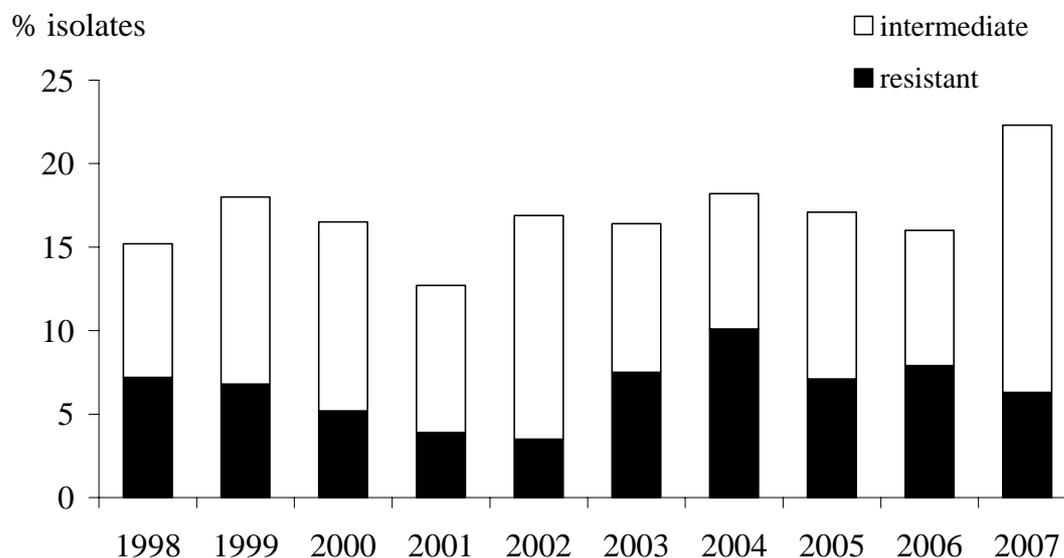


## Antimicrobial susceptibility of invasive *Streptococcus pneumoniae*, 2007

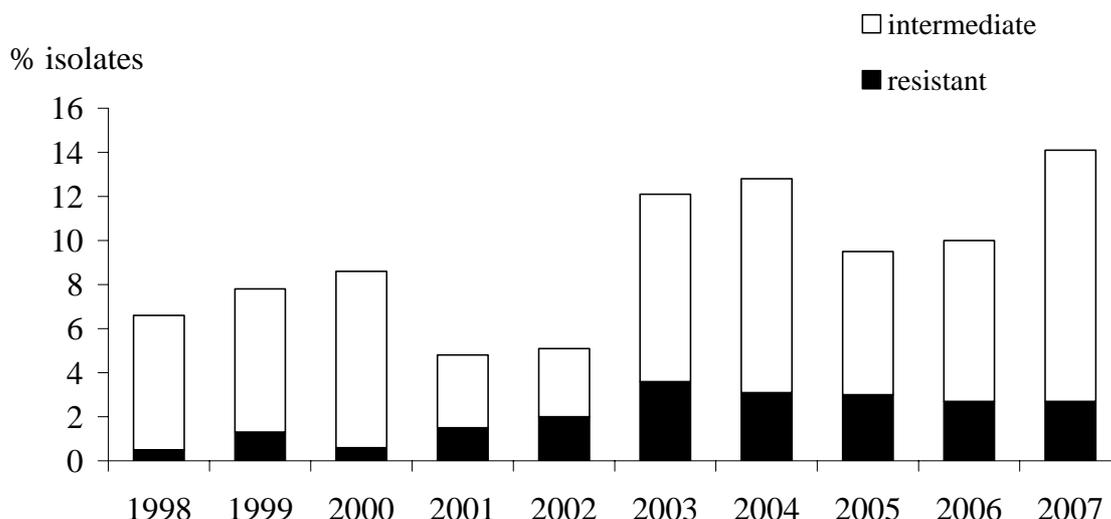
The antimicrobial susceptibility of all 555 viable invasive isolates of *S. pneumoniae* referred to ESR in 2007 was tested. 22.3% (124) were penicillin nonsusceptible (MIC  $\geq$ 0.12 mg/L): 6.3% (35) resistant (MIC  $\geq$ 2 mg/L) and 16.0% (89) intermediate (MIC 0.12-1 mg/L). These interpretations are based on the CLSI standards current in 2007. The CLSI penicillin interpretive standards for *S. pneumoniae* were amended in January 2008. While there has been considerable variation in the prevalence of penicillin resistance during the last 10 years, there was no significant difference ( $P \leq 0.05$ ) in the rate of resistance in 1998 (7.2%) and that in 2007 (6.3%) (Figure 1). Penicillin nonsusceptibility was constant over most of the last 10 years, but there was a significant increase between 2006 and 2007.

