ESR

SURVEILLANCE REPORT

Invasive pneumococcal disease in New Zealand

2011

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SUMMARY

SUMMARY

Since 17 October 2008, invasive pneumococcal disease (IPD) has been notifiable in New Zealand. On 1 June 2008, pneumococcal conjugate vaccine (PCV) was added to the New Zealand childhood immunisation schedule. The 7-valent conjugate vaccine (PCV7), Prevenar®, was used until late 2011, when it was replaced with the 10-valent conjugate vaccine (PCV10), Synflorix®.

In this report, the data presented for 2009–2011 is based on IPD case notifications supplemented with serotype and antimicrobial susceptibility data from ESR's national laboratory-based surveillance of invasive *Streptococcus pneumoniae* isolates. Data for earlier years is solely from ESR's laboratory-based surveillance. For this laboratory-based surveillance, diagnostic microbiology laboratories are requested to refer all invasive isolates of *S. pneumoniae* to ESR for serotyping and antimicrobial susceptibility testing.

There were 552 cases of IPD notified in 2011, which equates to a rate of 12.5 per 100 000 population. A *S. pneumoniae* isolate from an invasive site was received at ESR for serotyping and antimicrobial susceptibility testing for 533 (96.6%) of the notified cases.

The rate of IPD in infants aged <2 years has decreased by 76% since the introduction of PCV7: from an average annual incidence of 100.3 per 100 000 population in 2006/2007 to 23.8 per 100 000 in 2011. The reduction in IPD caused by PCV7 serotypes in this age group is even more striking than the reduction in all IPD, with a 97% decrease from an average of 83.1 per 100 000 in 2006/2007 to 2.4 per 100 000 in 2011 (note that the 2011 rate was calculated based on 3 cases only). The rate of IPD has now also decreased significantly in the 2-4 years age group, with a 54% reduction from an average of 20.8 per 100 000 population in 2006/2007 to 9.6 per 100 000 in 2011. This is as expected, as some of vaccine-eligible children (ie, those born in 2008 and 2009) were in this age group in 2011.

In 2011 the indirect or herd immunity effects of routine infant PCV immunisation were evident. The rate of IPD due to PCV7 serotypes in the ≥65 year age group has now decreased 41%, from an average of 22.2 per 100 000 population in 2006/2007 to 13.1 per 100 000 in 2011, while in the 5-64 year age group there has been a 28% decrease over the same time period (3.6 to 2.6 per 100 000). These results mean there have now been significant reductions in IPD due to PCV7 types in all age groups.

Rates of IPD in the Pacific Peoples and Māori ethnic groups were approximately 3-times the rate for the European or Other ethnic group. Between 2009 and 2011, among infants <2 years of age, there has been a significant decrease in IPD rates in the Māori and European or Other ethnic groups, but not Pacific Peoples infants.

In 2011 the all-age rate of pneumococcal meningitis was 0.9 per 100 000 population. The highest rate of meningitis occurred among those in the <2 years age group (4.8 per 100 000). The case-fatality rate was 6.3%.

Among the 28 cases who had received ≥1 dose of PCV, and for whom the serotype causing disease was known, 24 (86%) were due to non-PCV7 types. Of the four remaining cases, two had 19F disease, one had 6B disease and one had 18C disease.

Among the cases where risk factor information was reported, more than 50% were recorded as having a chronic illness. Smoking in the household and being born premature were the most common risk factors recorded for the <5 years age group.

In 2011, the highest rate of IPD was in Lakes District Health Board (DHB) (28.2 per 100 000 population), followed by Wairarapa (17.2 per 100 000) and Hawke's Bay (16.7 per 100 000) DHBs. Rates were similar across the four regions (11.1 to 14.3 per 100 000).

In 2011, the non-PCV7 serotype 19A was the most frequent serotype overall. There has been a significant increase in the rate of IPD due to 19A in the ≥65 year age group since the introduction of PCV7, but rates have remained fairly stable in other age groups.

