ANTIMICROBIAL RESISTANCE TRENDS IN NEW ZEALAND, 2001

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by

Helen Heffernan
Nick Garrett
Rosemary Woodhouse

Antibiotic Reference Laboratory
Communicable Disease Group
ESR
Porirua

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SUMMARY

This report describes some of the trends in antimicrobial resistance in New Zealand. It uses data routinely collected and generated as part of ESR's ongoing surveillance of antimicrobial resistance. Two data sources were used for this trend analysis: (1) antimicrobial resistance data from hospital and community diagnostic laboratories, and (2) data generated at ESR from the ongoing surveillance of resistance among invasive pathogens and *Salmonella* referred to ESR.

ESR has collected and analysed antimicrobial resistance data from hospital and community diagnostic laboratories since 1988. These data are based on the laboratories' routine diagnostic antimicrobial susceptibility testing. The data collected are limited to specific organisms and antibiotics. The number of diagnostic laboratories which have submitted data to this surveillance system has varied from year to year. When these data are analysed for trend, only data from laboratories which have participated in each of the years covered by the analyses (core laboratories) are included. The two previous trend analyses have covered 9- and 10-year periods and data from only four laboratories, all hospital laboratories, were able to be included. For this report the time period was reduced to the five years 1997-2001. As a result, data from the original four hospital laboratories, four community laboratories, and one laboratory which processes both hospital and community specimens were included. This enabled, for the first time, some comparisons of resistance among community and hospital isolates.

Analysis of data from the nine core diagnostic laboratories identified several notable and significant changes between 1997 and 2001, including:

- increases in resistance to all antibiotics analysed for trend among hospital and community *Staphylococcus aureus*
- decreases in resistance to several ß-lactams among the two members of the *Enterobacteriaceae* included in the study, *Escherichia coli* and *Klebsiella*, and among *Pseudomonas aeruginosa*
- increases in resistance to ampicillin, co-amoxiclav and co-trimoxazole, and ß-lactamase production among *Haemophilus influenzae* from non-invasive infections
- an increase in ampicillin resistance among hospital enterococci
- increases in resistance to methicillin/oxacillin, gentamicin and co-trimoxazole among coagulase-negative staphylococci from blood.

ESR also monitors resistance among isolates from invasive disease caused by *Streptococcus pneumoniae, H. influenzae* and *Neisseria meningitidis*. These isolates are referred to ESR as part of the laboratory-based surveillance of invasive disease. Similarly, resistance among *Salmonella* is monitored using isolates routinely referred to ESR for epidemiological typing. Trends in resistance among invasive pathogens over the 10 years 1992-2001 were analysed and trends in resistance among *Salmonella* since 1987 were analysed.

continued

SUMMARY *continued*

While over the whole 10 years 1992-2001, penicillin resistance in *S pneumoniae* increased, resistance decreased during the 1998-2001 period. Pneumococcal cefotaxime nonsusceptibility (resistance and intermediate resistance) also increased overall, but decreased in 2001. The prevalence of reduced penicillin susceptibility among meningococci from invasive disease increased between 1992 and 2001. However, these isolates are still susceptible to normal penicillin treatment regimens for meningococcal meningitis.

No significant trends in resistance among *Salmonella* were detected.

RECOMMENDATIONS

- The antimicrobial resistance data collated from diagnostic laboratories should continue to be reviewed for trends on a regular basis.

- The antimicrobial resistance of isolates from invasive disease and *Salmonella* should continue to be reviewed for trends on a regular basis.

- The analysis of trends in antimicrobial resistance should be extended by the inclusion of data from other existing surveillance systems, for example, the surveillance of antituberculosis-drug resistance.

- The information in this report should be made available to health professionals, including diagnostic laboratories, to encourage their participation in the surveillance of antimicrobial resistance.

1 INTRODUCTION

Each year since 1988, ESR has collected and analysed antimicrobial resistance data from hospital and community diagnostic laboratories. These data are based on the results of the laboratories' routine antimicrobial susceptibility testing. This surveillance system was begun in response to a request from the World Health Organization (WHO) for representative national antimicrobial resistance data from each country in the Western Pacific Region. The WHO specify a minimum data set of bacteria and resistances to be collected. This data set, in particular the antimicrobials included, has been extended to make the information more relevant to clinical and prescribing practice in New Zealand. For example, mupirocin resistance in *Staphylococcus aureus*, high-level gentamicin resistance in *Enterococcus*, cefotaxime resistance in *Streptococcus pneumoniae*, and erythromycin resistance in *Streptococcus pyogenes*, have been added.

In 1999, the Ministry of Health's Antimicrobial Resistance Working Group Surveillance Subcommittee recommended that the data from this surveillance system be analysed for trends. The number of diagnostic laboratories that have contributed data to the surveillance system each year has varied from seven in 1988 to a maximum of 28 in 2001. As a result, year-to-year variations in the estimated national rates of resistance could represent factors other than time trends. For example, they could represent geographical variations depending on the location of the contributing laboratories or differences between hospital-acquired and community-acquired pathogens depending on whether the contributing laboratories process specimens from in-patients or community patients. Therefore, the trend analyses included in this report only use data from laboratories which have consistently contributed to the surveillance system.

A second source of resistance data is used for the trend analyses included in this report. *S. pneumoniae, Haemophilus influenzae,* and *Neisseria meningitidis* isolates from bacteraemias and sterile sites (invasive disease) are routinely referred to ESR for further epidemiological evaluation. Similarly, all clinical *Salmonella* isolates and a proportion of isolates from other sources are routinely referred to ESR for epidemiological typing. At ESR, the antimicrobial susceptibility of these invasive isolates and *Salmonella* is tested. The referral of these isolates to ESR is either relatively complete or at least representative, so testing of the isolates provides reliable national data. The surveillance of antimicrobial resistance among *Salmonella* began in 1972, *N. meningitidis* in 1975, *S. pneumoniae* in 1976, and *H. influenzae* in 1987.

Data from these surveillance systems were first analysed in 2000 for trends over the nine years 1991 to 1999.[1] In 2001, data were analysed for trends during the 10 years 1991 to 2000.[2] In these first two analyses, data from only four hospital laboratories were included as these were the only diagnostic laboratories which had contributed data in each of the years. For the analyses in this report that use antimicrobial resistance data from diagnostic laboratories, the time period covered has been reduced to five years (1997-2001) to enable a larger number of laboratories, and in particular community laboratories, to be included.

2 METHODOLOGY

Nine diagnostic laboratories contributed data each year during the five-year period 1997-2001. These laboratories are referred to in the report as the 'core laboratories' and are the microbiology laboratories at Auckland and Children's Hospital; Middlemore Hospital; Medical Diagnostic Laboratory, Auckland; Rotorua Hospital; Wanganui Diagnostic Laboratory; MedLab Central, Palmerston North; Valley Diagnostic Laboratories, Lower Hutt; Christchurch Hospital (Canterbury Health Laboratories); and Southern Community Laboratories, Dunedin. These laboratories include four hospital laboratories, four community laboratories and one laboratory (MedLab Central) that processes specimens from both hospital and community patients. In addition, the four community laboratories process specimens from private hospitals and residential care facilities.

Antimicrobial resistance rates among *S. aureus,* coagulase-negative staphylococci from blood, *Escherichia coli* (urinary and non-urinary), *Klebsiella, Pseudomonas aeruginosa, H. influenzae, Enterococcus,* and *S. pneumoniae* from the core laboratories were analysed for trend. Where appropriate, data from hospital laboratories and community laboratories were analysed separately. When the data from hospital and community laboratories were analysed separately, the data from MedLab Central were excluded. An organism categorised as 'hospital' indicates that the data only includes that reported by the four core hospital laboratories. Correspondingly, an organism categorised as 'community' indicates that the data only includes that reported by the four core community laboratories.

Antimicrobial resistance rates among *S. pneumoniae, H. influenzae,* and *N. meningitidis* isolates from invasive disease, referred to ESR during the 10-year period 1992-2001, and non-typhoidal *Salmonella,* referred between 1987 and 2001, were also analysed for trend. The *Salmonella* susceptibilities were only tested every five years until 2000, after which they were tested each year.

In this report, the term co-amoxiclav refers to the combination of amoxicillin and clavulanic acid, and the term co-trimoxazole refers to the combination of trimethoprim and sulphamethoxazole. Fluoroquinolone data represent ciprofloxacin, norfloxacin or any other fluoroquinolones tested.

Statistical analysis: Resistance rates based on a sample of less than 10 isolates were not included in trend analyses. Poisson regression analysis was used to determine whether there was a significant trend of increasing or decreasing resistance to an antibiotic over the time period included in a trend analysis. An associated P value ≤ 0.05 indicated that the trend was significant at the 95% confidence level. Approximate 95% confidence intervals were calculated for some resistance rates to identify the precision of the rates. SAS was used to calculate these statistics.[3]

The data used to generate the charts presented in the results section that use data from the core diagnostic laboratories are tabulated in Appendix 1. This appendix also includes data for antibiotics not included in the charts and data for the four core hospital laboratories for the earlier years 1992-1996. Similar data for these five earlier years are not available for the five other core laboratories, as not all of these laboratories provided

data in each of these years.

The data used to generate the charts presented in the results section for the invasive isolates are tabulated in Appendix 2.

Annual resistance rates for the 10 years 1992-2001, based on the data from all laboratories that contributed data, rather than just the core laboratories, are tabulated in Appendix 3.

3 RESULTS

3.1 Trends in antimicrobial resistance among the core diagnostic laboratories, 1997-2001

3.1.1 *Staphylococcus aureus* from hospital laboratories

Resistance to co-trimoxazole, erythromycin, gentamicin and methicillin/oxacillin during the five years 1997-2001 is shown in Figure 1. Resistance to fluoroquinolones and mupirocin is shown in Figure 2.

- Resistance to all six antibiotics increased (Poisson regression P ≤0.0001).

Figure 1. *Staphylococcus aureus*: co-trimoxazole, erythromycin, gentamicin and methicillin/oxacillin resistance among hospital isolates, 1997-2001

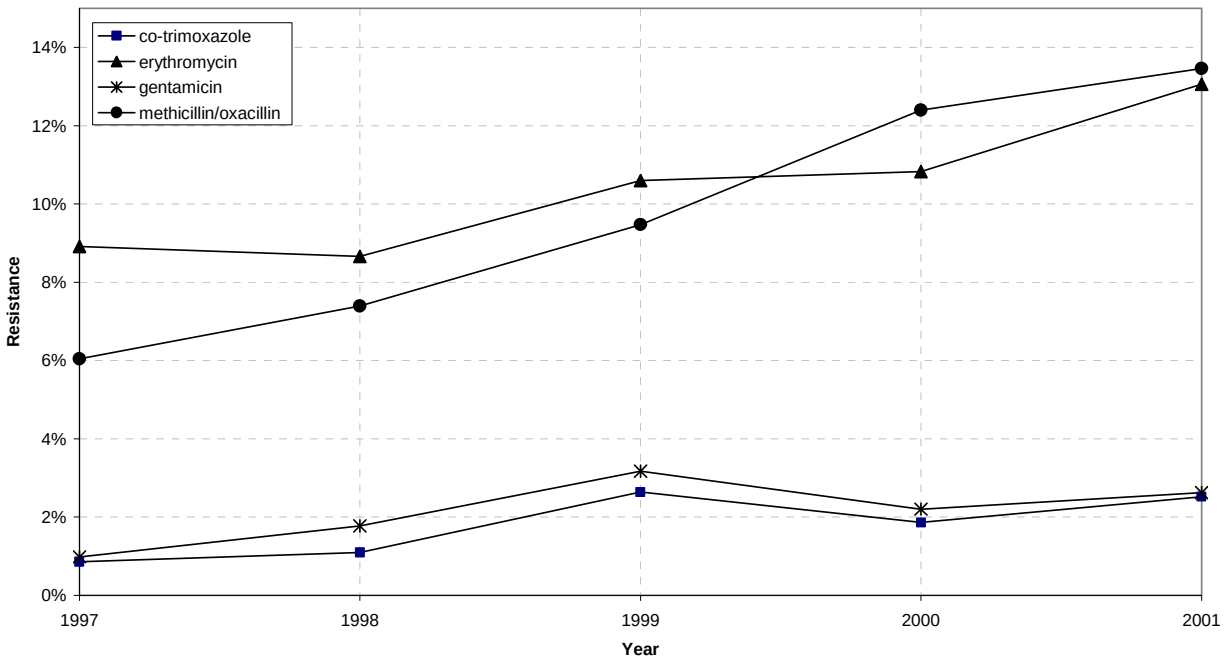
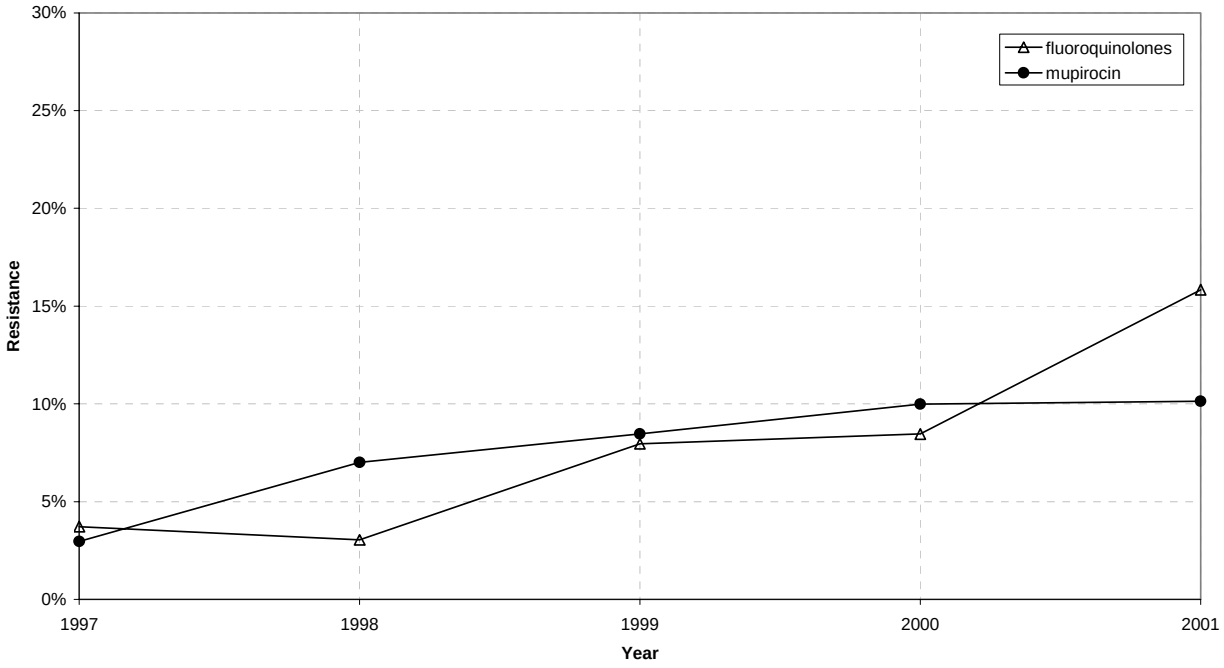


Figure 2. *Staphylococcus aureus*: fluoroquinolone and mupirocin resistance among hospital isolates, 1997-2001



3.1.2 *Staphylococcus aureus* from community laboratories

Resistance to co-trimoxazole, erythromycin and methicillin/oxacillin during the five years 1997-2001 is shown in Figure 3. Resistance to fluoroquinolones and mupirocin is shown in Figure 4.

- Resistance to all five antibiotics increased (Poisson regression P ≤0.0001).

Figure 3. *Staphylococcus aureus*: co-trimoxazole, erythromycin and methicillin/oxacillin resistance among community isolates, 1997-2001

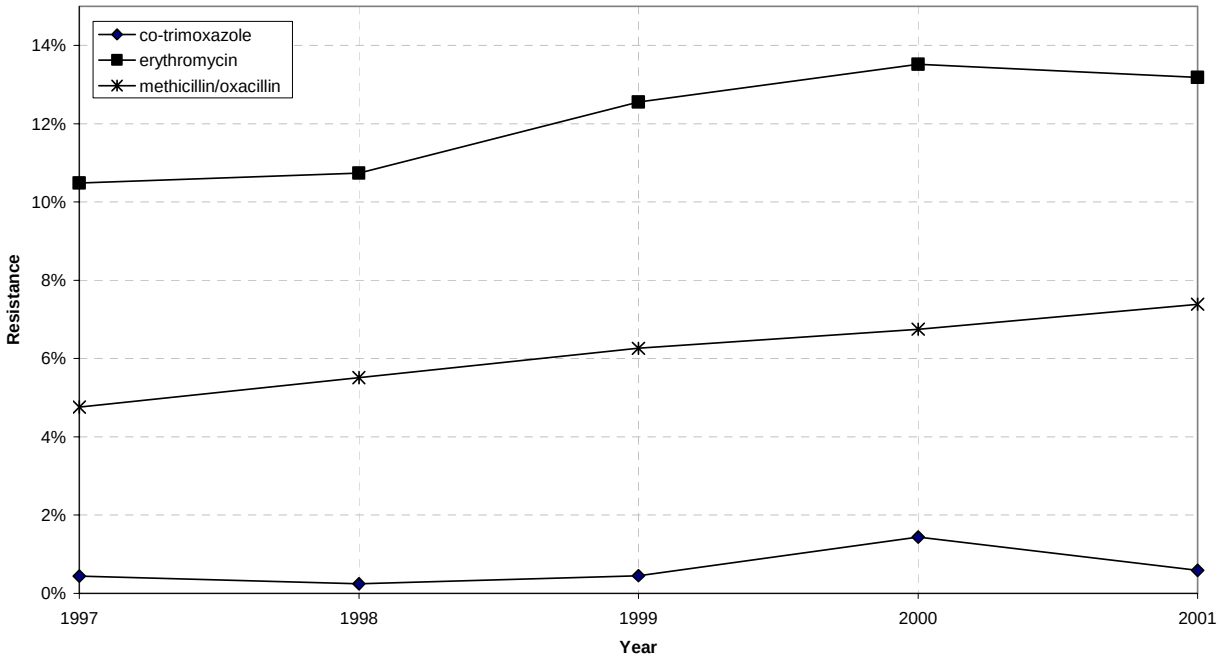
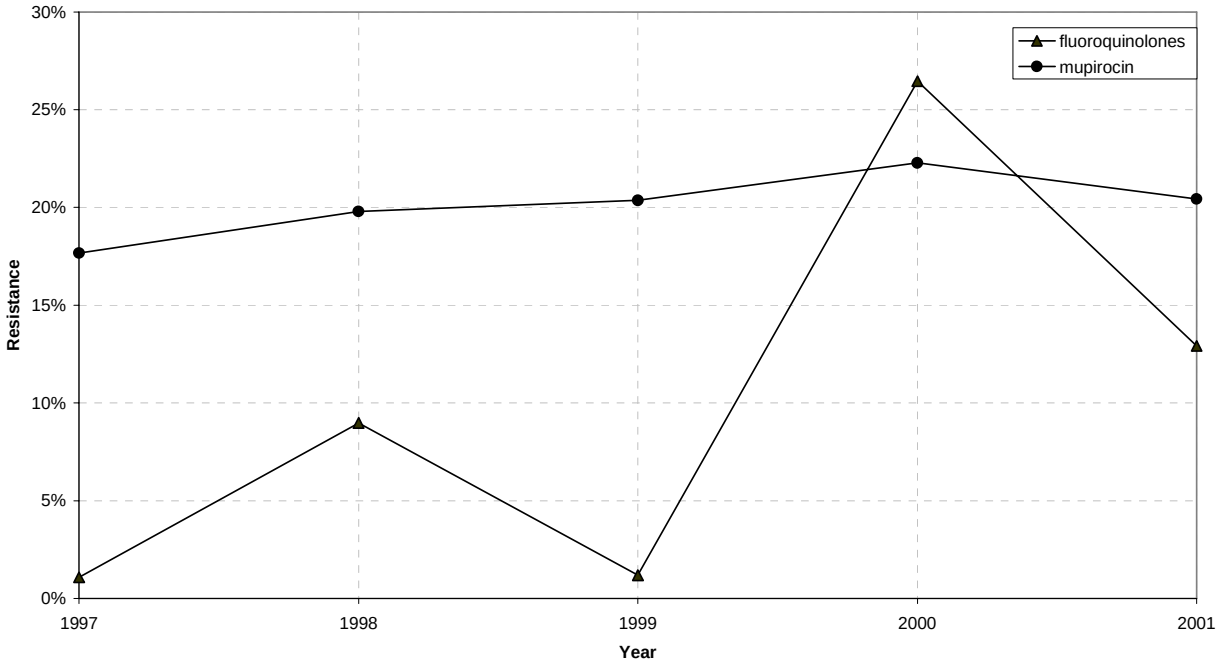


Figure 4. *Staphylococcus aureus*: fluoroquinolone and mupirocin resistance among community isolates, 1997-2001



3.1.3 Comparison of resistance among *Staphylococcus aureus* from hospital and community laboratories

	Percent resistance (1997 rate - 2001 rate)	
	Hospital	**Community**
co-trimoxazole	0.9-2.5	0.4-0.6
erythromycin	8.9-13.1	10.5-13.2
fluoroquinolone	3.7-15.8	1.1-12.9
gentamicin	1.0-2.6	-
methicillin/oxacillin	6.0-13.5	4.8-7.4
mupirocin	3.0-10.1	17.7-20.4

3.1.4 Non-urinary *Escherichia coli* from hospital laboratories

Resistance to β-lactams during the five years 1997-2001 is shown in Figure 5. Resistance to co-trimoxazole, fluoroquinolones and gentamicin is shown in Figure 6.

