ANTIMICROBIAL RESISTANCE TRENDS
IN NEW ZEALAND, 2003

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SUMMARY

This report describes 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 the trend analyses in this report: (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. The data collected are limited to specific organisms and antibiotics, and they are derived from the results of the laboratories' routine antimicrobial susceptibility testing. The diagnostic laboratories that have contributed data to this surveillance system have varied from year to year. When these data are analysed for trend, only data from laboratories that have contributed in each of the years covered by the analyses (the so-called core laboratories) are included. For the trend analyses in this report that use data from diagnostic laboratories, changes in resistance over the five-year period 1999 to 2003 were usually analysed. Data from 12 core laboratories (six hospital laboratories, four community laboratories, and two laboratories which processes both hospital and community specimens) were available for the analyses.

Analysis of data from these 12 core diagnostic laboratories identified several notable and significant changes between 1999 and 2003, including:

- Changes in resistance to several ß-lactams among *Escherichia coli.* Except for third-generation cephalosporins, there was a trend of decreasing resistance to ß-lactams.
- Increase in fluoroquinolone resistance among *E. coli*.
- Decrease in ampicillin resistance among non-invasive *Haemophilus influenzae*.
- Increase in third-generation cephalosporin resistance among *Klebsiella*.
- Increase in fluoroquinolone resistance among *Neisseria gonorrhoeae*.
- Increases in resistance to almost all antibiotics, including methicillin, among *Staphylococcus aureus* isolated in hospital laboratories.
- Increase in penicillin non-susceptibility among non-invasive isolates of *Streptococcus pneumoniae*.

ESR also monitors resistance among invasive isolates of *S. 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 1994-2003 and trends in resistance among clinical isolates of non-typhoidal *Salmonella* over the four years 2000-2003 were analysed.

In 2003 there was a complete reversal of the decrease in penicillin resistance among invasive pneumococci observed in the four years 1999-2002, with resistance reaching the highest rate ever recorded. Overall, during the 10 years 1994 to 2003, there were highly significant trends of increasing penicillin and third-generation cephalosporin resistance and non-susceptibility among invasive pneumococci. Among invasive *H. influenzae*, there were no

continued

SUMMARY *continued*

significant changes over the whole 10-year period, but ampicillin resistance and β-lactamase production decreased until 1999 and then increased to exceed the rates in the mid-1990s. The prevalence of reduced penicillin susceptibility among invasive meningococci is increasing, however, these isolates are still susceptible to normal penicillin treatment regimens for meningococcal meningitis.

There have been no significant changes in resistance among clinical isolates of non-typhoidal *Salmonella* since 2000 and resistance remains low.

RECOMMENDATIONS

- The relative merits of only including data from the core diagnostic laboratories in these trend analyses versus the power of including all available data should be re-examined.

- Diagnostic laboratories should be encouraged, where possible, to record their antimicrobial susceptibility testing results according to the three standard susceptibility categories: susceptible, intermediate and resistant.

- In the medium term, these analyses should be extended to trends in multiresistance. However, this will require the collection of individual record-level data from diagnostic laboratories rather than the cumulative resistance data currently collected. In the meantime, ESR-generated susceptibility data, in particular, for invasive pneumococci and *Salmonella,* should be analysed for trends in multiresistance.

1 INTRODUCTION

This report describes time-trends in antimicrobial resistance in New Zealand.

Each year since 1988, ESR has collected and analysed antimicrobial resistance data from hospital and community diagnostic laboratories throughout New Zealand. The data collected are limited to specific organisms and antibiotics. The data are derived from the results of the laboratories' routine antimicrobial susceptibility testing and are used to produce annual national estimates of the prevalence of resistance among medically important bacteria to commonly used antimicrobials. Since 1999, the data have also been used to examine time-trends in resistance in New Zealand.

A second source of resistance data is used for the trend analyses included in this report. Invasive isolates of *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Neisseria meningitidis* (ie, isolates from normally sterile sites) are routinely referred to ESR as part of the laboratory-based surveillance of invasive disease due to these three pathogens. Similarly, clinical *Salmonella* isolates are routinely referred to ESR for epidemiological typing. At ESR, the antimicrobial susceptibility of all the invasive isolates, a proportion of the non-typhoidal *Salmonella*, and all *S.* Typhi and *S.* Paratyphi are tested.

This is the fourth time-trends report.[1-3] While initially produced annually, it is now planned that these reports will be prepared 2-yearly. For the analyses in this report that use antimicrobial resistance data from diagnostic laboratories, the time period covered is usually five years (1999-2003) to maximise the number of laboratories from which data can be included. The time period covered for the *S. pneumoniae*, *H. influenzae* and *N. meningitidis* invasive isolates is 10 years (1994-2003). Trends among non-typhoidal *Salmonella* are analysed over four years (2000-2003).

2 METHODOLOGY

2.1 Data Sources

Two data sources were used for the analyses included in this report:

1 Antimicrobial resistance data from hospital and community diagnostic laboratories

Antimicrobial resistance among *Campylobacter, Enterococcus*, urinary *Escherichia coli*, non-invasive *H. influenzae, Klebsiella, Pseudomonas aeruginosa, Staphylococcus aureus,* coagulase-negative staphylococci from blood, non-invasive *S. pneumoniae* and *S. pyogenes* were analysed for trend over the five-year period 1999-2003. Antimicrobial resistance rates among *E. coli* from bacteraemia were analysed for trend over three years (2001-2003), as data by this specific infection category were not collected before 2001. Antimicrobial resistance rates among *Neisseria gonorrhoeae* were analysed for trend over four years (2000-2003), as gonococcal resistance data were not collected before 2000.

Only data from 12 laboratories, whose data were available for each of the five years, were included in the analyses. These 12 laboratories are referred to in the report as the 'core laboratories' and are the microbiology laboratories at Whangarei Hospital; Auckland City and Children's Hospital; Middlemore Hospital; Diagnostic Medlab, Auckland; Waikato Hospital; Rotorua Hospital; Medlab Bay of Plenty, Tauranga; 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 six hospital laboratories, four community laboratories, and two laboratories (Medlab Bay of Plenty and Medlab Central) that process specimens from both hospital and community patients. In addition, the four community laboratories process specimens from private hospitals and residential-care facilities.

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 Bay of Plenty and Medlab Central were excluded. An organism qualified as 'hospital' indicates the data only includes that reported by the six core hospital laboratories. Correspondingly, an organism qualified as 'community' indicates the data only includes that reported by the four core community laboratories.

With the exception of pneumococcal penicillin and cefotaxime non-susceptibility and reduced penicillin susceptibility in meningococci, the intent was to not include intermediate resistance with the resistance data reported in this report. However, for at least some organism/antibiotic combinations and some years, some of the 12 core laboratories were unable to exclude intermediate resistance from the resistance data that they supplied. Any resistance data that were reported to include intermediate resistance were not used in the trend analyses. This resulted in the exclusion of almost all data from some of the core laboratories, especially in the later years of the five-year period analysed.

2 Antimicrobial resistance among invasive *S. pneumoniae*, *H. influenzae* and *N. meningitidis* isolates and non-typhoidal *Salmonella* referred to ESR

Antimicrobial resistance rates among *S. pneumoniae*, *H. influenzae*, and *N. meningitidis* invasive isolates, referred to ESR during the 10-year period 1994-2003, and non-typhoidal *Salmonella* from clinical specimens, referred during the four-year period 2000-2003, were analysed for trend.

2.2 Statistical Analysis

Resistance rates based on a sample of less than 10 isolates were not included in the 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. Statistical analyses were performed using the Statistical Analysis Software (SAS) System version 8.2.[4]

2.3 Results Presentation

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

The annual resistance rates used to generate the charts presented in the results section that use data from the core diagnostic laboratories are tabulated in Appendix 1. Annual resistance rates for the 10 years 1994-2003, based on the data from all laboratories that contributed data rather than just the core laboratories, are tabulated in Appendix 4.

The annual resistance rates used to generate the charts presented in the results section for the invasive *S. pneumoniae*, *H. influenzae*, and *N. meningitidis* isolates are tabulated in Appendix 2. The annual resistance rates used to generate the charts presented in the results section for the clinical non-typhoidal *Salmonella* are tabulated in Appendix 3. This appendix also includes data on resistance among clinical *S.* Typhi and *S.* Paratyphi during the four years 2000-2003. However, these data were not analysed for trend.

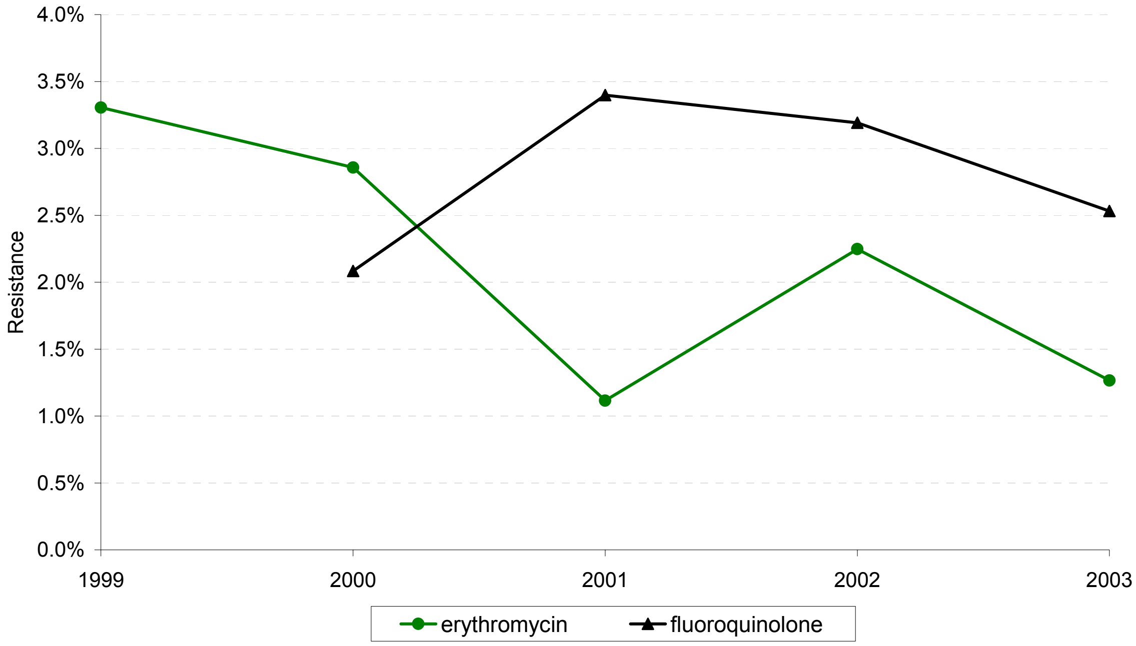
3 RESULTS

3.1 Trends in Antimicrobial Resistance Among the Core Diagnostic Laboratories, 1999-2003

The number of isolates tested and the annual resistance rates used to generate the charts presented in this section are tabulated in Appendix 1.

3.1.1 *Campylobacter*

Figure 1. *Campylobacter*: erythromycin and fluoroquinolone resistance, 1999-2003

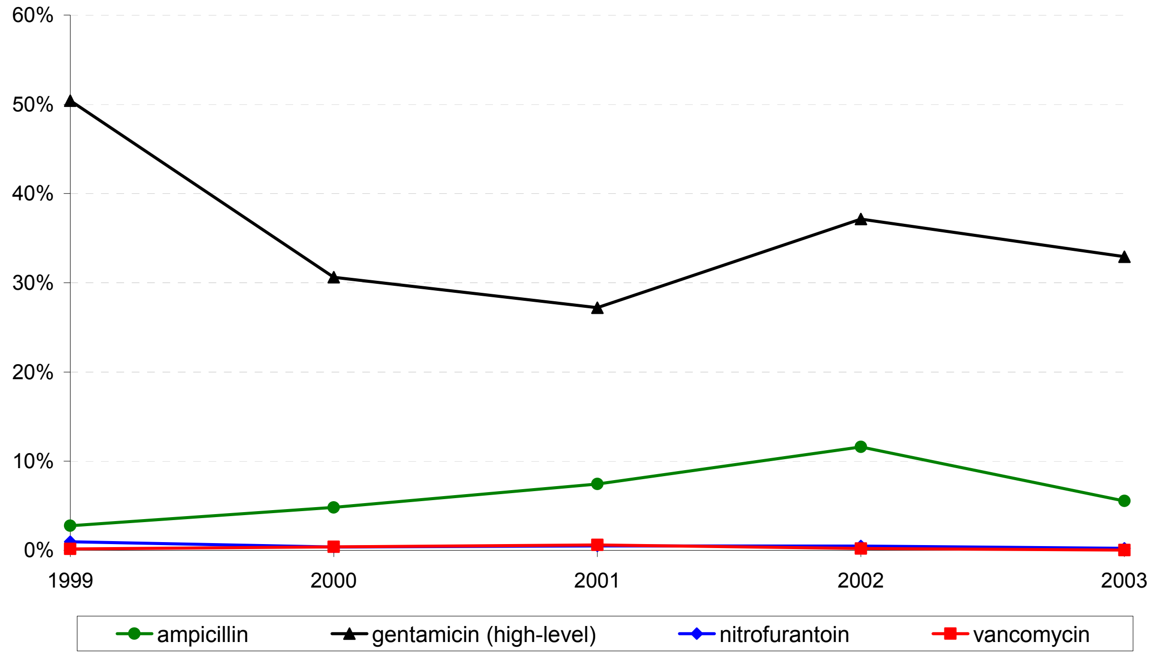


Note: there are no data for fluoroquinolone resistance in 1999

	Direction of the trend	Significance	P-value
erythromycin resistance	decrease	not significant	0.2154
fluoroquinolone resistance	decrease	not significant	0.8221

3.1.2 *Enterococcus* from Hospital Laboratories

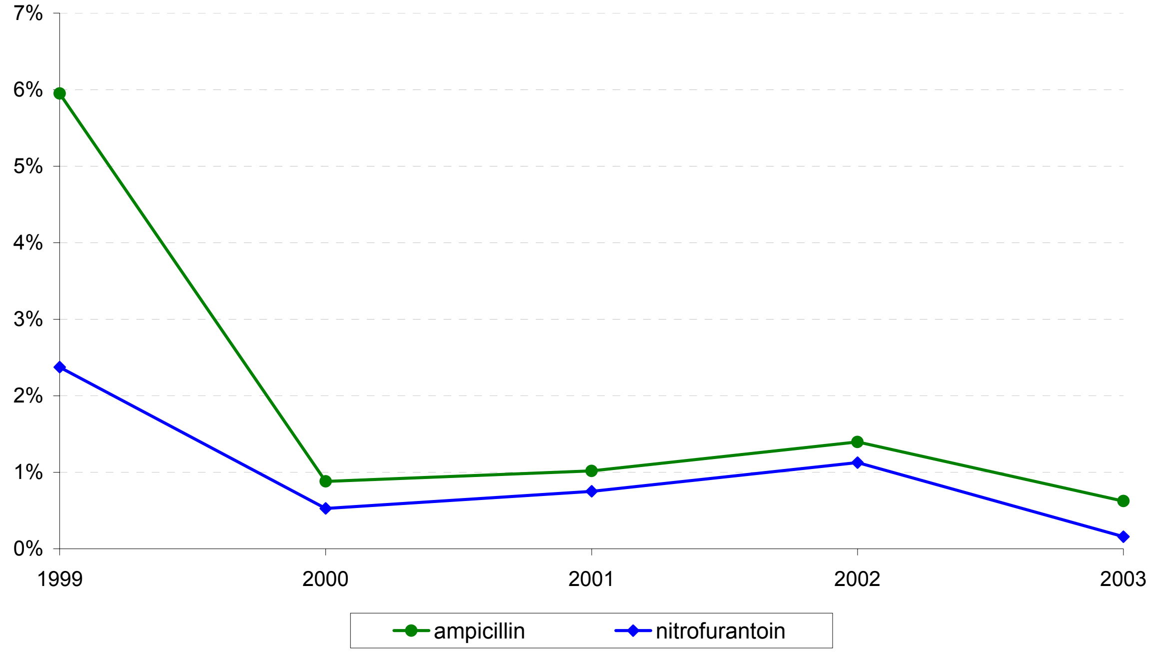
Figure 2. *Enterococcus*: ampicillin, high-level gentamicin, nitrofurantoin and vancomycin resistance among hospital isolates, 1999-2003



	Direction of the trend	Significance	P-value
ampicillin resistance	increase	significant	0.0002
high-level gentamicin resistance	decrease	not significant	0.4472
nitrofurantoin resistance	decrease	not significant	0.1628
vancomycin resistance	decrease	significant	0.0196

3.1.3 *Enterococcus* from Community Laboratories

Figure 3. *Enterococcus*: ampicillin and nitrofurantoin resistance among community isolates, 1999-2003



	Direction of the trend	Significance	P-value
ampicillin resistance	decrease	significant	<0.0001
nitrofurantoin resistance	decrease	significant	<0.0001

3.1.4 Comparison of Resistance Among *Enterococcus* from Hospital and Community Laboratories

	Percent resistance (1999 rate - 2003 rate)	
	Hospital	**Community**
ampicillin resistance	2.8 – 5.5	5.9 – 0.6
high-level gentamicin resistance	50.4 – 32.9	-
nitrofurantoin resistance	1.0 – 0.2	2.4 – 0.2
vancomycin resistance	0.2 – 0.04	-

3.1.5 *Escherichia coli* from Bacteraemia

Figure 4a. *Escherichia coli* from bacteraemia: β-lactam resistance, 2001-2003

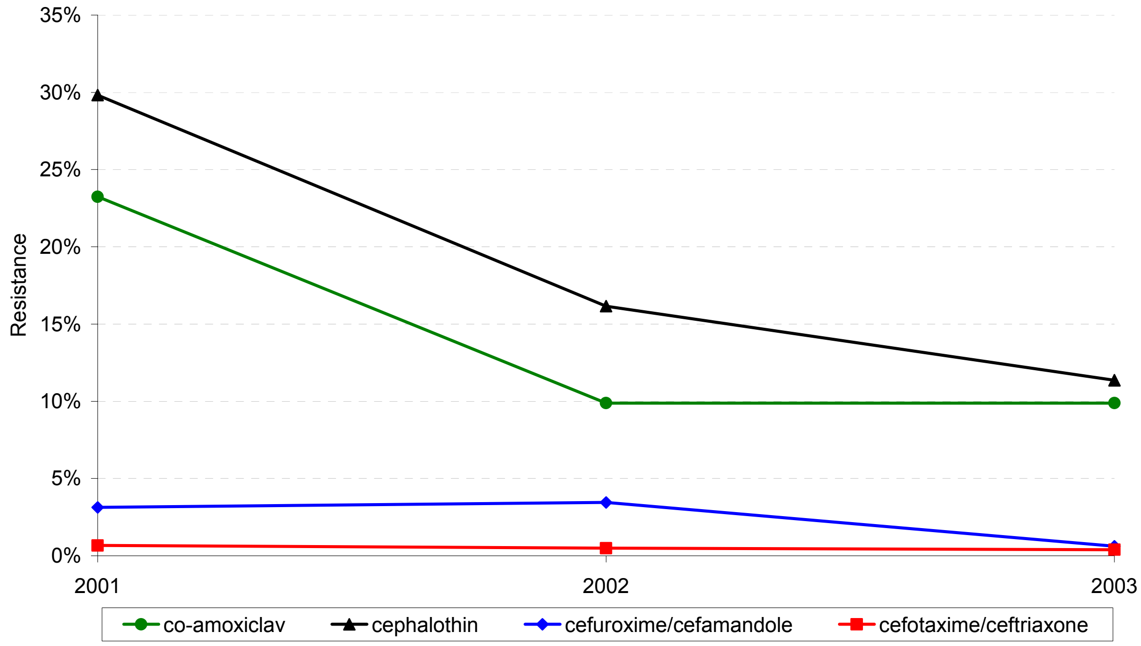
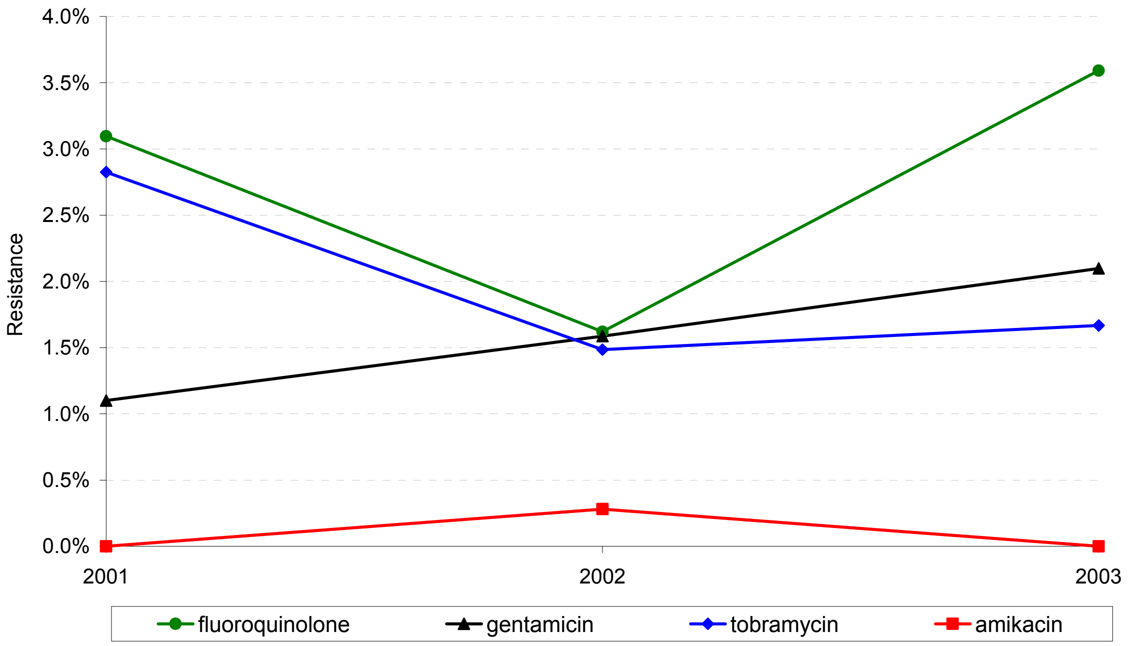