Figure 1. Penicillin resistance and nonsusceptibility among pneumococci from invasive disease, 1998-2007



Applying the CLSI meningitis interpretive standards, 14.1% (78) of the 555 invasive isolates were cefotaxime nonsusceptible (MIC  $\geq$ 1 mg/L): 2.7% (15) resistant (MIC  $\geq$ 2 mg/L) and 11.4% (63) intermediate (MIC 1 mg/L). Applying the non-meningitis interpretive standards, 2.7% (15) were cefotaxime nonsusceptible (MIC  $\geq$ 2 mg/L): 1.6% (9) resistant (MIC  $\geq$ 4 mg/L) and 1.1% (6) intermediate (MIC 2 mg/L). Trends in cefotaxime resistance and nonsusceptibility over the last 10 years are shown in Figure 2, and indicate a trend of increasing resistance to 3rd-generation cephalosporins, although there has been no increase in resistance over the last four years.

Figure 2. Cefotaxime resistance and nonsusceptibility (*meningitis interpretations*) among pneumococci from invasive disease, 1998-2007



The rates of resistance to other antibiotics among the 555 invasive isolates tested in 2007 included 35.0% co-trimoxazole resistance, 13.7% erythromycin resistance, 5.8% constitutive clindamycin resistance with another 0.5% inducible clindamycin resistance, and 8.5% tetracycline resistance. 3.6% of isolates had combined penicillin and erythromycin resistance, and 7.0% had combined penicillin-nonsusceptibility and erythromycin resistance. All isolates were susceptible to moxifloxacin and vancomycin.

Among the penicillin-resistant isolates, 51.4% (18/35) were multiresistant to  $\geq 3$  additional antibiotics, commonly co-trimoxazole, erythromycin and tetracycline with or without cefotaxime resistance. Among the penicillin-nonsusceptible isolates, 27.4% (34/124) were multiresistant to  $\geq 3$  additional antibiotics.

Penicillin and cefotaxime resistance and nonsusceptibility in each district health board (DHB) is shown in Figures 3 and 4. For the analyses presented in these two figures, the three DHBs in the greater Auckland area (Waitemata, Auckland and Counties Manukau) were combined, as were the Canterbury and South Canterbury DHBs. This DHB data is influenced to some extent by the small numbers of invasive pneumococci isolated in some DHBs. There were less than 20 isolates from the Lakes (19), Tairāwhiti (5), Taranaki (8), Whanganui (5) and Southland (6) DHBs, and no isolates from the Wairarapa, Nelson-Marlborough and West Coast DHBs.

Figure 3. Penicillin resistance and nonsusceptibility by district health board, 2007

