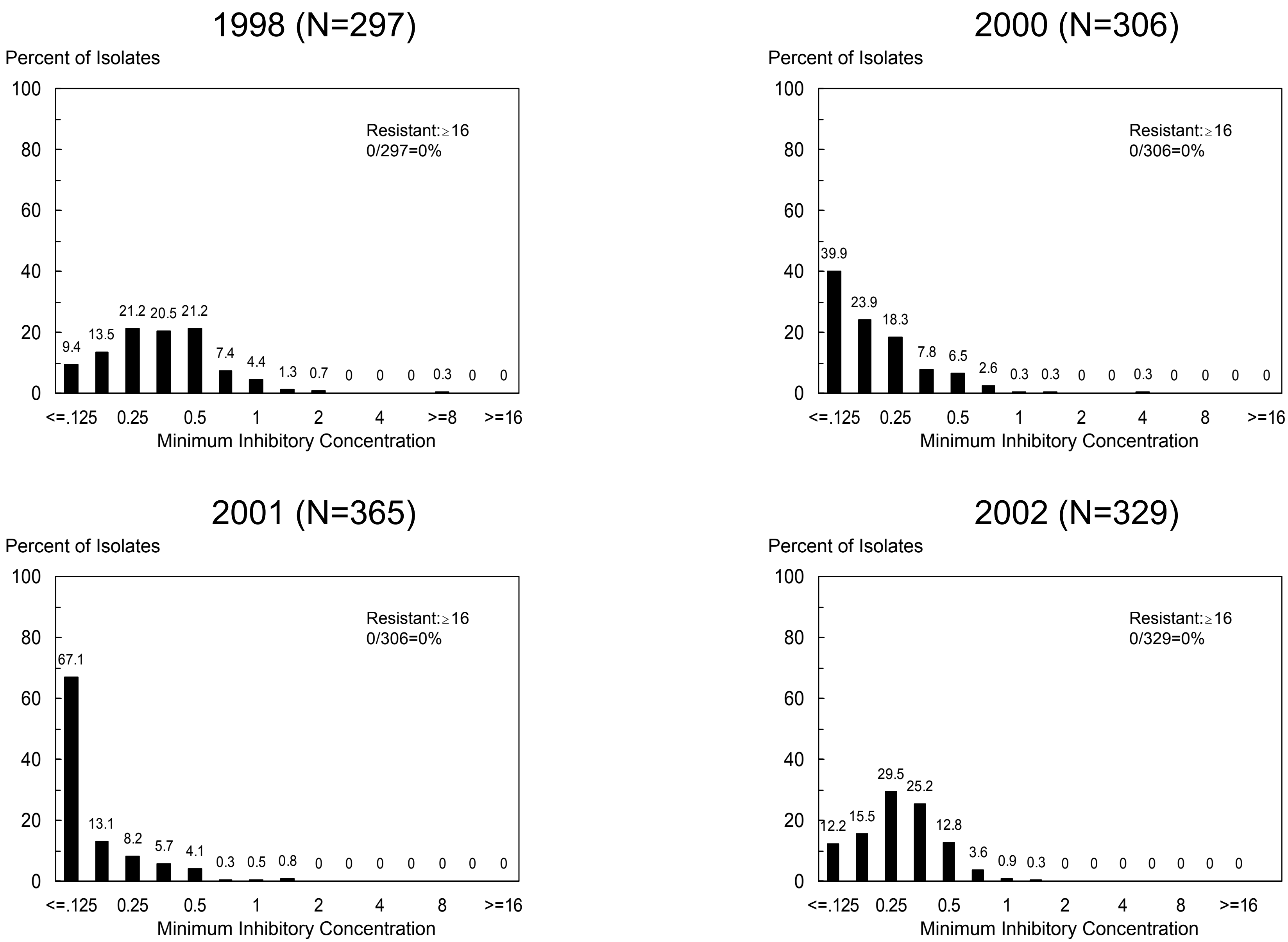

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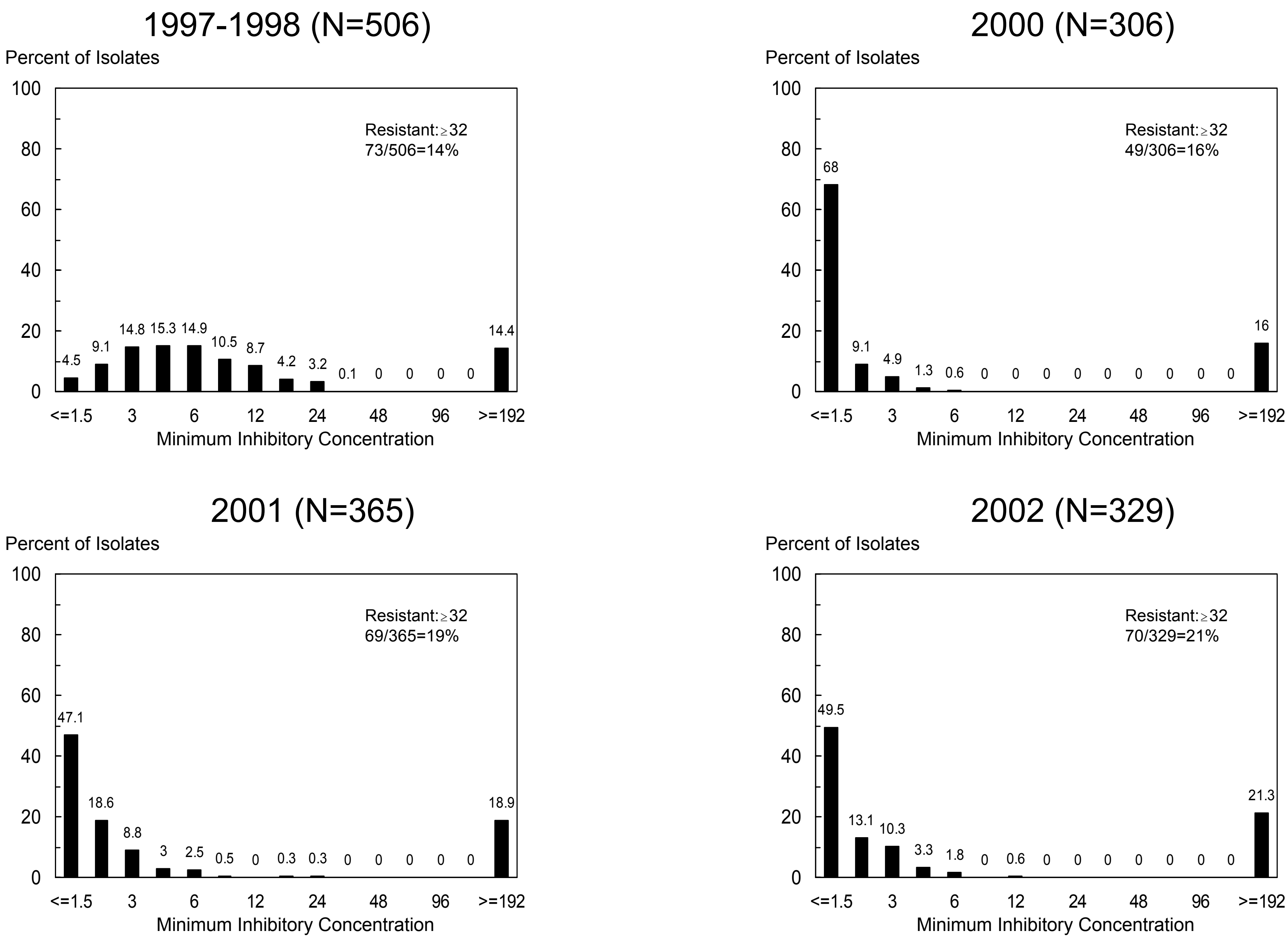
Figure 24g. MICs for nalidixic acid among *Campylobacter jejuni* isolates, 1997-98† and 2000-2002