Figure 4b. *Escherichia coli* from bacteraemia: fluoroquinolone, gentamicin, tobramycin and amikacin resistance, 2001-2003



Notes: 1 data on resistance among *E. coli* from bacteraemia only collected since 2001

2 the higher rate of tobramycin than gentamicin resistance recorded in 2001 is probably due to the inclusion of tobramycin susceptibility data based on second-line testing

	Direction of the trend	Significance	P-value
co-amoxiclav resistance	decrease	significant	<0.0001
cephalothin resistance	decrease	significant	<0.0001
cefuroxime/cefamandole resistance	decrease	significant	0.0038
cefotaxime/ceftriaxone resistance	decrease	not significant	0.4561
fluoroquinolone resistance	increase	not significant	0.5968
gentamicin resistance	increase	not significant	0.1234
tobramycin resistance	decrease	not significant	0.4403
amikacin resistance	increase	not significant	0.9581

3.1.6 Urinary *Escherichia coli* from Hospital Laboratories

Figure 5a. Urinary *Escherichia coli*: β-lactam resistance among hospital isolates, 1999-2003

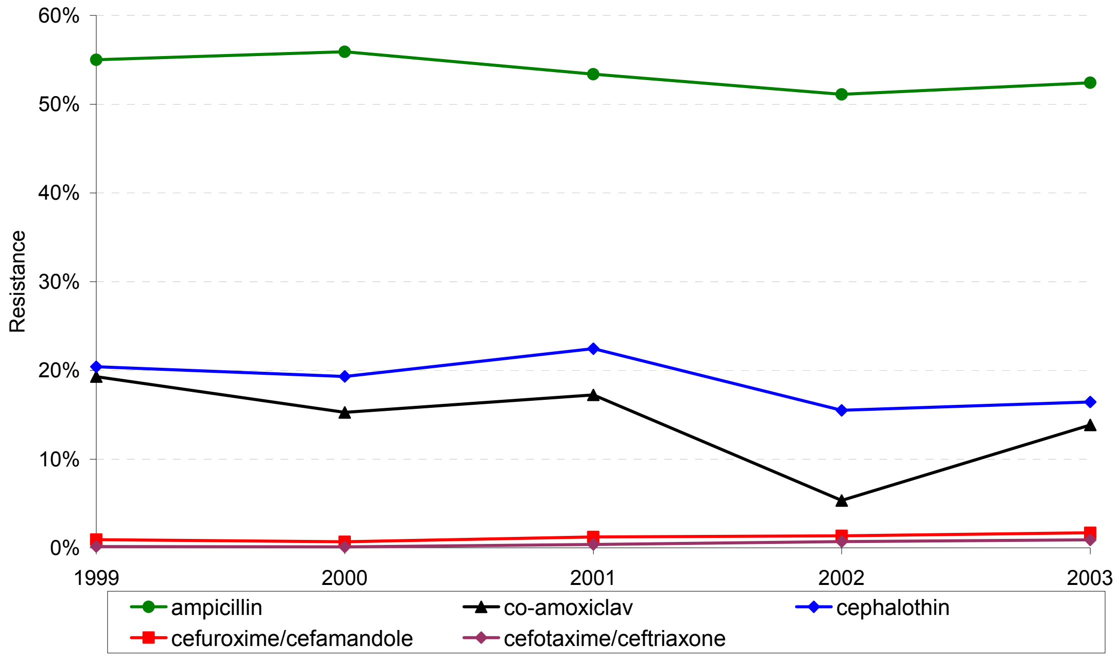
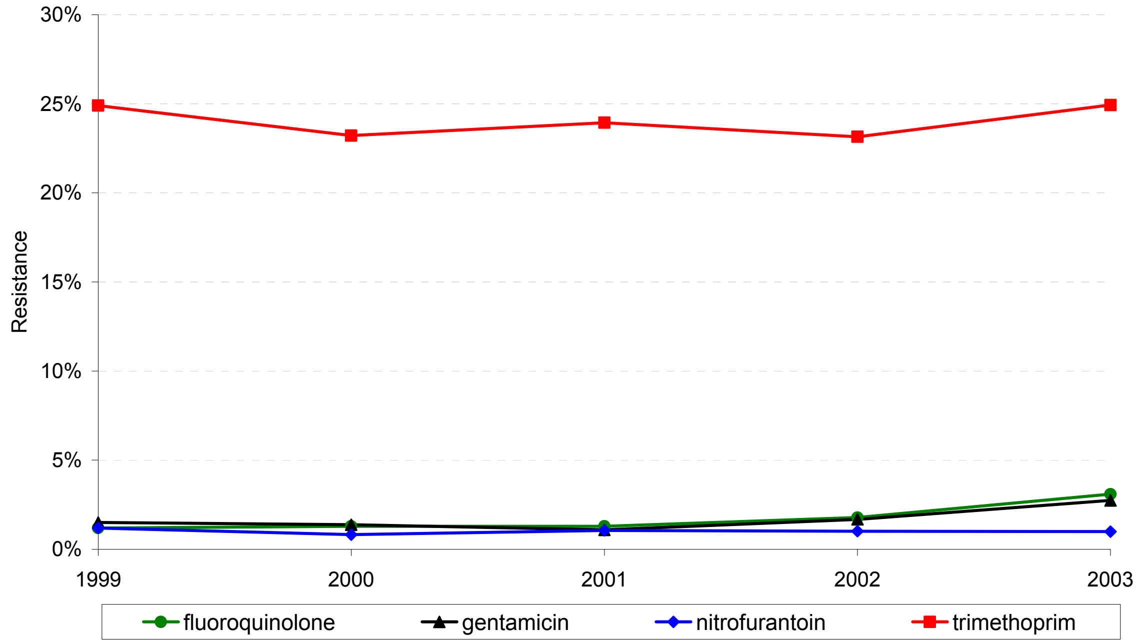


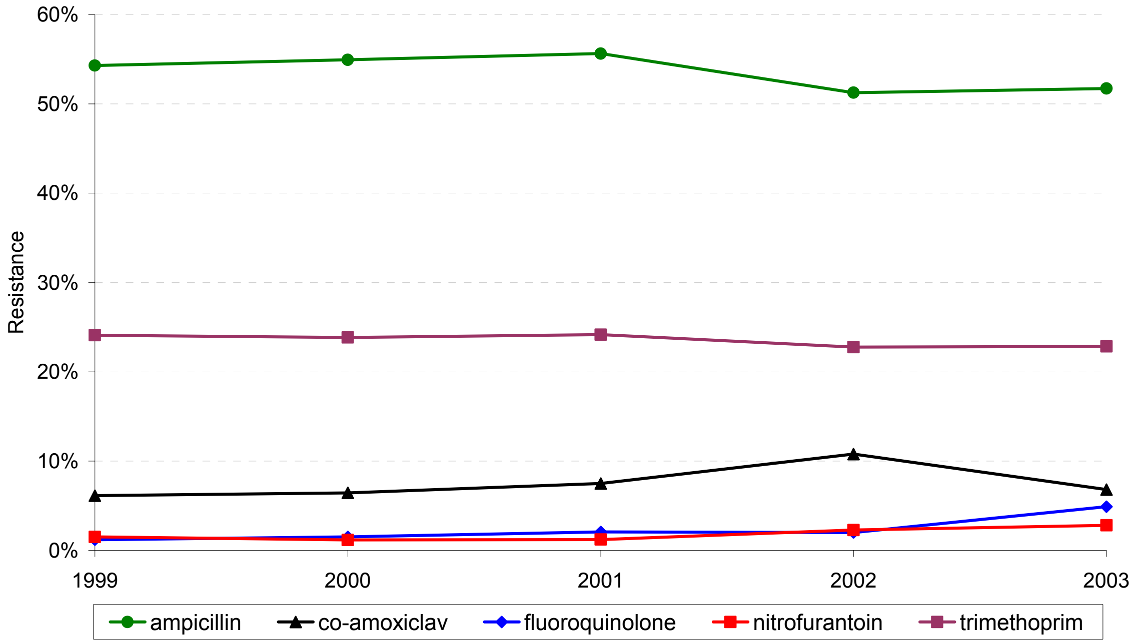
Figure 5b. Urinary *Escherichia coli*: fluoroquinolone, gentamicin, nitrofurantoin and trimethoprim resistance among hospital isolates, 1999-2003



	Direction of the trend	Significance	P-value
ampicillin resistance	decrease	significant	0.0002
co-amoxiclav resistance	decrease	significant	<0.0001
cephalothin resistance	decrease	significant	<0.0001
cefuroxime/cefamandole resistance	increase	significant	<0.0001
cefotaxime/ceftriaxone resistance	increase	significant	<0.0001
fluoroquinolone resistance	increase	significant	<0.0001
gentamicin resistance	increase	significant	<0.0001
nitrofurantoin resistance	decrease	not significant	0.7153
trimethoprim resistance	increase	not significant	0.7428

3.1.7 Urinary *Escherichia coli* from Community Laboratories

Figure 6. Urinary *Escherichia coli*: ampicillin, co-amoxiclav, fluoroquinolone, nitrofurantoin and trimethoprim resistance among community isolates, 1999-2003



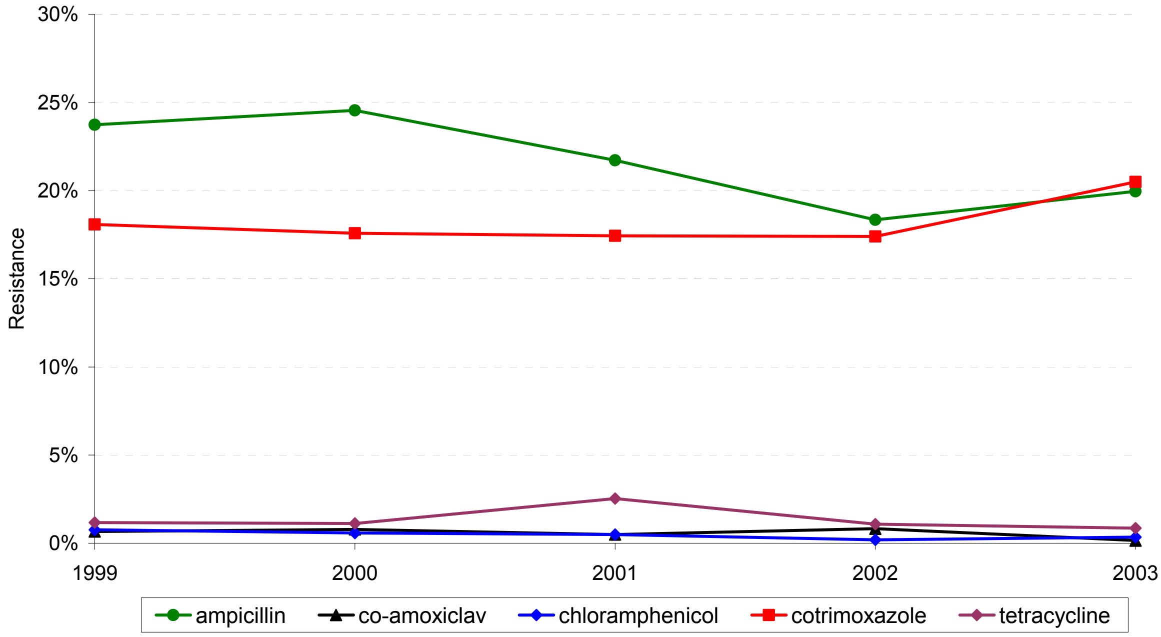
	Direction of the trend	Significance	P-value
ampicillin resistance	decrease	significant	0.0188
co-amoxiclav resistance	increase	significant	<0.0001
fluoroquinolone resistance	increase	significant	<0.0001
nitrofurantoin resistance	increase	significant	<0.0001
trimethoprim resistance	decrease	not significant	0.9635

3.1.8 Comparison of Resistance Among Urinary *Escherichia coli* from Hospital and Community Laboratories

	Percent resistance (1999 rate - 2003 rate)	
	Hospital	**Community**
ampicillin	55.0 – 52.4	54.3 – 51.7
co-amoxiclav	19.3 – 13.9	6.1 – 6.8
cephalothin	20.4 – 16.4	-
cefuroxime	0.9 – 1.7	-
cefotaxime	0.1 – 0.9	-
fluoroquinolone	1.2 –3.1	1.2 – 4.9
gentamicin	1.5 – 2.7	-
nitrofurantoin	1.2 – 1.0	1.5 – 2.8
trimethoprim	24.9 – 24.9	24.1 – 22.9

3.1.9 Non-invasive *Haemophilus influenzae*

Figure 7. Non-invasive *Haemophilus influenzae*: ampicillin, co-amoxiclav, chloramphenicol, cotrimoxazole and tetracycline resistance, 1999-2003



	Direction of the trend	Significance	P-value
ampicillin resistance	decrease	significant	<0.0001
co-amoxiclav resistance	decrease	significant	0.0349
chloramphenicol resistance	decrease	significant	0.0461
cotrimoxazole resistance	increase	significant	0.0023
tetracycline resistance	increase	not significant	0.8654

3.1.10 *Klebsiella* from Hospital Laboratories

Figure 8a. *Klebsiella*: β-lactam resistance among hospital isolates, 1999-2003

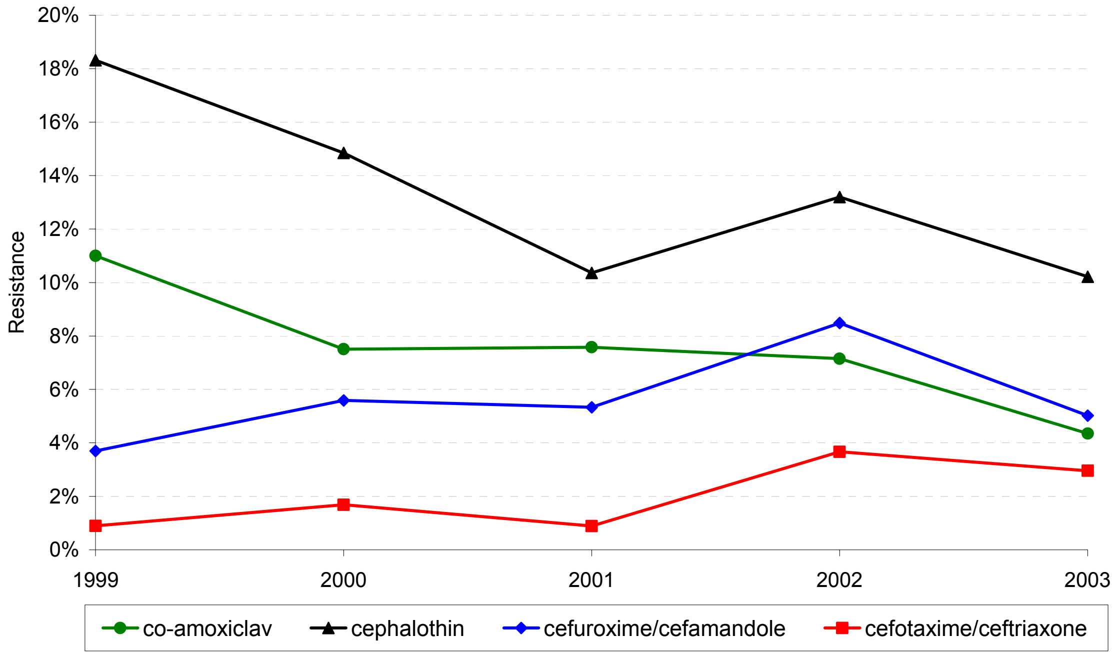
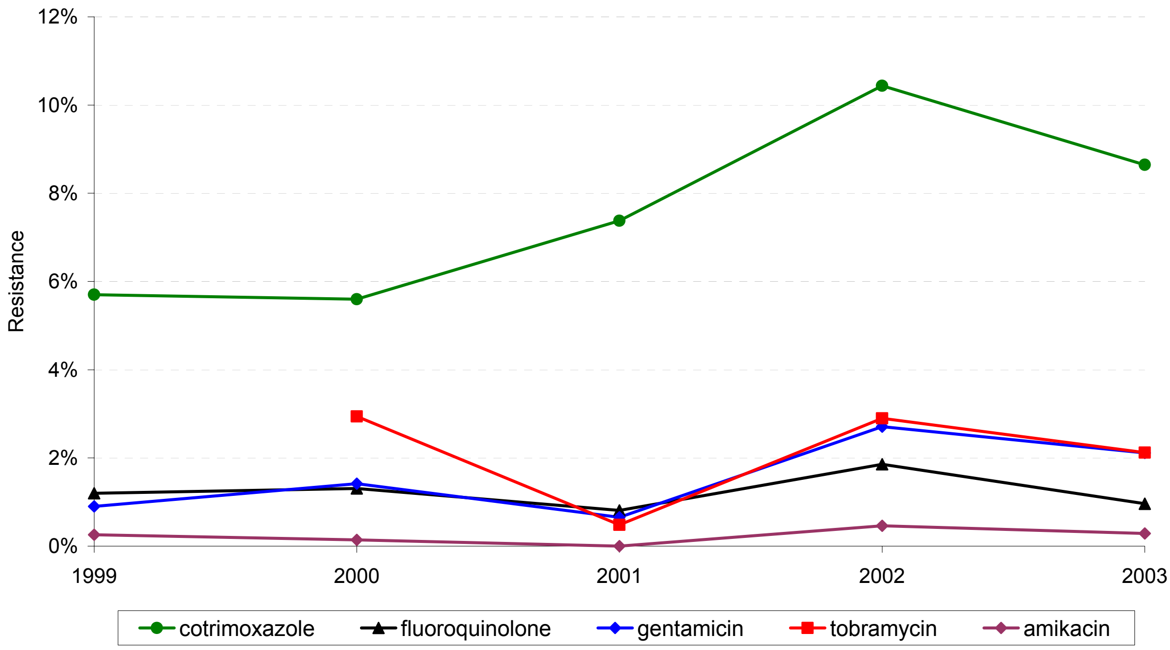