Three other non-PCV7 serotypes were prevalent in 2011: 1, 3 and 22F. It is now clear that New Zealand has experienced a recent 'outbreak' of serotype 1 disease which started in 2006, peaked in 2009 with 153 cases, and then declined to 35 cases in 2011. These serotype 1 cases were strongly associated with IPD in Māori and Pacific school-age children and young adults. Serotypes 3 and 22F are also most commonly isolated from IPD cases ≥5 years of age, and there were no cases of either of these serotypes in cases <5 years in 2011.

As yet there is little change in the prevalence of antimicrobial resistance among isolates from IPD cases in New Zealand, although the rate of penicillin resistance in 2011 was the lowest recorded in the last 10 years. In 2011, PCV7 serotypes accounted for a smaller proportion (67%) of the penicillin-resistant isolates than in previous years, whereas type 19A accounted for a larger proportion (21%) than previously. However, this increase in the proportion of penicillin-resistant isolates that were serotype 19A was not due to penicillin resistance becoming more prevalent among this serotype but rather due to type 19 causing a greater proportion of the IPD cases.

In late 2011, PCV10 (Synflorix®) replaced PCV7 on the childhood immunisation schedule. PCV10 will give additional coverage for serotypes 1, 5 and 7F. Hopefully, the serotype 1 coverage will prevent future outbreaks of this serotype such as that we have recently experienced in New Zealand.

INTRODUCTION

INTRODUCTION

Since 17 October 2008, invasive pneumococcal disease (IPD) has been notifiable in New Zealand. Prior to this date, the national surveillance of IPD was solely laboratory-based, with diagnostic laboratories referring invasive isolates of *Streptococcus pneumoniae* to the Institute of Environmental Science and Research Ltd (ESR) for serotyping and antimicrobial susceptibility testing.

On 1 June 2008, pneumococcal conjugate vaccine (PCV) was added to the New Zealand childhood immunisation schedule. The 7-valent conjugate vaccine (PCV7), Prevenar®, was used until late 2011, when it was replaced with the 10-valent conjugate vaccine (PCV10), Synflorix®.

This series of annual reports on the epidemiology of IPD in New Zealand commenced in 2008. The 2008 annual report was based on data available from ESR's national laboratory-based surveillance of IPD [1]. Subsequent annual reports have been based on IPD notifications, supplemented with serotype and antimicrobial susceptibility data from ESR's laboratory-based surveillance [2, 3].

Prior to these annual reports, information from ESR's laboratory-based surveillance of IPD was published periodically [4-8]. In addition, between 2002 and 2007, annual reports on the antimicrobial susceptibility of invasive pneumococcal isolates were published on ESR's Public Health Surveillance website at http://www.surv.esr.cri.nz/antimicrobial/streptococcus_pneumoniae.php.

Data on the IPD cases notified in 2011 is presented in this report, along with trend data for recent years.

METHODS

METHODS

Surveillance methods

In this report, data for 2009, 2010 and 2011 is based on invasive pneumococcal disease (IPD) case notifications, supplemented with serotype and antimicrobial susceptibility data from laboratory-based surveillance of invasive *S. pneumoniae* isolates by ESR. Data for earlier years is from ESR's national laboratory-based surveillance of IPD.

Since 17 October 2008, IPD has been notifiable to the local Medical Officer of Health under the Health Act 1956. A case of IPD requires laboratory confirmation by at least one of the following:

- isolation of *S. pneumoniae* from blood, CSF or another normally sterile site (for example, joint fluid, pleural fluid)
- detection of *S. pneumoniae* nucleic acid in blood, CSF or another normally sterile site
- a positive newer-generation *S. pneumoniae* antigen test on CSF.

Notification data is entered at each public health unit (PHU) via a secure web-based portal onto a computerised database (EpiSurv). The real-time data is collated and analysed on behalf of the Ministry of Health by ESR.

For the national laboratory-based surveillance of IPD, diagnostic microbiology laboratories in New Zealand are requested to refer all invasive isolates of *S. pneumoniae* (ie, isolates from CSF, blood or another normally sterile site) to ESR. In addition and less frequently, laboratories refer sterile site specimens to ESR to test for the presence of pneumococcal DNA by PCR. At ESR, all invasive isolates are serotyped and tested for susceptibility to a range of antibiotics (see below for further information).