†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

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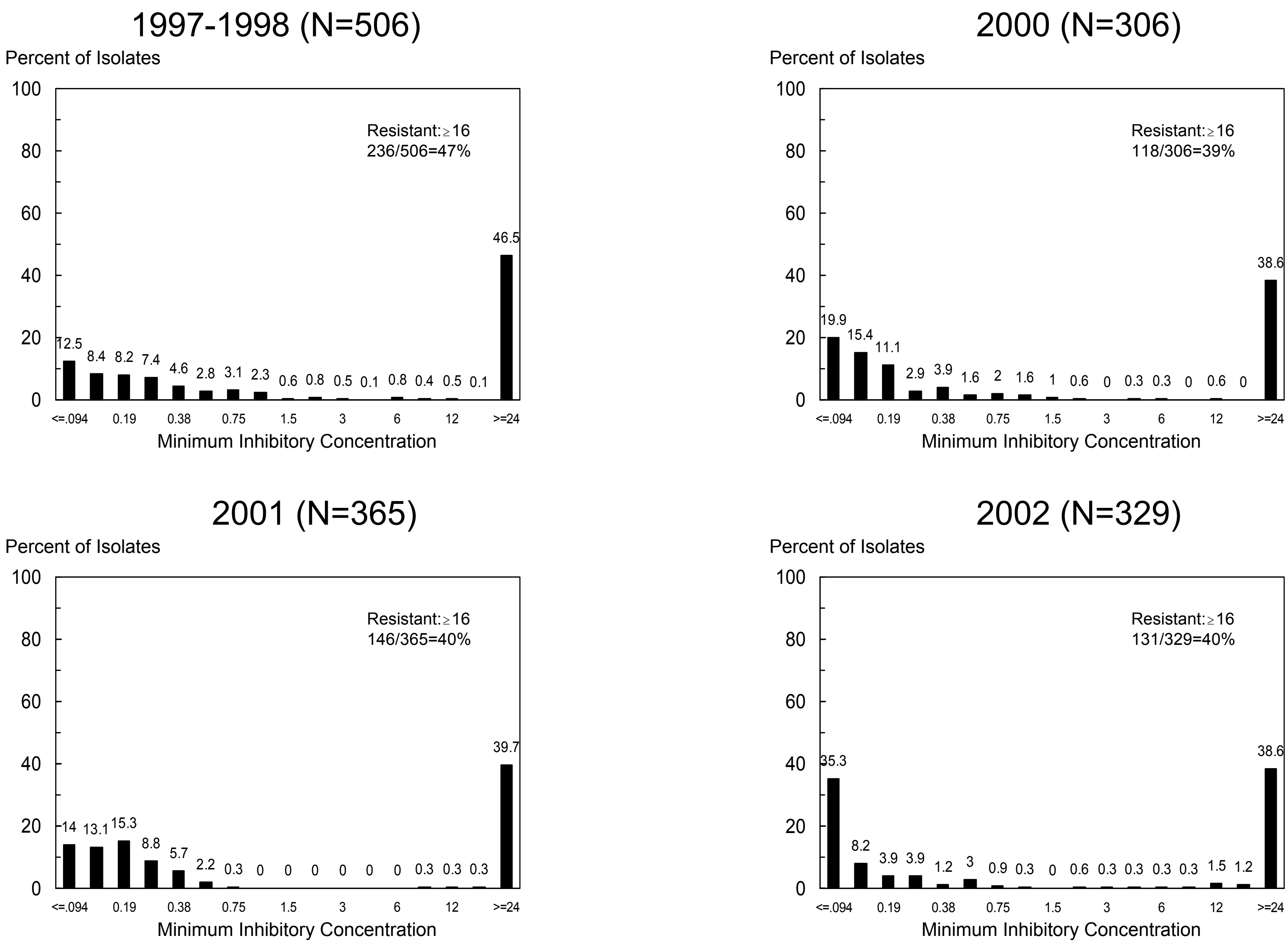
Figure 24h. MICs for tetracycline among *Campylobacter jejuni* isolates, 1997-98† and 2000-2002