Figure 8b. *Klebsiella*: cotrimoxazole, fluoroquinolone, gentamicin, tobramycin and amikacin resistance among hospital isolates, 1999-2003

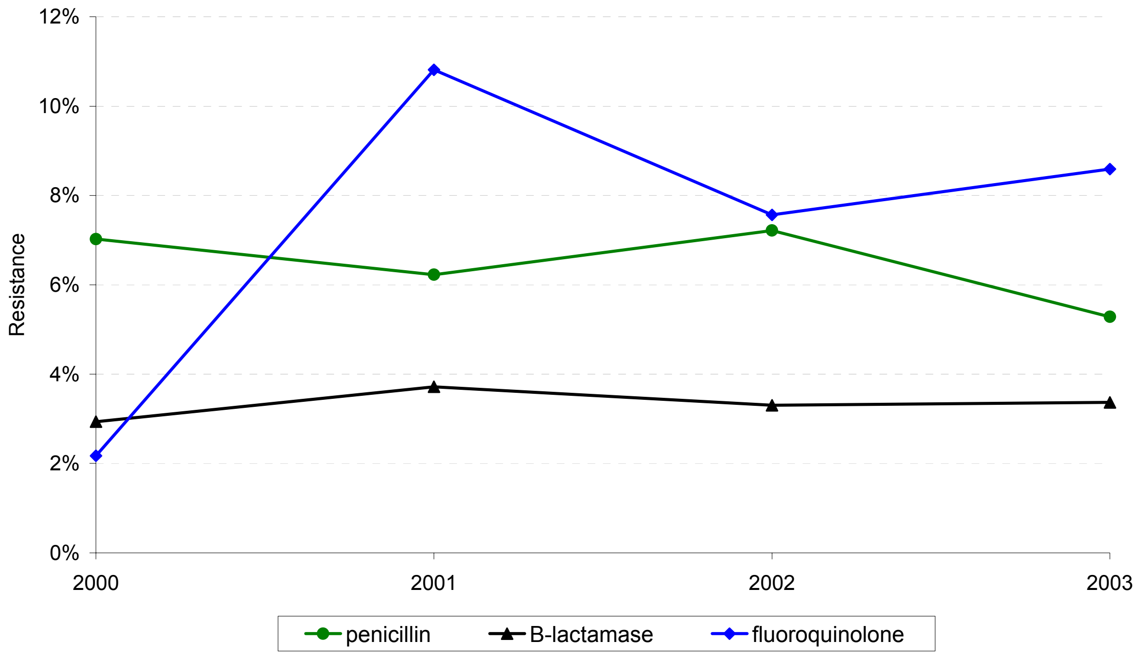


Note: there are no data for tobramycin resistance in 1999

	Direction of the trend	Significance	P-value
co-amoxiclav resistance	decrease	significant	<0.0001
cephalothin resistance	decrease	significant	<0.0001
cefuroxime/cefamandole resistance	increase	not significant	0.0789
cefotaxime/ceftriaxone resistance	increase	significant	0.0001
cotrimoxazole resistance	increase	significant	0.0001
fluoroquinolone resistance	decrease	not significant	0.9324
gentamicin resistance	increase	significant	0.0009
tobramycin resistance	increase	not significant	0.9189
amikacin resistance	increase	not significant	0.4421

3.1.11 *Neisseria gonorrhoeae*

Figure 9. *Neisseria gonorrhoeae*: penicillin, β-lactamase and fluoroquinolone resistance, 2000-2003



Note: data on gonococcal resistance only collected since 2000

	Direction of the trend	Significance	P-value
penicillin resistance	decrease	not significant	0.2115
B-lactamase positive	increase	not significant	0.6945
fluoroquinolone resistance	increase	significant	0.0002

3.1.12 *Pseudomonas aeruginosa* from Hospital Laboratories

Figure 10a. *Pseudomonas aeruginosa*: β-lactam resistance among hospital isolates, 1999-2003

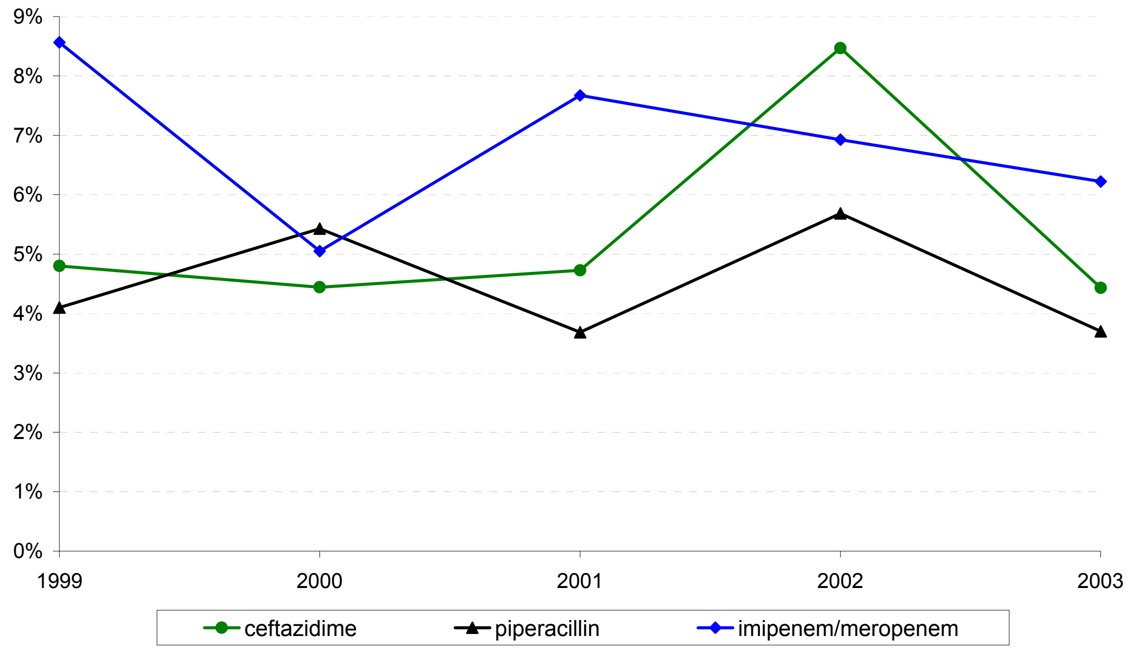
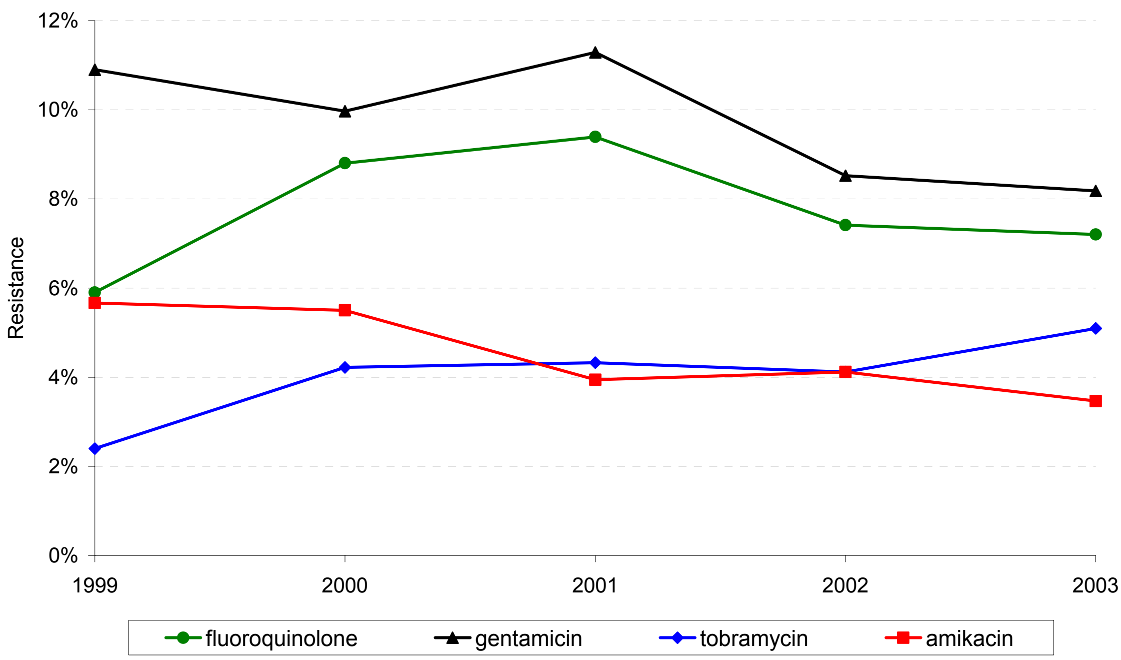


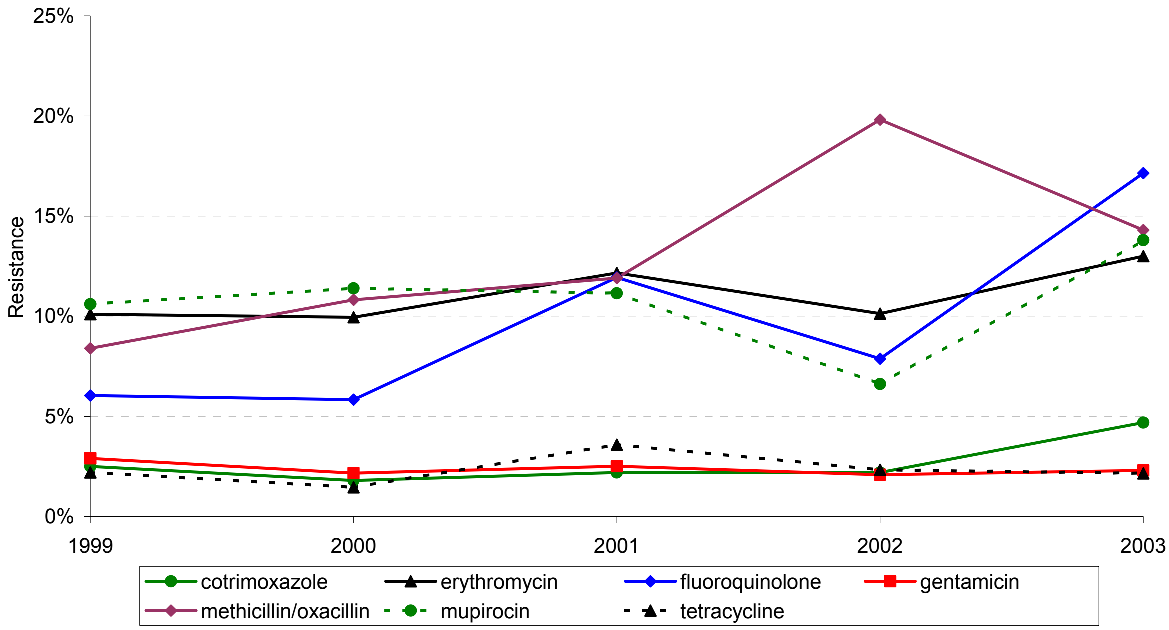
Figure 10b. *Pseudomonas aeruginosa*: fluoroquinolone, gentamicin, tobramycin and amikacin resistance among hospital isolates, 1999-2003



	Direction of the trend	Significance	P-value
ceftazidime resistance	increase	not significant	0.2732
piperacillin resistance	decrease	not significant	0.9298
imipenem/meropenem resistance	decrease	not significant	0.0514
fluoroquinolone resistance	increase	not significant	0.5860
gentamicin resistance	decrease	significant	0.0002
tobramycin resistance	increase	significant	0.0019
amikacin resistance	decrease	significant	0.0016

3.1.13 *Staphylococcus aureus* from Hospital Laboratories

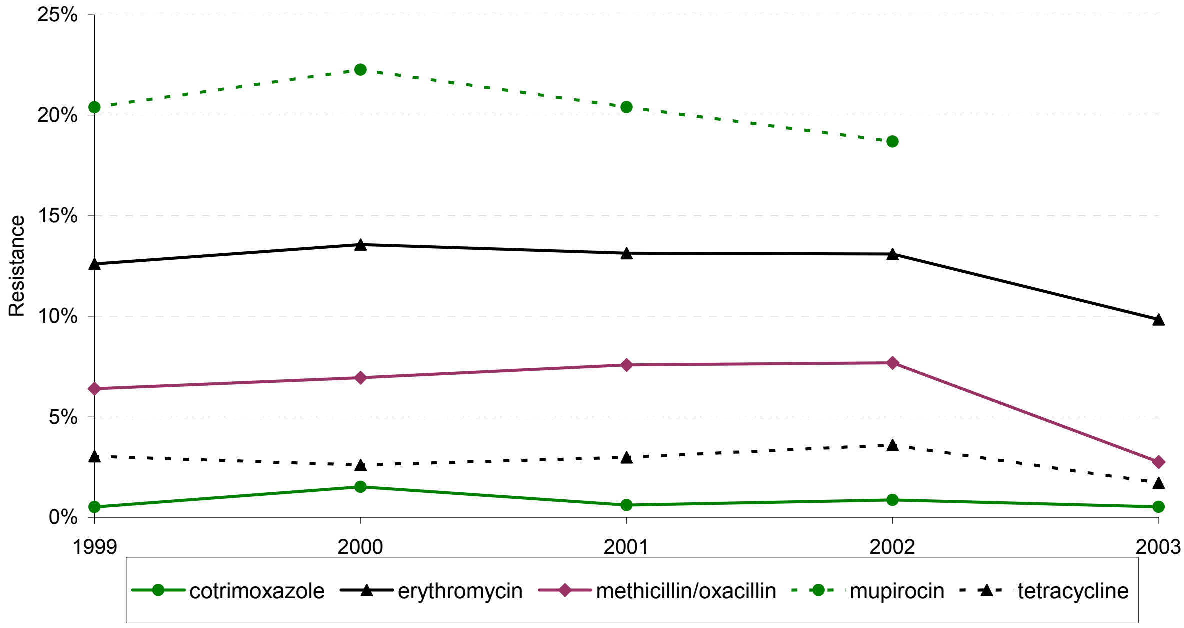
Figure 11. *Staphylococcus aureus*: cotrimoxazole, erythromycin, fluoroquinolone, gentamicin, methicillin/oxacillin, mupirocin and tetracycline resistance among hospital isolates, 1999-2003



	Direction of the trend	Significance	P-value
cotrimoxazole resistance	increase	significant	<0.0001
erythromycin resistance	increase	significant	<0.0001
fluoroquinolone resistance	increase	significant	<0.0001
gentamicin resistance	decrease	significant	0.0150
methicillin/oxacillin resistance	increase	significant	<0.0001
mupirocin resistance	increase	significant	0.0012
tetracycline resistance	increase	not significant	0.0820

3.1.14 *Staphylococcus aureus* from Community Laboratories

Figure 12. *Staphylococcus aureus*: cotrimoxazole, erythromycin, methicillin/oxacillin, mupirocin and tetracycline resistance among community isolates, 1999-2003



Note: there are no data for mupirocin resistance in 2003

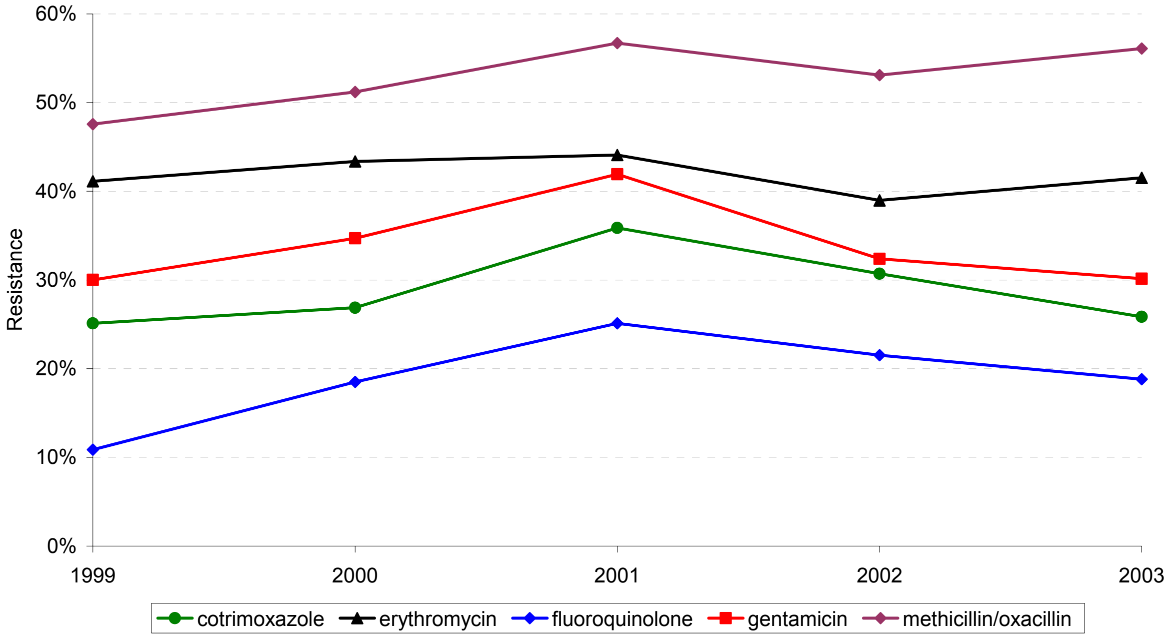
	Direction of the trend	Significance	P-value
cotrimoxazole resistance	increase	not significant	0.2797
erythromycin resistance	decrease	not significant	0.0540
methicillin/oxacillin resistance	increase	not significant	0.2434
mupirocin resistance	decrease	significant	<0.0001
tetracycline resistance	increase	not significant	0.6774

3.1.15 Comparison of Resistance Among *Staphylococcus aureus* from Hospital and Community Laboratories

	Percent resistance (1999 rate - 2003 rate)	
	Hospital	**Community**
cotrimoxazole	2.5 - 4.7	0.5 - 0.5
erythromycin	10.1 - 13.0	12.6 - 9.8
fluoroquinolone	6.0 - 17.1	-
gentamicin	2.9 - 2.3	
methicillin/oxacillin	8.4 - 14.3	6.4 - 2.8
mupirocin	10.6 - 13.8	20.4 – 18.7 (2002)
tetracycline	2.2 - 2.2	3.0 - 1.7

3.1.16 Coagulase-negative Staphylococci from Blood

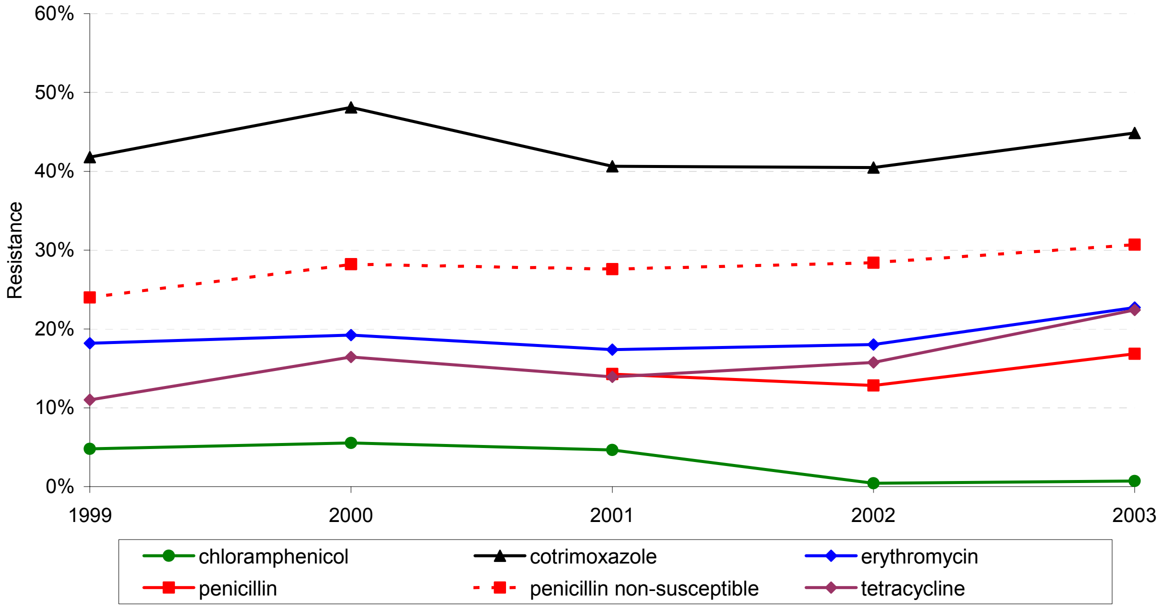
Figure 13. Coagulase-negative staphylococci from blood: cotrimoxazole, erythromycin, fluoroquinolone, gentamicin and methicillin/oxacillin resistance, 1999-2003