- Co-trimoxazole resistance increased (Poisson regression P=0.0009).
- Resistance to co-amoxiclav, cephalothin and cefuroxime decreased (Poisson regression P ≤0.0001, co-amoxiclav and cephalothin; P=0.0008, cefuroxime).
- There were no significant trends in resistance to ampicillin, cefotaxime, fluoroquinolones or gentamicin (Poisson regression P ≥0.05).

Figure 5. Non-urinary *Escherichia coli*: β-lactam resistance among hospital isolates, 1997-2001

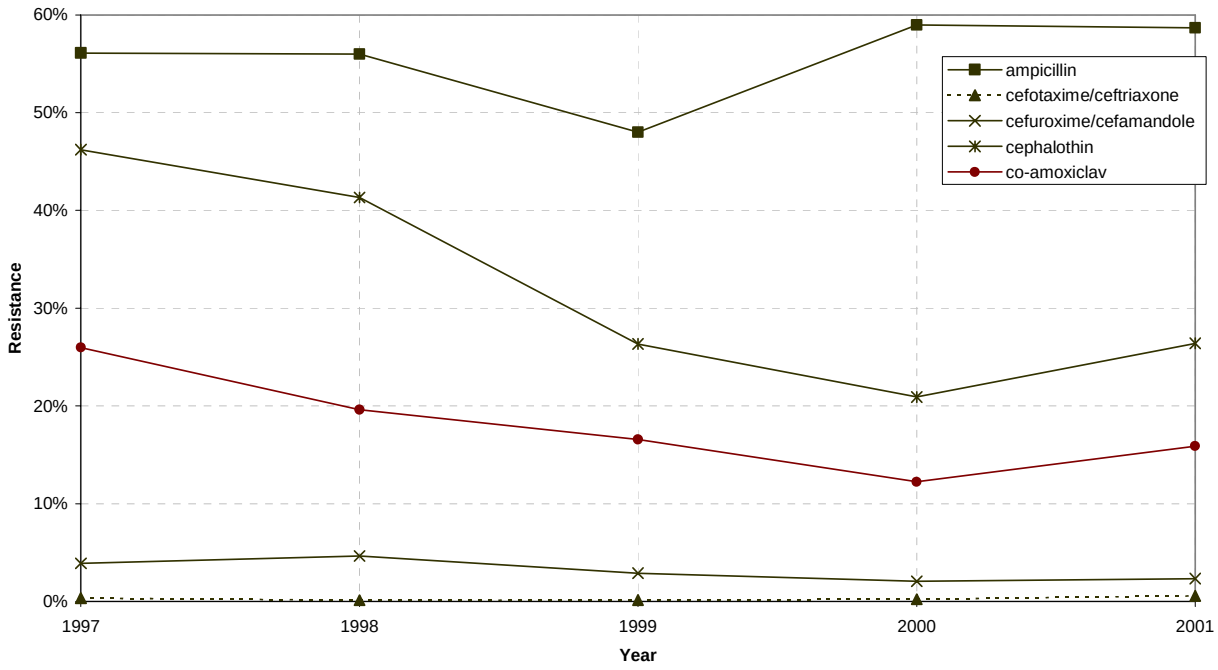
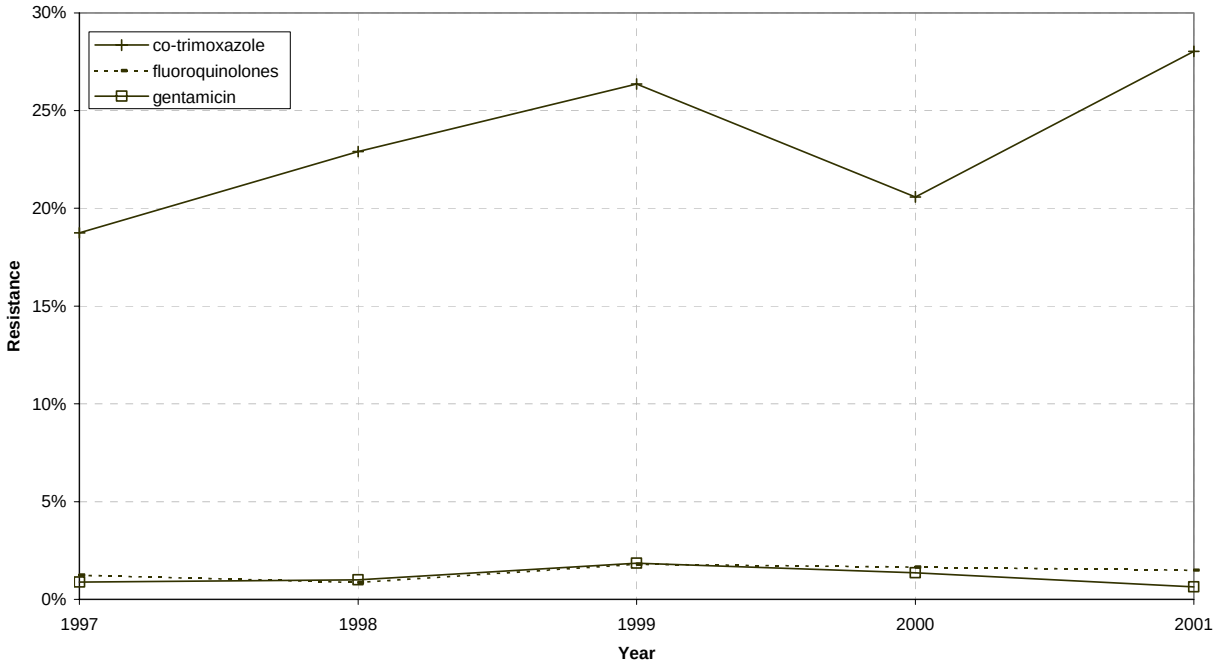


Figure 6. Non-urinary *Escherichia coli*: co-trimoxazole, fluoroquinolone and gentamicin resistance among hospital isolates, 1997-2001



3.1.5 Urinary *Escherichia coli* from hospital laboratories

Resistance to β-lactams during the five years 1997-2001 is shown in Figure 7. Resistance to co-trimoxazole, fluoroquinolones, gentamicin and trimethoprim is shown in Figure 8.

- Resistance to fluoroquinolones, gentamicin and trimethoprim increased (Poisson regression P ≤0.0001, fluoroquinolones and gentamicin; P=0.0002, trimethoprim).
- Resistance to co-amoxiclav, cephalothin and cefuroxime decreased (Poisson regression P ≤0.0001).
- There were no significant trends in resistance to ampicillin, cefotaxime or co-trimoxazole (Poisson regression P ≥0.05).

Figure 7. Urinary *Escherichia coli*: β-lactam resistance among hospital isolates, 1997-2001

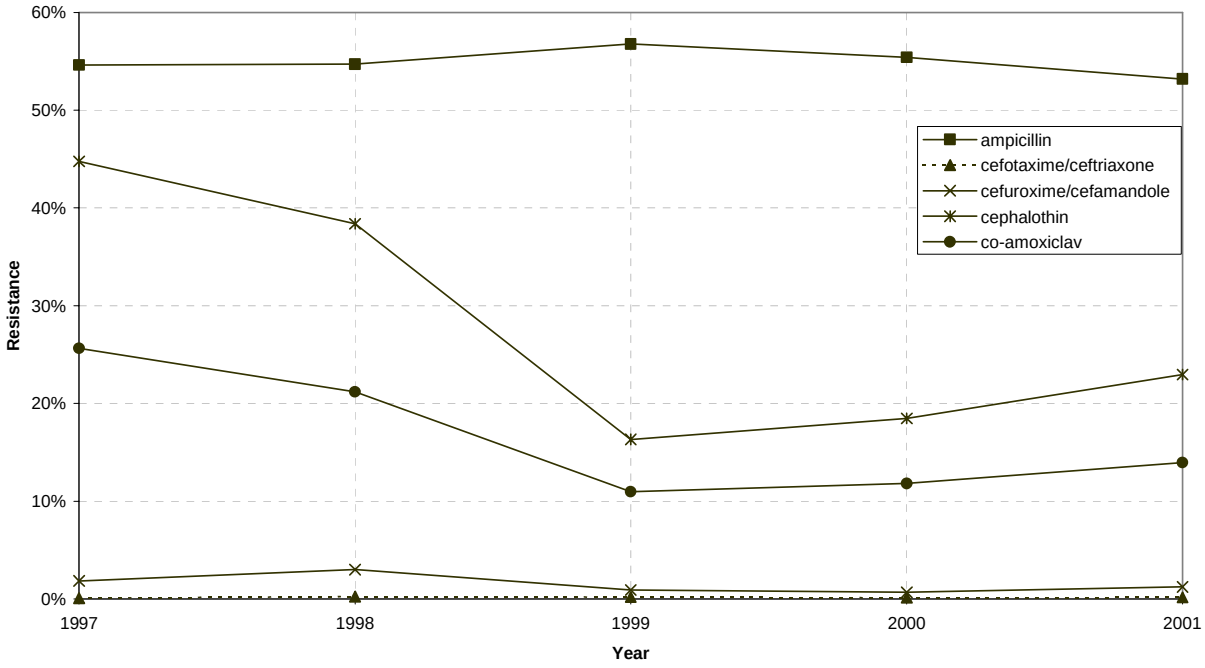
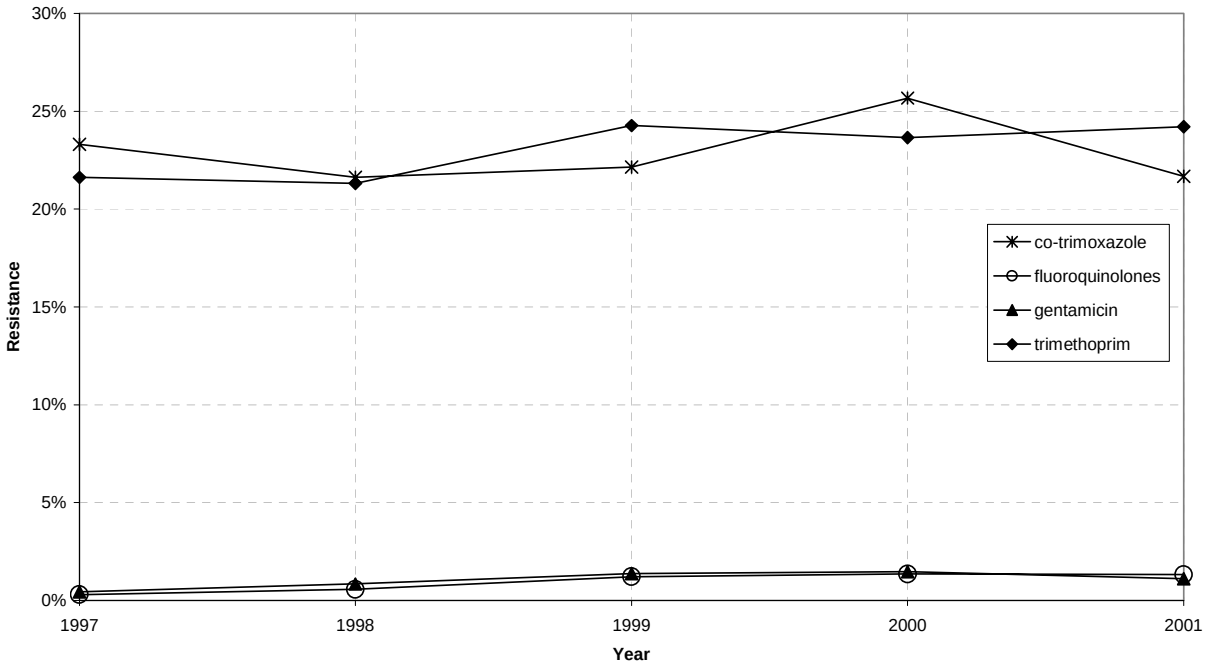


Figure 8. Urinary *Escherichia coli*: co-trimoxazole, fluoroquinolone, gentamicin and trimethoprim resistance among hospital isolates, 1997-2001



3.1.6 Urinary *Escherichia coli* from community laboratories

Resistance to β-lactams during the five years 1997-2001 is shown in Figure 9. Resistance to fluoroquinolones and trimethoprim is shown in Figure 10.

- Resistance to fluoroquinolones and trimethoprim increased (Poisson regression P ≤0.0001).
- Resistance to co-amoxiclav, cephalothin and ampicillin decreased (Poisson regression P ≤0.0001, co-amoxiclav and cephalothin; P=0.0015, ampicillin).

Figure 9. Urinary *Escherichia coli*: β-lactam resistance among community isolates, 1997-2001

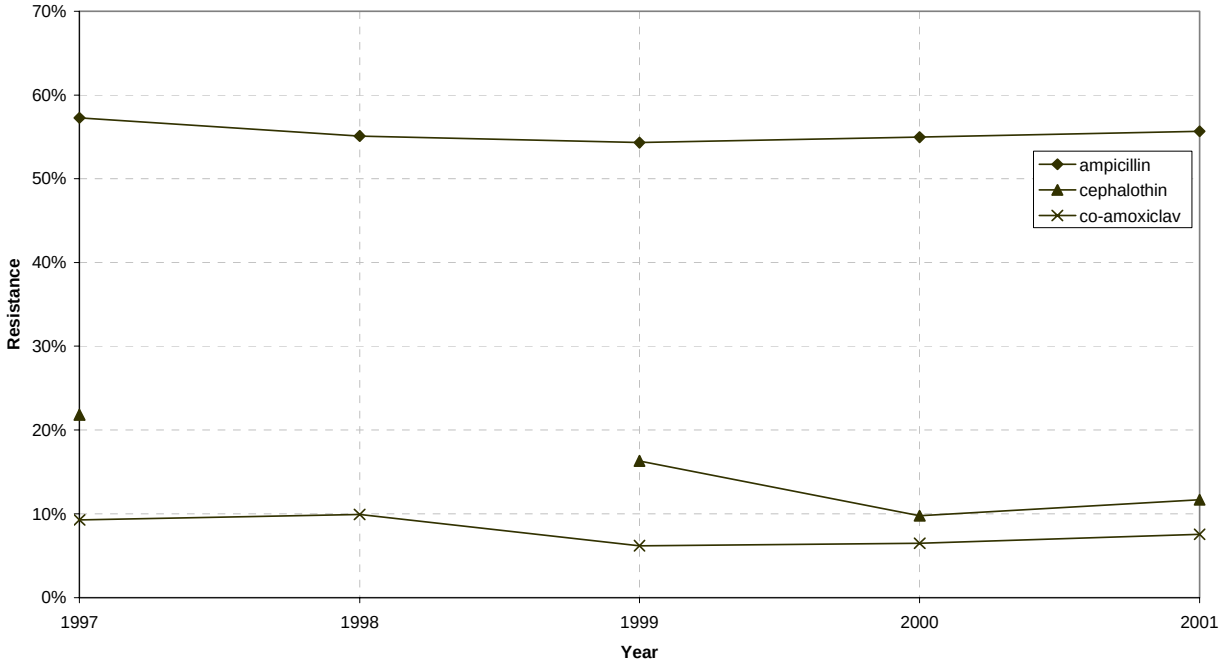
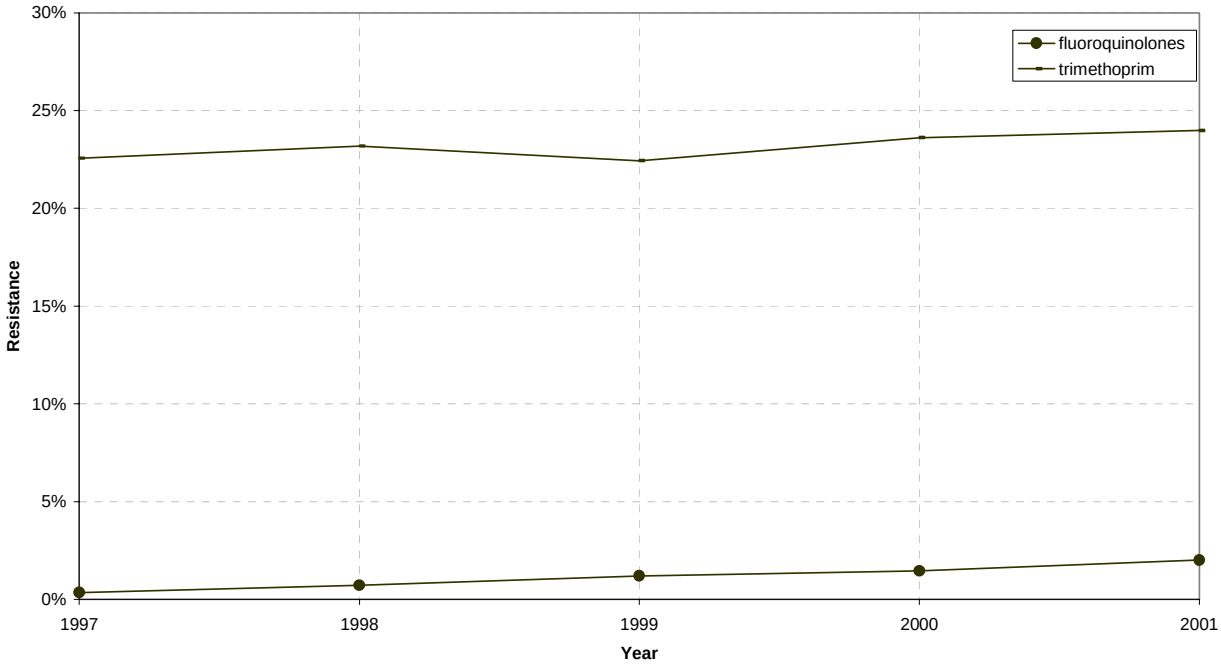


Figure 10. Urinary *Escherichia coli*: fluoroquinolone and trimethoprim resistance among community isolates, 1997-2001



3.1.7 Comparison of resistance among urinary *E. coli* from hospital and community laboratories

	Percent resistance (1997 rate - 2001 rate)	
	Hospital	**Community**
amikacin	0.1-0.05	-
ampicillin	54.6-53.2	57.3-55.7
cefotaxime	0.1-0.2	-
cefuroxime	1.8-1.2	-
cephalothin	44.8-23.0	21.8-11.7
co-amoxiclav	25.6-14.0	9.3-7.6
co-trimoxazole	23.3-21.7	23.6-9.3
fluoroquinolone	0.3-1.3	0.4-2.0
gentamicin	0.4-1.1	-
trimethoprim	21.6-24.2	22.6-24.0

3.1.8 *Klebsiella* from hospital laboratories

Resistance to β-lactams during the five years 1997-2001 is shown in Figure 11. Resistance to amikacin, gentamicin and fluoroquinolones is shown in Figure 12.