†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

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Figure 25a. MICs for azithromycin among *Campylobacter coli* isolates, 1998 and 2000-2002

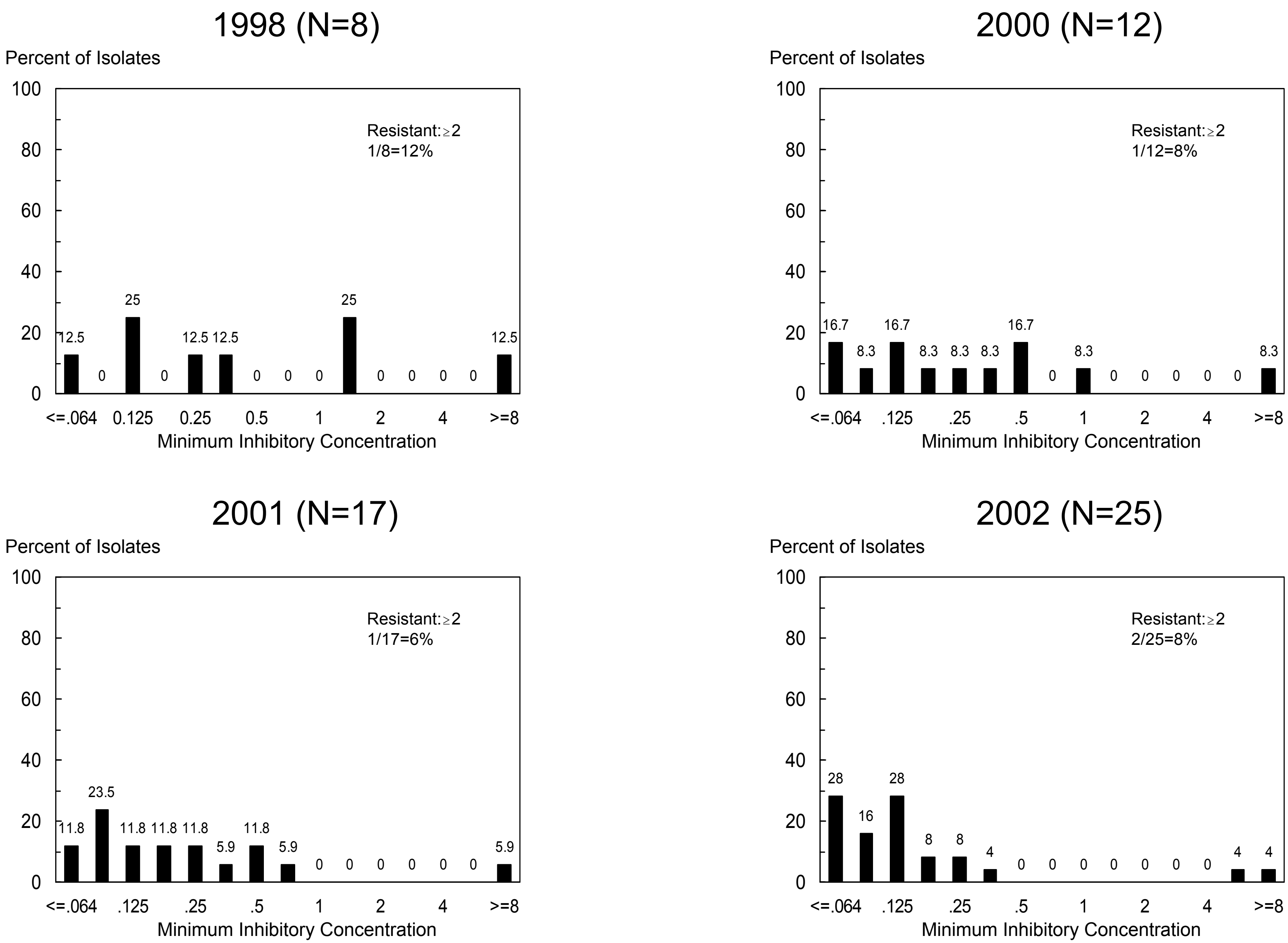

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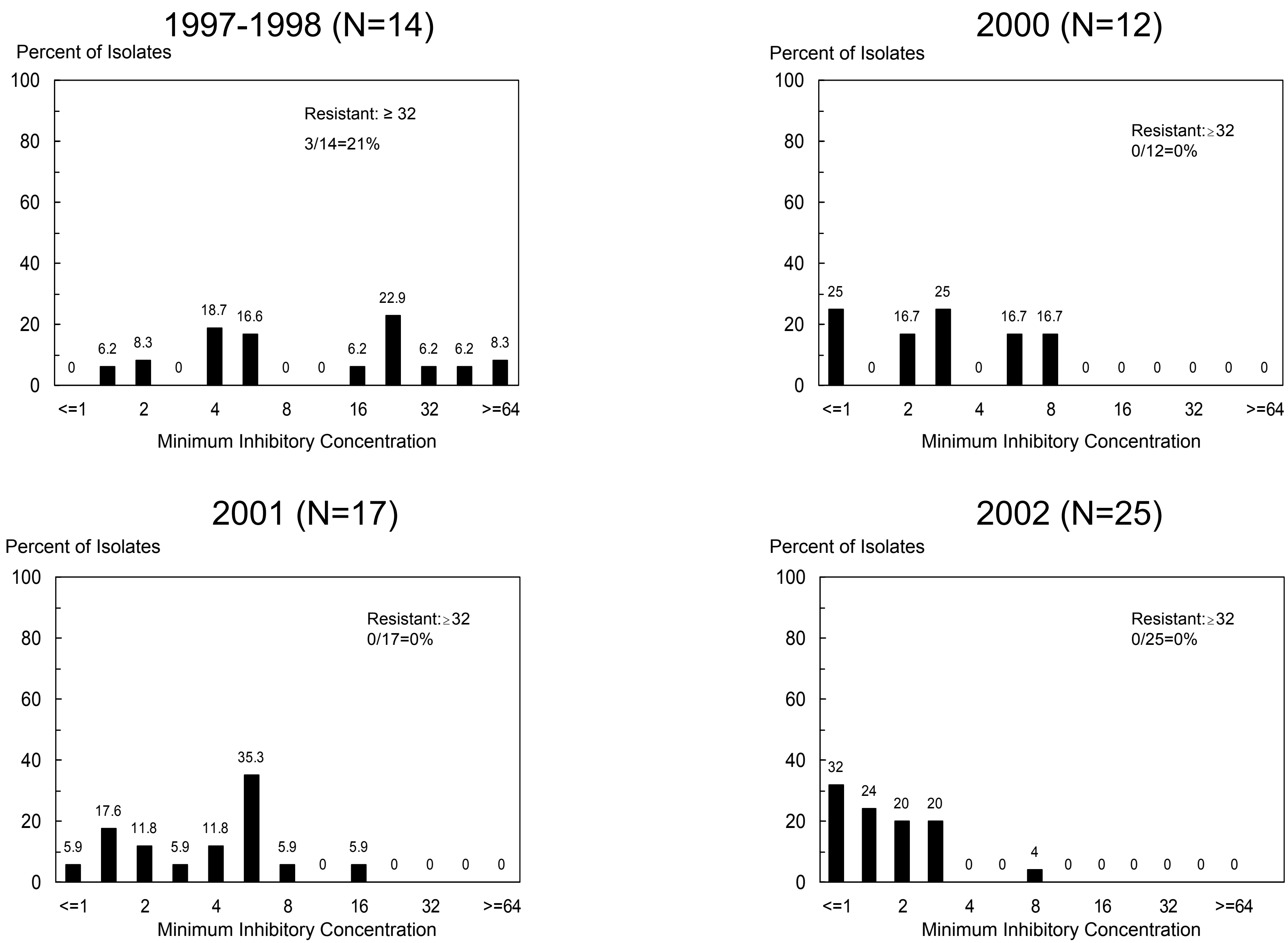
Figure 25b. MICs for chloramphenicol among *Campylobacter coli* isolates, 1997-98† and 2000-2002