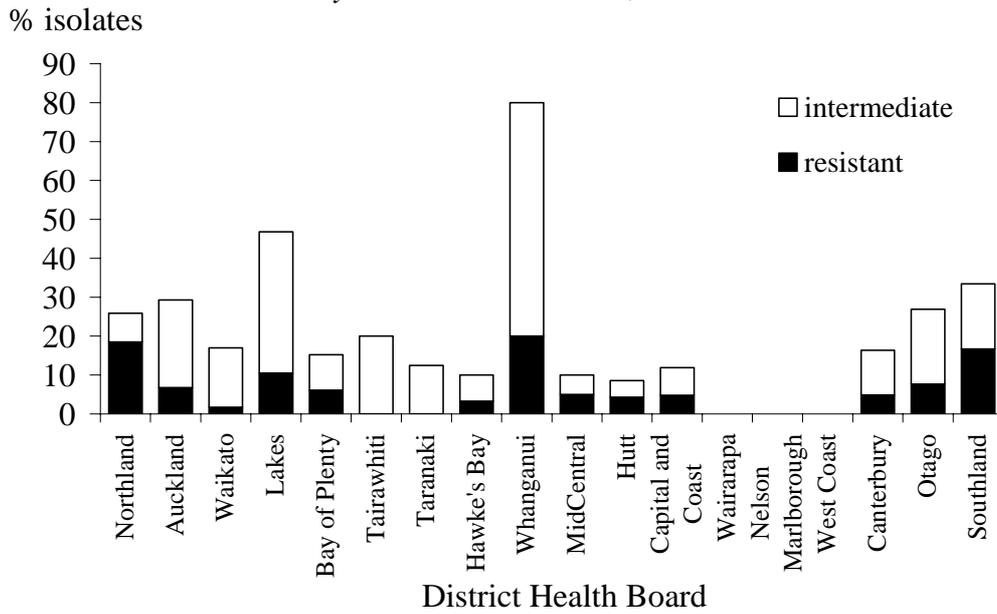
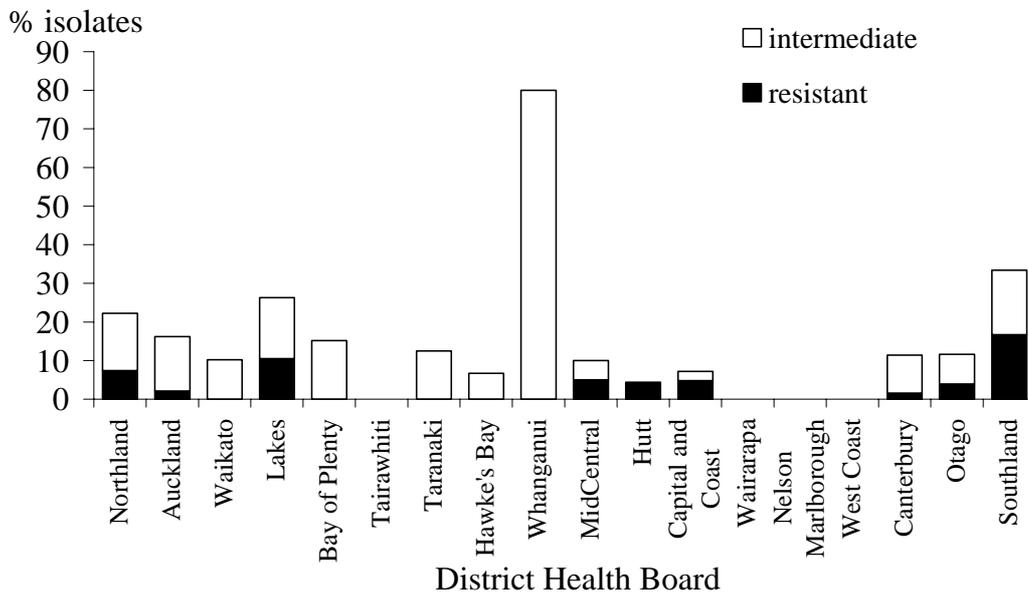


Figure 4. Cefotaxime resistance and nonsusceptibility (meningitis interpretations) by district health board, 2007



Penicillin and cefotaxime resistance and nonsusceptibility in the different age groups is shown in Table 1. Penicillin resistance and nonsusceptibility was highest in pneumococci isolated from patients under 5 years of age, However, cefotaxime resistance was highest among patients 65 years and older.