	Direction of the trend	Significance	P-value
cotrimoxazole resistance	decrease	not significant	0.8686
erythromycin resistance	decrease	not significant	0.5609
fluoroquinolone resistance	increase	significant	0.0251
gentamicin resistance	decrease	not significant	0.4123
methicillin/oxacillin resistance	increase	significant	0.0043

3.1.17 Non-invasive *Streptococcus pneumoniae*

Figure 14. Non-invasive *Streptococcus pneumoniae*: chloramphenicol, cotrimoxazole, erythromycin, penicillin and tetracycline resistance, and penicillin non-susceptibility, 1999-2003

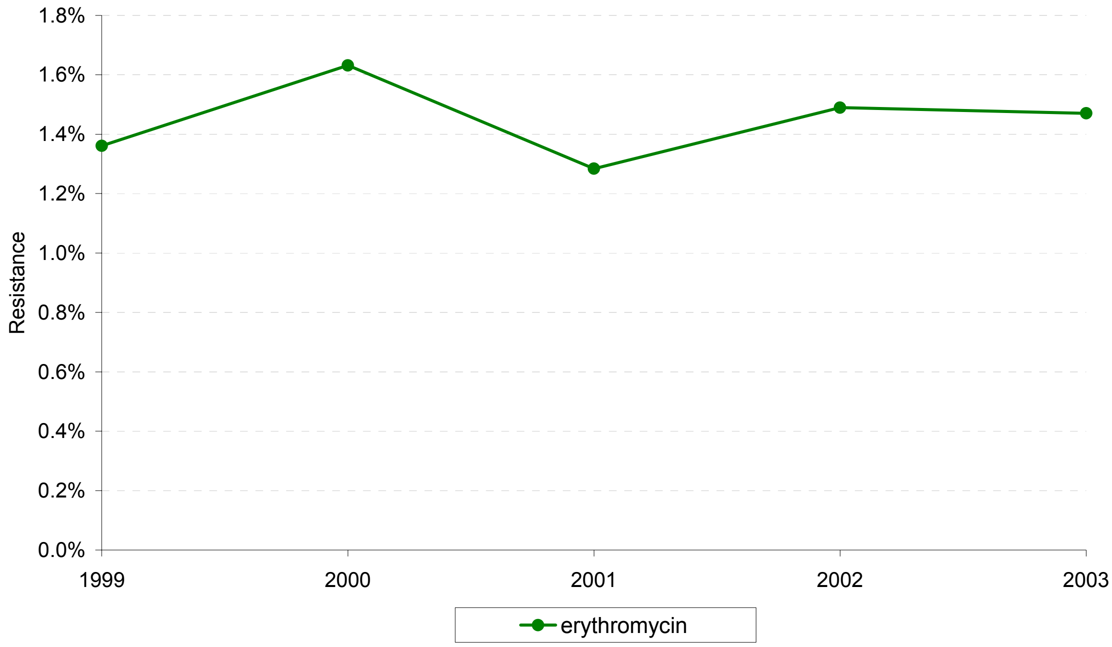


Note: there are no reliable data for penicillin resistance before 2001

	Direction of the trend	Significance	P-value
chloramphenicol resistance	decrease	significant	<0.0001
cotrimoxazole resistance	decrease	not significant	0.2432
erythromycin resistance	increase	significant	0.0003
penicillin non-susceptibility	increase	significant	<0.0001
tetracycline resistance	increase	significant	<0.0001

3.1.18 *Streptococcus pyogenes*

Figure 15. *Streptococcus pyogenes*: erythromycin resistance, 1999-2003



	Direction of the trend	Significance	P-value
erythromycin resistance	increase	not significant	0.8324

3.2 Trends in Antimicrobial Resistance Among Invasive Disease Pathogens

The number of isolates tested and the annual resistance rates used to generate the charts presented in this section are tabulated in Appendix 2.

3.2.1 *Streptococcus pneumoniae*

Figure 16a. *Streptococcus pneumoniae* from invasive disease: penicillin resistance (MIC ≥2 mg/L) and non-susceptibility (MIC ≥0.12 mg/L), 1994-2003 [with 95% confidence interval bars]

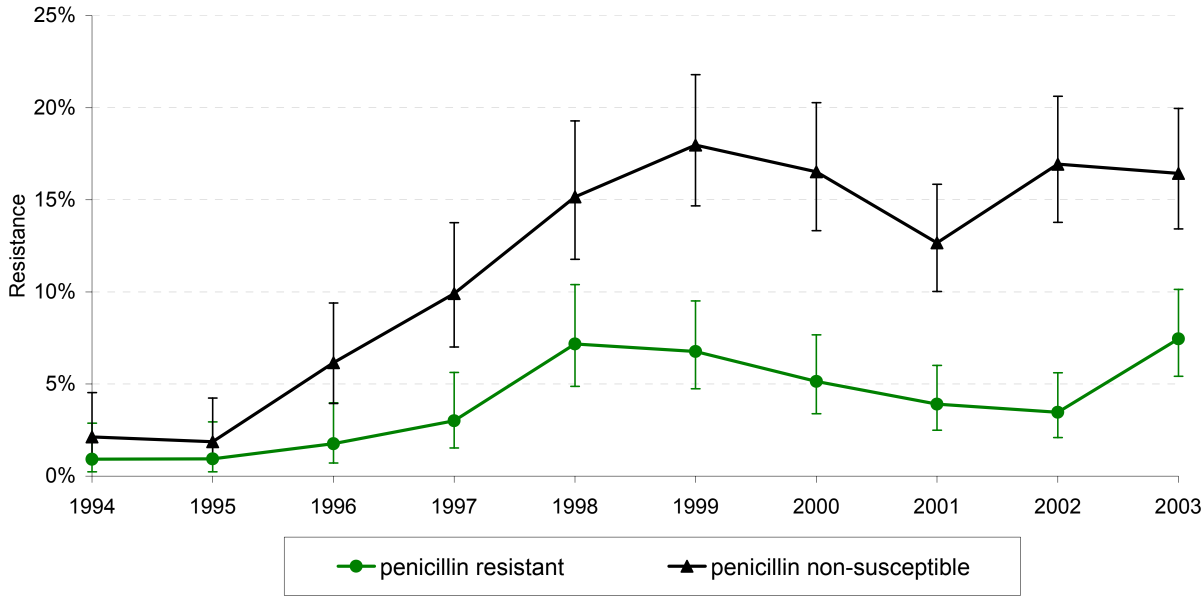


Figure 16b. *Streptococcus pneumoniae* from invasive disease: cefotaxime resistance (MIC ≥2 mg/L) and non-susceptibility (MIC ≥1 mg/L), meningitis interpretive standards, 1994-2003 [with 95% confidence interval bars]

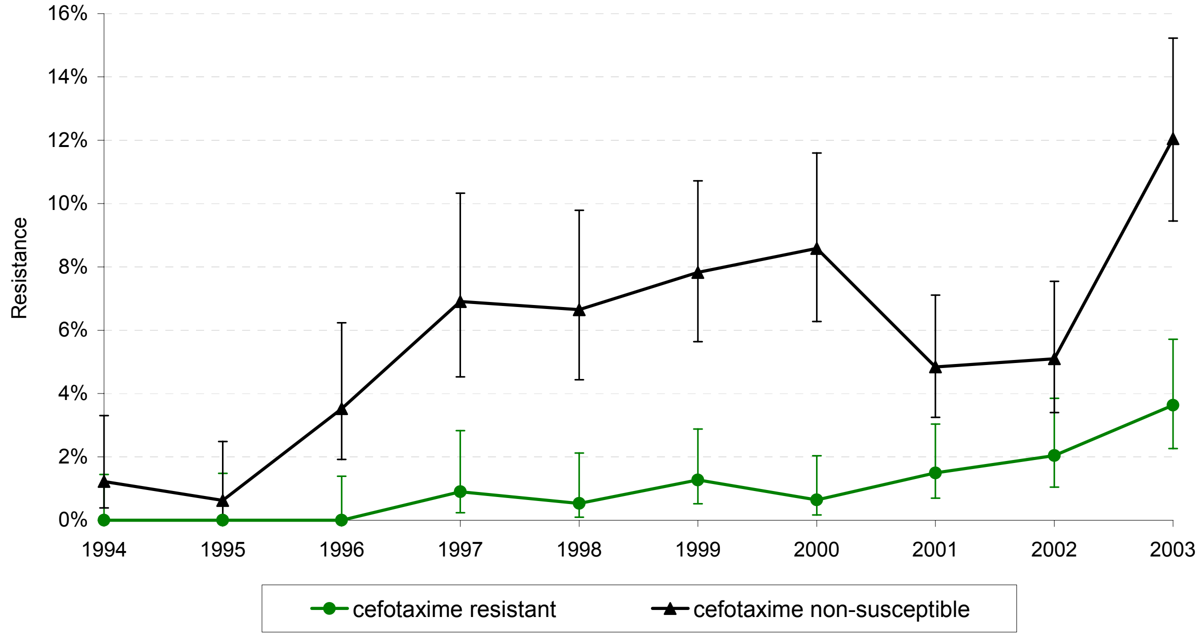


Figure 16c. ***Streptococcus pneumoniae*** **from invasive disease: cefotaxime resistance (MIC≥4 mg/L) and non-susceptibility (≥2 mg/L), non-meningitis interpretive standards, 1994-2003 [with 95% confidence interval bars]**

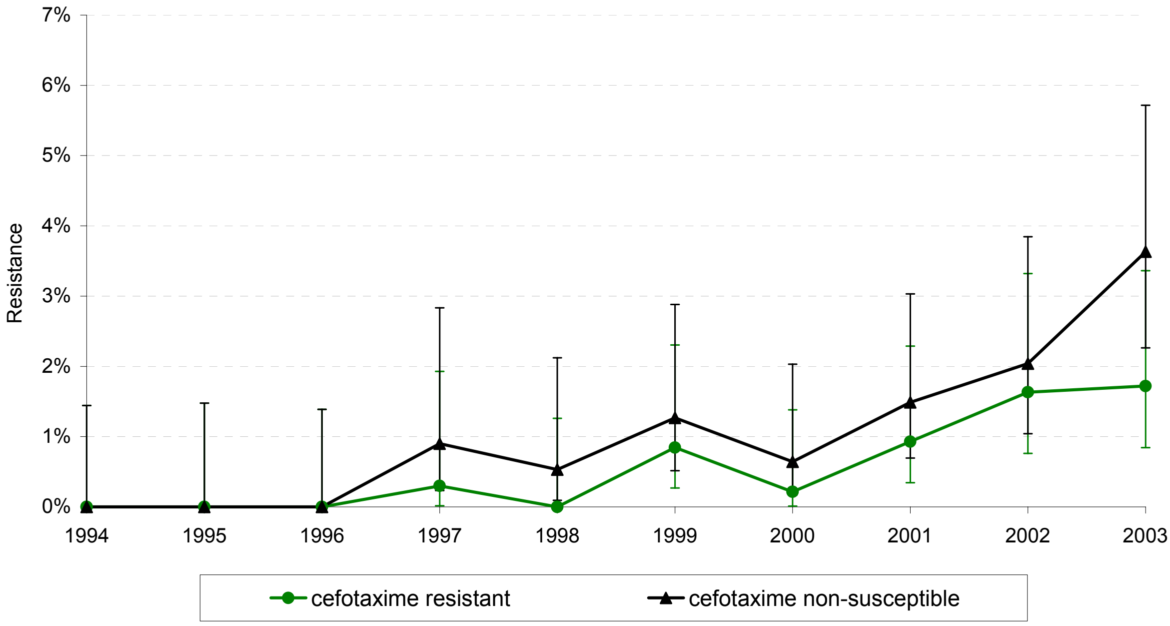
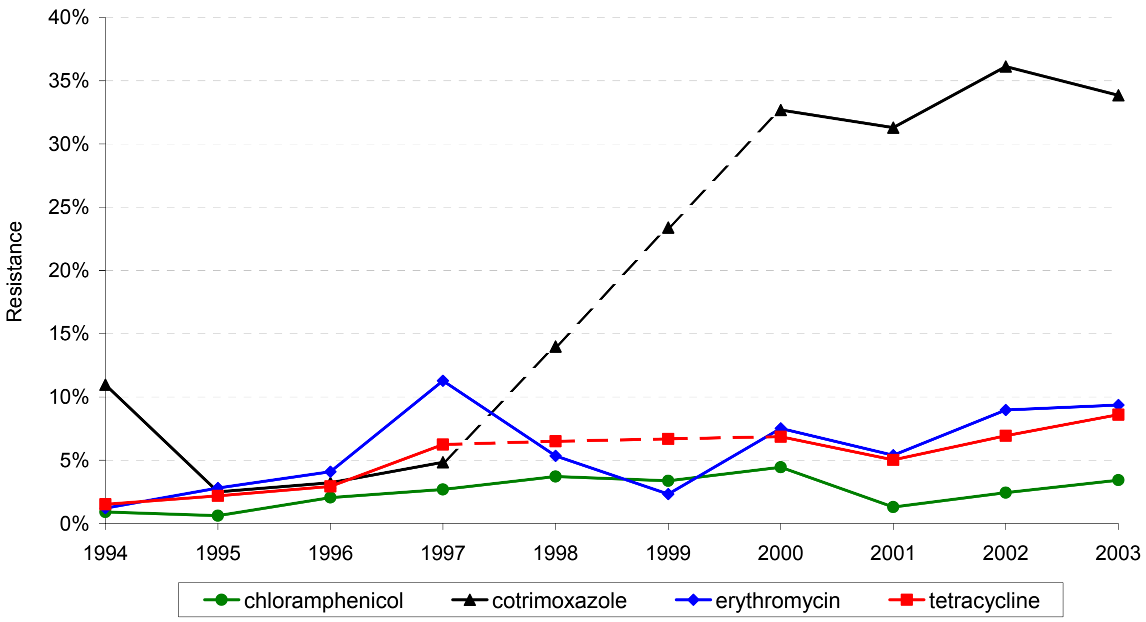


Figure 16d. ***Streptococcus pneumoniae*** **from invasive disease: chloramphenicol, cotrimoxazole, erythromycin and tetracycline resistance, 1994-2003**

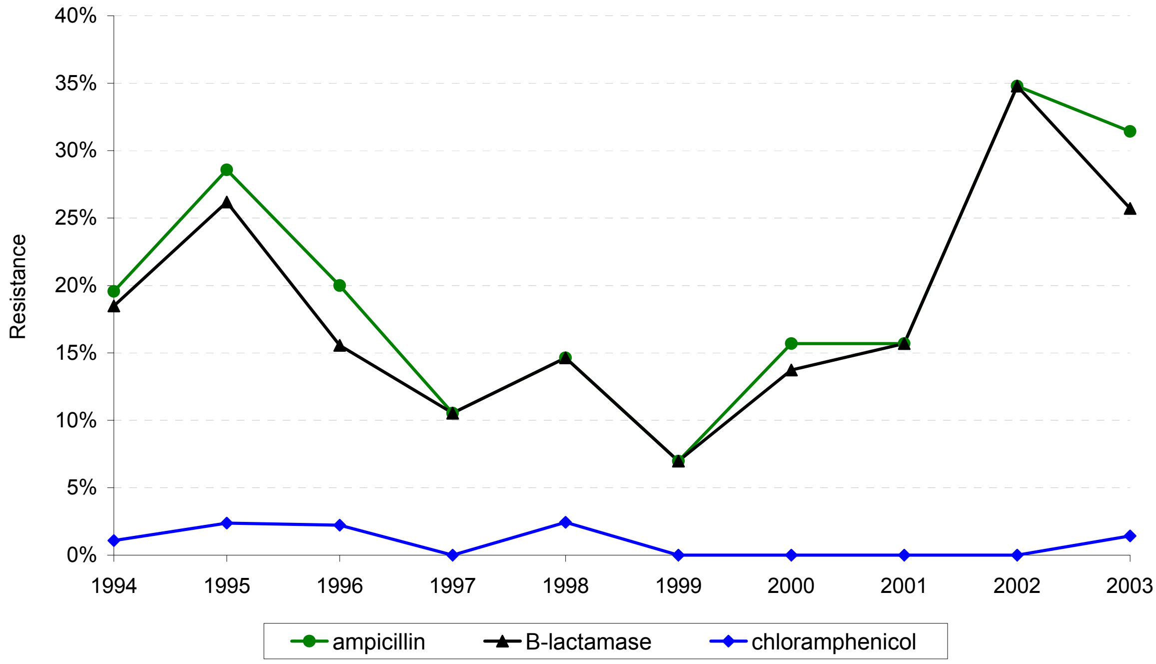


Note: In 1998 and 1999, cotrimoxazole and tetracycline susceptibility was not tested. Data for erythromycin, cotrimoxazole and tetracycline in 1997 were not included in the trend analyses as only a small proportion of the total number of isolates was tested.

	Direction of the trend	Significance	P-value
penicillin resistance	increase	significant	<0.0001
penicillin non-susceptibility	increase	significant	<0.0001
meningitis interpretation			
cefotaxime resistance	increase	significant	<0.0001
cefotaxime non-susceptibility	increase	significant	<0.0001
non-meningitis interpretation			
cefotaxime resistance	increase	significant	<0.0001
cefotaxime non-susceptibility	increase	significant	0.0011
chloramphenicol resistance	increase	significant	0.0320
cotrimoxazole resistance	increase	significant	<0.0001
erythromycin resistance	increase	significant	<0.0001
tetracycline resistance	increase	significant	<0.0001

3.2.2 *Haemophilus influenzae*

Figure 17. *Haemophilus influenzae* from invasive disease: ampicillin resistance, β-lactamase production and chloramphenicol resistance, 1994-2003

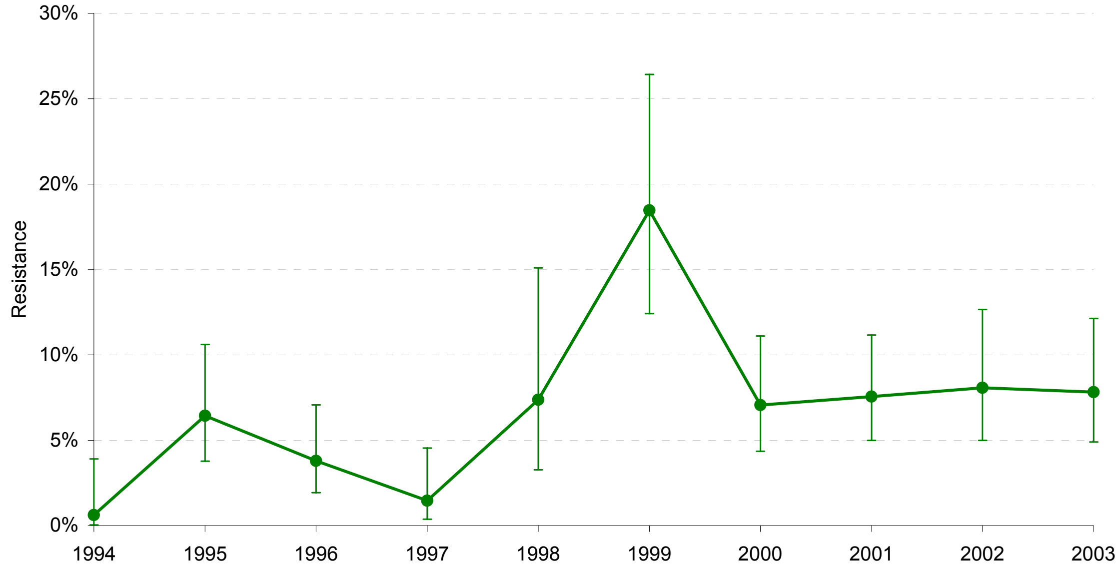


	Direction of the trend	Significance	P-value
ampicillin resistance	increase	not significant	0.4401
β-lactamase production	increase	not significant	0.3073
chloramphenicol resistance	decrease	not significant	0.4645

Note: *H. influenzae* invasive isolates in New Zealand remain universally susceptible to third-generation cephalosporins. Occasional rifampicin resistance has been identified, with just one rifampicin-resistant isolate being identified during the 10 years 1994-2003.