†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

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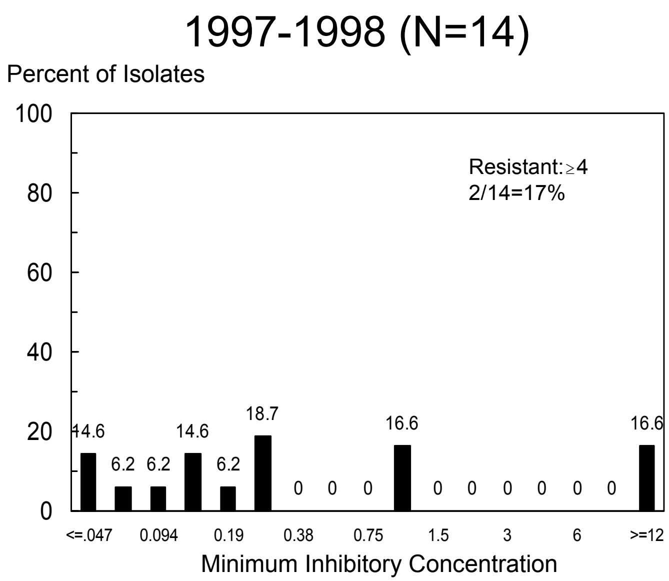
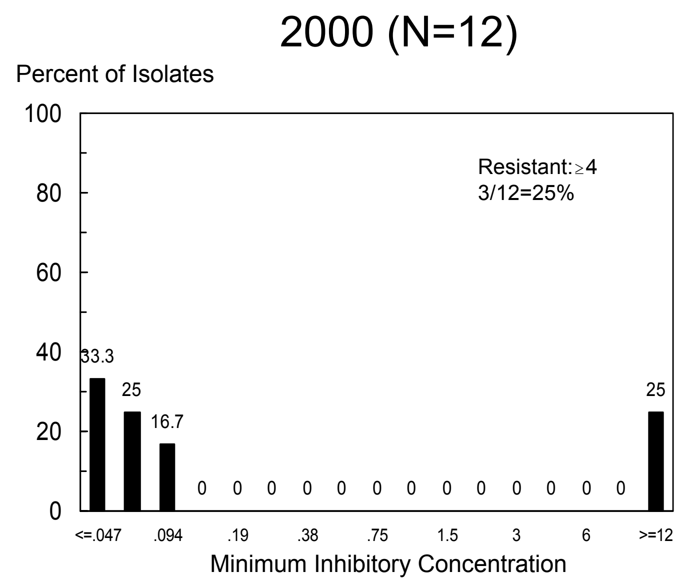
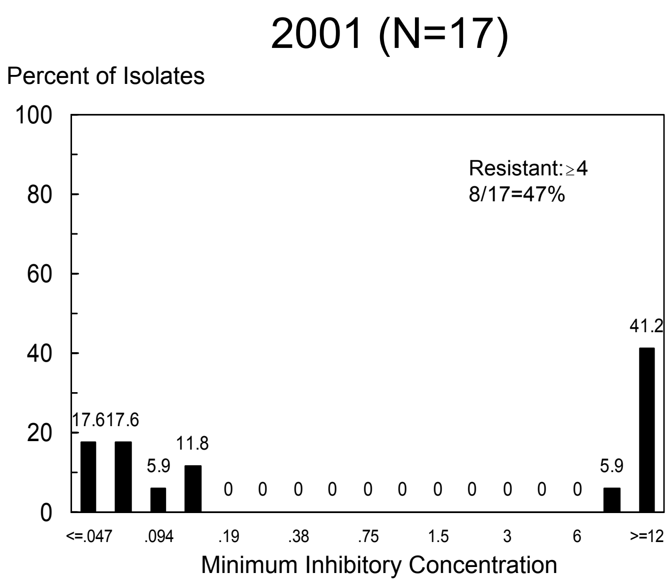
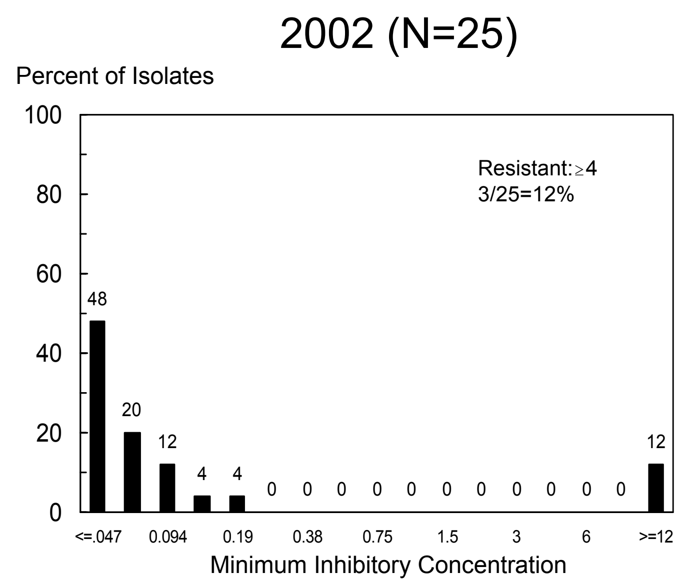
Figure 25c. MICs for ciprofloxacin among *Campylobacter coli* isolates, 1997-98† and 2000-2002