*Table 1. Penicillin and cefotaxime resistance and nonsusceptibility among invasive pneumococcal isolates by patient age, 2007*

Age (years)	Percent			
	Penicillin		Cefotaxime	
	Nonsusceptible MIC $\geq$ 0.12 mg/L	Resistant MIC $\geq$ 2 mg/L	Nonsusceptible <sup>1</sup> MIC $\geq$ 1 mg/L	Resistant <sup>1</sup> MIC $\geq$ 2 mg/L
<5 (n=156)	27.6	9.0	19.9	3.9
5-14 (n=29)	20.7	0	3.5	0
15-64 (n=184)	17.4	3.3	11.4	0
$\geq$ 65 (n=186)	23.1	8.1	13.4	4.8
All ages (n=555)	22.3	6.3	14.1	2.7

<sup>1</sup> Based on meningitis interpretive standards

The majority of the penicillin-nonsusceptible isolates belonged to the capsular types usually associated with penicillin resistance (Table 2). Until 2000, serotype 9V was the prevalent penicillin-resistant serotype (Figure 5). Then between 2000 and 2003, serotype 19F was prevalent. Since 2003, no one serotype has been clearly predominant. In 2007, there were no cases of invasive disease due to penicillin-resistant serotype 9V. Serotype 19F is the most common type among cefotaxime-resistant isolates. The majority (91.7%, 11/12) of these cefotaxime-resistant serotype 19F isolates belong to a strain that is multiresistant to penicillin, cefotaxime, co-trimoxazole, erythromycin and tetracycline.

In 2007, all penicillin-resistant and cefotaxime-resistant invasive isolates were serotypes included in the 7-valent pneumococcal conjugate vaccine (PCV-7). Similarly, a high proportion of penicillin-nonsusceptible and cefotaxime-nonsusceptible isolates causing invasive pneumococcal disease were serotypes included in PCV-7 (Table 2). Among patients <5 years of age, 93.0% of the penicillin-nonsusceptible and 96.8% of the cefotaxime-nonsusceptible isolates were serotypes included in PCV-7.

Table 2. Distribution of capsular antigen types among penicillin and cefotaxime resistant and nonsusceptible invasive pneumococcal isolates, 2007

Capsular antigen type		Number (% <sup>1</sup> ) isolates			
		Penicillin		Cefotaxime	
		Nonsusceptible MIC ≥0.12 mg/L	Resistant MIC ≥2 mg/L	Nonsusceptible <sup>2</sup> MIC ≥1 mg/L	Resistant <sup>2</sup> MIC ≥2 mg/L
PCV-7 serotypes <sup>3</sup>	6B	15 (12.1)	3 (8.6)	11 (14.1)	0
	9V	32 (25.8)	0	12 (15.4)	0
	14	31 (25.0)	14 (40.0)	27 (34.6)	3 (20.0)
	19F	32 (25.8)	17 (48.6)	24 (30.8)	12 (80.0)
	23F	7 (5.7)	1 (2.9)	3 (3.9)	0
	<b>Total for PCV-7 serotypes</b>	<b>117 (94.4)</b>	<b>35 (100)</b>	<b>77 (98.7)</b>	<b>15 (100)</b>
Non-PCV-7 serotypes	15	1 (0.8)	0	0	0
	19A	3 (2.4)	0	1 (1.3)	0
	23B	2 (1.6)	0	0	0
	Non-typable	1 (0.8)	0	0	0
<b>Total for all serotypes</b>		<b>124 (100)</b>	<b>35 (100)</b>	<b>78 (100)</b>	<b>15 (100)</b>

<sup>1</sup> Percentage of the nonsusceptible or resistant isolates

<sup>2</sup> Based on meningitis interpretive standards

<sup>3</sup> PCV-7, 7-valent pneumococcal conjugate vaccine. There were no penicillin or cefotaxime resistant or nonsusceptible isolates of serotypes 4 or 18C which are also included in PCV-7.

Figure 5. Capsular antigen type distribution among penicillin-resistant pneumococci from invasive disease, 1998-2007