3.2.3 *Neisseria meningitidis*

Figure 18. *Neisseria meningitidis* from invasive disease: reduced penicillin susceptibility (MIC ≥0.12 mg/L), 1994-2003 [with 95% confidence interval bars]



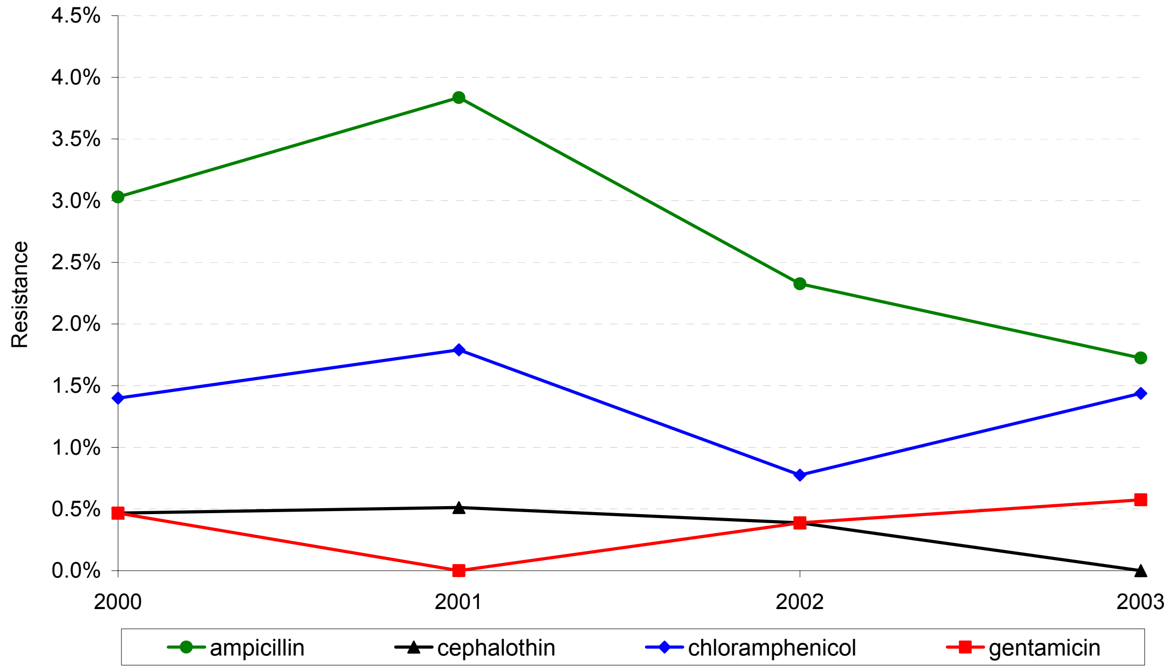
	Direction of the trend	Significance	P-value
penicillin reduced susceptibility	increase	significant	0.0005

Note: *N. meningitidis* invasive isolates in New Zealand remain universally susceptible to third-generation cephalosporins and ciprofloxacin. Occasional rifampicin resistance has been identified, with just two rifampicin-resistant isolates being identified during the 10 years 1994-2003.

3.3 Non-typhoidal *Salmonella*

The number of isolates tested and the annual resistance rates used to generate the charts presented in this section are tabulated in Appendix 3.

Figure 19. Non-typhoidal *Salmonella*: ampicillin, cephalothin, chloramphenicol and gentamicin resistance, 2000-2003



	Direction of the trend	Significance	P-value
ampicillin resistance	decrease	not significant	0.1836
cephalothin resistance	decrease	not significant	0.2861
chloramphenicol resistance	decrease	not significant	0.7910
gentamicin resistance	increase	not significant	0.6537

Note: the range of antibiotics analysed for trend was limited to the four antibiotics that have some clinical relevance and that have been consistently tested each year since 2000. Ciprofloxacin is also tested, but only one resistant isolate has been identified in New Zealand to date.

4 DISCUSSION

The trend analyses that are based on the antimicrobial resistance data collected from diagnostic laboratories have several limitations. The first of these limitations is that the analyses are based on a relatively small proportion of the total available data. The laboratories that have been able to contribute their resistance data have varied from year to year. To avoid any year-to-year variations in resistance that could merely reflect differences between the contributing laboratories (eg, their geographical location or whether they process hospital or community patient specimens), only data from laboratories that have contributed their data in each of the years covered by the analyses (the so-called core laboratories) have been included in the time-trend analyses in this report and earlier reports.[1-3]

This approach severely limits the data available for inclusion in these time-trend analyses. In these latest analyses, data from only 12 laboratories could be included. Moreover, some of the resistance data from three of these 12 laboratories were excluded as they were reported to include intermediate resistance. This was particularly the case for data for the years 2001-2003, when more effort was made during the data collection phase to identify data that included intermediate resistance. This increased effort since 2001 to identify, and not include, data that included intermediate resistance may have produced some unreal trends of decreasing resistance. The 1999 and 2000 resistance rates may include intermediate resistance, whereas the resistance rates for the later years do not, or are less likely to.

In addition to the limitation on the number of laboratories from which data are included, the trend analyses are potentially further limited by factors that may affect the validity of collating data from different laboratories, such as differences in protocols for which specimens are tested for antimicrobial susceptibility, differences in test methodologies, and differences in results interpretation.

Finally the trend analyses are also potentially limited by other factors that can limit the accuracy of any estimates of resistance rates, such as the inclusion of duplicate isolates from the same patient and not distinguishing between antibiotics tested as first line and those tested as second line against isolates demonstrating significant resistance.

Mindful of these limitations, there appeared to be several significant changes in antimicrobial resistance based on the data collected from the twelve core diagnostic laboratories for the five years 1999 to 2003:

- **Increase in ampicillin resistance among hospital enterococci**

  Ampicillin resistance increased among hospital isolates of enterococci and 5.5% resistance was recorded in 2003. In contrast, ampicillin resistance decreased among community isolates and the 2003 rate of resistance was just 0.6%.

- **Changes in resistance to several ß-lactams among bacteraemic and urinary *E. coli***

  While there was generally a trend of decreasing β-lactam resistance among *E. coli,* the trends varied between hospital and community isolates and among hospital isolates depending on the site of isolation. Conversely, resistance to third-generation cephalosporins seems to be increasing. Presumably most of this latter resistance is mediated by extended-spectrum β-lactamases.

  - Ampicillin resistance decreased in both hospital and community urinary isolates to rates of 52.4% and 51.7%, respectively, in 2003.
  - Co-amoxiclav resistance decreased among bacteraemic and hospital urinary isolates but increased in community urinary isolates. In 2003, 9.9% resistance was recorded among bacteraemic isolates, 13.9% among hospital urinary isolates and 6.8% among community urinary isolates.
  - Second-generation cephalosporin resistance decreased among bacteraemic isolates but increased among hospital urinary isolates, with 2003 rates of 0.6% and 1.7%, respectively.
  - Third-generation cephalosporin resistance showed no significant change among bacteraemic isolates but increased among hospital urinary isolates, with 2003 rates of 0.4% and 0.9%, respectively.

- **Increases in fluoroquinolone resistance among *E. coli***

  Fluoroquinolone resistance increased among both hospital and community urinary *E. coli* isolates to reach rates of 3.1% and 4.9%, respectively, in 2003.

- **Decrease in ampicillin resistance among *H. influenzae* from non-invasive infections**

  Ampicillin resistance decreased among non-invasive *H. influenzae* isolates and was 20.0% in 2003. This trend differs from that recorded for invasive isolates, among which ampicillin resistance has increased since 1999 to a rate of 31.4% in 2003.

- **Increase in third-generation cephalosporin resistance among *Klebsiella***

  While there were increases in resistance to third-generation and second-generation cephalosporins (although the increase was not significant for the second-generation cephalosporins), co-amoxiclav and cephalothin resistance decreased. The rate of resistance to third-generation cephalosporins was 3.0% in 2003.

- **Increase in fluoroquinolone resistance among gonococci**

  Since 2000 when data were first collected, fluoroquinolone resistance has increased from 2.2% to 8.6% in 2003. In contrast there has been no significant change in penicillin resistance, and, penicillin resistance is now less common than fluoroquinolone resistance (5.3% vs 8.6%). However, there is considerable variation in gonococcal resistance in different parts of the country.[5]

- **Differences in resistance trends between hospital and community *S. aureus***

  Among hospital isolates there has been a trend of increasing resistance to almost all antibiotics since 1999: methicillin/oxacillin, cotrimoxazole, erythromycin, fluoroquinolone, and mupirocin. Only gentamicin resistance decreased. In contrast, there were no significant increases in resistance among community isolates. Methicillin/oxacillin resistance appears to have more than halved between 2002 and 2003 (7.7% to 2.8%) among community isolates. This effect is probably due in large part to the exclusion of Auckland Diagnostic Medlab's 2003 data, as they advised that their 2003 data included isolates with intermediate resistance. As a consequence, the only laboratories contributing to the community *S. aureus* resistance data for 2003 were in Wellington, Wanganui and Dunedin – areas with only moderate or low rates of MRSA compared with the Auckland area.

- **Increase in penicillin non-susceptibility among non-invasive isolates of *S. pneumoniae***

  Penicillin non-susceptibility among pneumococci has been steadily increasing since the early 1990s, and this trend continued during the 1999-2003 period with non-susceptibility increasing from 24.0 to 30.7% over the 5-year period.

The referral of invasive isolates to ESR is either complete (in the case of *N. meningitidis*) or at least representative (*H. influenzae* and *S. pneumoniae*). Therefore, the trend analyses of antimicrobial resistance among these isolates should be an accurate representation of any changes in antimicrobial resistance among these pathogens in New Zealand. There were several notable changes in antimicrobial resistance during the 10 years 1994 to 2003, including:

- **Increases in resistance to all antimicrobials among invasive pneumococci**

  In 2003 there was a complete reversal of the decrease in penicillin resistance observed over the four years 1999-2002, with resistance reaching the highest rate ever recorded (7.5%). Overall, during the last 10 years 1994 to 2003, there were highly significant trends of increasing penicillin and third-generation cephalosporin resistance and non-susceptibility. Similarly, resistance increased to each of the other four antimicrobials that are routinely tested: cotrimoxazole, erythromycin, tetracycline and chloramphenicol.

- **Recent increase in ampicillin resistance among invasive *H. influenzae***

  While over the 10 years since 1994, there were no significant trends, ampicillin resistance and β-lactamase production decreased until 1999 and then increased to exceed the rates in the mid-1990s, with 31.4% ampicillin resistance recorded in 2003. In 2003 four β-lactamase-negative ampicillin-resistant (BLNAR) isolates were identified among the invasive *H. influenzae* isolates. Most of these isolates had a relatively low level of ampicillin resistance (MICs 0.5-2.0 mg/L).

- **Increasing reduced penicillin susceptibility among invasive meningococci**

  The prevalence of reduced penicillin susceptibility (MICs 0.12-0.5 mg/L) among meningococci from invasive disease increased over the 1994-2003 period to 7.8% in 2003, with an apparent peak of 18.5% in 1999. These isolates are still susceptible to normal penicillin treatment regimens for meningococcal meningitis.

The data available for analysis of antimicrobial resistance trends among non-typhoidal *Salmonella* are limited for two reasons. First, while ESR's surveillance of antimicrobial resistance among *Salmonella* began in 1972, between 1982 and 1997 only 5-yearly surveys were undertaken. Continuous surveillance resumed in 2000 and hence the period analysed for trend in this report was only 2000 to 2003. Second, since 2000 susceptibility to only five antimicrobials with any clinical relevance (ampicillin, cephalothin, chloramphenicol, ciprofloxacin and gentamicin) has been consistently tested in all years. Resistance to these five antimicrobials has not changed significantly since 2000, and resistance remains relatively low. Of particular note, only one ciprofloxacin-resistant isolate has been identified and was isolated in 2002 from a case who acquired the infection overseas. In 2002, the range of antibiotics tested was extended to include cotrimoxazole. In 2004, nalidixic acid was added, as an indicator of the efficacy of fluoroquinolones for extra-intestinal salmonellosis.

This is the fourth trend analysis that has been reported.[1-3] There are opportunities for improvements in the scope of the report and the quality of the data used. Currently, as mentioned above, probably the biggest limitation is the representativeness of the diagnostic laboratory data, as only a small proportion of the total available data is used. Data from only 12 core laboratories were used for the analyses of trends between 1999 and 2003 presented in this report. In comparison, a total of 21 laboratories contributed their data in 1999, 20 in 2000, 28 in 2001, 29 in 2002 and 35 in 2003. The relative merits of only including data from the core laboratories versus the power of including all available data should be re-examined. On the other hand, if all laboratories that contributed data in each of the years 2001 to 2003 also contribute their 2004 and 2005 data, when the next scheduled trend analysis is due and if the period covered remains at five years (ie, 2001-2005), then data from 24 core laboratories will be available.

Two other factors can result in erroneous resistance estimates: the categorisation of isolates with intermediate resistance with those with full resistance and the inclusion of resistance data for antibiotics that have been tested as second line. These factors should become less of a problem over time, as more effort is made during the data collection and initial analysis phase to identify such data and exclude them from both the annual national estimates of resistance and trend analyses. However, the need to exclude data from laboratories that categorise intermediate resistance with resistance will continue to limit the number of laboratories from whom data are available to estimate national rates of resistance and analyse trends. Therefore it is recommended that laboratories be encouraged, where possible, to record their antimicrobial susceptibility testing results according to the three standard susceptibility categories: susceptible, intermediate and resistant. This recommendation is in line with NCCLS's guideline for the analysis and presentation of cumulative antimicrobial susceptibility test data.[6] In addition, to maximise the amount of data available for surveillance purposes, laboratories should be encouraged to record in their databases the susceptibility test results for all antibiotics tested, rather than only those reported.

One of the key enhancement to these analyses would be the examination of trends in multiresistance. However, currently resistance pattern (antibiogram) data are only available for isolates tested at ESR, as data are not collected at the individual record (ie, isolate) level from diagnostic laboratories. This raises another serious shortcoming in the data collected from diagnostic laboratories and indicates a need to examine the feasibility of electronic transfer of record-level data. However, considerable resources are likely to be required to implement such data transfer. In the meantime, ESR-generated susceptibility data, in particular, for invasive pneumococci and *Salmonella,* could be analysed for trends in multiresistance.

5 CLINICAL MICROBIOLOGIST COMMENTARY

Antibiotic resistance trends are monitored in New Zealand at both local and national levels, with this ESR report describing the national picture as best we can. We can be confident that there is complete monitoring of invasive isolates of *S. pneumoniae*, *H. influenzae* and *N. meningitidis*. The situation is a little less clear when analysing collated resistance patterns from diagnostic laboratories for various organisms. There have been several factors which conspire to make the analysis difficult. These largely relate to consistency of data collection and some variation over the years as to whether an organism of intermediate susceptibility is counted as resistant or susceptible. This latter factor applies particularly to the β lactams and Enterobacteriaceae. In addition, not all isolates are clinically significant, and there can be a tendency to overestimate resistance when isolates from ulcer swabs, catheter stream urines, etc are included in collated results.

Having mentioned the caveats, these data are of great importance, because they 'smooth out' local variations, and underpin the development of guidelines for the empiric treatment of common infections. National monitoring of course also allows us to track the gradual emergence of new resistance problems either of local or international origin.

The control of antibiotic resistance has become more and more of an issue, because of the risks of loss of treatment options and increasing expense of antibiotics that retain efficacy. By and large resistance rates trend upwards, but there are notable exceptions. In particular, the quickly changing rates of antibiotic resistance in *S. pneumoniae* reflect changes in serotypes with characteristic resistance patterns, rather than acquisition of a new resistance pattern in a stable strain. This illustrates the fact that some resistance trends will reflect cross-infection of hospital pathogens, such as MRSA, and others will reflect disease epidemiology itself. The control of resistance therefore requires a cosmopolitan approach.

What are the "highlights" of this report?

Erythromycin resistance remains less common than ciprofloxacin resistance in *Campylobacter*
This indicates that in the rare event that treatment is indicated, erythromycin remains useful. Studies from the United Kingdom have shown that the major risk factor for *Campylobacter* resistance is overseas acquisition of disease. It may be useful to study this aspect in New Zealand, particularly with the interest in *Campylobacter* as a zoonotic organism. As such it may be an important indicator organism for monitoring resistance in human pathogens occurring as the consequence of antibiotic use in food-producing animals.

Vancomycin-resistant enterococci remain extremely rare in New Zealand
This is in contrast to many other countries where VRE have become either common nosocomial pathogens (eg, in the United States) or common in the community (eg, in Europe).

Resistance rates in *E. coli* changing: co-amoxiclav down, fluoroquinolones up
The resistance patterns in *E. coli* are quite intriguing. Resistance to co-amoxiclav and cephalosporins appears to be falling in hospital isolates from urine and blood, with halving of resistance rates to co-amoxiclav and first-generation cephalosporins over a three-year period. While this is pleasing, fluoroquinolone resistance rates have doubled. There does not seem to be any obvious reason for this increase, but it is quite alarming. One must assume that it is largely the result of norfloxacin and ciprofloxacin medical prescribing, because there is minimal non-medical use of fluoroquinolones in this country.

Changing cephalosporin resistance patterns in *Klebsiella*
These show a paradox of reducing resistance to co-amoxiclav and first-generation cephalosporins yet increasing resistance to third-generation cephalosporins. It would be interesting to examine this further by checking for the presence of particular β-lactamases.

Apparent changes in resistance in *S. aureus*
The main observation is the reduction in MRSA in hospital laboratory isolates in 2003, which is good news, and suggests good infection control practice in New Zealand. It is reassuring that cotrimoxazole remains active in over 95% of isolates, providing a useful alternative when flucloxacillin cannot be used.

As commented in the discussion, the apparent fall in community MRSA is largely due to the exclusion of Auckland Diagnostic Medlab's data. Community MRSA occurs mainly in people of Polynesian ethnicity, a large proportion of whom live in Auckland.

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APPENDIX 1

Collated Antimicrobial Susceptibility Data for the 12 Core Laboratories, 1999-2003

Core laboratories: Whangarei Hospital; Auckland City and Children's Hospital; Middlemore Hospital; Diagnostic Medlab, Auckland; Waikato Hospital; Rotorua Hospital; Medlab Bay of Plenty, Tauranga; Wanganui Diagnostic Laboratory; MedLab Central, Palmerston North; Valley Diagnostic Laboratories, Lower Hutt; Christchurch Hospital (Canterbury Health Laboratories); and Southern Community Laboratories, Dunedin.