The notification data in this report is based on the information recorded on EpiSurv as at 21 February 2012. Any changes made to the notification data by PHU staff after this date are not reflected in this report. Serotype and antimicrobial susceptibility data for invasive isolates was matched with the relevant case notification.

The immunisation status of eligible cases (born after 1 January 2008) is based on data from the national immunisation register (NIR), rather than the immunisation data reported with the case notification. IPD notifications were matched with relevant data in the NIR for cases born after 1 January 2008 only. The immunisation status of asplenic cases is based on the immunisation data reported with the case notification on EpiSurv.

Laboratory methods

Detection of pneumococcal DNA in clinical specimens

The presence of pneumococcal DNA in clinical specimens is detected by polymerase chain reaction (PCR).

Strain typing

S. pneumoniae isolates are serotyped by the capsular antigen reaction (Neufeld test) using the Danish system of nomenclature and sera obtained from the Statens Serum Institut [9]. Methods have not been established at ESR to identify the serotype when only pneumococcal DNA, rather than an isolate, is available. Therefore, the serotype can only be determined for culture-positive IPD cases.

Antimicrobial susceptibility testing

The penicillin and cefotaxime susceptibilities of *S. pneumoniae* isolates are determined by Etest (BioMerieux, France), using Mueller-Hinton agar with 5% sheep blood and incubation for 20-24 hours in 5% CO_2. Chloramphenicol, clindamycin, co-trimoxazole, erythromycin, moxifloxacin, rifampicin, tetracycline and vancomycin susceptibilities are determined by the Clinical and Laboratory Standards Institute's (CLSI's) disc susceptibility testing method [10]. Inducible clindamycin resistance is detected by the D-zone test [11]. All minimum inhibitory concentrations (MICs) and zone of inhibition diameters were interpreted according to the 2011 CLSI standards [11].

In this report, the penicillin interpretive standards, which were redefined in 2008, have been retrospectively applied to historical MIC data so that time trends are comparable. Also, in this report, when associations between penicillin or cefotaxime resistance and patient demographics, geographical distribution or serotypes are made, the meningitis interpretive standards have been used.

Multidrug resistance is defined as resistance to three antibiotics in addition to penicillin. For the purposes of this definition, the meningitis interpretive standards were used for both penicillin and cefotaxime.

Analytical methods

The denominator data used to determine all disease rates, except the rates for ethnic groups and deprivation index, was derived from the 2011 mid-year population estimates published by Statistics New Zealand. Note that rates presented in this report for years prior to 2011 may differ slightly from those published in earlier annual reports as the mid-year population estimates are updated each year. The denominator data used to determine disease rates for ethnic groups is based on the proportion of people in each ethnic group from the estimated resident 2006 census population applied to the 2011 mid-year population estimates. Ethnicity is prioritised in the following order: Māori, Pacific Peoples, Asian, Middle Eastern/Latin American/African (MELAA), and European or Other Ethnicity (including New Zealander).

A deprivation index, which ranges from 1 (least deprived) to 10 (most deprived), is calculated for each geographical mesh block in New Zealand. Approximately equal numbers of people reside in areas associated with each of the ten deprivation levels. The deprivation index analysis was confined to those cases for which the accuracy of index designation was recorded as exact or nearest. The IPD rates by deprivation index were calculated using the NZDep2006 classification and denominator data derived from the usually resident 2006 census population.

Rates have not been calculated where there are fewer than five notified cases in any category, as calculating population rates from fewer than five cases produces unstable rates.

In this report, any cases for which *S. pneumoniae* was identified in CSF (by culture, PCR or antigen test) and which were not notified as meningitis cases were considered to be cases of pneumococcal meningitis.