- Resistance to cephalothin and cefuroxime decreased (Poisson regression $P \leq 0.0001$, cephalothin; $P=0.0109$, cefuroxime).
- There were no significant trends in resistance to amikacin, cefotaxime, fluoroquinolones or gentamicin (Poisson regression $P \geq 0.05$).

Figure 11. *Klebsiella*: β-lactam resistance among hospital isolates, 1997-2001

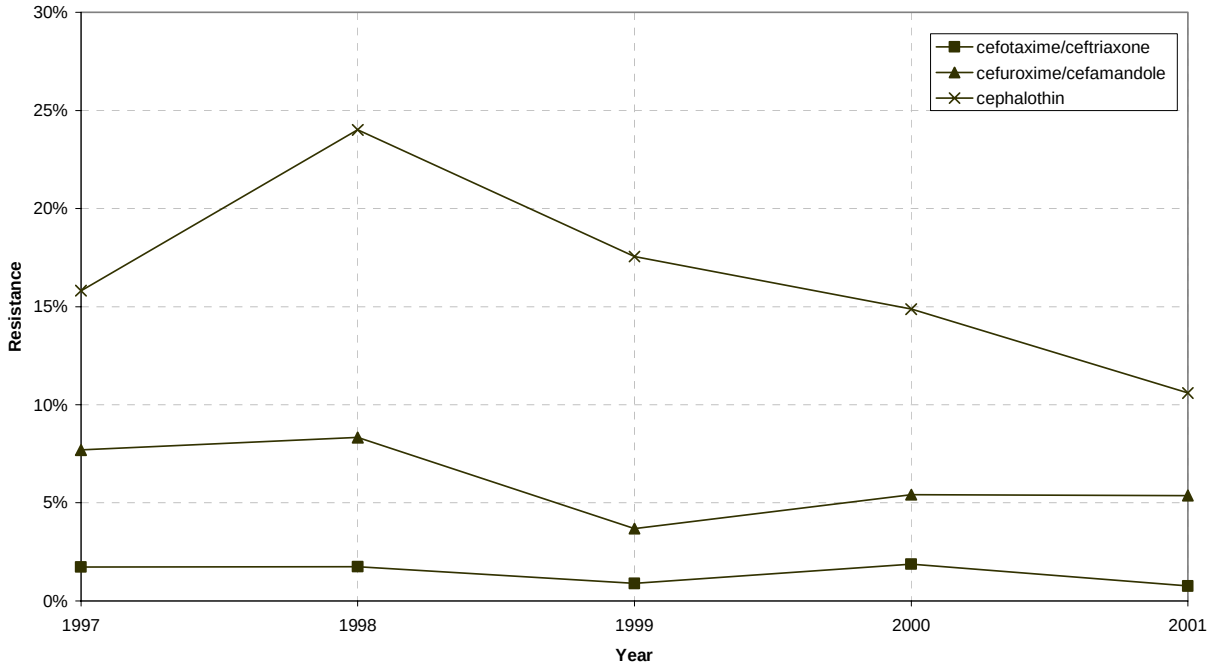
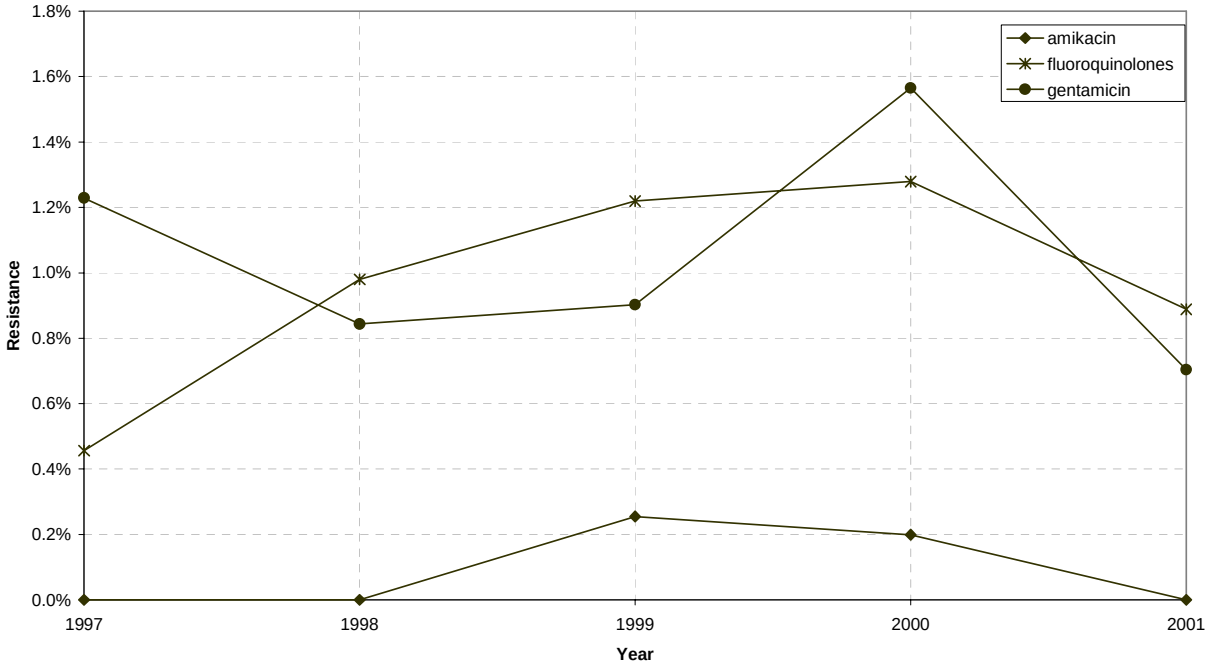


Figure 12. *Klebsiella*: amikacin, fluoroquinolone and gentamicin resistance among hospital isolates, 1997-2001



3.1.9 *Pseudomonas aeruginosa* from hospital laboratories

Resistance to β-lactams during the five years 1997-2001 is shown in Figure 13. Resistance to aminoglycosides and fluoroquinolones is shown in Figure 14.

- Tobramycin resistance increased (Poisson regression P=0.0242).
- Resistance to ceftazidime and piperacillin decreased (Poisson regression P ≤0.0001).
- There were no significant trends in resistance to amikacin, fluoroquinolones or gentamicin (Poisson regression P ≥0.05).

Figure 13. *Pseudomonas aeruginosa*: β-lactam resistance among hospital isolates, 1997-2001

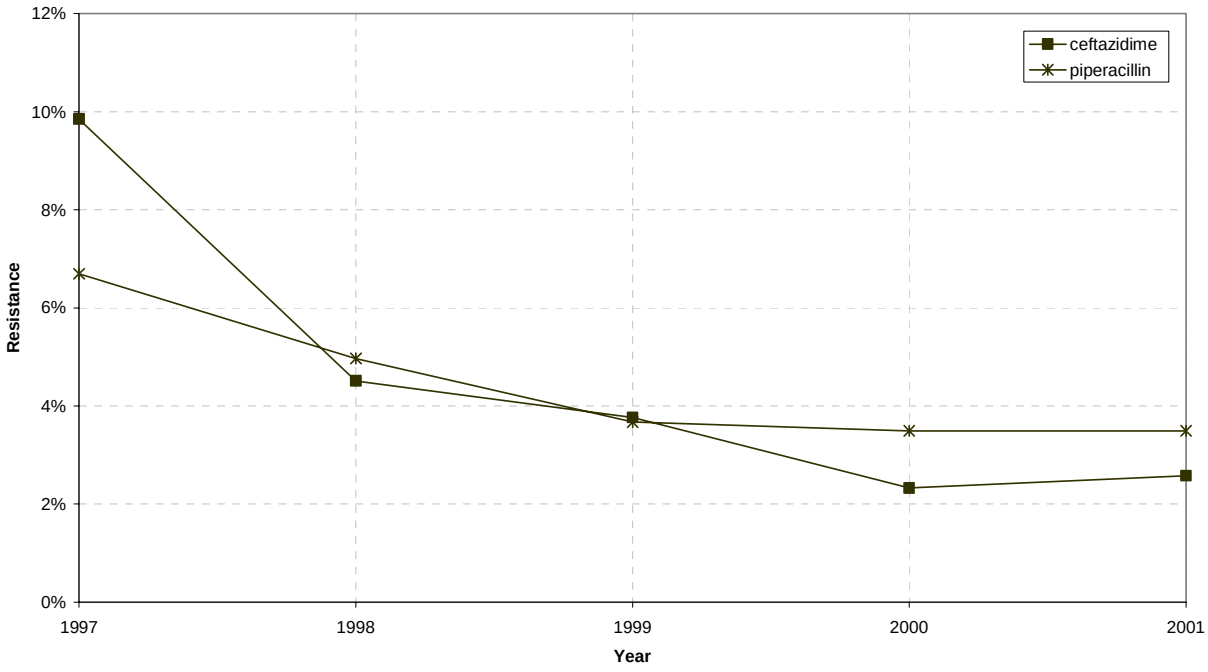
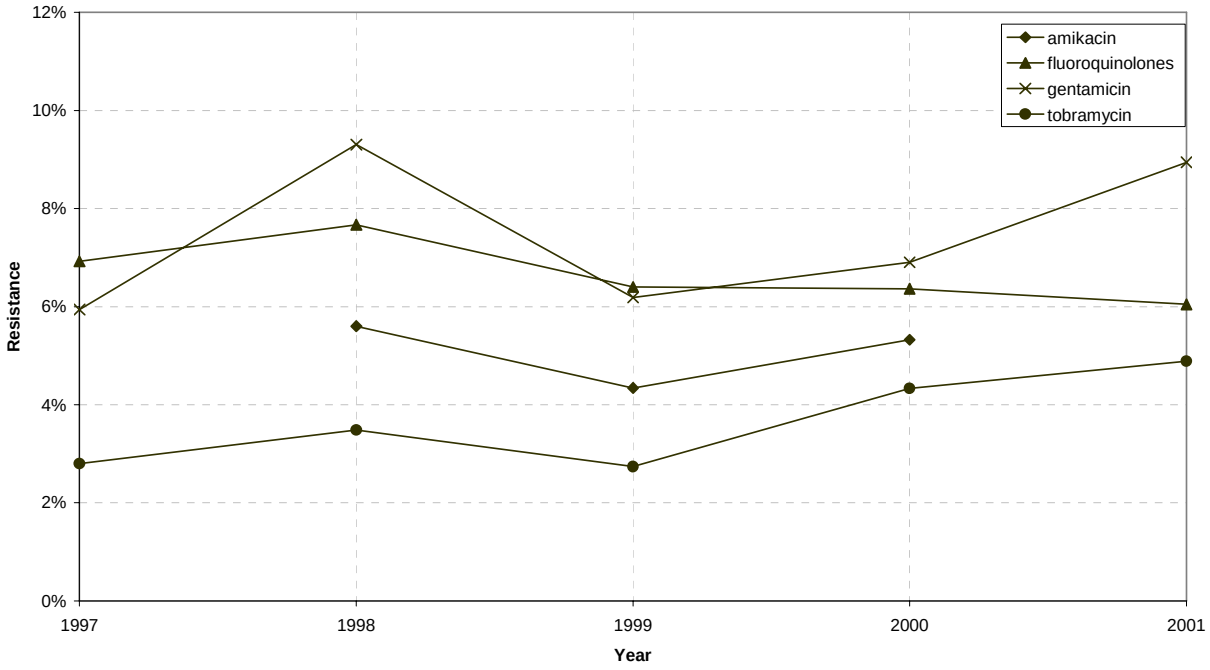


Figure 14. *Pseudomonas aeruginosa*: amikacin, fluoroquinolone, gentamicin and tobramycin resistance among hospital isolates, 1997-2001



3.1.10 Non-invasive *Haemophilus influenzae*

Resistance to β-lactams during the five years 1997-2001 is shown in Figure 15. Resistance to chloramphenicol and co-trimoxazole is shown in Figure 16.

- Ampicillin resistance, β-lactamase production, co-amoxiclav and co-trimoxazole resistance increased (Poisson regression P ≤0.0001, ampicillin and co-trimoxazole; P=0.0035, β-lactamase production; P=0.0281, co-amoxiclav).
- Chloramphenicol resistance decreased (Poisson regression P=0.0007).

Figure 15. Non-invasive *Haemophilus influenzae*: β-lactam resistance, 1997-2001

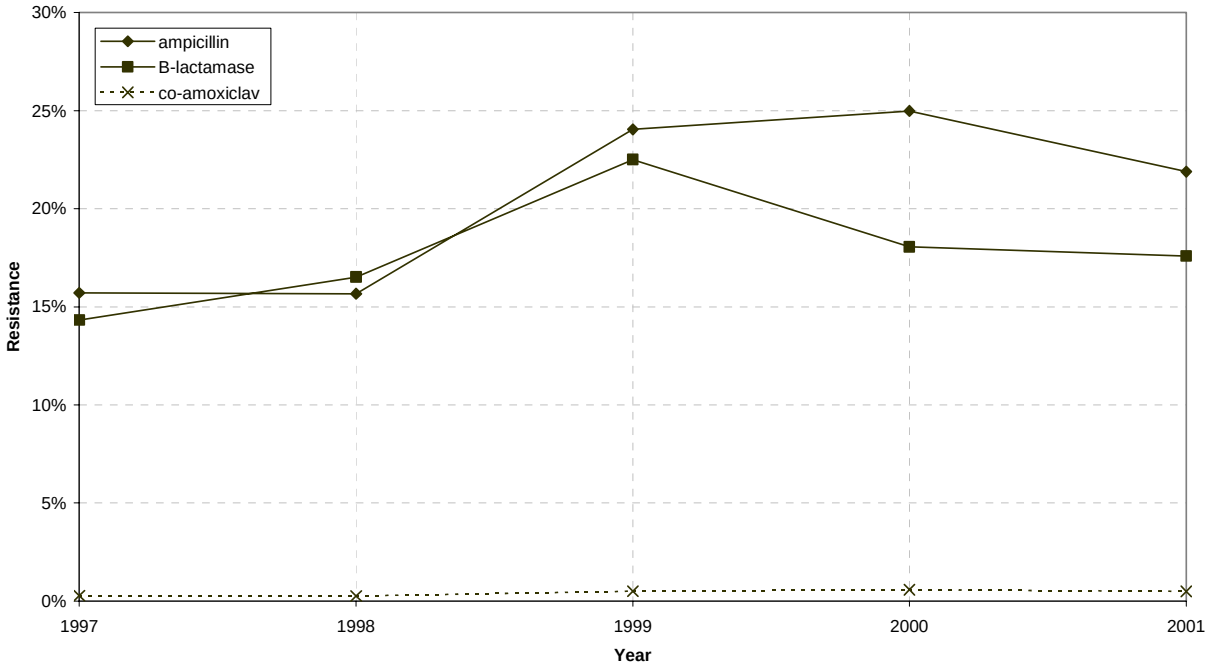
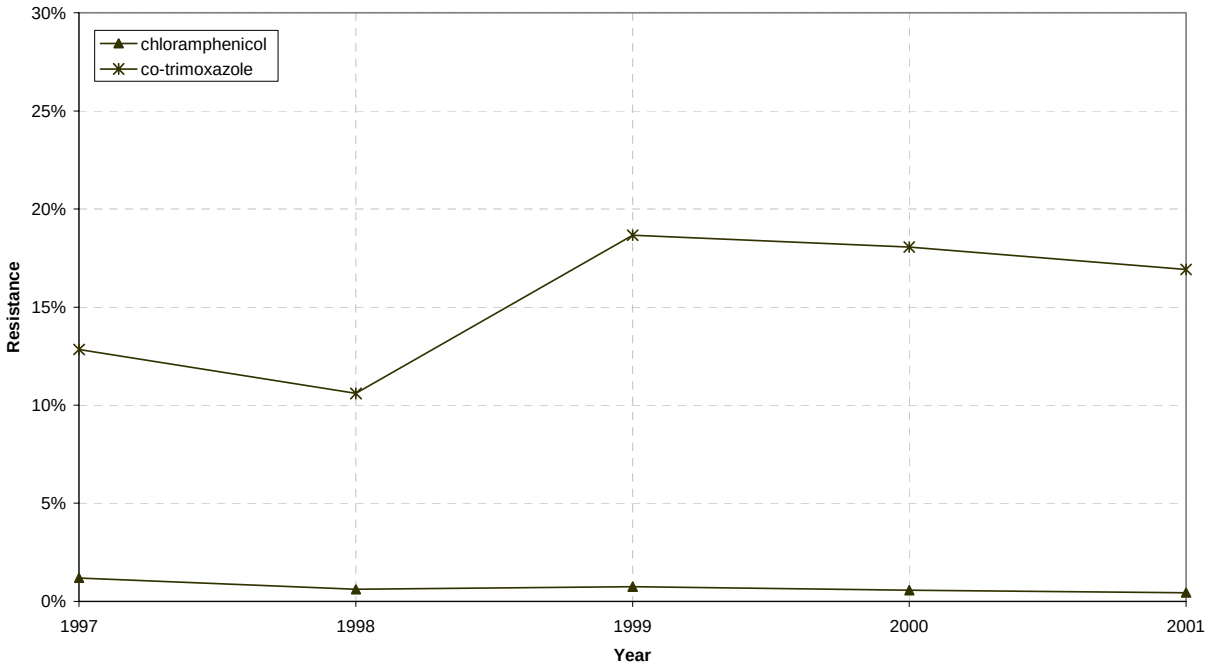


Figure 16. Non-invasive *Haemophilus influenzae*: chloramphenicol and co-trimoxazole resistance, 1997-2001

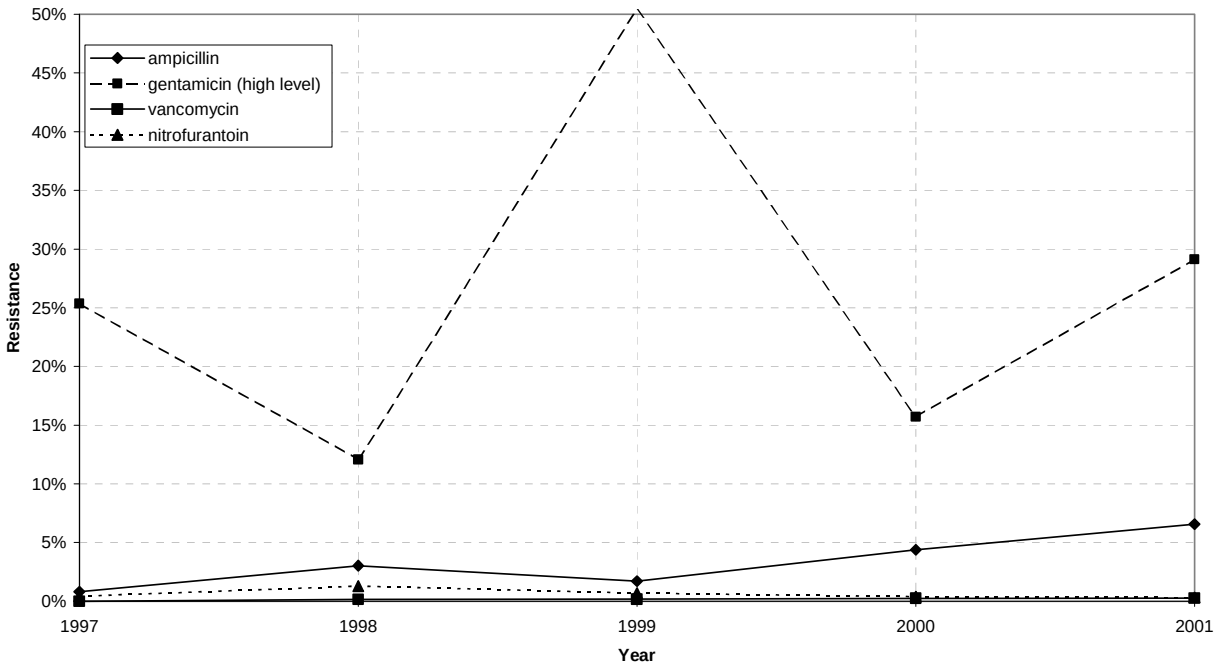


3.1.11 *Enterococcus* from hospital laboratories

Resistance to ampicillin, high-level gentamicin and vancomycin during the five years 1997-2001 is shown in Figure 17.