†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

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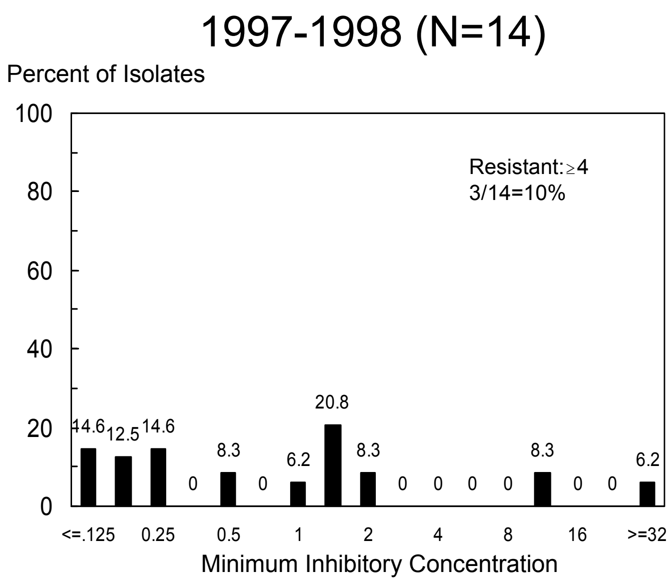
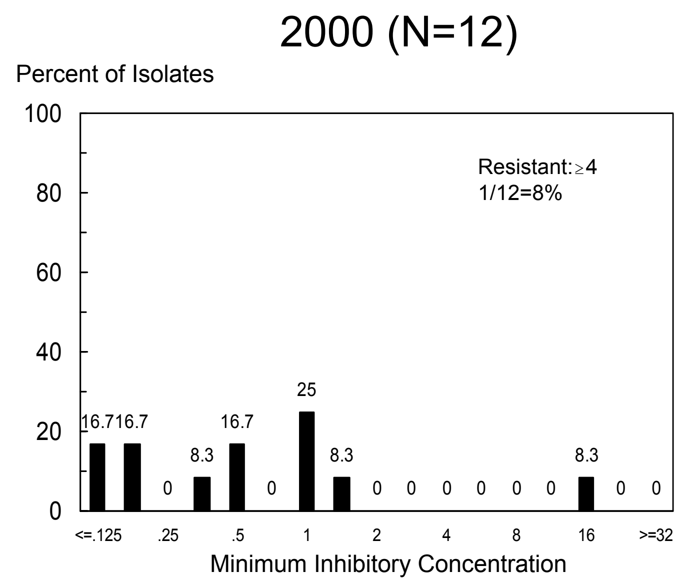
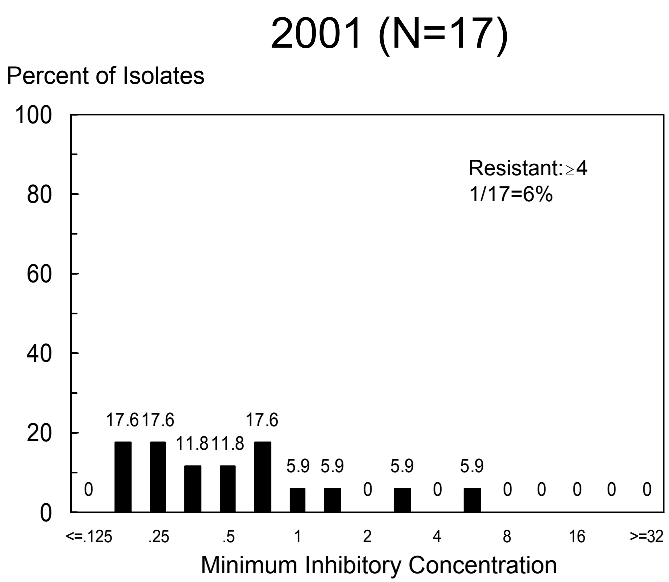
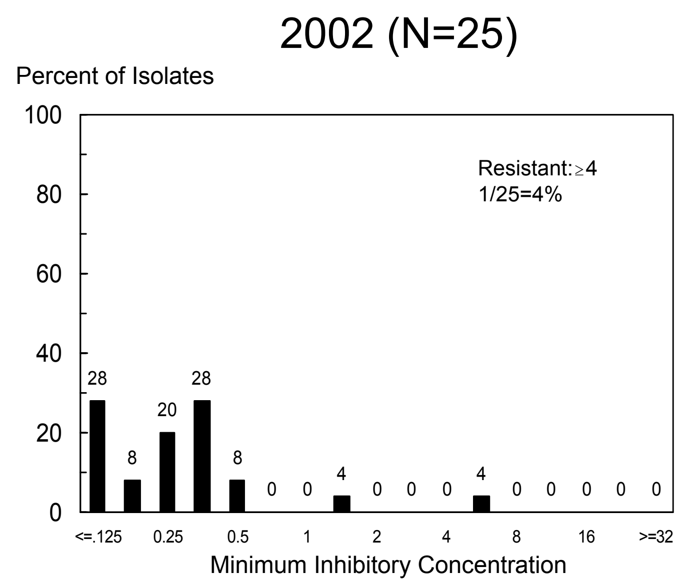
Figure 25d. MICs for clindamycin among *Campylobacter coli* isolates, 1997-98† and 2000-2002