More than one method of laboratory confirmation may be recorded for some cases of IPD. The method of laboratory confirmation is prioritised in the following order: culture of *S. pneumoniae* from CSF, culture of *S. pneumoniae* from blood, positive pneumococcal antigen test on CSF, culture of *S. pneumoniae* from pleural fluid, culture of *S. pneumoniae* from joint fluid, and culture of *S. pneumoniae* from another normally sterile site.

The Fisher's exact test was used to determine the significance of any observed differences. Linear regression was used to calculate the significance and direction of time trends. An associated p-value of <0.05 was used to identify whether a difference or trend was significant.

Data presented for 2009 onwards is based on IPD notifications and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD. Compared with notifications, laboratory-based surveillance is likely to underestimate the burden of IPD.

Abbreviations

PCV7: 7-valent pneumococcal conjugate vaccine with serotypes 4, 6B, 9V, 14, 18C, 19F and 23F.

PCV10: 10-valent pneumococcal conjugate vaccine with serotypes 1, 4, 5, 6B, 7F, 9V, 14, 18C, 19F and 23F.

PCV13: 13-valent pneumococcal conjugate vaccine with serotypes 1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F and 23F.

PPV-23: 23-valent pneumococcal polysaccharide vaccine with serotypes 1, 2, 3, 4, 5, 6B, 7F, 8, 9N, 9V, 10A, 11A, 12F, 14, 15B, 17F, 18C, 19A, 19F, 20, 22F, 23F and 33F.

RESULTS

RESULTS

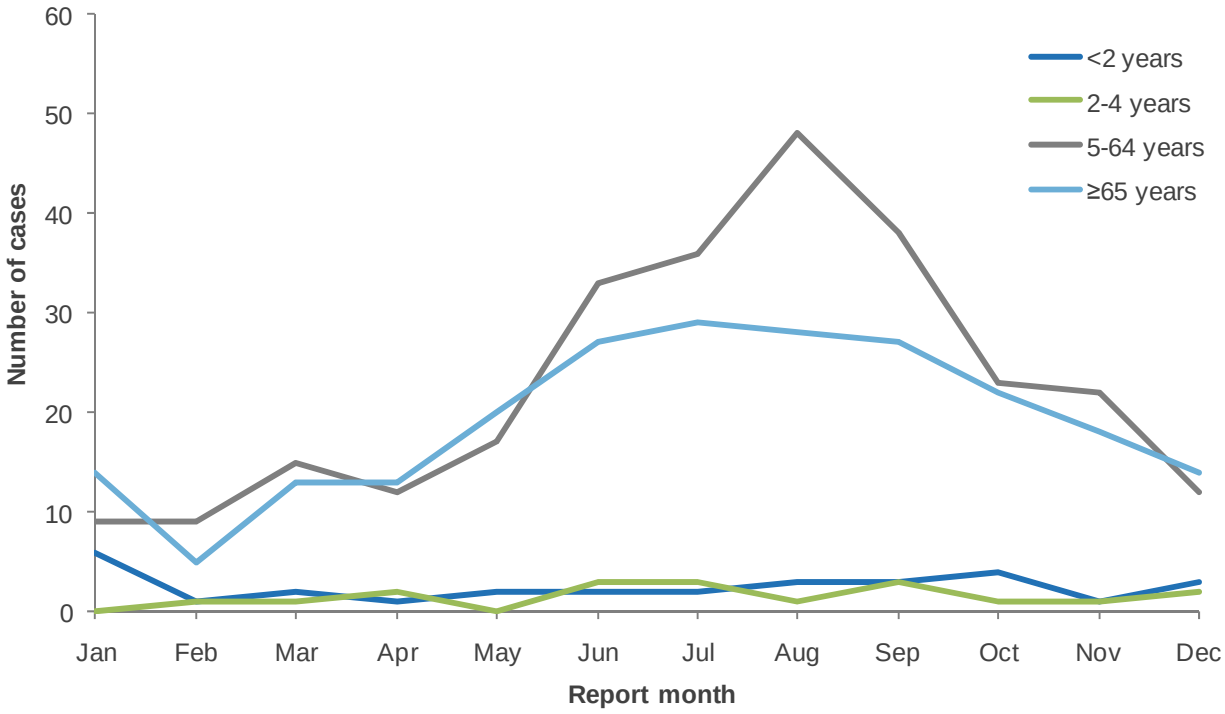
In 2011, 552 cases of IPD were notified. The 2011 notification rate for IPD was 12.5 per 100 000 population, similar to the 2010 rate (12.2 per 100 000, 535 cases), but a significant decrease from the 2009 rate (16.1 per 100 000, 697 cases).