- Ampicillin resistance increased (Poisson regression P ≤0.0001).
- There were no significant trends in resistance to high-level gentamicin, nitrofurantoin or vancomycin (Poisson regression P ≥0.05).

Figure 17. *Enterococcus*: ampicillin, high-level gentamicin and vancomycin resistance among hospital isolates, 1997-2001

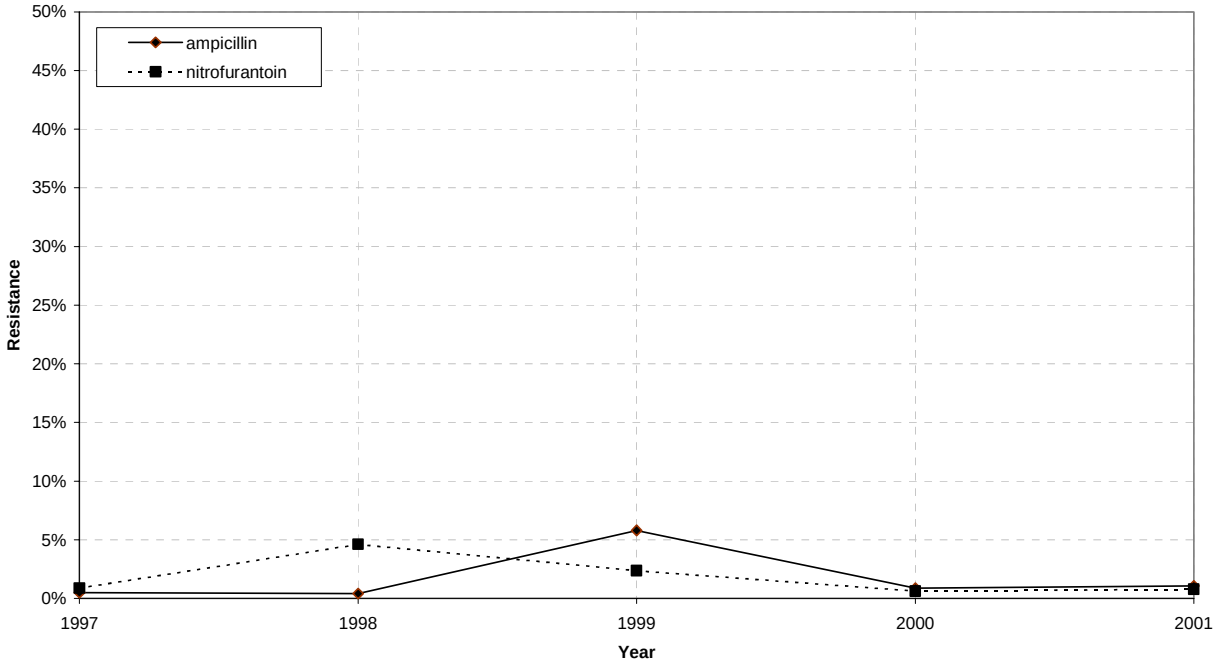


3.1.12 *Enterococcus* from community laboratories

Resistance to ampicillin and nitrofurantoin during the five years 1997-2001 is shown in Figure 18.

- Ampicillin resistance increased (Poisson regression P=0.0037).
- Nitrofurantoin resistance decreased (Poisson regression P=0.0480).

Figure 18. *Enterococcus*: ampicillin and nitrofurantoin resistance among community isolates, 1997-2001



3.1.13 Comparison of resistance among *Enterococcus* from hospital and community laboratories

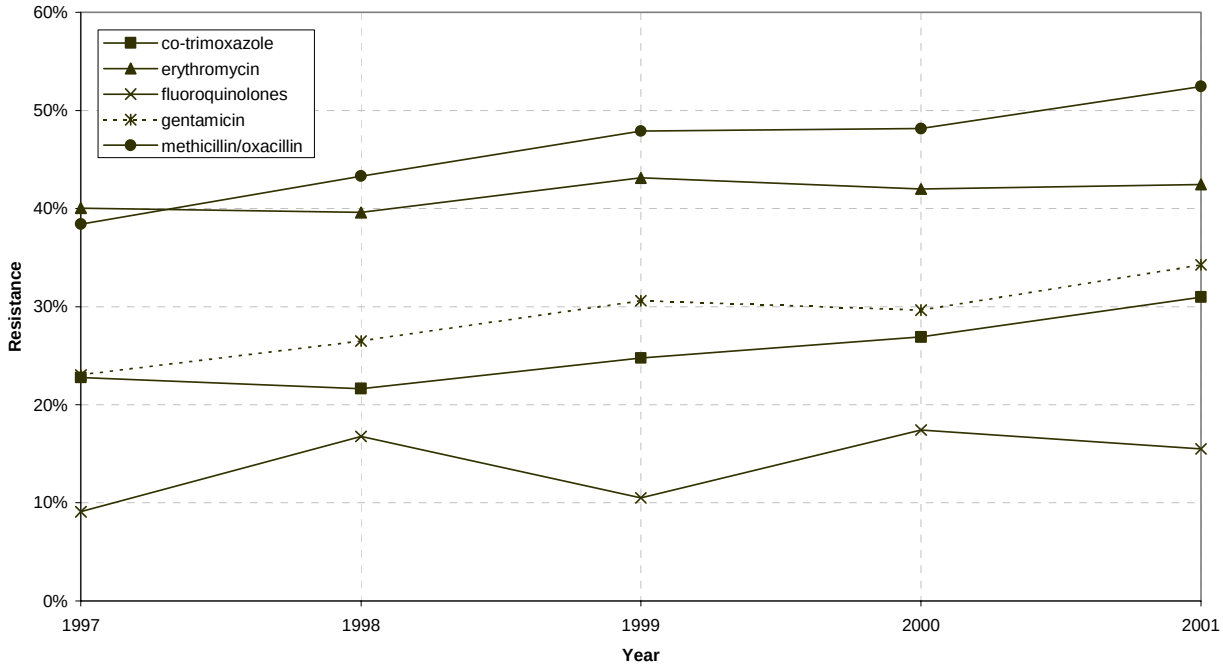
	Percent resistance (1997 rate - 2001 rate)	
	Hospital	**Community**
ampicillin	0.8-6.6	0.5-1.1
high-level gentamicin	25.4-29.1	-
nitrofurantoin	0.4-0.3	0.9-0.8
vancomycin	0.0-0.3	-

3.1.14 Coagulase-negative staphylococci from blood

Resistance to co-trimoxazole, erythromycin, fluoroquinolones, gentamicin and methicillin/oxacillin during the five years 1997-2001 is shown in Figure 19.

- Resistance to gentamicin, methicillin/oxacillin and co-trimoxazole increased (Poisson regression P ≤0.0001, gentamicin and methicillin/oxacillin; P=0.0045, co-trimoxazole).
- There were no significant trends in resistance to erythromycin or fluoroquinolones (Poisson regression P ≥0.05).

Figure 19. Coagulase-negative staphylococci from blood: co-trimoxazole, erythromycin, fluoroquinolones, gentamicin and methicillin/oxacillin resistance, 1997-2001



3.1.15 Non-invasive Streptococcus pneumoniae

Resistance to β-lactams during the five years 1997-2001 is shown in Figure 20. Resistance to chloramphenicol, co-trimoxazole, erythromycin and tetracycline is shown in Figure 21.

- Resistance to co-trimoxazole, erythromycin, tetracycline, penicillin and chloramphenicol increased (Poisson regression P ≤0.0001, co-trimoxazole and erythromycin; P=0.0003, tetracycline; P=0.0250, penicillin; P=0.0448, chloramphenicol).
- Cefotaxime resistance decreased, although data were only available for three years: 1998, 1999 and 2001 (Poisson regression P=0.0037).

Figure 20. Non-invasive *Streptococcus pneumoniae*: β-lactam resistance, 1997-2001

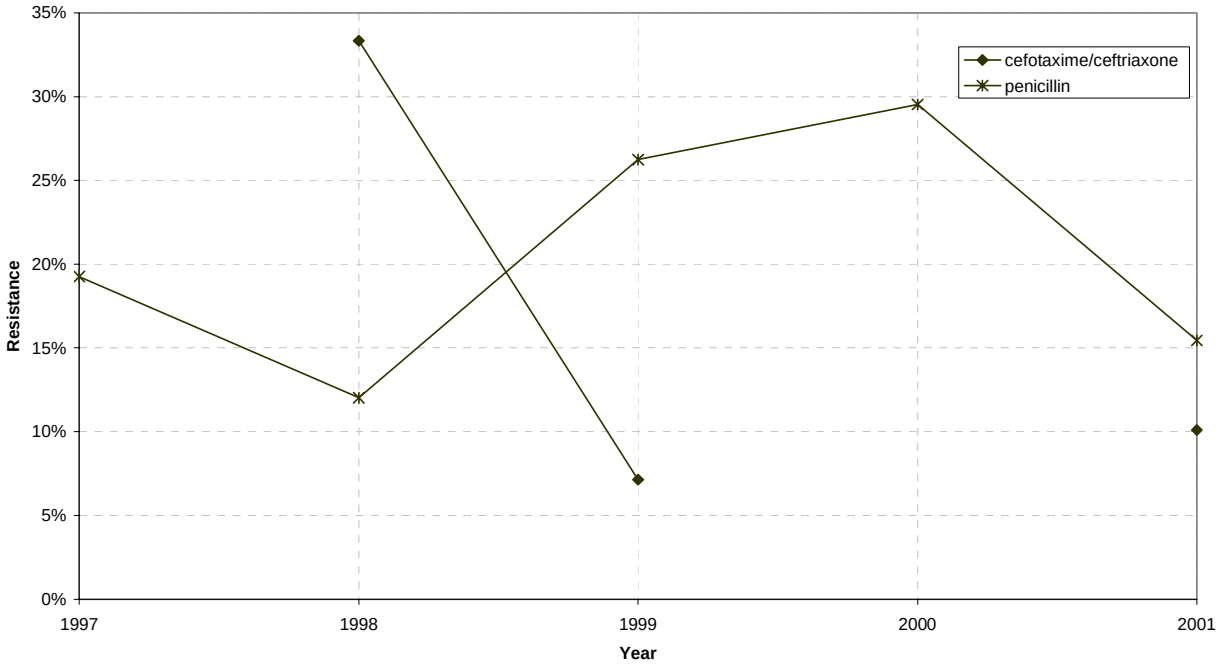
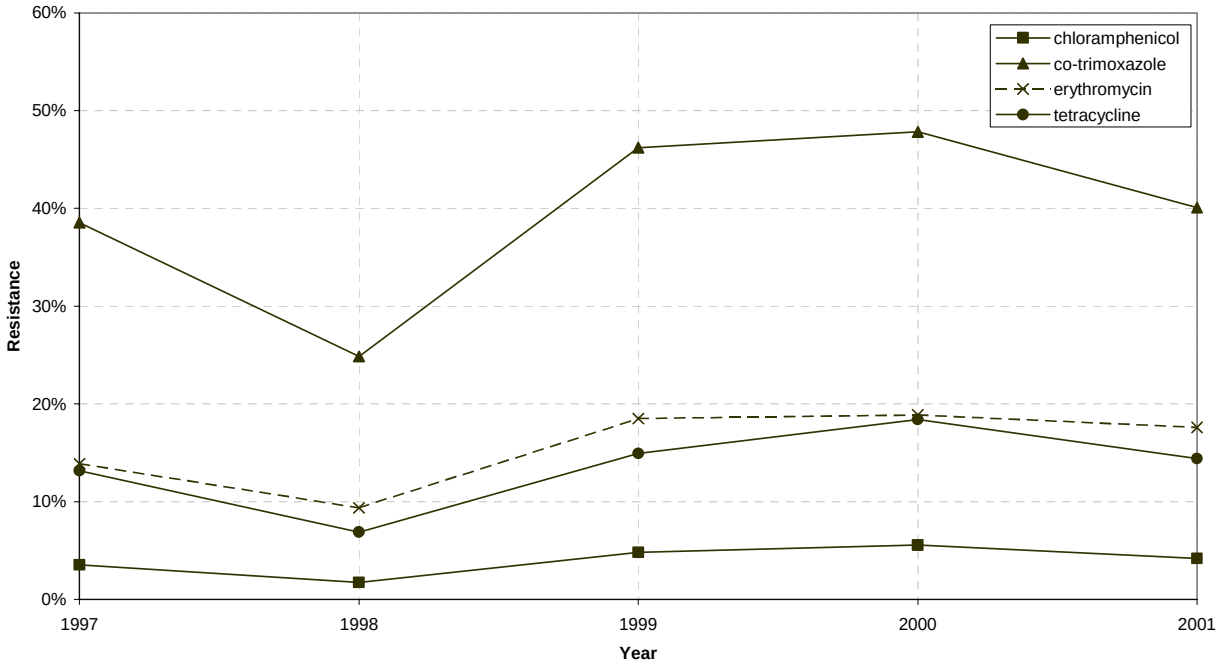


Figure 21. Non-invasive *Streptococcus pneumoniae*: chloramphenicol, co-trimoxazole, erythromycin and tetracycline resistance, 1997-2001



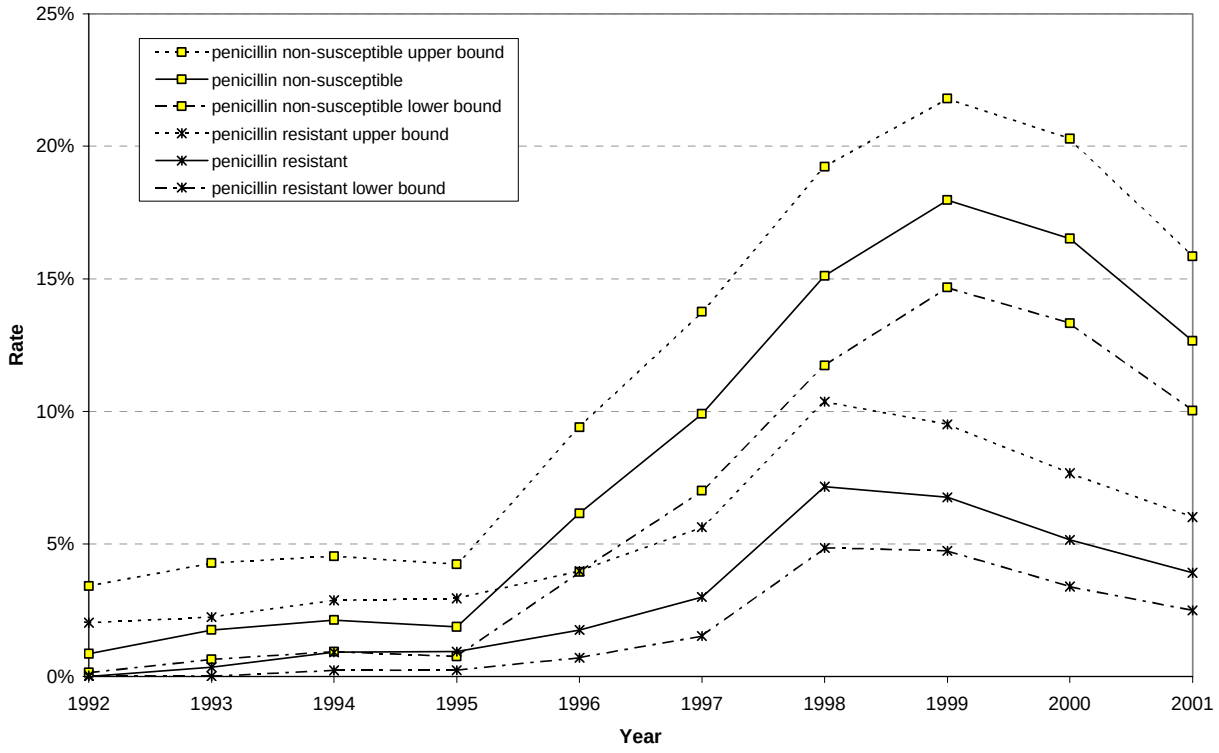
3.2 Trends in antimicrobial resistance among invasive disease pathogens, 1992-2001

3.2.1 *Streptococcus pneumoniae*

S. pneumoniae are commonly differentiated according to their level of penicillin resistance. Isolates with MICs ≥2 mg/L are categorised as resistant and those with MICs ≥0.12 mg/L as penicillin nonsusceptible. The penicillin-nonsusceptible category includes isolates with intermediate resistance (MIC 0.12-1.0 mg/L) and resistance. Penicillin resistance and nonsusceptibility, including 95% confidence intervals, is shown in Figure 22.

- Penicillin resistance and nonsusceptibility increased during the 10 years 1992-2001 (Poisson regression P ≤0.0001). However, there was a decrease in resistance and nonsusceptibility in the last three and two years, respectively.

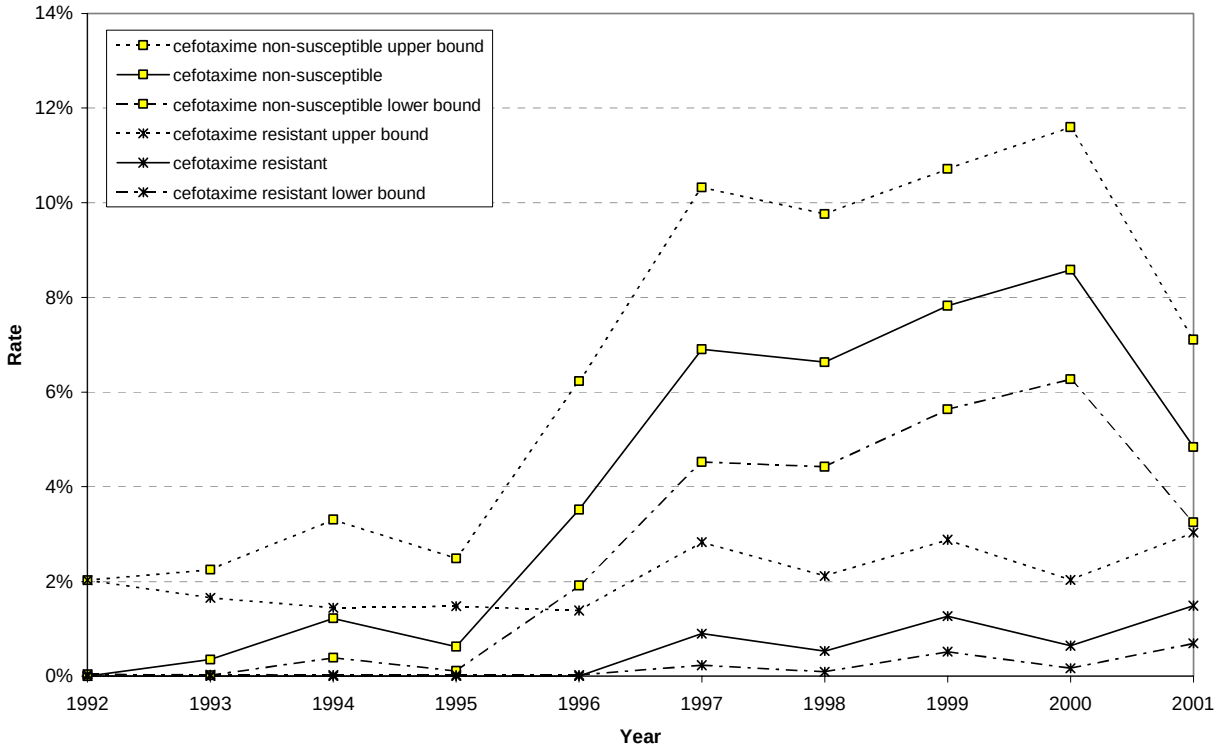
Figure 22. *Streptococcus pneumoniae* from invasive disease: penicillin resistance and nonsusceptibility, 1992-2001



As for penicillin, *S. pneumoniae* isolates are differentiated according to their level of cefotaxime resistance. Isolates from invasive disease with MICs ≥2 mg/L are defined as cefotaxime resistant and those with MICs ≥1 mg/L as cefotaxime nonsusceptible. The cefotaxime-nonsusceptible category includes isolates with intermediate resistance (MIC 1.0 mg/L) and resistance. Cefotaxime resistance and nonsusceptibility, including 95% confidence intervals, is shown in Figure 23.