†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

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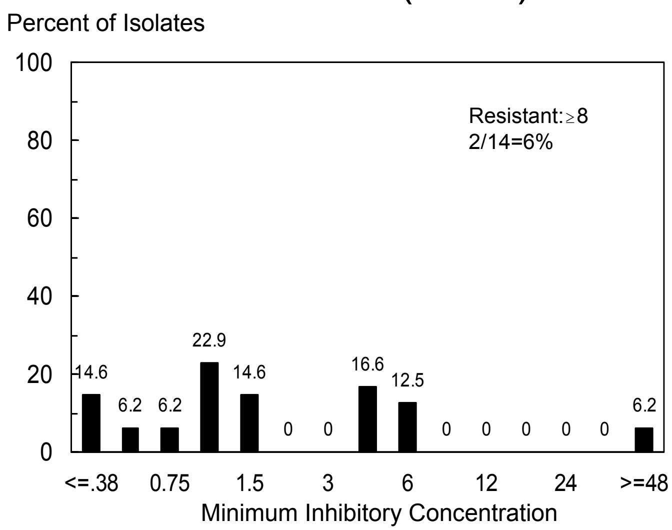
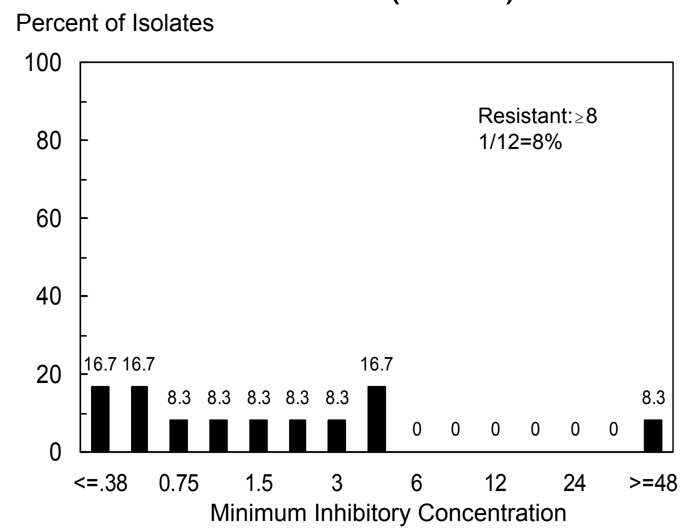
Figure 25e. MICs for erythromycin among *Campylobacter coli* isolates, 1997-98† and 2000-2002

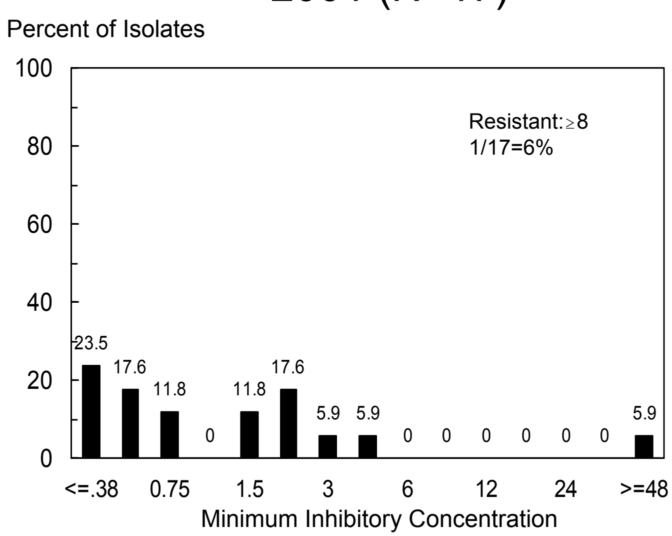
1997-98 (N=14)



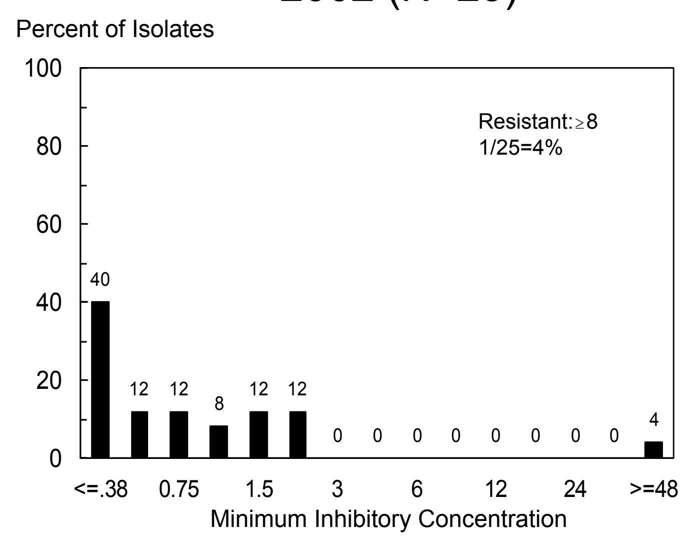
2000 (N=12)



2001 (N=17)



2002 (N=25)



†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

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Figure 25f. MICs for gentamicin among *Campylobacter coli* isolates, 1998 and 2000-2002