A breakdown of the laboratory criteria upon which the IPD diagnosis was based is available in Table 11 (Appendix). Approximately 90% of cases in 2011 were confirmed by culture of *S. pneumoniae* from blood. *S. pneumoniae* isolates from an invasive site were received by ESR for serotyping and antimicrobial susceptibility testing from 533 (96.6%) of the cases notified in 2011.

Disease incidence by season

During 2011, there was the usual marked peak in the winter months among cases aged ≥5 years. This winter peak was not present for cases <5 years old (Figure 1).

Figure 1. Number of invasive pneumococcal disease cases by age group and month, 2011



Disease incidence by age and sex

Age and sex were recorded for all IPD cases in 2011. The distribution of the 2011 cases by age group and sex is presented in Table 1. In most age groups, the rate of IPD was higher among males than females. The highest rates were in the elderly aged ≥75 years and in infants aged <1 year. Rates of IPD showed an increasing trend with age from 55 years upwards.

Table 1. Number and rate per 100 000 of invasive pneumococcal disease cases by age group and sex, 2011

Age group (years)	Female		Male		Total		
	Cases	Rate[a]	Cases	Rate	Cases	Rate	%[b]
<1	11	36.2	12	37.5	23	36.9	4.2
1	2	-	5	15.4	7	11.0	1.3
2-4	7	7.6	11	11.4	18	9.6	3.3
5-14	10	3.5	19	6.4	29	5.0	5.3
15-24	15	4.8	12	3.6	27	4.2	4.9
25-34	15	5.2	25	9.0	40	7.1	7.2
35-44	15	4.7	21	7.3	36	6.0	6.5
45-54	29	9.1	26	8.7	55	8.9	10.0
55-64	41	16.3	46	19.0	87	17.6	15.8
65-74	47	28.0	37	23.5	84	25.8	15.2
75-84	41	39.7	47	55.1	88	46.7	15.9
≥85	34	71.4	24	94.0	58	79.3	10.5
Aggregated age groups (years)							
<2[c]	13	21.2	17	26.4	30	23.8	5.4
<5	20	13.1	28	17.4	48	15.3	8.7
5-64	125	7.1	149	8.6	274	7.8	49.6
≥65	122	38.3	108	40.3	230	39.2	41.7
Total	**267**	**11.9**	**285**	**13.2**	**552**	**12.5**	