- Cefotaxime resistance and nonsusceptibility increased during the 10 years 1992-2001 (Poisson regression P ≤0.0001, nonsusceptibility; P=0.0005, resistance). However, there was a decrease in nonsusceptibility during the last year.

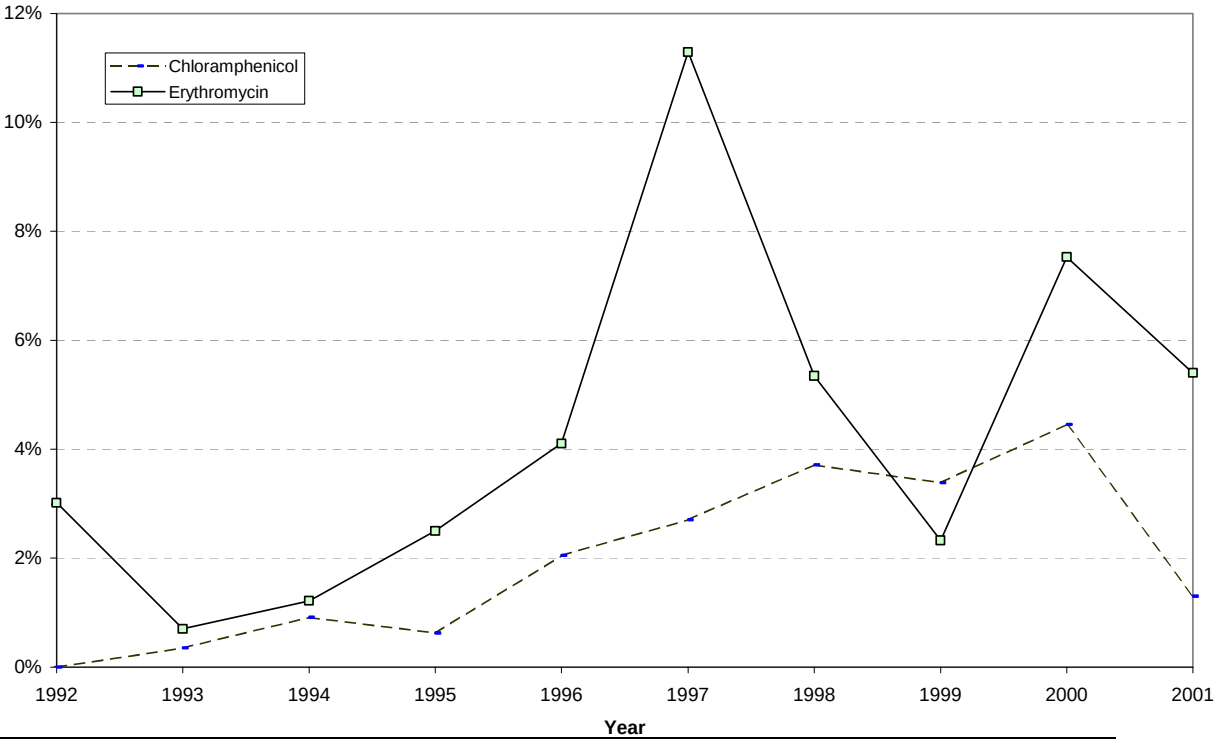
Figure 23. *Streptococcus pneumoniae* from invasive disease: cefotaxime resistance and nonsusceptibility, 1992-2001



Resistance to chloramphenicol and erythromycin during the 10 years 1992-2001 is shown in Figure 24.

- Resistance to erythromycin and chloramphenicol increased (Poisson regression P<0.0001, erythromycin; P=0.0001, chloramphenicol).

Figure 24. *Streptococcus pneumoniae* from invasive disease: chloramphenicol and erythromycin resistance, 1992-2001

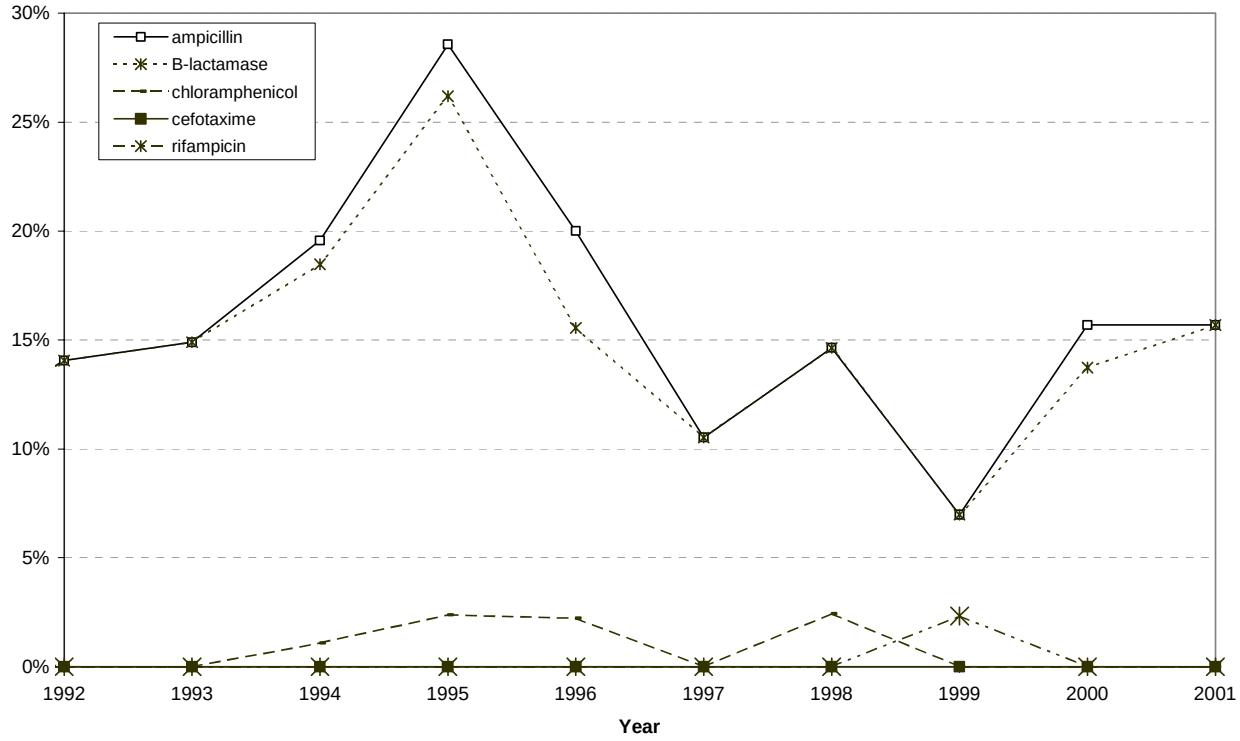


3.2.2 *Haemophilus influenzae*

Resistance to ampicillin, cefotaxime, chloramphenicol and rifampicin, and β-lactamase production during the 10 years 1992-2001 is shown in Figure 25.

- There were no significant trends in resistance to any of the antibiotics (Poisson regression P ≥0.05).

Figure 25. *Haemophilus influenzae* from invasive disease: ampicillin, chloramphenicol, cefotaxime and rifampicin resistance, and β-lactamase production, 1992-2001

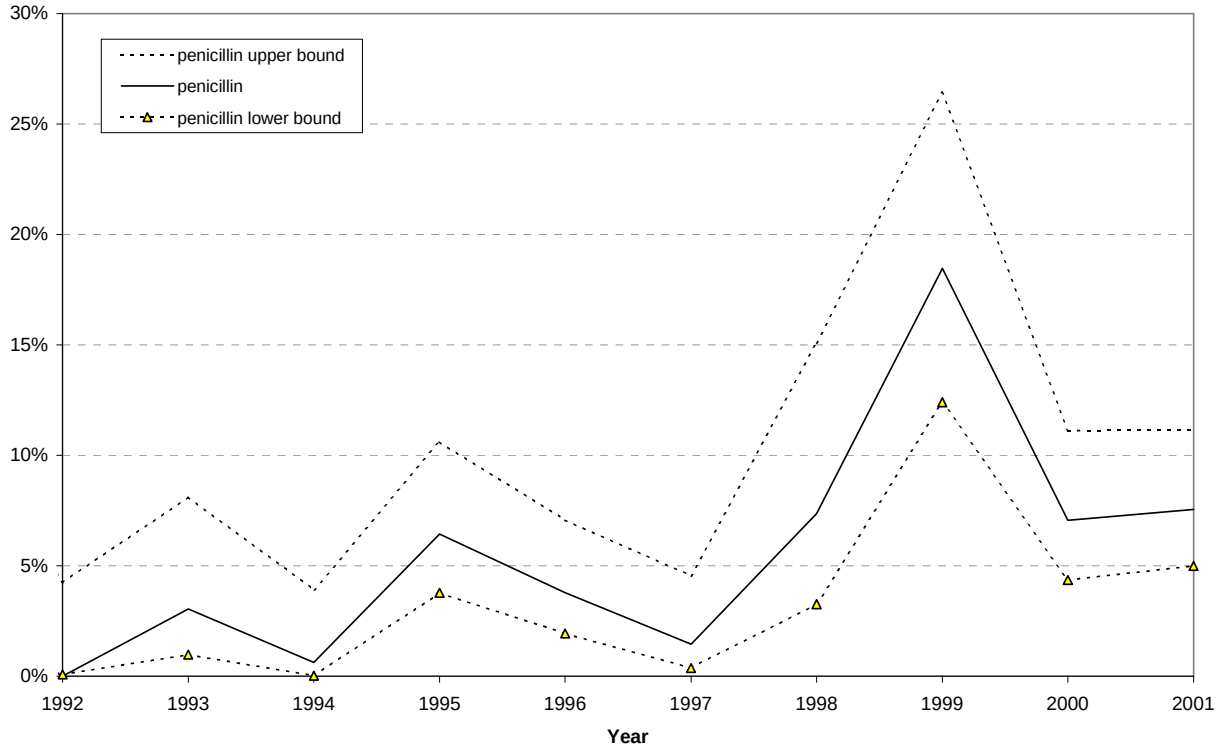


3.2.3 *Neisseria meningitidis*

The prevalence of reduced penicillin susceptibility (MIC ≥0.12 mg/L), including 95% confidence intervals, during the 10 years 1992-2001 is shown in Figure 26.

- The prevalence of reduced penicillin susceptibility increased (Poisson regression P<0.0001).

Figure 26. *Neisseria meningitidis* from invasive disease: reduced penicillin susceptibility, 1992-2001

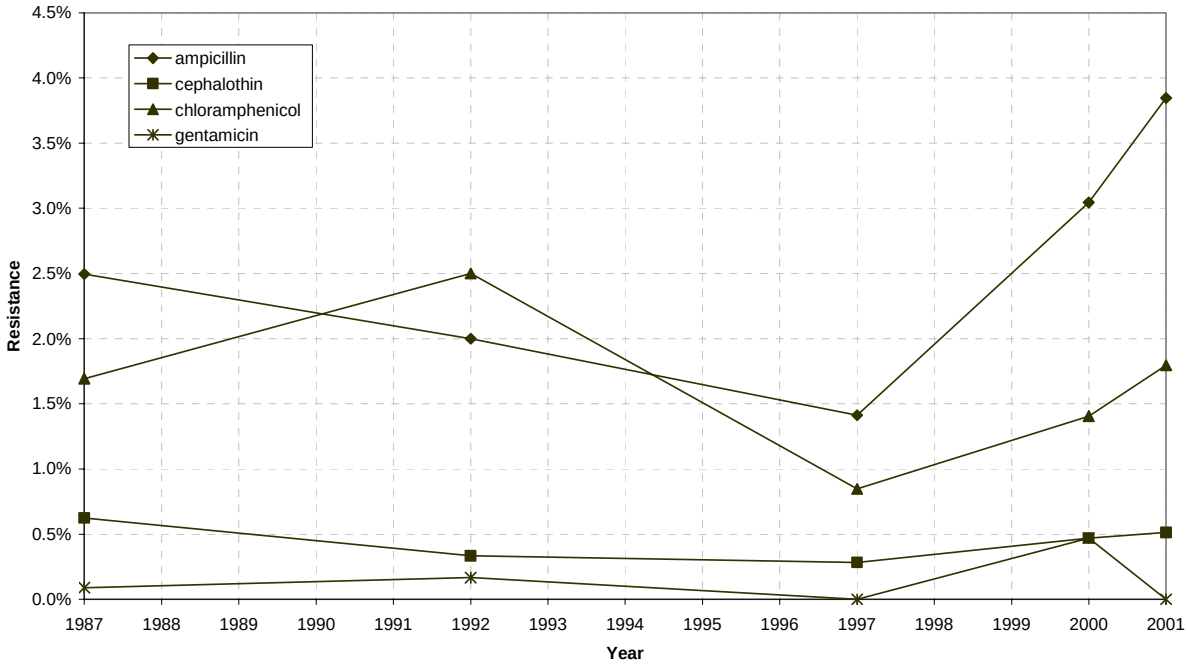


3.3 Non-typhoidal *Salmonella*

Resistance to ampicillin, cephalothin, chloramphenicol and gentamicin during the 15 years 1987-2001 is shown in Figure 27.

- There were no significant trends in resistance to any of the antibiotics (Poisson regression P ≥0.05).

Figure 27. Non-typhoidal *Salmonella*: ampicillin, cephalothin, chloramphenicol and gentamicin, 1987-2001



4 DISCUSSION

Data from two surveillance systems were used for the analyses of antimicrobial resistance trends in this report: (1) antimicrobial resistance data collected and collated annually from hospital and community diagnostic laboratories, and (2) the ongoing surveillance of resistance among invasive pathogens and *Salmonella* referred to ESR.

While antimicrobial resistance data have been collected from diagnostic laboratories in New Zealand since 1988, the laboratories that have contributed data have varied from year to year. As a consequence, apparent changes in resistance over time may merely reflect changes in the participant laboratories. For example, the mix of hospital and community laboratories or the geographic distribution of the laboratories. Therefore to maximise the validity of time-trend analyses, only data from laboratories which have participated in each of the years covered by the analyses (core laboratories) have been included. This restriction resulted in the two previous trend analyses, which covered 9- and 10-year periods, being limited to antimicrobial resistance data from just four core laboratories, all of which were hospital laboratories. The estimated trends may not have been typical for the pathogen or, more especially, for community-acquired infections.

For this report, the time period was reduced to five years to enable data from a greater number and type of diagnostic laboratories to be included. As a result, the data from the original four core hospital laboratories, four community laboratories, and one laboratory which processes both hospital and community specimens were included. These nine laboratories represented a reasonable geographic spread. The extension of the data to include those from community laboratories enabled, for the first time, some comparisons of resistance among community and hospital isolates.

Despite this improvement in the scope of laboratories included, this surveillance system it is still limited by several factors that may affect the data, such as differences between the core laboratories in their protocols specifying which specimens are tested for antimicrobial susceptibility, and differences in testing methods and interpretation of results.

Among the data collected from the nine core diagnostic laboratories, there were several notable and significant changes in antimicrobial resistance during the five years 1997 to 2001, including:

- **Increases in resistance to all antibiotics analysed for trend among hospital and community *S. aureus***

  Most notably, methicillin/oxacillin resistance increased from 6.0% in 1997 to 13.5% in 2001 among hospital isolates and from 4.8 to 7.4% among community isolates. Fluoroquinolone resistance increased from 3.7 to 15.8% among hospital isolates and from 1.1 to 12.9% among community isolates. Mupirocin resistance increased from 3.0 to 10.1% among hospital isolates.

- **Decreases in resistance to several ß-lactams among the two members of the *Enterobacteriaceae* included in the study, *E. coli* and *Klebsiella*, and among *P. aeruginosa***

  Among hospital and community urinary *E. coli*, and hospital non-urinary isolates, resistance to several ß-lactams decreased. Among hospital isolates, co-amoxiclav, cephalothin and cefuroxime resistance all decreased in both urinary and non-urinary isolates. Co-amoxiclav resistance decreased from 25.6% in 1997 to 14.0% in 2001 in urinary isolates and 26.0 to 15.9% in non-urinary isolates. Cephalothin resistance decreased from 44.8 to 23.0% in urinary isolates and 46.2 to 26.4% in non-urinary isolates. Decreases in cefuroxime resistance were smaller: 1.8 to 1.2% in urinary isolates and 3.9 to 2.4% in non-urinary isolates. Among community urinary isolates, co-amoxiclav resistance decreased from 9.3 to 7.6% and cephalothin resistance decreased from 21.8 to 11.7%.

  Cephalothin resistance among hospital isolates of *Klebsiella* spp decreased from 15.8% in 1997 to 10.6% in 2001 and cefuroxime resistance decreased from 7.7 to 5.4%.

  Ceftazidime resistance among hospital isolates of *P. aeruginosa* decreased from 9.9% in 1997 to 2.6% in 2001and piperacillin resistance decreased from 6.7 to 3.5%.

- **Increases in resistance to ampicillin, co-amoxiclav and co-trimoxazole, and ß-lactamase production among *H. influenzae* from non-invasive infections**

  Ampicillin resistance increased from 15.7% in 1997 to 21.9% in 2001, while ß-lactamase production increased from 14.3 to 17.6%. Co-trimoxazole resistance increased from 12.8 to 16.9%.

- **An increase in ampicillin resistance among hospital enterococci**

  Ampicillin resistance increased from 0.8% in 1997 to 6.6% in 2001. It is assumed that this resistance is not ß-lactamase mediated, as this type of resistance has not been identified among enterococci in New Zealand.

- **Increases in resistance to methicillin/oxacillin, gentamicin and co-trimoxazole among coagulase-negative staphylococci from blood**

  Methicillin/oxacillin resistance increased from 38.4% in 1997 to 52.5% in 2001. Gentamicin resistance increased from 23.1 to 34.3% and co-trimoxazole resistance increased from 22.8 to 31.0%.

The penicillin and cefotaxime resistance data for non-invasive pneumococci is probably quite unreliable for the years before 2001 and this may account for the apparent sharp decrease in penicillin resistance in 2001 (Figure 20). Before 2001, it is likely that some laboratories included isolates with intermediate resistance in the 'resistance' data that they submitted. When the 2001 data were collected, contributing laboratories were asked to specify whether their penicillin and cefotaxime resistance data for pneumococci included isolates with intermediate resistance. Such data were excluded when the national resistance rates were collated.

The data from the ongoing surveillance of invasive isolates are either complete (in the case of *N. meningitidis*) or at least representative (*H. influenzae* and *S. pneumoniae*). Therefore, the trend analyses for these pathogens should be an accurate representation of the changes in antimicrobial resistance among these pathogens in New Zealand.

Among the invasive isolate data, the most notable changes were recent decreases in penicillin resistance and nonsusceptibility (resistance and intermediate resistance), and cefotaxime nonsusceptibility, in *S. pneumoniae.* Over the whole 10-year period, 1992 to 2001, penicillin resistance increased from 0 to 3.9%. However, resistance peaked at 7.2% in 1998 and then fell in the following three years. Correspondingly, penicillin nonsusceptibility rose overall during the last 10 years, but decreased between 2000 and 2001. Cefotaxime resistance increased from 0.9% in 1997, when it was first detected, to 1.5% in 2001. Cefotaxime nonsusceptibility increased from 0.4% in 1993 to 8.6% in 2000, but decreased in 2001 to 4.8%.

The prevalence of reduced penicillin susceptibility (MICs 0.12-0.25 mg/L) among meningococci from invasive disease increased over the 1992-2001 period to 7.5% in 2001, with an apparent peak of 18.5% in 1999. These isolates are still susceptible to normal penicillin treatment regimens for meningococcal meningitis.

Salmonella susceptibility data were included in this trend analysis for the first time. These data are based on antimicrobial susceptibility testing at ESR. Prior to 2000, this testing was only undertaken every 5 years. Unfortunately, due to changes in the range of antibiotics tested, only four antibiotics (ampicillin, cephalothin, chloramphenicol and gentamicin) have been consistently tested in all years that testing has been undertaken since 1987. Between 1987 and 2001, resistance remained below 5% for these four antibiotics and there were no significant changes.