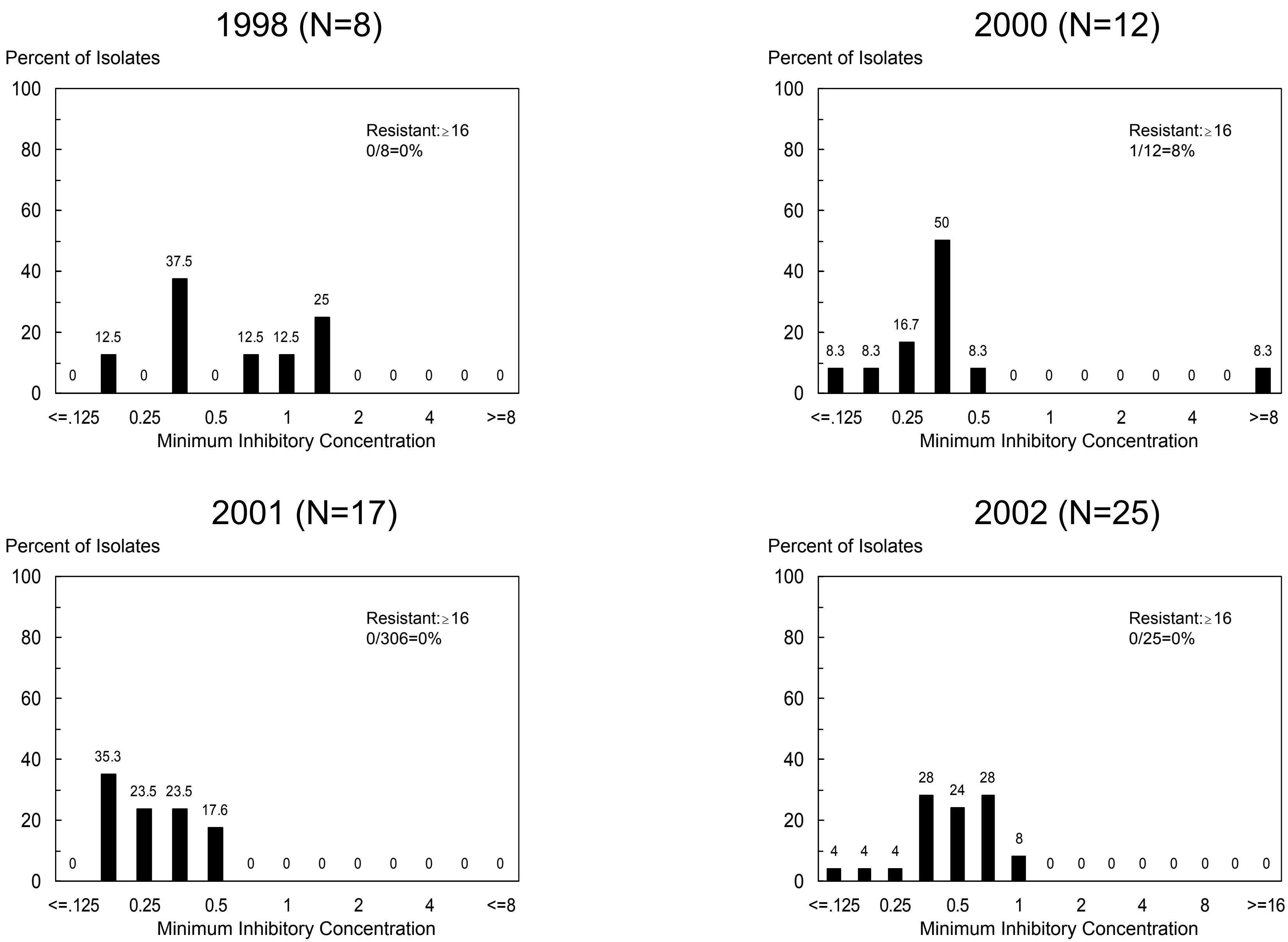

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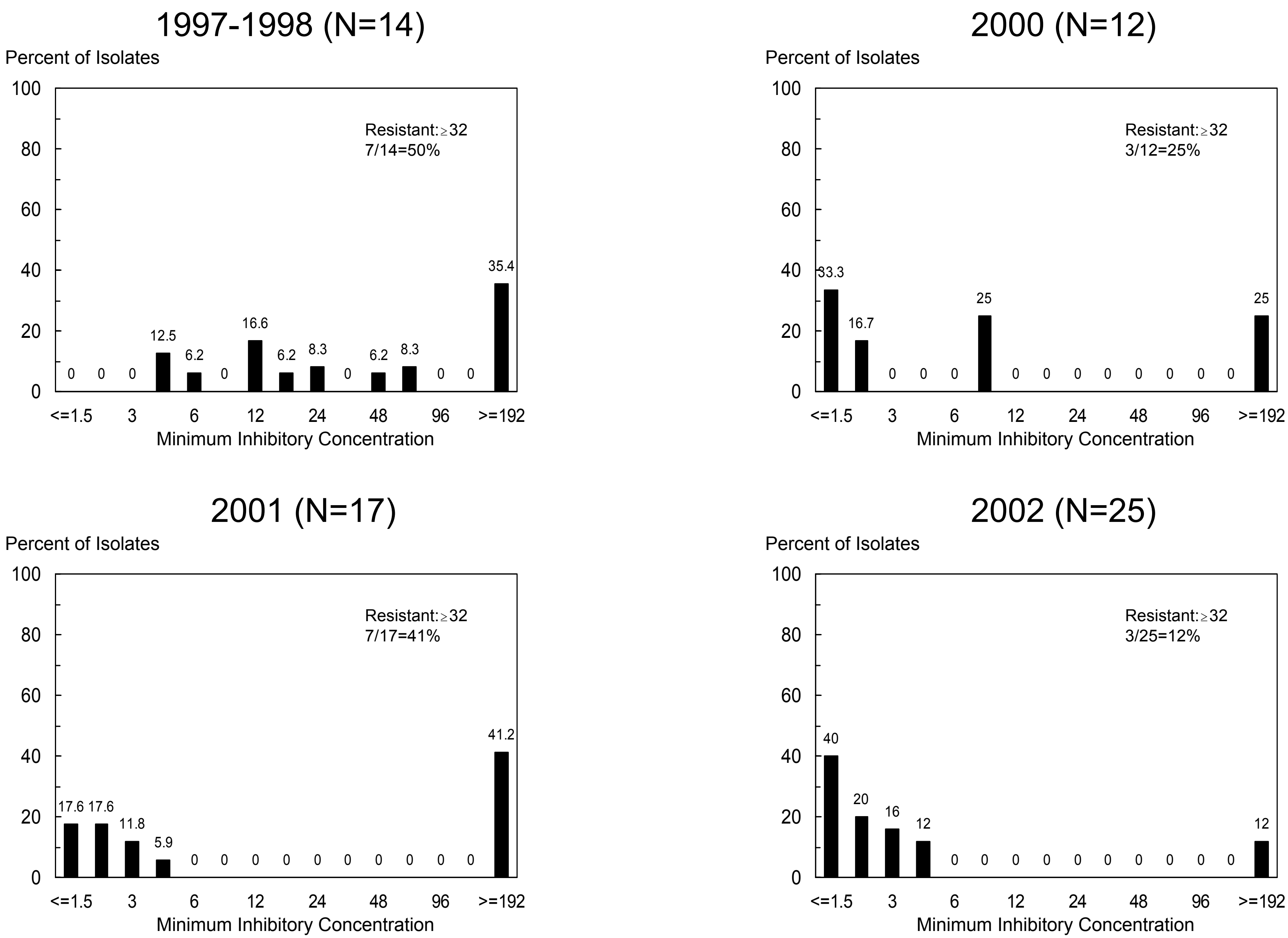
Figure 25g. MICs for nalidixic acid among *Campylobacter coli* isolates, 1997-98† and 1999-2002