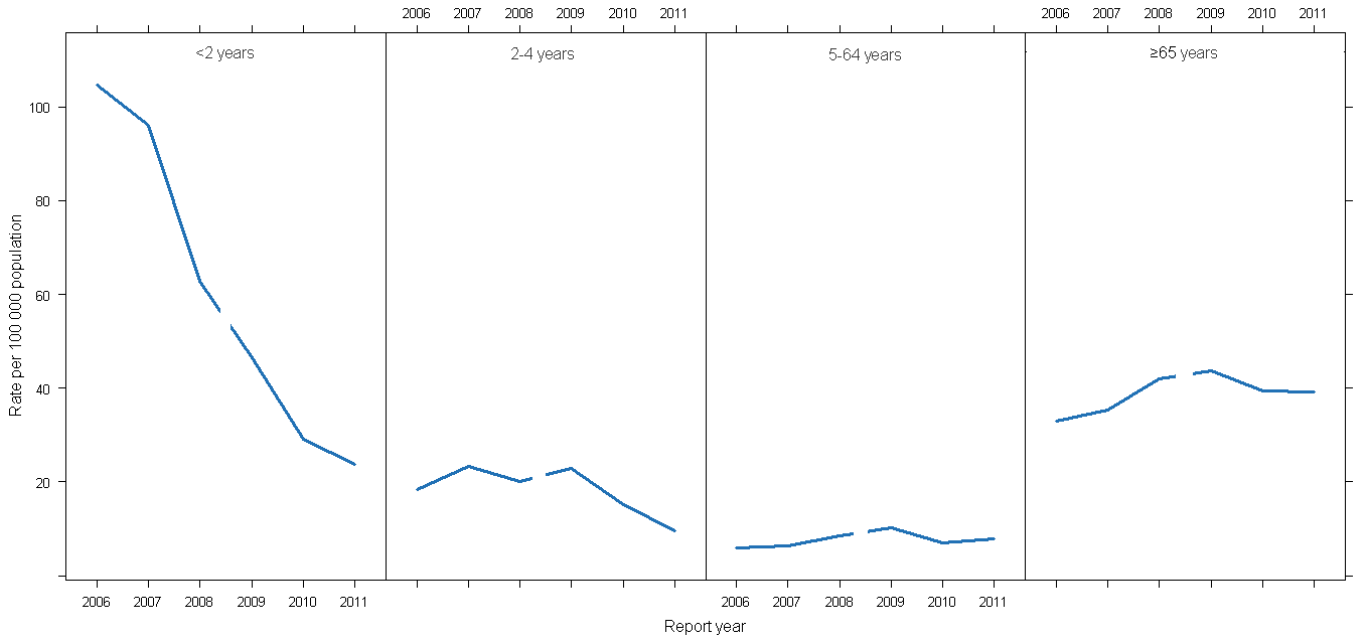
[a] Rates were not calculated where there were fewer than five cases in any category.

[b] Percentage of cases in each age group.

[c] The age in months of the cases <2 years of age is presented in Figure 9 (Appendix).

Between 2006 and 2011, there was a significant decrease in the rate of IPD in the <2 years (104.8 to 23.8 per 100 000 population) and 2-4 years (18.3 to 9.6 per 100 000) age groups (Figure 2). While rates in the older age groups (5-64 years and ≥65 years) were higher in 2011 than in 2006, these increases are hard to interpret as some of the increase is likely due to the change in 2009 from laboratory-based to the more sensitive notification-based surveillance. A further breakdown of cases and rates by age group over the past six years is available in Table 12 (Appendix).

Figure 2. Rate per 100 000 population of invasive pneumococcal disease cases by age group and year, 2006–2011



Note. Data presented for 2009 onwards is based on IPD notifications and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD.

Disease incidence by ethnic group

Ethnicity was recorded for 538 (97.5%) IPD cases in 2011. The age-standardised rates of IPD were highest in the Pacific Peoples (32.4 per 100 000 population, 62 cases) and Māori (29.4 per 100 000, 114 cases) ethnic groups. The rates for these two ethnic groups were approximately 3-times the rate for the European or Other ethnic group (9.8 per 100 000, 344 cases) (Table 2).

Among cases in the <2 years age group, rates were highest for the Pacific Peoples and Māori ethnic groups, with rates being 7.6 and 6.1 times, respectively, that for the European or Other ethnic group. However, these rates are based on relatively small numbers of cases in this age group.

Table 13 (Appendix) presents the rates of IPD by ethnic group and age group for the years 2009 to 2011. Between these years, the age-standardised IPD rates decreased in the Asian (45.5%), Pacific Peoples (23.4%), Māori (18.1%) and European or Other (16.9%) ethnic groups. Among cases in the <2 year age group, there were significant decreases in the European or Other (73.3%) and Māori (47.8%) infants, but a smaller and non-significant decrease in Pacific Peoples (11.6%) infants.