This is the third year that this trend analysis has been reported.[1,2] These analyses should be repeated on a regular, perhaps annual, basis. To ensure at least the same core laboratory data are available, it is vital that the nine core laboratories continue to contribute their antimicrobial resistance data annually. As was suggested in last year's report, this trend analysis report could be enhanced by the inclusion of other data. In particular, in future years, trends in antituberculosis-drug resistance could be included. These data were not included this year as a full analysis of antituberculosis-drug resistance during the 1995-2002 period was reported separately.[4]

It is recommended that the information in this report be made available to appropriate healthcare professionals, including laboratories which contribute their resistance data.

REFERENCES

1 Brett M, Garrett N. Trend analysis of antimicrobial resistance data collected in New Zealand between 1991 and 1999. Porirua: ESR; 2000.

2 Heffernan H, Garrett N. Antimicrobial; resistance trends in New Zealand, 1991-2000. Porirua: ESR; 2001.

3 SAS version 8.0. Cary (NC): SAS Institute; 1999.

4 Heffernan H, Vaughan R, McKnight L, Talbot V, Coley K, Garrett N. Antituberculosis-drug resistance in New Zealand, 1995-2001. Porirua: ESR; 2002.

APPENDIX 1

Collated antimicrobial susceptibility data for the core laboratories: Auckland and Children's Hospital; Middlemore Hospital; Medical Diagnostic Laboratory, Auckland; Rotorua Hospital; Wanganui Diagnostic Laboratory; MedLab Central, Palmerston North; Valley Diagnostic Laboratories, Lower Hutt; Christchurch Hospital (Canterbury Health Laboratories); and Southern Community Laboratories, Dunedin,
1997-2001

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Enterococcus* spp**																				
Community																				
ampicillin											4163	0.5%	1969	0.4%	1931	5.8%	2670	0.9%	2720	1.1%
gentamicin (high level)													170	1.2%						
nitrofurantoin											2780	0.9%	455	4.6%	1733	2.4%	2603	0.6%	2665	0.8%
vancomycin																	4	0%		
Hospital																				
ampicillin	984	0.7%	760	2.6%	1111	0.5%	1022	1.4%	1063	2.2%	1234	0.8%	1450	3.0%	756	1.7%	1347	4.4%	1601	6.6%
gentamicin (high level)							11	72.7%	7	14.3%	67	25.4%	58	12.1%	121	50.4%	70	15.7%	151	29.1%
nitrofurantoin	726	0.1%	418	0.7%	834	0.8%	699	0.4%	407	0.5%	717	0.4%	773	1.3%	289	0.7%	1005	0.4%	1223	0.3%
vancomycin	72	0%	55	0%	99	0%	344	0%	101	0%	687	0%	1202	0.2%	552	0.2%	1236	0.2%	1472	0.3%
***E. coli* non-urinary**																				
Hospital																				
amikacin	1	0%			1659	0.1%	250	0%	549	0%	479	0%	373	0%	412	0%	562	0%	557	0%
ampicillin	1811	46.5%	718	63.8%	1886	68.6%	3712	53.3%	1893	54.0%	1406	56.1%	2020	56.0%	1473	48.0%	1677	59.0%	1370	58.7%
cefotaxime/ceftriaxone	401	0%	245	0.4%	1286	0.5%	1853	0.1%	931	0.3%	870	0.3%	766	0.1%	674	0.1%	829	0.2%	1033	0.6%
cefuroxime/cefamandole	690	1.9%	412	3.4%	1358	3.9%	2007	1.7%	1255	3.6%	846	3.9%	1243	4.7%	932	2.9%	1067	2.1%	1106	2.4%
cephalothin	358	18.4%	231	62.3%	449	48.1%	1563	42.1%	324	49.7%	316	46.2%	409	41.3%	672	26.3%	822	20.9%	913	26.4%
co-amoxiclav	819	16.7%	514	36.4%	1282	28.0%	1922	31.0%	1148	29.0%	1170	26.0%	1621	19.6%	1140	16.6%	1332	12.2%	1220	15.9%
co-trimoxazole	951	13.1%	368	12.5%	1043	23.0%	761	21.8%	1263	20.9%	1248	18.8%	1240	22.9%	1138	26.4%	1472	20.6%	1006	28.0%
fluoroquinolone	376	0%	307	0.3%	1043	0.3%	630	0.3%	1238	0.6%	647	1.2%	1395	0.9%	943	1.8%	1090	1.7%	1138	1.5%
gentamicin	1821	0.2%	709	0.8%	1793	1.0%	4357	0.4%	1846	1.0%	1594	0.9%	1593	1.0%	1457	1.9%	1687	1.4%	1401	0.6%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***E. coli* urinary**																				
Community																				
ampicillin											41534	57.3%	21111	55.1%	23412	54.3%	42499	55.0%	44988	55.7%
cefuroxime/cefamandole																			3	0%
cephalothin											1703	21.8%			557	16.3%	1585	9.8%	1618	11.7%
co-amoxiclav											41520	9.3%	24496	9.9%	23415	6.2%	42499	6.5%	44922	7.6%
co-trimoxazole											1498	23.6%	591	28.4%	948	8.4%	59	39.0%	54	9.3%
fluoroquinolone											36801	0.4%	21475	0.7%	7543	1.2%	39488	1.5%	44628	2.0%
gentamicin											494	1.4%	6	0%	593	0.5%	12	8.3%	27	18.5%
trimethoprim											38172	22.6%	24036	23.2%	7193	22.4%	42494	23.6%	44972	24.0%
Hospital																				
amikacin			1571	0.1%	128	1.6%	682	0%	1314	0%	1410	0.1%	1733	0.1%	1696	0.2%	1909	0%	2014	0.05%
ampicillin	3453	51.7%	3934	65.5%	4774	56.5%	3156	52.1%	5739	56.4%	4106	54.6%	5744	54.7%	5814	56.8%	6049	55.4%	6092	53.2%
cefotaxime/ceftriaxone	1799	0.1%	2647	0.2%	2545	0.1%	713	0.3%	2633	0.3%	2447	0.1%	3557	0.3%	3601	0.2%	3952	0.1%	3656	0.2%
cefuroxime/cefamandole	1824	0.7%	2779	2.9%	2621	2.0%	853	1.6%	2796	2.3%	2608	1.8%	4144	3.0%	3737	0.9%	4086	0.7%	3907	1.2%
cephalothin	2145	17.8%	1521	47.3%	1889	46.6%	630	45.6%	1843	53.0%	1061	44.8%	1998	38.4%	3640	16.3%	3951	18.5%	3366	23.0%
co-amoxiclav	2182	8.6%	3056	18.5%	3220	25.6%	1378	24.7%	3755	31.3%	2887	25.6%	4179	21.2%	4214	11.0%	5633	11.8%	4291	14.0%
co-trimoxazole	1920	17.7%	2866	20.2%	2812	19.1%	840	19.6%	1631	21.9%	2038	23.3%	2700	21.6%	2555	22.2%	1913	25.7%	3124	21.7%
fluoroquinolone	2167	0%	2416	0.1%	5923	0.3%	4180	0.4%	5185	2.0%	4417	0.3%	5686	0.6%	5273	1.2%	6301	1.3%	6081	1.3%
gentamicin	3087	0.3%	3562	0.4%	4491	0.8%	2539	0.3%	4659	0.4%	4122	0.4%	5333	0.8%	5449	1.4%	5934	1.5%	5698	1.1%
trimethoprim	3439	16.1%	3835	17.6%	5119	17.5%	4294	17.8%	5323	20.3%	4798	21.6%	5755	21.3%	5716	24.3%	6304	23.7%	6093	24.2%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Haemophilus influenzae* noninvasive**																				
ampicillin											5614	15.7%	4154	15.7%	5747	24.0%	7647	25.0%	7484	21.9%
ß-lactamase											1941	14.3%	2391	16.5%	1164	22.5%	1030	18.1%	1154	17.6%
chloramphenicol											2515	1.2%	1462	0.6%	3040	0.8%	4696	0.6%	4032	0.4%
co-amoxiclav											4423	0.3%	2975	0.3%	4876	0.5%	2594	0.6%	2598	0.5%
co-trimoxazole											4021	12.8%	3159	10.6%	4682	18.7%	7107	18.1%	6762	16.9%
***Klebsiella* spp**																				
Hospital																				
amikacin	294	0.3%	220	0.5%	270	0.4%	225	0.4%	241	0%	266	0%	402	0%	392	0.3%	502	0.2%	486	0%
cefotaxime/ceftriaxone	578	0.3%	410	1.7%	559	3.0%	493	2.8%	563	1.4%	520	1.7%	745	1.7%	782	0.9%	855	1.9%	790	0.8%
cefuroxime/cefamandole	665	7.2%	456	7.0%	719	7.1%	575	9.0%	651	7.2%	585	7.7%	768	8.3%	785	3.7%	886	5.4%	930	5.4%
cephalothin	315	8.9%	234	12.0%	312	13.1%	287	16.4%	280	16.8%	215	15.8%	354	24.0%	786	17.6%	834	14.9%	755	10.6%
fluoroquinolone	81	0%	142	1.4%	699	1.6%	413	2.2%	604	0.8%	658	0.5%	816	1.0%	738	1.2%	860	1.3%	1013	0.9%
gentamicin	858	2.0%	738	1.5%	1128	1.4%	826	1.2%	871	2.0%	895	1.2%	1186	0.8%	1108	0.9%	1150	1.6%	1278	0.7%
Pseudomonas aeruginosa																				
Hospital																				
amikacin	450	11.8%	392	9.2%	556	5.0%	645	7.1%	680	5.9%			750	5.6%	921	4.3%	1033	5.3%		
ceftazidime	282	10.6%	445	5.6%	896	6.1%	960	5.5%	1011	5.9%	944	9.9%	953	4.5%	1116	3.8%	1374	2.3%	1435	2.6%
fluoroquinolone	398	13.3%	568	12.3%	1370	9.3%	1087	7.5%	1389	10.0%	1444	6.9%	1643	7.7%	1781	6.4%	2011	6.4%	2051	6.0%
gentamicin	864	15.6%	1089	15.4%	1424	14.3%	1530	14.6%	1660	14.9%	1532	5.9%	1698	9.3%	2004	6.2%	2086	6.9%	2024	8.9%
piperacillin	466	2.1%	778	4.8%	1423	7.9%	1516	8.4%	1685	7.8%	1673	6.7%	1811	5.0%	2070	3.7%	2204	3.5%	2261	3.5%
tobramycin	628	3.0%	341	4.1%	793	2.5%	747	3.5%	720	5.4%	643	2.8%	775	3.5%	767	2.7%	831	4.3%	777	4.9%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
Staphylococcus aureus																				
Community																				
co-trimoxazole											26771	0.4%	17464	0.2%	19515	0.5%	13523	1.4%	29710	0.6%
erythromycin											29842	10.5%	18807	10.7%	21823	12.6%	35952	13.5%	31982	13.2%
fluoroquinolone											12986	1.1%	501	9.0%	4180	1.2%	223	26.5%	387	12.9%
gentamicin											787	0.4%	1274	0.8%	3	0%			3	0%
methicillin/oxacillin											30832	4.8%	19801	5.5%	21848	6.3%	41756	6.8%	37308	7.4%
mupirocin											18809	17.7%	10476	19.8%	12996	20.4%	29841	22.3%	25166	20.4%
Hospital																				
amikacin			17	0%	228	0.4%	40	0%	2	0%	1	0%	2	0%	1	0%				
co-trimoxazole	4704	1.0%	3577	0.6%	4523	0.7%	4607	0.7%	4670	0.8%	5129	0.9%	5645	1.1%	6026	2.6%	8208	1.9%	7383	2.5%
erythromycin	7263	6.8%	5130	10.0%	7575	9.1%	7863	8.5%	8007	7.7%	7842	8.9%	8328	8.7%	9255	10.6%	11118	10.8%	10069	13.1%
fluoroquinolone	2800	0.5%	1501	4.9%	2251	2.6%	2141	2.9%	2278	2.3%	2414	3.7%	2661	3.0%	2840	8.0%	4056	8.5%	2867	15.8%
gentamicin	4895	1.0%	3232	1.3%	5088	1.0%	5645	1.4%	5591	1.4%	2843	1.0%	5930	1.8%	6935	3.2%	7714	2.2%	7626	2.6%
methicillin/oxacillin	8288	0.7%	5948	1.6%	8585	1.4%	8889	2.8%	9195	4.4%	8475	6.0%	9035	7.4%	10175	9.5%	11309	12.4%	10868	13.5%
mupirocin			15	0%			183	2.7%	785	2.5%	742	3.0%	1070	7.0%	1642	8.5%	1622	10.0%	1893	10.1%
Staphylococci (coagulase negative) from blood																				
amikacin													13	0%						
co-trimoxazole											391	22.8%	619	21.6%	327	24.8%	327	26.9%	381	31.0%
erythromycin											789	40.1%	1212	39.6%	937	43.1%	976	42.0%	857	42.5%
fluoroquinolone											187	9.1%	638	16.8%	314	10.5%	373	17.4%	200	15.5%
gentamicin											603	23.1%	947	26.5%	843	30.6%	648	29.6%	642	34.3%
methicillin/oxacillin											661	38.4%	1300	43.3%	1090	47.9%	974	48.2%	854	52.5%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Streptococcus pneumoniae* non-invasive**																				
cefotaxime/ceftriaxone													18	33.3%	14	7.1%			871	10.1%
chloramphenicol											1412	3.5%	518	1.7%	1373	4.8%	2682	5.6%	2648	4.2%
co-trimoxazole											2550	38.5%	889	24.9%	541	46.2%	3642	47.8%	3170	40.1%
erythromycin											3471	13.9%	1988	9.4%	3317	18.5%	4660	18.9%	3911	17.6%
penicillin											3498	19.3%	1463	12.0%	3320	26.2%	4508	29.5%	1176	13.5%
tetracycline											2688	13.2%	696	6.9%	864	14.9%	1711	18.4%	1464	14.4%

APPENDIX 2

Antimicrobial susceptibility data for isolates from invasive disease, 1992-2001

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
Streptococcus pneumoniae																				
penicillin MIC ≥2 mg/L	232	0.0%	285	0.4%	328	0.9%	320	0.9%	341	1.8%	333	3.0%	377	7.2%	473	6.8%	466	5.2%	537	3.9%
penicillin MIC ≥0.12 mg/L	232	0.9%	285	1.8%	328	2.1%	320	1.9%	341	6.2%	333	9.9%	377	15.1%	473	18.0%	466	16.5%	537	12.7%
cefotaxime MIC ≥ 2 mg/L	232	0%	285	0%	328	0%	320	0%	341	0%	333	0.9%	377	0.5%	473	1.3%	466	0.6%	537	1.5%
cefotaxime MIC ≤ 1 mg/L	232	0%	285	0.4%	328	1.2%	320	0.6%	341	3.5%	333	6.9%	377	6.6%	473	7.8%	466	8.6%	537	4.8%
chloramphenicol	232	0%	285	0.4%	328	0.9%	320	0.6%	341	2.1%	333	2.7%	377	3.7%	473	3.4%	449	4.5%	537	1.3%
erythromycin	232	3.0%	285	0.7%	328	1.2%	320	2.5%	341	4.1%	62	11.3%	318	5.3%	473	2.3%	465	7.5%	537	5.4%
Neisseria meningitidis																				
penicillin MIC 0.12-0.25 mg/L	109	0%	131	3.1%	162	0.6%	233	6.4%	264	3.8%	206	1.5%	95	7.4%	130	18.5%	255	7.1%	318	7.5%
rifampicin	109	0.9%	131	0%	162	0%	233	0%	264	0%	206	0%	95	0%	130	0%	255	0%	318	0%
ciprofloxacin	109	0%	131	0%	162	0%	233	0%	264	0%	206	0%	95	0%	130	0%	255	0%	318	0%
ceftriaxone					162	0%	233	0%	264	0%	206	0%	95	0%	130	0%	255	0%	318	0%
Haemophilus influenzae																				
ampicillin	185	14.1%	141	14.9%	92	19.6%	42	28.6%	45	20.0%	38	10.5%	41	14.6%	43	7.0%	51	15.7%	51	15.7%
ß-lactamase	185	14.1%	141	14.9%	92	18.5%	42	26.2%	45	15.6%	38	10.5%	41	14.6%	43	7.0%	51	13.7%	51	15.7%
chloramphenicol	185	0%	141	0%	92	1.1%	42	2.4%	45	2.2%	38	0%	41	2.4%	43	0%	51	0%	51	0%
cefotaxime	185	0%	141	0%	92	0%	42	0%	45	0%	38	0%	41	0%	43	0%	51	0%	51	0%
rifampicin	185	0%	141	0%	92	0%	42	0%	45	0%	38	0%	41	0%	43	2.3%	51	0%	51	0%

APPENDIX 3

Collated antimicrobial susceptibility data for all contributing laboratories, 1992-2001