	1999		2000		2001		2002		2003	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Campylobacter* spp**										
erythromycin	121	3.3%	175	2.9%	269	1.1%	267	2.2%	237	1.3%
fluoroquinolone			48	2.1%	206	3.4%	282	3.2%	237	2.5%
Enterococcus										
Community										
ampicillin	1866	5.9%	2498	0.9%	2555	1.0%	644	1.4%	639	0.6%
nitrofurantoin	1685	2.4%	2464	0.5%	2530	0.8%	621	1.1%	624	0.2%
Hospital										
ampicillin	832	2.8%	1703	4.8%	1990	7.4%	1862	11.6%	2672	5.5%
gentamicin (high level)	121	50.4%	307	30.6%	408	27.2%	366	37.2%	416	32.9%
nitrofurantoin	308	1.0%	1281	0.4%	1538	0.5%	1606	0.5%	2047	0.2%
vancomycin	569	0.2%	1497	0.4%	1794	0.6%	1956	0.2%	2673	0.04%
***E. coli* bacteraemia**										
Hospital										
amikacin					332	0%	355	0.3%	291	0%
cefotaxime/ceftriaxone					747	0.7%	610	0.5%	758	0.4%
cefuroxime/cefamandole					638	3.1%	522	3.4%	651	0.6%
cephalothin					466	29.8%	359	16.2%	440	11.4%
co-amoxiclav					667	23.2%	506	9.9%	536	9.9%
fluoroquinolone					775	3.1%	679	1.6%	724	3.6%
gentamicin					818	1.1%	693	1.6%	715	2.1%
tobramycin					177	2.8%	202	1.5%	180	1.7%
***E. coli* urinary**										
Community										
ampicillin	22855	54.3%	40914	54.9%	43356	55.6%	7207	51.3%	7444	51.7%
co-amoxiclav	22858	6.1%	40914	6.4%	43290	7.5%	7514	10.8%	7441	6.8%
fluoroquinolone	6986	1.2%	37903	1.5%	42996	2.1%	7156	2.0%	7433	4.9%
nitrofurantoin	22501	1.5%	40901	1.2%	43224	1.2%	7177	2.3%	7432	2.8%
trimethoprim	6636	24.1%	40909	23.8	43343	24.2%	7159	22.8%	7439	22.9%
Hospital										
ampicillin	7449	55.0%	7857	55.9%	7982	53.4%	6370	51.1%	8492	52.4%
cefotaxime/ceftriaxone	4688	0.1%	5175	0.1%	4911	0.4%	3249	0.7%	5167	0.9%
cefuroxime/cefamandole	3737	0.9%	4086	0.7%	3907	1.2%	2221	1.4%	3816	1.7%
cephalothin	5267	20.4%	5739	19.3%	5214	22.4%	3977	15.5%	3873	16.4%
co-amoxiclav	5849	19.3%	6876	15.3%	6165	17.2%	4627	5.3%	6076	13.9%
fluoroquinolone	6365	1.2%	7524	1.3%	7927	1.3%	6114	1.8%	8433	3.1%
gentamicin	6542	1.5%	7177	1.4%	6993	1.1%	5304	1.7%	7855	2.7%
nitrofurantoin	6521	1.2%	8109	0.8%	7982	1.1%	6322	1.0%	8457	1.0%
trimethoprim	6804	24.9%	7544	23.2%	7981	23.9%	6358	23.2%	8455	24.9%
***Haemophilus influenzae* non-invasive**										
ampicillin	6518	23.7%	8488	24.6%	8292	21.7%	2928	18.3%	3096	20.0%
chloramphenicol	3040	0.8%	4711	0.6%	4090	0.5%	526	0.2%	888	0.3%
co-amoxiclav	5727	0.7%	3327	0.8%	3282	0.5%	1468	0.8%	2045	0.1%
cotrimoxazole	5453	18.1%	7944	17.6%	7565	17.4%	1988	17.4%	5493	20.5%
tetracycline	5281	1.2%	3470	1.1%	3363	2.5%	1949	1.1%	2106	0.9%

	1999		2000		2001		2002		2003	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Klebsiella* spp**										
Hospital										
amikacin	392	0.3%	711	0.1%	691	0%	650	0.5%	704	0.3%
cefotaxime/ceftriaxone	782	0.9%	1069	1.7%	1010	0.9%	682	3.7%	1049	3.0%
cefuroxime/cefamandole	785	3.7%	931	5.6%	957	5.3%	625	8.5%	897	5.0%
cephalothin	830	18.3%	869	14.8%	975	10.4%	697	13.2%	832	10.2%
co-amoxiclav	1054	11.0%	1399	7.5%	1332	7.6%	951	7.2%	1242	4.3%
cotrimoxazole	770	5.7%	1161	5.6%	1152	7.4%	958	10.4%	1122	8.6%
fluoroquinolone	738	1.2%	1073	1.3%	1233	0.8%	1077	1.9%	1356	1.0%
gentamicin	1147	0.9%	1410	1.4%	1532	0.7%	1181	2.7%	1421	2.1%
tobramycin			34	2.9%	207	0.5%	207	2.9%	283	2.1%
Neisseria gonorrhoeae										
β-lactamase positive			749	2.9%	296	3.7%	424	3.3%	713	3.4%
fluoroquinolone			783	2.2%	786	10.8%	423	7.6%	617	8.6%
penicillin			854	7.0%	851	6.2%	762	7.2%	1041	5.3%
Pseudomonas aeruginosa										
Hospital										
amikacin	1429	5.7%	1454	5.5%	279	3.9%	1336	4.1%	1357	3.5%
ceftazidime	1816	4.8%	2071	4.4%	2010	4.7%	1287	8.5%	2459	4.4%
fluoroquinolone	2550	5.9%	2658	8.8%	2609	9.4%	2145	7.4%	3026	7.2%
gentamicin	2598	10.9%	2789	10.0%	2614	11.3%	2171	8.5%	3092	8.2%
imipenem/meropenem	2102	8.6%	1327	5.0%	1538	7.7%	1386	6.9%	1929	6.2%
piperacillin	2495	4.1%	2468	5.4%	2471	3.7%	1935	5.7%	1405	3.7%
tobramycin	1328	2.4%	1351	4.2%	1132	4.3%	1093	4.1%	1551	5.1%
Staphylococcus aureus										
Community										
cotrimoxazole	19067	0.5%	12430	1.5%	28640	0.6%	26942	0.9%	3230	0.5%
erythromycin	21375	12.6%	34837	13.6%	30897	13.1%	28828	13.1%	4744	9.8%
methicillin/oxacillin	21400	6.4%	40610	6.9%	36180	7.6%	33099	7.7%	4831	2.8%
mupirocin	12996	20.4%	29841	22.3%	25142	20.4%	23648	18.7%		
tetracycline	21345	3.0%	4233	2.6%	30266	3.0%	23017	3.6%	4741	1.7%
Hospital										
cotrimoxazole	6772	2.5%	9068	1.8%	9331	2.2%	5288	2.2%	10700	4.7%
erythromycin	11790	10.1%	13871	9.9%	12789	12.2%	10214	10.1%	14175	13.0%
fluoroquinolone	4703	6.0%	6055	5.8%	4750	11.9%	2133	7.9%	5150	17.1%
gentamicin	8756	2.9%	9657	2.2%	9502	2.5%	8522	2.1%	10298	2.3%
methicillin/oxacillin	12711	8.4%	14068	10.8%	13594	11.9%	16428	19.8%	14978	14.3%
mupirocin	1853	10.6%	1923	11.4%	2171	11.1%	907	6.6%	4284	13.8%
tetracycline	2267	2.2%	6385	1.5%	2563	3.6%	2791	2.3%	3250	2.2%
Staphylococci (coagulase negative) from blood										
cotrimoxazole	478	25.1%	495	26.9%	920	35.9%	586	30.7%	967	25.9%
erythromycin	1094	41.1%	1340	43.4%	1563	44.1%	965	39.0%	1327	41.5%
fluoroquinolone	377	10.9%	605	18.5%	872	25.1%	497	21.5%	601	18.8%
gentamicin	903	30.0%	879	34.7%	1162	41.9%	843	32.4%	1314	30.1%
methicillin/oxacillin	1148	47.6%	1340	51.2%	1578	56.7%	1224	53.1%	1335	56.1%

	1999		2000		2001		2002		2003	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
***Streptococcus pneumoniae* non-invasive**										
chloramphenicol	1355	4.8%	2687	5.5%	2666	4.7%	472	0.4%	418	0.7%
cotrimoxazole	1036	41.8%	3919	48.1%	3292	40.6%	1510	40.5%	3118	44.9%
erythromycin	3830	18.2%	4984	19.2%	4118	17.4%	1469	18.0%	3375	22.7%
penicillin					1393	14.3%	1355	12.8%	1679	16.9%
penicillin non-susceptibility	4122	24.0%	5015	28.2%	4336	27.6%	3816	28.4%	3425	30.7%
tetracycline	1316	11.0%	1976	16.4%	1630	13.9%	3081	15.8%	1494	22.4%
Streptococcus pyogenes										
erythromycin	10509	1.4%	7845	1.6%	10905	1.3%	9398	1.5%	2924	1.5%

APPENDIX 2

Antimicrobial Susceptibility Data for Invasive Isolates of *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Neisseria meningitidis*, 1994-2003

	1994		1995		1996		1997		1998		1999		2000		2001		2002		2003	
	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[1]	328	0.9%	320	0.9%	341	1.8%	333	3.0%	376	7.2%	473	6.8%	466	5.2%	537	3.9%	490	3.5%	523	7.5%
penicillin MIC ≥0.12[1]	328	2.1%	320	1.9%	341	6.2%	333	9.9%	376	15.2%	473	18.0%	466	16.5%	537	12.7%	490	16.9%	523	16.4%
cefotaxime MIC ≥4[2]	328	0%	320	0%	341	0%	333	0.3%	376	0%	473	0.8%	466	0.2%	537	0.9%	490	1.6%	523	1.7%
cefotaxime MIC ≥2[2]	328	0%	320	0%	341	0%	333	0.9%	376	0.5%	473	1.3%	466	0.6%	537	1.5%	490	2.0%	523	3.6%
cefotaxime MIC ≥1[2]	328	1.2%	320	0.6%	341	3.5%	333	6.9%	376	6.6%	473	7.8%	466	8.6%	537	4.8%	490	5.1%	523	12.0%
chloramphenicol	328	0.9%	320	0.6%	341	2.1%	333	2.7%	376	3.7%	473	3.4%	449	4.5%	537	1.3%	490	2.4%	523	3.4%
erythromycin	328	1.2%	320	2.8%	341	4.1%	62	11.3%	318	5.3%	473	2.3%	465	7.5%	537	5.4%	490	9.0%	523	9.4%
cotrimoxazole	328	11.0%	320	2.5%	341	3.2%	62	4.8%	0		0		465	32.7%	537	31.3%	490	36.1%	523	33.8%
tetracycline	328	1.5%	320	2.2%	341	2.9%	32	6.3%	0		0		466	6.9%	537	5.0%	490	6.9%	523	8.6%
Haemophilus influenzae																				
ampicillin	92	19.6%	42	28.6%	45	20.0%	38	10.5%	41	14.6%	43	7.0%	51	15.7%	51	15.7%	23	34.8%	70	31.4%
B-lactamase positive	92	18.5%	42	26.2%	45	15.6%	38	10.5%	41	14.6%	43	7.0%	51	13.7%	51	15.7%	23	34.8%	70	25.7%
chloramphenicol	92	1.1%	42	2.4%	45	2.2%	38	0%	41	2.4%	43	0%	51	0%	51	0%	23	0%	70	1.4%
cefotaxime	92	0%	42	0%	45	0%	38	0%	41	0%	43	0%	51	0%	51	0%	23	0%	70	0%
rifampicin	92	0%	42	0%	45	0%	38	0%	41	0%	43	2.3%	51	0%	51	0%	23	0%	70	0%
Neisseria meningitidis																				
penicillin MIC ≥2	162	0%	233	0%	264	0%	206	0%	95	0%	130	0%	255	0%	318	0%	223	0%	243	0%
penicillin MIC ≥0.12	162	0.6%	233	6.4%	264	3.8%	206	1.5%	95	7.4%	130	18.5%	255	7.1%	318	7.5%	223	8.1%	243	7.8%
rifampicin	162	0%	233	0%	264	0%	206	0.5%	95	0%	130	0%	255	0%	318	0%	223	0%	243	0.4%
ciprofloxacin	162	0%	233	0%	264	0%	206	0%	95	0%	130	0%	255	0%	318	0%	223	0%	243	0%
ceftriaxone	162	0%	233	0%	264	0%	206	0%	95	0%	130	0%	255	0%	318	0%	223	0%	243	0%

1 MIC ≥2 mg/L = penicillin resistant, MIC ≥0.12 mg/L = penicillin non-susceptible

2 MIC ≥4 mg/L = cefotaxime resistant (non-meningitis interpretation), MIC ≥2 mg/L = cefotaxime resistant (meningitis interpretation) and cefotaxime non-susceptible (non-meningitis interpretation), MIC ≥1 mg/L = cefotaxime non-susceptible (meningitis interpretation)

APPENDIX 3

Antimicrobial Susceptibility Data for *Salmonella*, 2000-2003

	2000		2001		2002		2003	
	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant	No. tested	% resistant
Non-typhoidal *Salmonella*								
ampicillin	429	3.0%	391	3.8%	258	2.3%	348	1.7%
cephalothin	429	0.5%	391	0.5%	258	0.4%	348	0%
chloramphenicol	429	1.4%	391	1.8%	258	0.8%	348	1.4%
ciprofloxacin	429	0%	391	0%	258	0.4%	348	0%
cotrimoxazole					258	0.8%	348	1.4%
gentamicin	429	0.5%	391	0%	258	0.4%	348	0.6%
streptomycin	429	2.6%	391	4.1%	258	3.1%	348	2.6%
sulphonamides					258	1.2%	348	3.2%
tetracycline	429	4.0%	391	5.6%	258	3.5%	348	3.4%
trimethoprim					258	0.8%	348	1.4%
***Salmonella* Typhi**								
ampicillin			26	3.9%	23	0%	18	5.6%
cephalothin			26	0%	23	0%	18	5.6%
chloramphenicol			26	3.9%	23	0%	18	11.1%
ciprofloxacin			26	0%	23	0%	18	0%
cotrimoxazole			26		23	0%	18	5.6%
gentamicin			26	0%	23	0%	18	0%
streptomycin			26	3.9%	23	4.4%	18	33.3%
sulphonamides			26		23	0%	18	5.6%
tetracycline			26	3.9%	23	0%	18	5.6%
trimethoprim			26		23	0%	18	5.6%
***Salmonella* Paratyphi A**								
ampicillin					3	0%	10	0%
cephalothin					3	0%	10	0%
chloramphenicol					3	0%	10	0%
ciprofloxacin					3	0%	10	0%
cotrimoxazole					3	0%	10	0%
gentamicin					3	0%	10	0%
streptomycin					3	0%	10	0%
sulphonamides					3	0%	10	0%
tetracycline					3	0%	10	0%
trimethoprim					3	0%	10	0%
***Salmonella* Paratyphi B**								
ampicillin					21	28.6%	11	18.2%
cephalothin					21	0%	11	18.2%
chloramphenicol					21	28.6%	11	0%
ciprofloxacin					21	0%	11	0%
cotrimoxazole					21	0%	11	0%
gentamicin					21	0%	11	0%
streptomycin					21	23.8%	11	18.2%
sulphonamides					21	23.8%	11	18.2%
tetracycline					21	23.8%	11	18.2%
trimethoprim					21	0%	11	0%

APPENDIX 4

Collated Antimicrobial Susceptibility Data for all Contributing Laboratories, 1994-2003

	1994		1995		1996		1997		1998		1999		2000		2001		2002		2003	
	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	141	1.4%	79	3.8%	99	3.0%	76	3.9%	101	4.0%	163	6.7%	144	2.8%	133	9.0%	100	6.0%	92	3.3%
ceftazidime	209	4.8%	117	7.7%	111	18.0%	141	24.1%	135	24.4%	339	12.4%	239	14.6%	211	22.3%	147	16.3%	204	11.3%
cotrimoxazole	433	14.5%	216	27.3%	297	37.7%	337	31.2%	511	19.6%	610	21.0%	507	14.0%	600	18.0%	335	12.2%	389	10.5%
fluoroquinolone	406	17.7%	247	12.6%	280	13.6%	358	16.2%	368	17.1%	598	18.9%	465	8.6%	651	17.7%	400	6.3%	531	5.1%
gentamicin	576	9.0%	397	9.1%	376	29.0%	449	20.7%	654	14.7%	600	18.7%	524	12.2%	671	13.7%	465	6.9%	474	7.0%
imipenem/meropenem											469	2.1%	205	4.4%	346	2.0%	118	2.5%	215	0.9%
netilmicin	25	4.0%			43	4.7%	34	2.9%	31	6.5%	94	8.5%	88	10.2%	65	32.3%				
piperacillin	263	38.0%	201	39.8%	248	55.6%	215	50.7%	228	39.9%	411	29.4%	184	33.2%	219	39.3%	90	36.7%	42	28.6%
ticarcillin	149	38.9%	11	9.1%	48	31.3%	34	35.3%	31	22.6%	60	10.0%	35	22.9%			24	4.2%	23	8.7%
tobramycin	102	11.8%	8	12.5%	56	10.7%	109	6.4%	65	21.5%	250	5.2%	175	10.9%	155	9.7%	123	13.0%	121	6.6%
***Campylobacter* spp**																				
erythromycin											121	3.3%	175	2.9%	342	1.2%	303	2.0%	367	1.1%
fluoroquinolone											1	0%	48	2.1%	279	2.9%	318	2.8%	367	1.9%
Citrobacter freundii																				
amikacin	36	8.3%	36	27.8%	32	0%	44	0%	76	0%	82	1.2%	126	0%	96	0%	60	21.7%	80	0%
ampicillin	393	86.3%	322	88.5%	269	86.6%	580	90.2%	631	85.6%	542	77.7%	297	83.2%	797	92.8%	409	86.1%	394	91.4%
cefazolin	12	66.7%					44	90.9%	55	63.6%	34	67.6%	60	71.7%						
cefotaxime/ceftriaxone	151	11.9%	124	21.8%	151	31.1%	240	17.1%	199	16.1%	158	13.3%	138	14.5%	152	23.0%	100	33.0%	140	19.3%
cefuroxime/cefamandole	171	27.5%	121	28.1%	170	24.1%	197	26.9%	181	25.4%	129	28.7%	164	32.9%	118	22.0%	106	38.7%	161	30.4%
cephalothin	163	71.8%	70	84.3%	116	85.3%	156	83.3%	153	61.4%	168	72.0%	161	86.3%	128	82.8%	111	81.1%	127	90.6%
chloramphenicol	5	20.0%	4	0%			8	12.5%	6	50.0%	10	40.0%	8	25.0%						
co-amoxiclav	327	69.4%	271	70.8%	235	68.5%	575	68.5%	520	68.1%	614	53.9%	286	55.6%	708	49.0%	394	66.0%	371	65.5%
cotrimoxazole	195	6.2%	110	2.7%	177	5.6%	267	4.1%	345	11.3%	221	8.1%	184	6.0%	348	10.9%	256	9.0%	202	6.4%
fluoroquinolone	224	0.4%	162	0%	223	1.3%	367	0.8%	317	0.3%	314	2.9%	264	1.5%	701	3.6%	410	4.4%	361	1.7%
gentamicin	319	1.9%	249	0.8%	283	1.1%	419	2.1%	403	1.5%	226	3.5%	234	3.0%	272	2.6%	218	3.2%	299	3.7%
imipenem/meropenem											137	1.5%	112	1.8%	146	0%	75	0%	99	0%
netilmicin	12	16.7%			34	0%	44	0%	55	1.8%	69	1.4%	100	1.0%	60	0%				