Table 2. Number of cases, age-specific and age-standardised rate per 100 000 population of invasive pneumococcal disease cases by ethnic group and age group, 2011

Age group (years)	Māori		Pacific Peoples		Asian		MELAA[a]		European or Other	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
<1	13	77.3	5	79.2	2	-	0	-	2	-
1	2	-	2	-	0	-	0	-	3	-
2-4	5	10.6	1	-	4	-	1	-	7	6.7
5-14	11	8.0	6	11.4	0	-	1	-	9	2.7
15-24	5	4.1	5	9.9	2	-	0	-	15	4.1
25-34	6	6.7	6	14.9	1	-	0	-	26	7.3
35-44	11	13.9	6	17.4	0	-	1	-	17	4.0
45-54	21	31.1	7	26.0	1	-	0	-	24	5.1
55-64	11	27.3	12	70.2	3	-	0	-	60	14.7
65-74	14	64.1	8	86.6	1	-	0	-	60	21.6
75-84	13	197.5	4	-	0	-	0	-	69	39.7
≥85	2	-	0	-	1	-	0	-	52	74.3
Aggregated age groups (years)										
<2	15	45.2	7	56.6	2	-	0	-	5	7.4
<5	20	24.9	8	25.7	6	22.8	1	-	12	6.9
5-64	65	12.0	42	18.7	7	2.0	2	-	151	6.4
≥65	29	98.3	12	92.3	2	-	0	-	181	34.7
All ages[b,c]	**114**	**29.4**	**62**	**32.4**	**15**	**5.6**	**3**	**-**	**344**	**9.8**

[a] Middle Eastern/Latin American/African.

[b] Rates presented for all ages are direct-standardised to the age distribution of the total New Zealand population.

[c] Ethnicity was recorded for 538 (97.5%) cases notified in 2011.

Note: Denominator data used to determine disease rates for ethnic groups is based on the proportion of people in each ethnic group from the estimated resident 2006 census population applied to the 2011 mid-year population estimates from Statistics New Zealand. Ethnicity is prioritised in the following order: Māori, Pacific Peoples, Asian, MELAA and European or Other Ethnicity (including New Zealander). Where there were fewer than five cases in any category, a rate has not been calculated.

Disease incidence by deprivation

New Zealand deprivation (NZDep) index data was available for 520 (94.2%) of the 552 IPD cases in 2011. With the exception of the 2–4 year age group, the highest numbers of cases were in the most deprived NZDep quintile (ie, NZDep indices 9–10) (Table 3). Rates of IPD within NZDep quintiles could only be calculated for all ages, as population data by NZDep index and age groups was not available. There was a trend of increasing rates of IPD in each NZDep quintile from the least deprived (NZDep indices 1–2) to the most deprived quintile. The rate in the most deprived quintile (20.3 per 100 000 population, 172 cases) was more than double that in the least deprived quintile (9.4 per 100 000, 70 cases).

Between 2009 and 2011, rates of IPD decreased in all NZDep quintiles (Figure 3), with the largest decreases for NZDep indices 5−6, 7−8, and 9−10 (approximately 22% each).

Table 3. Number and percentage of invasive pneumococcal disease notifications by quintiles of the 2006 New Zealand deprivation index and age group, 2011

NZDep index[a]	<2 years		2–4 years		5–64 years		≥65 years		Total		
	Cases	%[b]	Cases	%[b]	Cases	%[b]	Cases	%[b]	Cases	%[b]	Rate[c]
1-2	1	3.3	1	6.7	28	10.9	40	18.4	70	13.5	9.4
3-4	0	-	5	33.3	41	15.9	35	16.1	81	15.6	10.9
5-6	4	13.3	5	33.3	36	14.0	37	17.1	82	15.8	10.1
7-8	6	20.0	1	6.7	61	23.6	47	21.7	115	22.1	13.2
9-10	19	63.3	3	20.0	92	35.7	58	26.7	172	33.1	20.3
Total[d]	**30**		**15**		**258**		**217**		**520**		