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Acinetobacter* spp**																				
amikacin	58	0%	145	0.7%	141	1.4%	79	3.8%	99	3.0%	76	3.9%	101	4.0%	163	6.7%	144	2.8%	133	9.0%
ceftazidime	5	0%	72	30.6%	209	4.8%	117	7.7%	111	18.0%	141	24.1%	135	24.4%	339	12.4%	239	14.6%	211	22.3%
co-trimoxazole	138	15.9%	233	6.4%	433	14.5%	216	27.3%	297	37.7%	337	31.2%	511	19.6%	610	21.0%	507	14.0%	600	18.0%
fluoroquinolone	19	21.1%	83	8.4%	406	17.7%	247	12.6%	280	13.6%	358	16.2%	368	17.1%	598	18.9%	465	8.6%	651	17.7%
gentamicin	235	11.5%	343	12.5%	576	9.0%	397	9.1%	376	29.0%	449	20.7%	654	14.7%	600	18.7%	524	12.2%	671	13.7%
imipenem/meropenem															469	2.1%	205	4.4%	346	2.0%
netilmicin					25	4.0%			43	4.7%	34	2.9%	31	6.5%	94	8.5%	88	10.2%	65	32.3%
piperacillin	8	0%	137	35.8%	263	38.0%	201	39.8%	248	55.6%	215	50.7%	228	39.9%	411	29.4%	184	33.2%	219	39.3%
ticarcillin	66	18.2%	147	9.5%	149	38.9%	11	9.1%	48	31.3%	34	35.3%	31	22.6%	60	10.0%	35	22.9%		
tobramycin	51	5.9%	2	0%	102	11.8%	8	12.5%	56	10.7%	109	6.4%	65	21.5%	250	5.2%	175	10.9%	155	9.7%
***Campylobacter* spp**																				
erythromycin															121	3.3%	175	2.9%	342	1.2%
fluoroquinolone															1	0%	48	2.1%	279	2.9%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
Citrobacter freundii																				
amikacin	22	0%	24	0%	36	8.3%	36	27.8%	32	0%	44	0%	76	0%	82	1.2%	126	0%	96	0%
ampicillin	65	67.7%	126	88.1%	393	86.3%	322	88.5%	269	86.6%	580	90.2%	631	85.6%	542	77.7%	297	83.2%	797	92.8%
cefazolin					12	66.7%					44	90.9%	55	63.6%	34	67.6%	60	71.7%		
cefotaxime/ceftriaxone	48	4.2%	46	15.2%	151	11.9%	124	21.8%	151	31.1%	240	17.1%	199	16.1%	158	13.3%	138	14.5%	152	23.0%
cefuroxime/cefamandole	33	42.4%	47	27.7%	171	27.5%	121	28.1%	170	24.1%	197	26.9%	181	25.4%	129	28.7%	164	32.9%	118	22.0%
cephalothin			22	90.9%	163	71.8%	70	84.3%	116	85.3%	156	83.3%	153	61.4%	168	72.0%	161	86.3%	128	82.8%
chloramphenicol	1	0%	2	0%	5	20.0%	4	0%			8	12.5%	6	50.0%	10	40.0%	8	25.0%		
co-amoxiclav	79	43.0%	117	62.4%	327	69.4%	271	70.8%	235	68.5%	575	68.5%	520	68.1%	614	53.9%	286	55.6%	708	49.0%
co-trimoxazole	79	8.9%	108	10.2%	195	6.2%	110	2.7%	177	5.6%	267	4.1%	345	11.3%	221	8.1%	184	6.0%	348	10.9%
fluoroquinolone	1	0%	34	2.9%	224	0.4%	162	0%	223	1.3%	367	0.8%	317	0.3%	314	2.9%	264	1.5%	701	3.6%
gentamicin	65	0%	87	1.1%	319	1.9%	249	0.8%	283	1.1%	419	2.1%	403	1.5%	226	3.5%	234	3.0%	272	2.6%
imipenem/meropenem															137	1.5%	112	1.8%	146	0%
netilmicin					12	16.7%			34	0%	44	0%	55	1.8%	69	1.4%	100	1.0%	60	0%
tetracycline	12	0%	10	20.0%	34	5.9%	9	22.2%	47	2.1%	77	2.6%	62	6.5%	63	30.2%	60	13.3%	26	3.8%
tobramycin	27	0%			34	2.9%	3	0%	32	0%	57	1.8%	61	0%	55	0%	79	6.3%	76	0%
***E. coli* blood isolates**																				
amikacin																			352	0%
ampicillin																			1014	55.6%
cefotaxime/ceftriaxone																			818	0.6%
cefuroxime/cefamandole																			823	2.8%
cephalothin																			554	28.9%
co-amoxiclav																			858	20.9%
fluoroquinolone																			969	2.7%
gentamicin																			1015	1.1%
imipenem/meropenem																			489	0%
netilmicin																			226	0%
tobramycin																			229	2.2%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***E. coli* non-urinary**																				
amikacin	1	0%			2170	0.3%	250	0%	1571	0%	1458	0%	1354	0%	1413	0.1%	1572	0%	2387	0.3%
ampicillin	2053	47.4%	1134	63.1%	3447	61.3%	4304	53.7%	3268	52.2%	4247	55.3%	6821	55.1%	6251	56.6%	4501	56.3%	5062	56.2%
cefazolin					452	4.0%					979	9.0%	906	13.8%	819	8.1%	762	8.0%		
cefotaxime/ceftriaxone	415	0%	245	0.4%	2283	0.5%	2245	0.1%	1953	5.9%	2736	0.3%	2633	0.6%	2271	0.2%	2129	0.2%	2738	0.5%
cefuroxime/cefamandole	707	1.8%	412	3.4%	2250	3.6%	2173	2.0%	2277	4.2%	2288	3.9%	2559	5.7%	2046	3.7%	2440	3.2%	2742	4.5%
cephalothin	529	17.0%	500	42.0%	1353	27.1%	1663	41.4%	1582	38.9%	1479	38.1%	1707	39.4%	2673	25.7%	1835	24.8%	2426	34.9%
chloramphenicol	13	0%	70	15.7%	87	9.2%	58	10.3%	1028	1.0%	91	14.3%	111	6.3%	167	12.6%	57	8.8%		
co-amoxiclav	1004	16.3%	931	25.2%	2793	22.9%	2441	28.0%	2522	20.4%	3966	21.6%	6100	25.6%	5882	18.0%	3936	17.8%	4907	18.9%
co-trimoxazole	1122	14.5%	783	15.1%	2020	19.0%	920	21.1%	2592	19.4%	3069	17.0%	5449	20.5%	3349	21.6%	3756	19.2%	3389	21.4%
fluoroquinolone	376	0%	352	0.3%	1871	0.2%	794	0.4%	2261	0.8%	2905	1.0%	5331	0.7%	2564	0.8%	3175	1.4%	3693	2.5%
gentamicin	1901	0.4%	1137	0.6%	3290	1.4%	4472	0.4%	2984	0.9%	3497	0.5%	4284	0.7%	6008	1.2%	3695	1.4%	4256	2.0%
imipenem/meropenem															1749	0%	1567	0.6%	2151	0.3%
netilmicin			12	8.3%	452	0%	34	0%	16	0%	980	0%	977	0%	1161	0.3%	1314	0.1%	2096	0.3%
tetracycline	234	29.5%	431	16.2%	1019	16.4%	180	21.1%	1374	15.9%	1476	16.7%	1237	20.1%	1631	13.1%	1013	15.6%	1652	16.9%
tobramycin	26	0%			631	2.1%	55	0%	1038	1.6%	1107	0.3%	1009	1.3%	1071	1.3%	1066	1.1%	1328	2.0%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***E. coli* urinary**																				
amikacin			1571	0.1%	448	0.4%	682	0%	2073	0%	2163	0.05%	3127	0.03%	3623	0.3%	3647	0%	4384	0.02%
ampicillin	7109	52.1%	10547	59.3%	22698	55.1%	15422	56.3%	12631	58.9%	59563	58.3%	47657	55.5%	46661	54.5%	69909	55.2%	77932	55.4%
cefazolin					320	1.9%					753	10.0%	2487	13.7%	609	9.0%	536	8.0%		
cefotaxime/ceftriaxone	1799	0.1%	2647	0.2%	3314	0.2%	736	0.3%	3392	2.2%	3281	0.2%	5233	0.2%	6069	0.3%	5726	0.1%	6228	0.6%
cefuroxime/cefamandole	1824	0.7%	2779	2.9%	3115	1.9%	945	1.7%	3555	2.7%	3406	2.6%	5791	3.2%	5103	1.7%	4624	1.0%	4761	2.2%
cephalothin	2196	17.5%	2618	29.2%	10281	10.9%	2185	29.3%	4428	39.8%	3517	33.7%	4486	35.6%	7172	26.9%	9369	18.1%	10945	19.8%
chloramphenicol															1	0%				
co-amoxiclav	5838	7.6%	9675	7.5%	20954	8.3%	13084	11.0%	10605	18.1%	58178	11.4%	48102	12.6%	45219	10.6%	67758	8.9%	76164	10.0%
co-trimoxazole	1971	17.9%	8785	21.0%	8597	19.9%	1445	18.9%	2392	20.4%	4304	22.2%	10342	19.9%	13740	18.9%	4534	23.1%	6670	21.3%
fluoroquinolone	3112	0.1%	3233	0.3%	18102	0.2%	15258	0.3%	8429	1.5%	55851	0.4%	47714	0.6%	30502	0.9%	65995	1.2%	83600	1.6%
gentamicin	3144	0.3%	4298	0.4%	6714	0.8%	4891	0.2%	7552	0.4%	10119	0.4%	8306	0.7%	15770	0.9%	15076	1.0%	15726	1.0%
imipenem/meropenem															11	0%				
mecillinam																			2866	5.1%
nalidixic acid	3951	2.2%	4846	2.3%	5515	2.4%			60	8.3%	10994	3.1%	69	15.9%	155	2.6%	65	12.3%		
netilmicin					320	0%	10	0%	772	0%	753	0%	1392	6.7%	2244	0.4%	2414	0.6%	2907	0.1%
nitrofurantoin	7092	1.4%	9047	1.3%	22623	1.2%	15327	1.3%	10173	3.2%	58101	1.5%	42746	1.8%	38685	1.5%	68650	1.5%	83481	1.5%
tetracycline					320	9.1%	1	0%	759	13.0%	3846	23.0%	1553	21.4%	1351	19.6%	537	17.9%		
tobramycin	1	0%	23	0%	760	0.9%	16	0%	2659	15.9%	757	1.2%	1400	0.1%	2490	0.8%	1757	0.7%	2109	1.0%
trimethoprim	7094	17.8%	10451	20.8%	22645	19.1%	16597	19.5%	10677	21.1%	57614	22.3%	46035	22.5%	23228	22.4%	69465	22.5%	84517	22.5%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Enterobacter* spp**																				
amikacin	199	0%	158	0%	302	1.0%	181	0.6%	320	0.6%	360	1.4%	475	0%	532	0.2%	591	0.2%	733	0.1%
ampicillin	959	91.9%	679	92.8%	1377	91.5%	1350	94.1%	940	91.0%	1740	94.6%	1926	94.8%	2199	90.9%	1976	93.6%	2267	95.3%
cefazolin					75	78.7%			114	78.9%	153	90.2%	174	89.1%	128	91.4%	118	82.2%		
cefotaxime/ceftriaxone	472	10.2%	324	12.7%	686	18.2%	608	16.0%	511	25.0%	805	14.8%	943	20.6%	895	18.4%	818	12.6%	1039	20.9%
cefuroxime/cefamandole	521	41.7%	394	44.2%	710	41.5%	515	42.1%	488	52.9%	608	49.3%	725	54.3%	664	48.2%	761	35.1%	938	45.1%
cephalothin	312	79.5%	297	87.9%	617	53.6%	241	90.9%	260	92.7%	307	92.5%	471	93.0%	888	91.6%	688	93.5%	927	95.8%
chloramphenicol	3	0%	24	0%	30	13.3%	28	3.6%	2	50.0%	27	7.4%	16	12.5%	172	7.0%	13	7.7%		
co-amoxiclav	706	77.2%	600	77.7%	1204	79.4%	964	83.9%	688	84.7%	1793	81.7%	1691	88.1%	2242	76.8%	1804	82.4%	2196	84.5%
co-trimoxazole	670	14.3%	556	5.2%	693	2.9%	801	49.6%	683	4.2%	933	3.5%	1252	6.8%	1320	5.7%	1144	6.4%	1540	7.1%
fluoroquinolone	184	0%	183	0%	717	1.0%	498	5.8%	631	2.4%	917	2.6%	1310	2.5%	1311	3.2%	1274	3.4%	1641	4.6%
gentamicin	799	1.4%	644	1.7%	1141	1.1%	1002	2.1%	868	2.2%	1279	2.5%	1503	3.5%	1854	3.3%	1293	3.9%	1535	4.3%
imipenem/meropenem															815	0.6%	547	0.4%	1027	0.5%
netilmicin			10	0%	94	0%			115	1.7%	153	0%	174	1.7%	366	0.8%	449	2.0%	448	1.3%
tetracycline	70	2.9%	138	8.0%	195	6.7%	47	6.4%	176	12.5%	405	19.5%	317	6.9%	436	10.1%	230	7.8%	349	9.7%
tobramycin	50	0%			247	0.8%	30	6.7%	161	1.9%	173	1.2%	193	2.6%	243	2.9%	271	3.7%	337	4.7%
trimethoprim															120	28.3%				
***Enterococcus* spp**																				
ampicillin	1259	1.6%	760	2.6%	2803	1.4%	3046	1.5%	1713	1.5%	6716	1.1%	6147	1.4%	5848	4.3%	6487	2.1%	8418	2.8%
gentamicin (high level)					151	8.6%	11	72.7%	7	14.3%	67	25.4%	376	2.4%	232	26.3%	313	30.4%	739	17.6%
nitrofurantoin	872	2.9%	418	0.7%	2143	1.4%	2144	1.3%	758	0.8%	4186	1.2%	2778	2.4%	4391	5.3%	5298	1.2%	7028	1.1%
tetracycline	288	40.3%	34	50.0%	499	60.7%	452	43.4%	210	50.0%	505	58.4%	1023	48.6%	816	55.3%	864	59.3%	1478	62.6%
vancomycin	72	0%	55	0%	305	0.3%	578	0%	298	0.3%	1213	0.3%	2116	0.4%	1423	0.7%	1807	0.3%	2718	0.7%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Haemophilus influenzae* noninvasive**																				
ampicillin	1773	8.6%	1114	10.9%	4867	10.1%	5007	12.6%	2821	14.5%	6859	15.8%	5433	16.1%	7798	23.3%	10016	23.3%	11624	21.0%
ß-lactamase	1339	7.5%	640	11.9%	2294	10.8%	4543	12.2%	2366	14.2%	2973	13.4%	3099	15.5%	2108	21.7%	3111	17.7%	4422	18.6%
chloramphenicol	340	0.3%	303	0.7%	1934	0.9%	1947	0.8%	570	0.2%	2821	1.1%	1841	0.5%	3626	0.7%	5127	0.5%	5276	0.4%
co-amoxiclav			1136	1.1%	4343	1.1%	4044	0.6%	1460	2.3%	5060	0.4%	4278	0.5%	6644	0.5%	4518	0.4%	6179	0.6%
co-trimoxazole	512	6.1%	722	7.6%	2764	10.2%	2889	14.2%	955	9.6%	4613	13.3%	3877	10.7%	6608	17.1%	8463	17.4%	9098	17.0%
tetracycline	1175	1.9%	418	0.2%	3300	0.8%	3258	1.2%	1252	0.6%	4958	1.7%	2303	1.9%	6381	1.0%	4721	0.9%	6196	1.5%
***Klebsiella* spp**																				
amikacin	294	0.3%	220	0.5%	406	0.5%	225	0.4%	530	0.4%	622	0%	787	1.0%	738	0.3%	861	0.1%	895	0.2%
ampicillin	1183	88.6%	1051	80.5%	2559	97.2%	1881	97.8%	1328	88.0%	3511	93.3%	4619	89.4%	4461	93.5%	4971	89.4%	5316	96.8%
cefazolin					107	3.7%			289	28.7%	356	17.1%	243	15.6%	179	20.7%	170	24.1%		
cefotaxime/ceftriaxone	695	0.3%	410	1.7%	995	1.7%	743	1.9%	852	3.8%	1358	2.5%	1602	2.7%	1428	1.9%	1257	1.8%	1598	1.4%
cefuroxime/cefamandole	665	7.2%	456	7.0%	1073	6.1%	721	7.4%	940	8.7%	1108	11.0%	1298	14.2%	1147	6.5%	1168	6.3%	1530	8.3%
cephalothin	366	8.5%	272	11.0%	1012	8.5%	365	16.2%	615	19.7%	698	17.3%	838	30.5%	1506	17.7%	1196	16.1%	1565	11.4%
chloramphenicol	5	0%	25	8.0%	35	45.7%	16	6.3%	4	0%	43	2.3%	193	0.5%	108	9.3%	51	0%		
co-amoxiclav	1084	6.8%	852	11.6%	2136	8.6%	1289	8.5%	1148	10.5%	3346	12.9%	3781	14.5%	4267	9.9%	4449	7.8%	4650	9.8%
co-trimoxazole	964	18.7%	744	23.8%	1332	7.3%	837	6.2%	944	12.0%	1438	6.7%	1818	6.3%	2170	6.6%	1668	5.0%	2821	7.5%
fluoroquinolone	81	0%	162	1.2%	1043	2.1%	619	2.1%	962	1.8%	1753	2.7%	3547	2.2%	2135	3.1%	3852	1.9%	4460	2.8%
gentamicin	1041	1.8%	842	1.4%	1971	1.4%	1360	0.7%	1213	1.9%	2167	0.8%	2776	1.5%	2816	0.9%	2141	1.1%	2866	0.6%
imipenem/meropenem															1339	0.4%	953	0.1%	1607	0.2%
netilmicin			10	0%	126	0%	21	0%	301	0%	356	0.6%	385	5.5%	524	0.6%	637	0.9%	443	0.2%
tetracycline	103	9.7%	66	7.6%	311	10.3%	69	0%	363	9.1%	633	10.9%	624	9.9%	430	10.5%	254	9.8%	468	6.2%
tobramycin	123	1.6%			254	3.5%	18	0%	354	3.1%	405	0.5%	429	1.4%	356	0.6%	199	1.0%	551	1.1%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
Moraxella (Branhamella) catarrhalis																				
ampicillin	432	81.0%	260	77.3%	1099	90.6%	1239	89.9%	605	91.6%	1391	89.6%	1080	86.6%	1205	92.2%	1203	90.5%	1415	93.6%
ß-lactamase	422	84.4%	121	83.5%	450	80.4%	937	89.2%	301	88.4%	705	91.2%	773	86.2%	667	78.4%	1130	77.3%	1331	94.9%
erythromycin	432	2.1%	225	2.7%	831	1.1%	972	1.0%	413	0.7%	1382	1.9%	608	1.3%	1479	2.6%	1058	1.7%	1011	2.4%
tetracycline	579	2.4%	210	0.5%	1070	1.1%	1145	1.2%	442	0.5%	1336	1.3%	646	1.5%	1413	0.6%	1141	1.7%	1217	2.4%
Morganella morganii																				
amikacin	69	1.4%	22	0%	46	0%			88	4.5%	109	0%	152	0%	123	0.8%	145	2.1%	152	1.3%
ampicillin	251	88.4%	156	78.2%	447	94.2%	312	97.1%	284	95.4%	443	94.6%	609	95.4%	558	93.9%	607	96.5%	712	97.1%
cefazolin					14	92.9%			40	100.0%	54	96.3%	61	62.3%	29	100.0%	27	100.0%		
cefotaxime/ceftriaxone	94	4.3%	61	4.9%	170	1.8%	122	2.5%	158	8.2%	209	4.3%	306	7.2%	222	7.2%	197	1.0%	260	5.0%
cefuroxime/cefamandole	101	89.1%	80	81.3%	167	79.6%	112	80.4%	178	84.8%	198	81.8%	210	91.0%	195	87.2%	278	76.3%	256	85.2%
cephalothin	13	84.6%	65	90.8%	197	94.4%	74	97.3%	100	98.0%	114	96.5%	114	93.0%	228	93.0%	201	97.5%	274	99.3%
chloramphenicol	1	0%	4	0%	7	14.3%	2	0%	6	33.3%	12	16.7%	46	4.3%	23	17.4%	2	0%		
co-amoxiclav	188	84.0%	126	91.3%	380	92.1%	282	95.4%	243	91.4%	403	83.4%	532	93.0%	539	92.4%	563	94.0%	681	95.3%
co-trimoxazole	178	16.3%	116	6.9%	238	5.0%	96	3.1%	190	8.4%	190	7.9%	411	11.4%	367	9.0%	369	12.2%	403	12.9%
fluoroquinolone	1	0%	19	0%	228	0.4%	141	0%	187	0%	244	0.8%	445	4.7%	330	3.9%	376	6.4%	539	9.1%
gentamicin	221	0.9%	137	1.5%	363	0.8%	260	0.4%	262	1.5%	344	3.8%	487	8.8%	386	7.8%	354	11.0%	449	11.8%
imipenem/meropenem															213	4.2%	159	1.9%	242	3.3%
netilmicin					14	0%			40	5.0%	54	0%	67	3.0%	91	1.1%	110	1.8%	110	1.8%
tetracycline	25	24.0%	34	26.5%	66	31.8%	20	10.0%	72	22.2%	70	32.9%	127	27.6%	80	27.5%	49	32.7%	58	25.9%
tobramycin	23	0%	1	0%	52	0%	1	0%	53	9.4%	59	0%	68	2.9%	55	0%	78	3.8%	96	0%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
Neisseria gonorrhoeae																				
ß-lactamase																	830	3.0%	328	4.0%
fluoroquinolone																	851	2.0%	906	9.7%
penicillin																	935	7.0%	990	6.4%
tetracycline																	900	4.7%	509	19.4%
***Proteus mirabilis* (indole negative)**																				
amikacin	213	0%	176	0%	338	1.2%	913	12.7%	493	3.0%	477	0%	535	1.5%	626	0.8%	697	1.0%	565	0.2%
ampicillin	1129	12.6%	1337	16.1%	2798	13.5%	1451	15.1%	1524	11.2%	4364	14.9%	4715	16.8%	4240	13.6%	5180	13.7%	5815	13.6%
cefazolin					135	7.4%			290	5.2%	236	5.9%	204	6.4%	224	10.3%	278	11.9%		
cefotaxime/ceftriaxone	362	0%	391	0.5%	792	0%	605	0.5%	695	0.7%	1069	0.4%	1100	1.0%	1024	0.6%	1018	0.7%	1147	0.3%
cefuroxime/cefamandole	290	2.1%	439	2.7%	636	5.3%	532	2.6%	799	2.1%	832	4.0%	844	3.4%	903	3.1%	902	3.7%	827	1.9%
cephalothin	100	2.0%	393	6.6%	1159	4.8%	313	8.9%	599	6.8%	526	5.7%	490	9.0%	1077	7.8%	1171	6.0%	1387	5.1%
chloramphenicol	20	5.0%	65	13.8%	98	12.2%	27	11.1%	7	14.3%	90	26.7%	107	21.5%	83	12.0%	42	33.3%		
co-amoxiclav	819	2.4%	1194	3.4%	2188	5.3%	1672	4.4%	1221	3.0%	4199	3.0%	4273	3.6%	4005	2.9%	4920	2.7%	5578	2.8%
co-trimoxazole	927	8.6%	1129	7.9%	1439	5.6%	508	9.6%	816	9.3%	1045	6.2%	2550	5.1%	1623	5.4%	1711	12.6%	2379	9.8%
fluoroquinolone	6	0%	129	1.6%	923	0.9%	805	0.4%	1080	1.1%	1552	0.5%	3026	1.0%	3397	1.4%	4578	1.0%	4822	0.9%
gentamicin	471	1.3%	867	1.2%	1209	2.1%	1257	0.6%	1244	2.9%	1903	0.8%	2078	1.2%	1973	0.8%	2072	0.9%	2100	1.3%
imipenem/meropenem															943	1.7%	785	3.2%	869	0.2%
netilmicin					135	0%			290	0.3%	236	0.8%	296	2.4%	506	0.4%	503	0.6%	477	0.2%
tetracycline	255	98.0%	206	98.1%	406	99.0%	56	98.2%	359	99.2%	343	97.1%	406	71.7%	503	90.5%	418	92.6%	272	98.5%
tobramycin	135	0%			245	5.7%	15	6.7%	332	7.2%	300	1.0%	310	4.2%	361	1.9%	456	2.9%	336	1.5%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Proteus vulgaris* (indole positive)**																				
amikacin	13	0%	1	0%	16	0%	15	0%	30	0%	34	0%	39	0%	40	0%	25	0%	32	0%
ampicillin	61	75.4%	32	71.9%	108	58.3%	99	84.8%	82	91.5%	149	87.9%	126	86.5%	143	83.2%	118	83.1%	159	87.4%
cefazolin					5	100.0%			15	86.7%	13	100.0%	29	82.8%	12	91.7%	5	100.0%		
cefotaxime/ceftriaxone	26	7.7%	15	0%	35	2.9%	44	11.4%	44	31.8%	89	12.4%	69	24.6%	68	19.1%	50	8.0%	55	1.8%
cefuroxime/cefamandole	19	89.5%	18	55.6%	38	65.8%	37	81.1%	44	93.2%	57	91.2%	61	90.2%	51	92.2%	48	60.4%	39	87.2%
cephalothin	1	100.0%	14	50.0%	47	74.5%	15	80.0%	29	93.1%	46	84.8%	40	97.5%	69	87.0%	54	85.2%	74	93.2%
chloramphenicol	3	0%	4	25.0%	3	66.7%			1	0%	1	100.0%	1	100.0%	4	0%				
co-amoxiclav	47	17.0%	35	14.3%	86	25.6%	88	42.0%	57	15.8%	146	28.1%	106	17.0%	137	11.7%	113	27.4%	162	26.5%
co-trimoxazole	39	12.8%	27	3.7%	56	5.4%	35	2.9%	56	7.1%	79	6.3%	86	5.8%	95	4.2%	39	10.3%	106	2.8%
fluoroquinolone	1	0%	11	0%	49	2.0%	37	5.4%	65	1.5%	108	0%	93	16.1%	103	1.0%	73	2.7%	126	3.2%
gentamicin	56	1.8%	28	0%	79	0%	67	0%	80	0%	124	0.8%	110	0.9%	128	1.6%	76	1.3%	94	2.1%
imipenem/meropenem															52	3.8%	46	0%	51	0%
netilmicin					5	0%			15	0%	13	0%	21	0%	28	0%	16	0%	21	0%
tetracycline	5	20.0%			8	75.0%			18	44.4%	20	45.0%	21	90.5%	33	60.6%	7	42.9%	20	60.0%
tobramycin	12	0%			5	0%			21	19.0%	13	0%	21	9.5%	25	4.0%	19	0%	20	5.0%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Providencia* spp**																				
amikacin	9	0%	15	0%	17	0%	5	20.0%	25	0%	14	0%	23	0%	25	0%	53	3.8%	31	3.2%
ampicillin	82	89.0%	54	85.2%	98	79.6%	73	74.0%	59	84.7%	84	76.2%	108	81.5%	82	81.7%	176	78.4%	177	83.6%
cefazolin					10	100.0%			16	50.0%	4	100.0%	2	100.0%	5	100.0%	17	23.5%		
cefotaxime/ceftriaxone	8	0%	20	0%	20	10.0%	10	0%	28	7.1%	37	2.7%	40	0%	34	2.9%	61	0%	60	0%
cefuroxime/cefamandole	33	9.1%	39	7.7%	50	20.0%	25	0%	45	20.0%	23	0%	46	17.4%	33	21.2%	54	11.1%	71	36.6%
cephalothin			5	80.0%	30	63.3%	3	33.3%	19	78.9%	23	73.9%	8	87.5%	33	81.8%	73	75.3%	55	80.0%
chloramphenicol	2	50.0%	1	100.0%							1	0%	1	0%	2	100.0%				
co-amoxiclav	60	55.0%	37	75.7%	65	78.5%	50	58.0%	55	67.3%	74	68.9%	99	63.6%	81	69.1%	165	65.5%	167	77.2%
co-trimoxazole	36	30.6%	20	30.0%	35	28.6%	18	16.7%	37	45.9%	47	19.1%	60	1.7%	48	14.6%	77	28.6%	88	12.5%
fluoroquinolone	3	0%	1	0%	56	12.5%	34	8.8%	59	6.8%	63	7.9%	76	7.9%	77	13.0%	109	6.4%	134	6.7%
gentamicin	76	19.7%	56	14.3%	67	14.9%	47	34.0%	59	10.2%	55	20.0%	85	5.9%	47	2.1%	105	10.5%	117	12.0%
imipenem/meropenem															30	0%	45	4.4%	45	2.2%
netilmicin					10	0%			16	12.5%	4	50.0%	2	0%	11	0%	36	11.1%	19	10.5%
tetracycline	1	100.0%			13	100.0%	2	0%	19	89.5%	13	76.9%	2	50.0%	5	80.0%	29	79.3%	25	52.0%
tobramycin	11	18.2%			14	14.3%	1	100.0%	17	17.6%	5	40.0%	5	0%	5	0%	32	6.3%	19	15.8%
Pseudomonas aeruginosa																				
amikacin	450	11.8%	392	9.2%	1048	13.2%	793	14.9%	1016	8.3%	622	14.3%	1623	7.3%	2563	6.9%	1678	6.4%	953	6.5%
ceftazidime	487	7.2%	713	5.5%	2945	4.7%	1044	5.8%	1409	7.2%	3406	5.3%	3671	4.2%	4054	5.9%	4384	3.8%	5506	3.4%
fluoroquinolone	650	9.4%	917	9.1%	3726	9.0%	2777	6.7%	2205	13.0%	4429	10.3%	5647	11.3%	6566	8.3%	6718	10.9%	8717	8.9%
gentamicin	1501	10.6%	1836	11.8%	4112	12.7%	3510	12.6%	2561	14.3%	5825	7.6%	7499	9.4%	7309	11.0%	8280	11.6%	9337	11.9%
imipenem/meropenem															3456	8.4%	1737	5.2%	2519	7.3%
netilmicin					231	14.3%	16	31.3%	295	22.7%	354	19.5%	448	24.8%	1108	23.3%	1238	24.5%	1095	20.5%
piperacillin	466	2.1%	778	4.8%	2350	8.1%	2304	10.1%	2098	8.3%	3455	6.6%	3992	5.1%	4232	4.7%	4279	5.0%	5095	3.5%
ticarcillin	1319	13.6%	710	15.1%	1916	24.5%	908	16.0%	429	7.9%	533	13.5%	409	9.0%	1809	10.2%	222	13.5%	605	16.0%
tobramycin	1045	2.3%	734	5.2%	2859	2.9%	2340	4.2%	1553	5.1%	3375	2.5%	3613	3.2%	4127	2.8%	3290	3.6%	4063	3.3%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Salmonella* Paratyphi A**																				
ampicillin					1	0%	1	0%			1	0%	6	33.3%	2	0%				
cefotaxime/ceftriaxone													6	0%	2	0%				
co-trimoxazole							1	0%			1	0%	6	33.3%	2	0%				
fluoroquinolone					1	0%	1	0%					6	0%	2	0%				
***Salmonella* Typhi**																				
ampicillin	1	0%	3	0%	20	0%	3	0%	6	0%	6	0%	19	0%	7	28.6%	23	4.3%	22	4.5%
cefotaxime/ceftriaxone	1	0%	3	0%	16	0%	3	0%	6	0%	3	0%	17	0%	6	0%	13	0%		
cephalothin																			22	0%
chloramphenicol			1	0%	9	0%											1	0%	22	4.5%
co-trimoxazole	1	0%	3	0%	14	0%	2	0%	6	0%	6	0%	17	0%	7	28.6%	23	4.3%		
fluoroquinolone	1	0%	1	0%	20	0%	3	0%	6	0%	3	0%	17	0%	7	0%	21	0%	22	0%
gentamicin																			22	0%
streptomycin																			9	11.1%
tetracycline																			22	4.5%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Serratia* spp**																				
amikacin	63	0%	57	1.8%	79	2.5%	57	0%	89	1.1%	95	0%	152	0.7%	162	0%	303	4.3%	367	0.8%
ampicillin	189	95.2%	206	91.3%	374	84.5%	432	93.8%	340	79.7%	666	90.8%	679	94.6%	733	94.3%	1228	94.2%	1837	94.4%
cefazolin					12	75.0%			21	100.0%	24	100.0%	37	94.6%	34	100.0%	115	98.3%		
cefotaxime/ceftriaxone	95	8.4%	105	3.8%	160	7.5%	202	2.0%	161	9.3%	243	8.2%	342	4.7%	380	15.8%	574	37.1%	723	14.8%
cefuroxime/cefamandole	114	94.7%	123	85.4%	179	82.1%	173	82.7%	202	98.0%	218	93.1%	246	90.7%	282	80.1%	581	88.6%	697	89.8%
cephalothin	25	100.0%	37	97.3%	158	96.2%	72	97.2%	98	100.0%	99	94.9%	159	64.8%	376	97.9%	410	98.3%	579	97.9%
chloramphenicol	1	0%	5	0%	8	62.5%	14	14.3%	6	33.3%	9	11.1%	15	13.3%	33	45.5%	6	33.3%		
co-amoxiclav	157	89.2%	194	72.2%	325	87.7%	415	88.4%	276	78.6%	654	86.5%	644	85.4%	717	85.4%	1088	90.7%	1745	87.6%
co-trimoxazole	140	7.1%	164	9.1%	255	11.8%	210	6.7%	259	9.3%	317	13.2%	425	10.8%	564	8.7%	796	21.1%	1230	10.2%
fluoroquinolone	5	0%	55	5.5%	221	14.5%	199	17.1%	229	5.2%	453	25.8%	503	12.5%	540	22.0%	789	23.2%	1298	14.9%
gentamicin	181	1.1%	178	2.8%	316	2.8%	331	2.4%	312	5.4%	516	2.7%	572	2.3%	626	1.0%	915	2.7%	1205	3.2%
imipenem/meropenem															351	2.0%	388	0.3%	625	0.2%
netilmicin					17	0%	6	0%	22	0%	24	0%	29	0%	91	0%	221	7.7%	185	3.8%
tetracycline	25	60.0%	17	23.5%	56	58.9%	34	44.1%	63	39.7%	79	53.2%	67	67.2%	100	75.0%	194	85.1%	167	64.1%
tobramycin	24	4.2%	1	0%	68	1.5%	22	4.5%	70	8.6%	48	0%	42	2.4%	57	10.5%	255	9.8%	248	2.4%
Shigella boydii																				
ampicillin					7	14.3%	8	62.5%	1	0%	2	0%	2	0%	3	0%	2	0%	3	0%
co-trimoxazole					6	0%	7	71.4%	1	0%	2	100.0%	2	0%	3	0%	2	50.0%	3	0%
fluoroquinolone					5	0%	11	0%	1	0%	1	0%	2	0%	3	0%	2	0%	2	0%
tetracycline					6	50.0%	4	50.0%			2	100.0%							1	0%
trimethoprim					1	0%	1	0%	1	0%			1	0%						
Shigella dysenteriae																				
ampicillin							4	100.0%					2	0%	1	100.0%	3	66.7%		
co-trimoxazole							4	75.0%					2	100.0%	1	100.0%	3	100.0%		
fluoroquinolone							4	0%					2	0%	1	0%	3	0%		
trimethoprim							3	66.7%												