†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.

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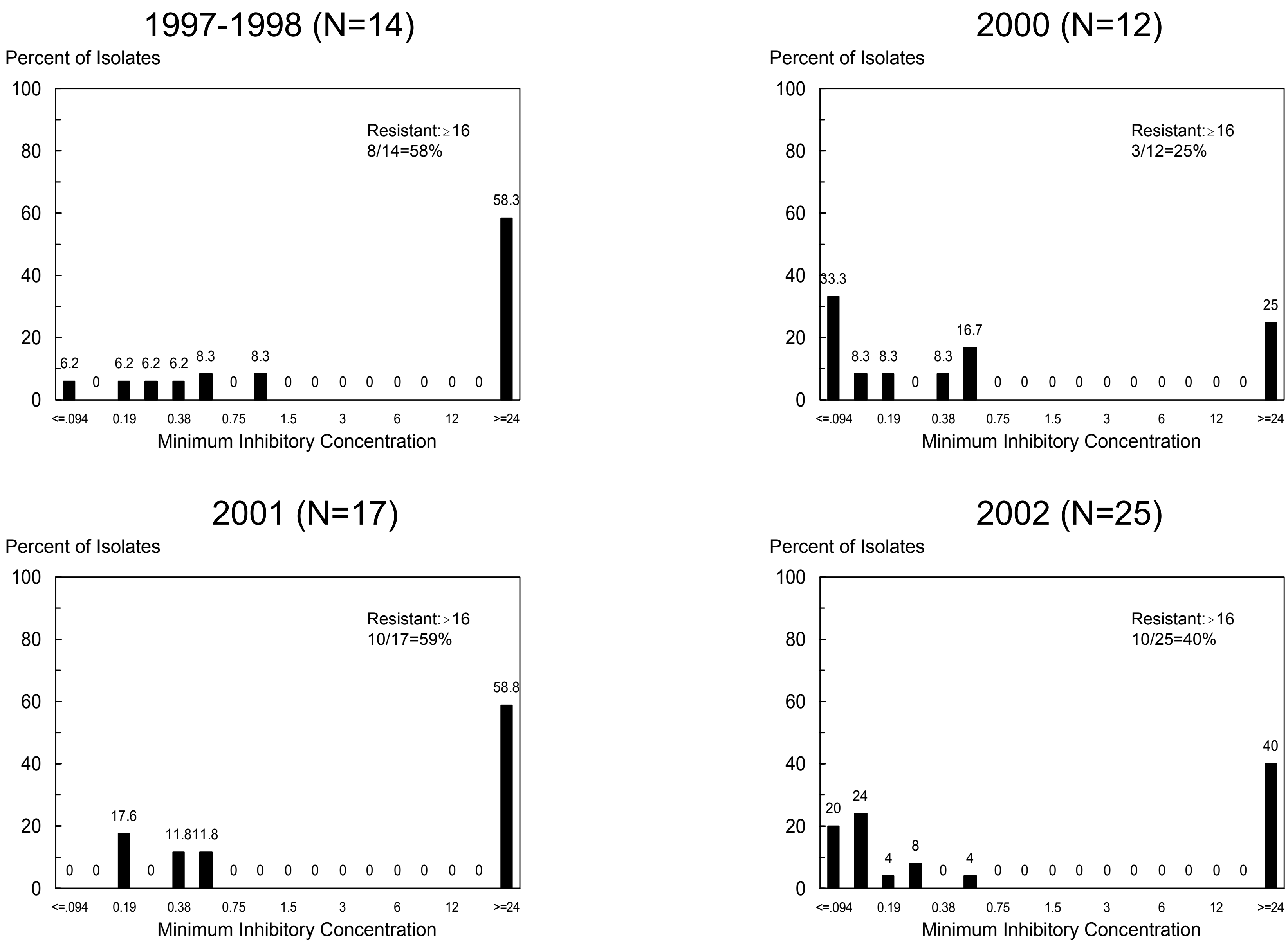
Figure 25h. MICs for tetracycline among *Campylobacter coli* isolates, 1997-98† and 2000-2002



†1997-1998 data include the total number of isolates (N) and average percentage of isolates corresponding to the MICs values for the two years.