	1994		1995		1996		1997		1998		1999		2000		2001		2002		2003	
	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 continued																				
tetracycline	34	5.9%	9	22.2%	47	2.1%	77	2.6%	62	6.5%	63	30.2%	60	13.3%	26	3.8%	11	9.1%	11	0%
tobramycin	34	2.9%	3	0%	32	0%	57	1.8%	61	0%	55	0%	79	6.3%	76	0%	69	2.9%	56	0%
***E. coli* bacteraemia**																				
amikacin															352	0%	371	0.3%	340	0%
ampicillin															1014	55.6%	912	52.3%	990	57.0%
cefotaxime/ceftriaxone															818	0.6%	706	0.4%	841	0.4%
cefuroxime/cefamandole															823	2.8%	713	3.4%	941	1.5%
cephalothin															554	28.9%	451	19.5%	489	11.7%
co-amoxiclav															858	20.9%	708	11.0%	828	11.1%
fluoroquinolone															969	2.7%	869	2.0%	1003	4.0%
gentamicin															1015	1.1%	895	1.8%	1034	1.9%
imipenem/meropenem															489	0%	535	0%	522	0%
netilmicin															226	0%				
tobramycin															229	2.2%	292	1.7%	281	1.1%
***E. coli* non-urinary**																				
amikacin	2170	0.3%	250	0%	1571	0%	1458	0%	1354	0%	1413	0.1%	1572	0%	2387	0.3%	762	0.5%	1466	0%
ampicillin	3447	61.3%	4304	53.7%	3268	52.2%	4247	55.3%	6821	55.1%	6251	56.6%	4501	56.3%	5062	56.2%	2813	56.4%	3016	54.6%
cefazolin	452	4.0%					979	9.0%	906	13.8%	819	8.1%	762	8.0%						
cefotaxime/ceftriaxone	2283	0.5%	2245	0.1%	1953	5.9%	2736	0.3%	2633	0.6%	2271	0.2%	2129	0.2%	2738	0.5%	1159	1.6%	1672	0.4%
cefuroxime/cefamandole	2250	3.6%	2173	2.0%	2277	4.2%	2288	3.9%	2559	5.7%	2046	3.7%	2440	3.2%	2742	4.5%	1394	5.1%	2568	3.6%
cephalothin	1353	27.1%	1663	41.4%	1582	38.9%	1479	38.1%	1707	39.4%	2673	25.7%	1835	24.8%	2426	34.9%	1083	20.2%	1659	25.4%
chloramphenicol	87	9.2%	58	10.3%	1028	1.0%	91	14.3%	111	6.3%	167	12.6%	57	8.8%						
co-amoxiclav	2793	22.9%	2441	28.0%	2522	20.4%	3966	21.6%	6100	25.6%	5882	18.0%	3936	17.8%	4907	18.9%	2665	14.3%	3337	15.4%
cotrimoxazole	2020	19.0%	920	21.1%	2592	19.4%	3069	17.0%	5449	20.5%	3349	21.6%	3756	19.2%	3389	21.4%	2546	22.0%	2618	20.4%
fluoroquinolone	1871	0.2%	794	0.4%	2261	0.8%	2905	1.0%	5331	0.7%	2564	0.8%	3175	1.4%	3693	2.5%	1953	4.0%	2356	3.2%
gentamicin	3290	1.4%	4472	0.4%	2984	0.9%	3497	0.5%	4284	0.7%	6008	1.2%	3695	1.4%	4256	2.0%	2441	4.6%	3318	2.4%
imipenem/meropenem											1749	0%	1567	0.6%	2151	0.3%	764	0%	1515	0.5%

	1994		1995		1996		1997		1998		1999		2000		2001		2002		2003	
	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** continued																				
netilmicin	452	0%	34	0%	16	0%	980	0%	977	0%	1161	0.3%	1314	0.1%	2096	0.3%	17	0%	801	1.0%
tetracycline	1019	16.4%	180	21.1%	1374	15.9%	1476	16.7%	1237	20.1%	1631	13.1%	1013	15.6%	1652	16.9%	520	16.3%	1075	16.1%
tobramycin	631	2.1%	55	0%	1038	1.6%	1107	0.3%	1009	1.3%	1071	1.3%	1066	1.1%	1328	2.0%	375	4.5%	1085	1.6%
***E. coli* urinary**																				
amikacin	448	0.4%	682	0%	2073	0%	2163	0.05%	3127	0.03%	3623	0.3%	3647	0%	4384	0.02%	3218	0%	4079	0.1%
ampicillin	22698	55.1%	15422	56.3%	12631	58.9%	59563	58.3%	47657	55.5%	46661	54.5%	69909	55.2%	77932	55.4%	46958	51.3%	38706	51.8%^
cefazolin	320	1.9%					753	10.0%	2487	13.7%	609	9.0%	536	8.0%						
cefotaxime/ceftriaxone	3314	0.2%	736	0.3%	3392	2.2%	3281	0.2%	5233	0.2%	6069	0.3%	5726	0.1%	6228	0.6%	4609	1.0%	5905	0.9%
cefuroxime/cefamandole	3115	1.9%	945	1.7%	3555	2.7%	3406	2.6%	5791	3.2%	5103	1.7%	4624	1.0%	4761	2.2%	4642	8.3%	6483	1.8%
cephalothin	10281	10.9%	2185	29.3%	4428	39.8%	3517	33.7%	4486	35.6%	7172	26.9%	9369	18.1%	10945	19.8%	8153	13.6%	7834	16.4%
chloramphenicol											1	0%								
co-amoxiclav	20954	8.3%	13084	11.0%	10605	18.1%	58178	11.4%	48102	12.6%	45219	10.6%	67758	8.9%	76164	10.0%	51028	9.9%	44848	9.4%
cotrimoxazole	8597	19.9%	1445	18.9%	2392	20.4%	4304	22.2%	10342	19.9%	13740	18.9%	4534	23.1%	6670	21.3%	18263	20.8%	7230	21.7%
fluoroquinolone	18102	0.2%	15258	0.3%	8429	1.5%	55851	0.4%	47714	0.6%	30502	0.9%	65995	1.2%	83600	1.6%	51787	1.9%	45217	3.1%
gentamicin	6714	0.8%	4891	0.2%	7552	0.4%	10119	0.4%	8306	0.7%	15770	0.9%	15076	1.0%	15726	1.0%	8498	2.0%	12149	2.3%
imipenem/meropenem											11	0%								
mecillinam															2866	5.1%	10099	4.1%		
nalidixic acid	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%	2	0%	633	0.9%
nitrofurantoin	22623	1.2%	15327	1.3%	10173	3.2%	58101	1.5%	42746	1.8%	38685	1.5%	68650	1.5%	83481	1.5%	54018	1.5%	46970	1.5%
tetracycline	320	9.1%	1	0%	759	13.0%	3846	23.0%	1553	21.4%	1351	19.6%	537	17.9%						
tobramycin	760	0.9%	16	0%	2659	15.9%	757	1.2%	1400	0.1%	2490	0.8%	1757	0.7%	2109	1.0%	2298	1.3%	2975	0.7%
trimethoprim	22645	19.1%	16597	19.5%	10677	21.1%	57614	22.3%	46035	22.5%	23228	22.4%	69465	22.5%	84517	22.5%	53855	21.7%	46823	22.2%
***Enterobacter* spp**																				
amikacin	302	1.0%	181	0.6%	320	0.6%	360	1.4%	475	0%	532	0.2%	591	0.2%	733	0.1%	546	0.7%	564	0.4%
ampicillin	1377	91.5%	1350	94.1%	940	91.0%	1740	94.6%	1926	94.8%	2199	90.9%	1976	93.6%	2267	95.3%	1857	96.9%	2103	97.1%
cefazolin	75	78.7%			114	78.9%	153	90.2%	174	89.1%	128	91.4%	118	82.2%						

	1994		1995		1996		1997		1998		1999		2000		2001		2002		2003	
	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** continued																				
cefotaxime/ceftriaxone	686	18.2%	608	16.0%	511	25.0%	805	14.8%	943	20.6%	895	18.4%	818	12.6%	1039	20.9%	843	21.7%	1071	18.8%
cefuroxime/cefamandole	710	41.5%	515	42.1%	488	52.9%	608	49.3%	725	54.3%	664	48.2%	761	35.1%	938	45.1%	762	47.9%	1192	41.3%
cephalothin	617	53.6%	241	90.9%	260	92.7%	307	92.5%	471	93.0%	888	91.6%	688	93.5%	927	95.8%	843	94.4%	912	94.1%
chloramphenicol	30	13.3%	28	3.6%	2	50.0%	27	7.4%	16	12.5%	172	7.0%	13	7.7%						
co-amoxiclav	1204	79.4%	964	83.9%	688	84.7%	1793	81.7%	1691	88.1%	2242	76.8%	1804	82.4%	2196	84.5%	1948	84.9%	2089	84.7%
cotrimoxazole	693	2.9%	801	49.6%	683	4.2%	933	3.5%	1252	6.8%	1320	5.7%	1144	6.4%	1540	7.1%	1428	8.5%	1588	9.1%
fluoroquinolone	717	1.0%	498	5.8%	631	2.4%	917	2.6%	1310	2.5%	1311	3.2%	1274	3.4%	1641	4.6%	1461	4.5%	1818	4.7%
gentamicin	1141	1.1%	1002	2.1%	868	2.2%	1279	2.5%	1503	3.5%	1854	3.3%	1293	3.9%	1535	4.3%	1337	6.4%	1518	4.9%
imipenem/meropenem											815	0.6%	547	0.4%	1027	0.5%	565	0.5%	831	0%
netilmicin	94	0%			115	1.7%	153	0%	174	1.7%	366	0.8%	449	2.0%	448	1.3%				
tetracycline	195	6.7%	47	6.4%	176	12.5%	405	19.5%	317	6.9%	436	10.1%	230	7.8%	349	9.7%	208	7.7%	104	3.8%
tobramycin	247	0.8%	30	6.7%	161	1.9%	173	1.2%	193	2.6%	243	2.9%	271	3.7%	337	4.7%	412	6.1%	359	5.3%
trimethoprim											120	28.3%								
									%											
Enterococcus **spp**																				
ampicillin	2803	1.4%	3046	1.5%	1713	1.5%	6716	1.1%	6147	1.4%	5848	4.3%	6487	2.1%	8418	2.8%	7661	4.0%	8391	3.2%
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%	634	21.9%	1000	29.2%
nitrofurantoin	2143	1.4%	2144	1.3%	758	0.8%	4186	1.2%	2778	2.4%	4391	5.3%	5298	1.2%	7028	1.1%	6236	0.5%	6887	0.5%
tetracycline	499	60.7%	452	43.4%	210	50.0%	505	58.4%	1023	48.6%	816	55.3%	864	59.3%	1478	62.6%	1342	65.0%	1333	67.5%
vancomycin	305	0.3%	578	0%	298	0.3%	1213	0.3%	2116	0.4%	1423	0.7%	1807	0.3%	2718	0.7%	2980	0.3%	3671	0.03%
Haemophilus influenzae **non-invasive**																				
ampicillin	4867	10.1%	5007	12.6%	2821	14.5%	6859	15.8%	5433	16.1%	7798	23.3%	10016	23.3%	11624	21.0%	6836	21.4%	6407	23.4%
B-lactamase positive	2294	10.8%	4543	12.2%	2366	14.2%	2973	13.4%	3099	15.5%	2108	21.7%	3111	17.7%	4422	18.6%	3665	22.3%	7802	26.8%
chloramphenicol	1934	0.9%	1947	0.8%	570	0.2%	2821	1.1%	1841	0.5%	3626	0.7%	5127	0.5%	5276	0.4%	2295	0.3%	1947	0.2%
co-amoxiclav	4343	1.1%	4044	0.6%	1460	2.3%	5060	0.4%	4278	0.5%	6644	0.5%	4518	0.4%	6179	0.6%	5483	0.9%	5760	0.8%
cotrimoxazole	2764	10.2%	2889	14.2%	955	9.6%	4613	13.3%	3877	10.7%	6608	17.1%	8463	17.4%	9098	17.0%	4882	17.9%	7868	19.2%
tetracycline	3300	0.8%	3258	1.2%	1252	0.6%	4958	1.7%	2303	1.9%	6381	1.0%	4721	0.9%	6196	1.5%	4716	1.1%	4876	0.7%

	1994		1995		1996		1997		1998		1999		2000		2001		2002		2003	
	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
***Klebsiella* spp**																				
amikacin	406	0.5%	225	0.4%	530	0.4%	622	0%	787	1.0%	738	0.3%	861	0.1%	895	0.2%	656	0.5%	917	0.2%
ampicillin	2559	97.2%	1881	97.8%	1328	88.0%	3511	93.3%	4619	89.4%	4461	93.5%	4971	89.4%	5316	96.8%	4656	98.3%	6275	97.6%
cefazolin	107	3.7%			289	28.7%	356	17.1%	243	15.6%	179	20.7%	170	24.1%						
cefotaxime/ceftriaxone	995	1.7%	743	1.9%	852	3.8%	1358	2.5%	1602	2.7%	1428	1.9%	1257	1.8%	1598	1.4%	1130	3.1%	1653	2.9%
cefuroxime/cefamandole	1073	6.1%	721	7.4%	940	8.7%	1108	11.0%	1298	14.2%	1147	6.5%	1168	6.3%	1530	8.3%	1114	9.2%	1738	5.8%
cephalothin	1012	8.5%	365	16.2%	615	19.7%	698	17.3%	838	30.5%	1506	17.7%	1196	16.1%	1565	11.4%	1352	13.7%	1170	13.8%
chloramphenicol	35	45.7%	16	6.3%	4	0%	43	2.3%	193	0.5%	108	9.3%	51	0%						
co-amoxiclav	2136	8.6%	1289	8.5%	1148	10.5%	3346	12.9%	3781	14.5%	4267	9.9%	4449	7.8%	4650	9.8%	4839	8.8%	4095	6.4%
cotrimoxazole	1332	7.3%	837	6.2%	944	12.0%	1438	6.7%	1818	6.3%	2170	6.6%	1668	5.0%	2821	7.5%	2721	7.8%	2069	7.3%
fluoroquinolone	1043	2.1%	619	2.1%	962	1.8%	1753	2.7%	3547	2.2%	2135	3.1%	3852	1.9%	4460	2.8%	4455	6.4%	3859	2.2%
gentamicin	1971	1.4%	1360	0.7%	1213	1.9%	2167	0.8%	2776	1.5%	2816	0.9%	2141	1.1%	2866	0.6%	2130	2.3%	2675	1.7%
imipenem/meropenem											1339	0.4%	953	0.1%	1607	0.2%	688	0.4%	1326	0.2%
netilmicin	126	0%	21	0%	301	0%	356	0.6%	385	5.5%	524	0.6%	637	0.9%	443	0.2%	9	0%	213	0%
tetracycline	311	10.3%	69	0%	363	9.1%	633	10.9%	624	9.9%	430	10.5%	254	9.8%	468	6.2%	202	5.0%	330	9.7%
tobramycin	254	3.5%	18	0%	354	3.1%	405	0.5%	429	1.4%	356	0.6%	199	1.0%	551	1.1%	599	1.3%	804	1.9%
Moraxella (Branhamella) catarrhalis																				
ampicillin	1099	90.6%	1239	89.9%	605	91.6%	1391	89.6%	1080	86.6%	1205	92.2%	1203	90.5%	1415	93.6%	1458	91.3%	1209	91.6
B-lactamase positive	450	80.4%	937	89.2%	301	88.4%	705	91.2%	773	86.2%	667	78.4%	1130	77.3%	1331	94.9%	995	91.0%	1346	90.0
erythromycin	831	1.1%	972	1.0%	413	0.7%	1382	1.9%	608	1.3%	1479	2.6%	1058	1.7%	1011	2.4%	966	1.2%	439	3.2
tetracycline	1070	1.1%	1145	1.2%	442	0.5%	1336	1.3%	646	1.5%	1413	0.6%	1141	1.7%	1217	2.4%	1490	0.9%	1106	0.7
Morganella morganii																				
amikacin	46	0%			88	4.5%	109	0%	152	0%	123	0.8%	145	2.1%	152	1.3%	132	0.8%	153	0%
ampicillin	447	94.2%	312	97.1%	284	95.4%	443	94.6%	609	95.4%	558	93.9%	607	96.5%	712	97.1%	552	96.6%	572	97.6%
cefazolin	14	92.9%			40	100.0%	54	96.3%	61	62.3%	29	100.0%	27	100.0%						
cefotaxime/ceftriaxone	170	1.8%	122	2.5%	158	8.2%	209	4.3%	306	7.2%	222	7.2%	197	1.0%	260	5.0%	192	2.6%	297	2.7%
cefuroxime/cefamandole	167	79.6%	112	80.4%	178	84.8%	198	81.8%	210	91.0%	195	87.2%	278	76.3%	256	85.2%	185	91.9%	324	81.8%
cephalothin	197	94.4%	74	97.3%	100	98.0%	114	96.5%	114	93.0%	228	93.0%	201	97.5%	274	99.3%	184	99.5%	225	98.2%

	1994		1995		1996		1997		1998		1999		2000		2001		2002		2003	
	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
Morganella morganii continued																				
chloramphenicol	7	14.3%	2	0%	6	33.3%	12	16.7%	46	4.3%	23	17.4%	2	0%						
co-amoxiclav	380	92.1%	282	95.4%	243	91.4%	403	83.4%	532	93.0%	539	92.4%	563	94.0%	681	95.3%	551	93.3%	577	95.3%
cotrimoxazole	238	5.0%	96	3.1%	190	8.4%	190	7.9%	411	11.4%	367	9.0%	369	12.2%	403	12.9%	396	15.2%	366	15.3%
fluoroquinolone	228	0.4%	141	0%	187	0%	244	0.8%	445	4.7%	330	3.9%	376	6.4%	539	9.1%	439	8.7%	539	6.1%
gentamicin	363	0.8%	260	0.4%	262	1.5%	344	3.8%	487	8.8%	386	7.8%	354	11.0%	449	11.8%	394	13.5%	514	9.5%
imipenem/meropenem											213	4.2%	159	1.9%	242	3.3%	243	0%	220	0%
netilmicin	14	0%			40	5.0%	54	0%	67	3.0%	91	1.1%	110	1.8%	110	1.8%				
tetracycline	66	31.8%	20	10.0%	72	22.2%	70	32.9%	127	27.6%	80	27.5%	49	32.7%	58	25.9%	42	40.5%	30	30.0%
tobramycin	52	0%	1	0%	53	9.4%	59	0%	68	2.9%	55	0%	78	3.8%	96	0%	81	44.4%	93	2.2%
Neisseria gonorrhoeae																				
B-lactamase positive													830	3.0%	328	4.0%	694	3.7%	984	3.2%
fluoroquinolone													851	2.0%	906	9.7%	749	6.0%	994	8.1%
penicillin													935	7.0%	990	6.4%	1098	7.3%	1426	5.1%
tetracycline													900	4.7%	509	19.4%	680	17.1%	658	16.6%
Proteus mirabilis **(indole negative)**																				
amikacin	338	1.2%	913	12.7%	493	3.0%	477	0%	535	1.5%	626	0.8%	697	1.0%	565	0.2%	547	0.2%	570	0%
ampicillin	2798	13.5%	1451	15.1%	1524	11.2%	4364	14.9%	4715	16.8%	4240	13.6%	5180	13.7%	5815	13.6%	4640	11.2%	3969	12.4%
cefazolin	135	7.4%			290	5.2%	236	5.9%	204	6.4%	224	10.3%	278	11.9%						
cefotaxime/ceftriaxone	792	0%	605	0.5%	695	0.7%	1069	0.4%	1100	1.0%	1024	0.6%	1018	0.7%	1147	0.3%	973	0.1%	1042	0.3%
cefuroxime/cefamandole	636	5.3%	532	2.6%	799	2.1%	832	4.0%	844	3.4%	903	3.1%	902	3.7%	827	1.9%	684	1.9%	1118	2.5%
cephalothin	1159	4.8%	313	8.9%	599	6.8%	526	5.7%	490	9.0%	1077	7.8%	1171	6.0%	1387	5.1%	1125	4.8%	1126	6.4%
chloramphenicol	98	12.2%	27	11.1%	7	14.3%	90	26.7%	107	21.5%	83	12.0%	42	33.3%						
co-amoxiclav	2188	5.3%	1672	4.4%	1221	3.0%	4199	3.0%	4273	3.6%	4005	2.9%	4920	2.7%	5578	2.8%	4615	2.2%	4060	2.6%
cotrimoxazole	1439	5.6%	508	9.6%	816	9.3%	1045	6.2%	2550	5.1%	1623	5.4%	1711	12.6%	2379	9.8%	2501	8.7%	1543	8.4%
fluoroquinolone	923	0.9%	805	0.4%	1080	1.1%	1552	0.5%	3026	1.0%	3397	1.4%	4578	1.0%	4822	0.9%	4232	1.2%	4239	1.1%
gentamicin	1209	2.1%	1257	0.6%	1244	2.9%	1903	0.8%	2078	1.2%	1973	0.8%	2072	0.9%	2100	1.3%	1661	1.1%	1968	1.4%
imipenem/meropenem											943	1.7%	785	3.2%	869	0.2%	798	0%	803	0%