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
Shigella flexneri																				
ampicillin			6	50.0%	13	53.8%	13	76.9%	8	75.0%	19	42.1%	41	65.9%	24	87.5%	20	75.0%	63	65.1%
chloramphenicol					1	100.0%			1	0%	2	0%							3	0%
co-trimoxazole			6	66.7%	12	66.7%	15	66.7%	6	66.7%	14	64.3%	41	61.0%	23	87.0%	20	85.0%	61	80.3%
fluoroquinolone			4	0%	6	0%	21	0%	8	0%	19	5.3%	41	0%	22	0%	17	0%	62	1.6%
nalidixic acid							1	0%												
tetracycline					6	66.7%	13	76.9%	1	0%	6	83.3%			5	20.0%	5	40.0%	17	41.2%
trimethoprim			2	50.0%	1	100.0%	9	66.7%	7	28.6%	8	87.5%			1	100.0%	1	100.0%	1	100.0%
Shigella sonnei																				
ampicillin	2	100.0%	4	75.0%	31	25.8%	15	26.7%	14	21.4%	14	35.7%	41	14.6%	30	36.7%	77	37.7%	57	21.1%
chloramphenicol									11	0%	2	0%	1	0%						
co-trimoxazole	2	50.0%	4	100.0%	30	40.0%	16	12.5%	17	70.6%	13	46.2%	39	59.0%	33	72.7%	74	55.4%	57	57.9%
fluoroquinolone	2	0%	3	0%	19	0%	28	0%	17	0%	12	41.7%	41	2.4%	34	0%	72	0%	51	0%
tetracycline					23	52.2%	17	29.4%	11	90.9%	9	44.4%	2	0%	17	70.6%	59	47.5%	34	41.2%
trimethoprim			1	100.0%	2	0%	5	20.0%	1	0%	3	33.3%	2	0%			1	0%		

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Staphylococci* (coagulase negative) from blood**																				
amikacin			20	5.0%	76	10.5%	87	4.6%	82	37.8%	16	0%	91	0%	24	0%				
chloramphenicol	192	6.3%	26	0%	35	14.3%	18	0%	10	0%	17	11.8%	78	1.3%	37	5.4%				
clindamycin			83	24.1%	203	17.2%	120	10.0%	64	28.1%	17	5.9%	221	15.4%	302	15.6%	302	24.8%	905	22.5%
co-trimoxazole	865	32.0%	519	22.5%	664	26.4%	1179	22.0%	689	12.5%	505	22.2%	735	21.8%	505	24.2%	850	22.7%	1159	33.1%
erythromycin	1334	31.4%	993	39.1%	1404	40.5%	1980	41.0%	1139	36.2%	918	39.3%	1555	39.4%	1356	41.0%	1718	41.2%	2056	42.1%
fluoroquinolone	29	13.8%	192	3.1%	593	17.5%	268	17.9%	192	8.9%	282	8.2%	873	15.0%	650	10.8%	631	17.7%	1172	22.9%
gentamicin	1492	24.8%	761	32.5%	1453	26.6%	2166	31.7%	953	23.3%	691	20.7%	1180	28.3%	1166	30.3%	1212	28.5%	1588	38.0%
methicillin/oxacillin	1497	42.0%	1204	46.3%	1826	43.1%	2391	46.1%	1191	44.7%	784	36.4%	1663	43.1%	1436	47.2%	1720	49.0%	2067	54.5%
netilmicin	33	0%	136	2.9%	64	0%	87	4.6%	94	5.3%	11	0%	3	0%	68	8.8%	128	4.7%	233	4.3%
penicillin	1608	77.4%	1200	81.0%	1666	82.0%	2410	84.0%	1223	79.2%	774	78.3%	1732	82.4%	1555	81.4%	1362	83.5%	2019	84.7%
tetracycline	93	12.9%	94	26.6%	292	17.8%	144	19.4%	56	14.3%	126	11.9%	708	5.5%	384	19.0%	399	14.0%	1159	9.6%
vancomycin	691	0.1%	536	0%	1158	0%	1770	0%	977	0%	545	0.4%	589	0.2%	458	0%	1232	0%	1378	0%
Staphylococcus aureus																				
amikacin			17	0%	583	0.2%	40	0%	800	2.1%	723	1.1%	1340	1.4%	1686	0.9%	678	1.0%	164	0.6%
chloramphenicol	1840	0.5%	1207	0.7%	3574	1.1%	1499	0.5%	2246	0.6%	6408	0.9%	4546	0.7%	6612	1.0%	9805	1.8%	11686	0.8%
clindamycin			47	14.9%	894	3.5%	110	5.5%	1103	6.9%	813	1.2%	3429	2.6%	4066	3.0%	2843	4.1%	6006	2.4%
co-trimoxazole	6918	1.7%	5848	0.7%	13132	0.6%	11245	0.8%	8973	1.0%	36126	0.5%	29404	0.4%	38229	0.8%	29944	1.5%	55969	0.8%
erythromycin	13430	7.1%	9368	8.7%	23102	8.0%	20153	8.2%	13100	8.2%	48035	9.9%	46179	10.3%	52424	11.9%	67962	11.8%	75491	12.2%
fluoroquinolone	2809	0.5%	1536	4.8%	9992	1.3%	11892	1.5%	4684	2.1%	19392	1.6%	6805	4.6%	16254	4.3%	10362	5.2%	13625	9.7%
gentamicin	5688	0.9%	3380	1.2%	9906	1.1%	10427	1.4%	8174	2.0%	7653	1.1%	14210	1.6%	19796	2.5%	16294	2.6%	22178	1.7%
methicillin/oxacillin	14484	0.6%	10234	1.1%	24211	1.1%	21702	4.1%	14436	3.8%	50395	4.3%	47833	4.7%	51470	5.8%	74415	6.9%	82600	6.8%
mupirocin			16	0%	3952	10.7%	4554	11.0%	785	2.5%	19631	17.1%	11645	18.5%	14906	19.3%	32183	21.5%	28033	19.7%
netilmicin	162	0%	251	0%	230	0%	41	0%	4	0%	1	0%			1974	0.2%	4123	0.2%	4246	0.1%
penicillin	14265	87.7%	9916	88.0%	22771	87.9%	21973	85.5%	14328	87.4%	49144	90.5%	41939	90.7%	53223	86.0%	66818	89.4%	75771	88.1%
tetracycline	6737	3.3%	4636	3.8%	15836	3.7%	10491	3.0%	5080	3.2%	34757	3.0%	26498	2.7%	42677	2.9%	22555	2.5%	56548	2.8%

	1992		1993		1994		1995		1996		1997		1998		1999		2000		2001	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Streptococcus pneumoniae* noninvasive**																				
cefotaxime/ceftriaxone													331	6.3%	194	6.7%	82	2.4%	1074	10.8%
chloramphenicol	258	0%	231	0%	1376	1.9%	1025	1.8%	298	10.1%	1618	3.6%	857	2.2%	1762	4.5%	2922	5.2%	3398	4.1%
co-trimoxazole	24	8.3%	60	20.0%	1691	17.0%	1589	25.9%	503	23.5%	2969	38.7%	1041	26.6%	1265	42.8%	4273	46.5%	3765	40.2%
erythromycin	703	4.7%	315	2.9%	3014	7.4%	2635	10.2%	1345	7.0%	4353	12.6%	2826	10.0%	4632	18.2%	5780	18.4%	4875	18.2%
imipenem/meropenem																	55	1.8%	4	25.0%
penicillin	719	2.4%	464	2.2%	3184	8.6%	2696	11.4%	1359	7.9%	4381	17.6%	2350	11.7%	4844	22.6%	5830	25.7%	2542	11.2%
tetracycline	612	5.9%	207	5.8%	2303	9.5%	1926	13.6%	814	6.3%	3458	11.6%	1046	7.6%	1643	12.2%	2446	15.5%	2535	13.6%
Streptococcus pyogenes																				
erythromycin													7898	0.9%	11418	1.3%	10710	1.5%	15433	1.3%
penicillin													8442	0.1%	11434	0.02%	10754	0%	15504	0%