	1994		1995		1996		1997		1998		1999		2000		2001		2002		2003	
	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 mirabilis* (indole negative)** continued																				
netilmicin	135	0%			290	0.3%	236	0.8%	296	2.4%	506	0.4%	503	0.6%	477	0.2%				
tetracycline	406	99.0%	56	98.2%	359	99.2%	343	97.1%	406	71.7%	503	90.5%	418	92.6%	272	98.5%	164	96.3%	100	97.0%
tobramycin	245	5.7%	15	6.7%	332	7.2%	300	1.0%	310	4.2%	361	1.9%	456	2.9%	336	1.5%	417	1.2%	292	0%
***Proteus vulgaris* (indole positive)**																				
amikacin	16	0%	15	0%	30	0%	34	0%	39	0%	40	0%	25	0%	32	0%	40	32.5%	39	0%
ampicillin	108	58.3%	99	84.8%	82	91.5%	149	87.9%	126	86.5%	143	83.2%	118	83.1%	159	87.4%	124	75.8%	140	81.4%
cefazolin	5	100.0%			15	86.7%	13	100.0%	29	82.8%	12	91.7%	5	100.0%						
cefotaxime/ceftriaxone	35	2.9%	44	11.4%	44	31.8%	89	12.4%	69	24.6%	68	19.1%	50	8.0%	55	1.8%	70	0%	74	8.1%
cefuroxime/cefamandole	38	65.8%	37	81.1%	44	93.2%	57	91.2%	61	90.2%	51	92.2%	48	60.4%	39	87.2%	42	81.0%	75	88.0%
cephalothin	47	74.5%	15	80.0%	29	93.1%	46	84.8%	40	97.5%	69	87.0%	54	85.2%	74	93.2%	52	76.9%	56	94.6%
chloramphenicol	3	66.7%			1	0%	1	100.0%	1	100.0%	4	0%								
co-amoxiclav	86	25.6%	88	42.0%	57	15.8%	146	28.1%	106	17.0%	137	11.7%	113	27.4%	162	26.5%	169	18.3%	142	38.7%
cotrimoxazole	56	5.4%	35	2.9%	56	7.1%	79	6.3%	86	5.8%	95	4.2%	39	10.3%	106	2.8%	92	9.8%	81	6.2%
fluoroquinolone	49	2.0%	37	5.4%	65	1.5%	108	0%	93	16.1%	103	1.0%	73	2.7%	126	3.2%	151	2.6%	136	4.4%
gentamicin	79	0%	67	0%	80	0%	124	0.8%	110	0.9%	128	1.6%	76	1.3%	94	2.1%	129	1.6%	128	2.3%
imipenem/meropenem											52	3.8%	46	0%	51	0%	59	0%	55	0%
netilmicin	5	0%			15	0%	13	0%	21	0%	28	0%	16	0%	21	0%				
tetracycline	8	75.0%			18	44.4%	20	45.0%	21	90.5%	33	60.6%	7	42.9%	20	60.0%	5	80.0%	3	66.7%
tobramycin	5	0%			21	19.0%	13	0%	21	9.5%	25	4.0%	19	0%	20	5.0%	22	0%	20	0%
***Providencia* spp**																				
amikacin	17	0%	5	20.0%	25	0%	14	0%	23	0%	25	0%	53	3.8%	31	3.2%	6	16.7%	26	0%
ampicillin	98	79.6%	73	74.0%	59	84.7%	84	76.2%	108	81.5%	82	81.7%	176	78.4%	177	83.6%	82	76.8%	116	73.3%
cefazolin	10	100.0%			16	50.0%	4	100.0%	2	100.0%	5	100.0%	17	23.5%						
cefotaxime/ceftriaxone	20	10.0%	10	0%	28	7.1%	37	2.7%	40	0%	34	2.9%	61	0%	60	0%	30	0%	57	8.8%
cefuroxime/cefamandole	50	20.0%	25	0%	45	20.0%	23	0%	46	17.4%	33	21.2%	54	11.1%	71	36.6%	41	12.2%	77	15.6%
cephalothin	30	63.3%	3	33.3%	19	78.9%	23	73.9%	8	87.5%	33	81.8%	73	75.3%	55	80.0%	24	87.5%	32	62.5%
chloramphenicol							1	0%	1	0%	2	100.0%								

	1994		1995		1996		1997		1998		1999		2000		2001		2002		2003	
	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** continued																				
co-amoxiclav	65	78.5%	50	58.0%	55	67.3%	74	68.9%	99	63.6%	81	69.1%	165	65.5%	167	77.2%	95	66.3%	125	77.6%
cotrimoxazole	35	28.6%	18	16.7%	37	45.9%	47	19.1%	60	1.7%	48	14.6%	77	28.6%	88	12.5%	38	13.2%	77	9.1%
fluoroquinolone	56	12.5%	34	8.8%	59	6.8%	63	7.9%	76	7.9%	77	13.0%	109	6.4%	134	6.7%	105	0%	124	6.5%
gentamicin	67	14.9%	47	34.0%	59	10.2%	55	20.0%	85	5.9%	47	2.1%	105	10.5%	117	12.0%	64	7.8%	97	13.4%
imipenem/meropenem											30	0%	45	4.4%	45	2.2%	12	0%	38	0%
netilmicin	10	0%			16	12.5%	4	50.0%	2	0%	11	0%	36	11.1%	19	10.5%				
tetracycline	13	100.0%	2	0%	19	89.5%	13	76.9%	2	50.0%	5	80.0%	29	79.3%	25	52.0%	5	100%		
tobramycin	14	14.3%	1	100.0%	17	17.6%	5	40.0%	5	0%	5	0%	32	6.3%	19	15.8%	6	16.7%	11	0%
Pseudomonas aeruginosa																				
amikacin	1048	13.2%	793	14.9%	1016	8.3%	622	14.3%	1623	7.3%	2563	6.9%	1678	6.4%	953	6.5%	1943	6.0%	2156	5.4%
ceftazidime	2945	4.7%	1044	5.8%	1409	7.2%	3406	5.3%	3671	4.2%	4054	5.9%	4384	3.8%	5506	3.4%	3358	5.0%	6260	3.6%
fluoroquinolone	3726	9.0%	2777	6.7%	2205	13.0%	4429	10.3%	5647	11.3%	6566	8.3%	6718	10.9%	8717	8.9%	7434	8.2%	8902	7.5%
gentamicin	4112	12.7%	3510	12.6%	2561	14.3%	5825	7.6%	7499	9.4%	7309	11.0%	8280	11.6%	9337	11.9%	7944	7.7%	8881	6.4%
imipenem/meropenem											3456	8.4%	1737	5.2%	2519	7.3%	2046	6.2%	3975	4.9%
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%	8	0%	230	29.1%
piperacillin	2350	8.1%	2304	10.1%	2098	8.3%	3455	6.6%	3992	5.1%	4232	4.7%	4279	5.0%	5095	3.5%	3129	4.8%	4205	3.2%
ticarcillin	1916	24.5%	908	16.0%	429	7.9%	533	13.5%	409	9.0%	1809	10.2%	222	13.5%	605	16.0%	248	12.1%	530	10.8%
tobramycin	2859	2.9%	2340	4.2%	1553	5.1%	3375	2.5%	3613	3.2%	4127	2.8%	3290	3.6%	4063	3.3%	2928	3.3%	3100	3.7%
Serratia spp																				
amikacin	79	2.5%	57	0%	89	1.1%	95	0%	152	0.7%	162	0%	303	4.3%	367	0.8%	156	0%	282	0.4%
ampicillin	374	84.5%	432	93.8%	340	79.7%	666	90.8%	679	94.6%	733	94.3%	1228	94.2%	1837	94.4%	1058	93.5%	1099	95.2%
cefazolin	12	75.0%			21	100.0%	24	100.0%	37	94.6%	34	100.0%	115	98.3%						
cefotaxime/ceftriaxone	160	7.5%	202	2.0%	161	9.3%	243	8.2%	342	4.7%	380	15.8%	574	37.1%	723	14.8%	307	12.1%	525	10.9%
cefuroxime/cefamandole	179	82.1%	173	82.7%	202	98.0%	218	93.1%	246	90.7%	282	80.1%	581	88.6%	697	89.8%	316	89.6%	594	93.1%
cephalothin	158	96.2%	72	97.2%	98	100.0%	99	94.9%	159	64.8%	376	97.9%	410	98.3%	579	97.9%	270	96.7%	460	97.8%
chloramphenicol	8	62.5%	14	14.3%	6	33.3%	9	11.1%	15	13.3%	33	45.5%	6	33.3%						
co-amoxiclav	325	87.7%	415	88.4%	276	78.6%	654	86.5%	644	85.4%	717	85.4%	1088	90.7%	1745	87.6%	1070	83.7%	1120	86.6%

	1994		1995		1996		1997		1998		1999		2000		2001		2002		2003	
	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 continued																				
cotrimoxazole	255	11.8%	210	6.7%	259	9.3%	317	13.2%	425	10.8%	564	8.7%	796	21.1%	1230	10.2%	795	9.8%	833	8.2%
fluoroquinolone	221	14.5%	199	17.1%	229	5.2%	453	25.8%	503	12.5%	540	22.0%	789	23.2%	1298	14.9%	855	17.0%	968	13.4%
gentamicin	316	2.8%	331	2.4%	312	5.4%	516	2.7%	572	2.3%	626	1.0%	915	2.7%	1205	3.2%	760	1.4%	1115	0.4%
imipenem/meropenem											351	2.0%	388	0.3%	625	0.2%	302	0%	390	0.3%
netilmicin	17	0%	6	0%	22	0%	24	0%	29	0%	91	0%	221	7.7%	185	3.8%	1	0%		
tetracycline	56	58.9%	34	44.1%	63	39.7%	79	53.2%	67	67.2%	100	75.0%	194	85.1%	167	64.1%	129	52.7%	68	50.0%
tobramycin	68	1.5%	22	4.5%	70	8.6%	48	0%	42	2.4%	57	10.5%	255	9.8%	248	2.4%	227	1.3%	138	1.4%
Shigella boydii																				
ampicillin	7	14.3%	8	62.5%	1	0%	2	0%	2	0%	3	0%	2	0%	3	0%	4	50.0%	2	0%
cotrimoxazole	6	0%	7	71.4%	1	0%	2	100.0%	2	0%	3	0%	2	50.0%	3	0%	4	75.0%	2	0%
fluoroquinolone	5	0%	11	0%	1	0%	1	0%	2	0%	3	0%	2	0%	2	0%	4	0%	5	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%			1	0%		
cotrimoxazole			4	75.0%					2	100.0%	1	100.0%	3	100.0%			1	0%		
fluoroquinolone			4	0%					2	0%	1	0%	3	0%			1	0%		
trimethoprim			3	66.7%																
Shigella flexneri																				
ampicillin	13	53.8%	13	76.9%	8	75.0%	19	42.1%	41	65.9%	24	87.5%	20	75.0%	63	65.1%	32	78.1%	26	80.8%
chloramphenicol	1	100.0%			1	0%	2	0%							3	0%	3	33.3%	1	0%
cotrimoxazole	12	66.7%	15	66.7%	6	66.7%	14	64.3%	41	61.0%	23	87.0%	20	85.0%	61	80.3%	38	71.1%	28	71.4%
fluoroquinolone	6	0%	21	0%	8	0%	19	5.3%	41	0%	22	0%	17	0%	62	1.6%	38	0%	41	0%
nalidixic acid			1	0%													6	0%	12	0%
tetracycline	6	66.7%	13	76.9%	1	0%	6	83.3%			5	20.0%	5	40.0%	17	41.2%	3	33.3%	1	0%
trimethoprim	1	100.0%	9	66.7%	7	28.6%	8	87.5%			1	100.0%	1	100.0%	1	100.0%	1	100%		

	1994		1995		1996		1997		1998		1999		2000		2001		2002		2003	
	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 sonnei																				
ampicillin	31	25.8%	15	26.7%	14	21.4%	14	35.7%	41	14.6%	30	36.7%	77	37.7%	57	21.1%	5	0%	6	33.3%
chloramphenicol					11	0%	2	0%	1	0%										
cotrimoxazole	30	40.0%	16	12.5%	17	70.6%	13	46.2%	39	59.0%	33	72.7%	74	55.4%	57	57.9%	33	48.5%	6	33.3%
fluoroquinolone	19	0%	28	0%	17	0%	12	41.7%	41	2.4%	34	0%	72	0%	51	0%	35	0%	27	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%	1	0%		
trimethoprim	2	0%	5	20.0%	1	0%	3	33.3%	2	0%			1	0%			1	0%		
Staphylococci (coagulase negative) from blood																				
amikacin	76	10.5%	87	4.6%	82	37.8%	16	0%	91	0%	24	0%								
chloramphenicol	35	14.3%	18	0%	10	0%	17	11.8%	78	1.3%	37	5.4%								
clindamycin	203	17.2%	120	10.0%	64	28.1%	17	5.9%	221	15.4%	302	15.6%	302	24.8%	905	22.5%	628	15.4%	488	22.7%
cotrimoxazole	664	26.4%	1179	22.0%	689	12.5%	505	22.2%	735	21.8%	505	24.2%	850	22.7%	1159	33.1%	990	26.3%	1213	26.0%
erythromycin	1404	40.5%	1980	41.0%	1139	36.2%	918	39.3%	1555	39.4%	1356	41.0%	1718	41.2%	2056	42.1%	1446	36.8%	1650	40.9%
fluoroquinolone	593	17.5%	268	17.9%	192	8.9%	282	8.2%	873	15.0%	650	10.8%	631	17.7%	1172	22.9%	763	18.5%	621	18.8%
gentamicin	1453	26.6%	2166	31.7%	953	23.3%	691	20.7%	1180	28.3%	1166	30.3%	1212	28.5%	1588	38.0%	1129	31.2%	1391	29.8%
methicillin/oxacillin	1826	43.1%	2391	46.1%	1191	44.7%	784	36.4%	1663	43.1%	1436	47.2%	1720	49.0%	2067	54.5%	1710	51.0%	1668	54.0%
netilmicin	64	0%	87	4.6%	94	5.3%	11	0%	3	0%	68	8.8%	128	4.7%	233	4.3%	92	0%	266	0.4%
penicillin	1666	82.0%	2410	84.0%	1223	79.2%	774	78.3%	1732	82.4%	1555	81.4%	1362	83.5%	2019	84.7%	1676	82.2%	1630	85.7%
tetracycline	292	17.8%	144	19.4%	56	14.3%	126	11.9%	708	5.5%	384	19.0%	399	14.0%	1159	9.6%	847	15.5%	527	12.1%
vancomycin	1158	0%	1770	0%	977	0%	545	0.4%	589	0.2%	458	0%	1232	0%	1378	0%	1339	0.1%	1389	0.1%
Staphylococcus aureus																				
amikacin	583	0.2%	40	0%	800	2.1%	723	1.1%	1340	1.4%	1686	0.9%	678	1.0%	164	0.6%	4	100%	1645	1.0%
chloramphenicol	3574	1.1%	1499	0.5%	2246	0.6%	6408	0.9%	4546	0.7%	6612	1.0%	9805	1.8%	11686	0.8%	13767	0.9%	9172	0.7%
clindamycin	894	3.5%	110	5.5%	1103	6.9%	813	1.2%	3429	2.6%	4066	3.0%	2843	4.1%	6006	2.4%	5770	3.0%	12883	2.2%
cotrimoxazole	13132	0.6%	11245	0.8%	8973	1.0%	36126	0.5%	29404	0.4%	38229	0.8%	29944	1.5%	55969	0.8%	63253	1.3%	42028	2.2%
erythromycin	23102	8.0%	20153	8.2%	13100	8.2%	48035	9.9%	46179	10.3%	52424	11.9%	67962	11.8%	75491	12.2%	77941	11.9%	60633	12.2%
fluoroquinolone	9992	1.3%	11892	1.5%	4684	2.1%	19392	1.6%	6805	4.6%	16254	4.3%	10362	5.2%	13625	9.7%	11189	14.7%	14771	9.3%
gentamicin	9906	1.1%	10427	1.4%	8174	2.0%	7653	1.1%	14210	1.6%	19796	2.5%	16294	2.6%	22178	1.7%	19031	1.6%	16828	2.3%

	1994		1995		1996		1997		1998		1999		2000		2001		2002		2003	
	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 continued																				
methicillin/oxacillin	24211	1.1%	21702	4.1%	14436	3.8%	50395	4.3%	47833	4.7%	51470	5.8%	74415	6.9%	82600	6.8%	94433	7.7%	62782	7.5%
mupirocin	3952	10.7%	4554	11.0%	785	2.5%	19631	17.1%	11645	18.5%	14906	19.3%	32183	21.5%	28033	19.7%	31339	18.8%	14032	17.5%
netilmicin	230	0%	41	0%	4	0%	1	0%			1974	0.2%	4123	0.2%	4246	0.1%	4299	0.2%	3117	0.3%
penicillin	22771	87.9%	21973	85.5%	14328	87.4%	49144	90.5%	41939	90.7%	53223	86.0%	66818	89.4%	75771	88.1%	77291	87.3%	61221	87.2%
tetracycline	15836	3.7%	10491	3.0%	5080	3.2%	34757	3.0%	26498	2.7%	42677	2.9%	22555	2.5%	56548	2.8%	54271	2.9%	32313	2.6%
***Staphylococcus saprophyticus* from urine**																				
cotrimoxazole	292	6.8%	123	8.1%	96	7.3%	1199	0.3%	548	2.9%	550	2.2%	216	6.9%	675	7.3%	909	1.4%	134	1.5%
fluoroquinolone	834	2.2%	695	0.3%	180	1.7%	2184	1.4%	2227	0.8%	1907	1.0%	3344	1.2%	2219	3.6%	1614	0.7%	2112	0.1%
methicillin/oxacillin	359	29.2%	137	29.9%	226	54.4%	606	30.2%	1654	20.4%	848	74.3%	992	45.3%	1665	29.6%	1191	29.7%	389	72.0%
nitrofurantoin	1003	0.3%	814	0.5%	282	0%	3513	0.1%	2942	0.3%	2322	18.8%	3799	0.2%	4772	0.3%	3429	0.1%	2982	0.3%
penicillin	147	76.9%	188	52.1%	222	60.8%	208	64.9%	285	79.6%	1437	14.1%	535	69.9%	2949	13.3%	950	5.9%	35	68.6%
tetracycline	37	10.8%	61	50.8%	1	0%	5	0%	174	8.6%	25	8.0%	170	1.2%	253	6.7%	90	2.2%	17	0%
trimethoprim	833	3.0%	826	11.1%	335	12.5%	3582	9.2%	3337	8.4%	2314	7.9%	3785	6.7%	4701	5.6%	4968	6.2%	2711	5.3%
***Streptococcus pneumoniae* non-invasive**																				
cefotaxime/ceftriaxone									331	6.3%	194	6.7%	82	2.4%	1074	10.8%	771	10.9%	736	6.1%
chloramphenicol	1376	1.9%	1025	1.8%	298	10.1%	1618	3.6%	857	2.2%	1762	4.5%	2922	5.2%	3398	4.1%	2007	2.1%	1239	1.9%
cotrimoxazole	1691	17.0%	1589	25.9%	503	23.5%	2969	38.7%	1041	26.6%	1265	42.8%	4273	46.5%	3765	40.2%	2652	40.8%	4361	43.7
erythromycin	3014	7.4%	2635	10.2%	1345	7.0%	4353	12.6%	2826	10.0%	4632	18.2%	5780	18.4%	4875	18.2%	3749	19.3%	5118	20.6%
imipenem/meropenem													55	1.8%	4	25.0%	8	37.5%	45	0%
penicillin non-susceptibility	3184	8.6%	2696	11.4%	1359	7.9%	4381	17.6%	2350	11.7%	4844	22.6%	5830	25.7%	3354	28.3%	3675	26.2%	5792	26.9%
penicillin resistance															2542	11.2%	2717	10.0%	2880	15.7%
tetracycline	2303	9.5%	1926	13.6%	814	6.3%	3458	11.6%	1046	7.6%	1643	12.2%	2446	15.5%	2535	13.6%	4495	16.4%	2761	18.9%
Streptococcus pyogenes																				
erythromycin									7898	0.9%	11418	1.3%	10710	1.5%	15433	1.3%	17301	1.4%	11807	1.1%
penicillin									8442	0.1%	11434	0.02%	10754	0%	15504	0%	19829	0%	10029	0%