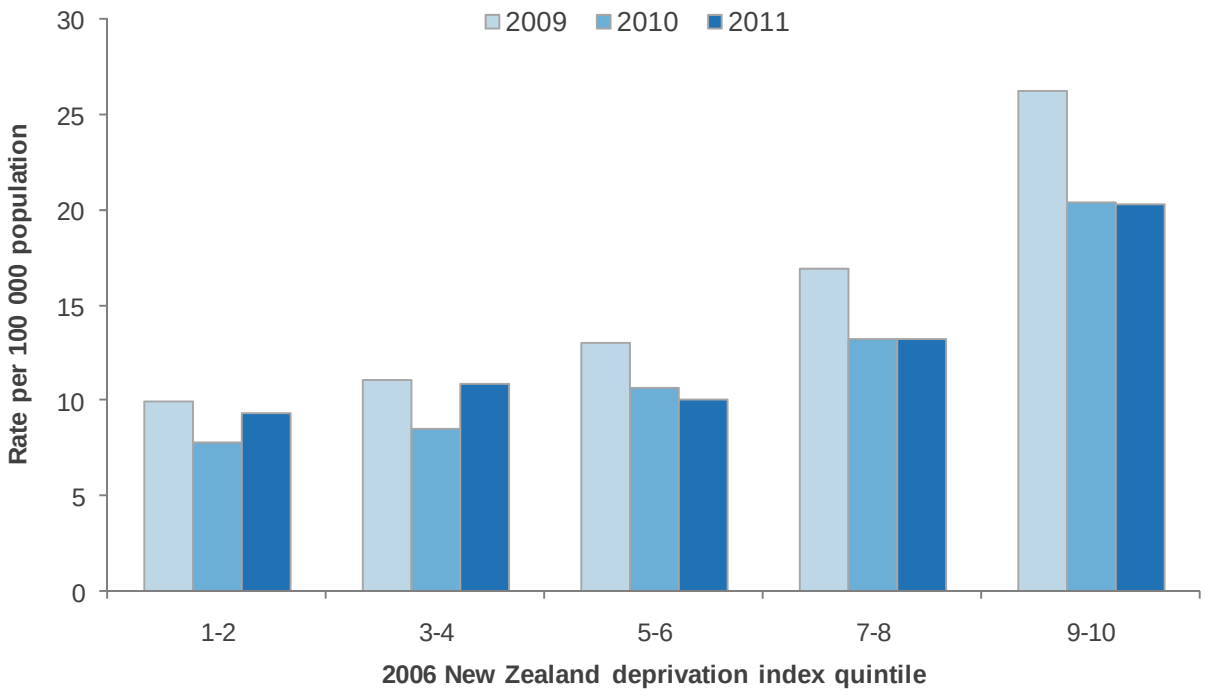
[a] Quintile of the 2006 New Zealand deprivation index.

[b] Percentage of cases within the age group in the quintile.

[c] Rate per 100 000 population, based on the 2006 census data from Statistics New Zealand. These rates should not be compared with disease rates used elsewhere in the report which have been calculated using the 2011 mid-year population estimates from Statistics New Zealand.

[d] Accurate New Zealand deprivation (NZDep) index data was available for 520 (94.2%) cases notified in 2011.

Figure 3. Rate per 100 000 population of invasive pneumococcal disease by quintiles of the 2006 New Zealand deprivation index and year, 2009–2011



Disease presentation, hospitalisations and fatalities

In 2011, 503 (91.1%) of the 552 IPD cases had at least one clinical presentation recorded (Table 4). Meningitis was the most common presentation for the <2 years age group and pneumonia for cases aged ≥5 years.

The rate of pneumococcal meningitis was 0.9 per 100 000 population for all ages, 4.8 per 100 000 for the <2 years age group and 2.5 per 100 000 for the <5 years age group.

Of the four cases of pneumococcal meningitis in infants aged <1 year old, three were in the Māori ethnic group and one in the Pacific Peoples ethnic group.

Table 4. Clinical presentation of invasive pneumococcal disease cases by age group, 2011

Age group (years)	Meningitis		Bacteraemia without focus		Empyema		Pneumonia		Other		Total[c]
	No[a]	%[b]	No[a]	%[b]	No[a]	%[b]	No[a]	%[b]	No[a]	%[b]	
<1	4	22.2	4	22.2	1	5.6	4	22.2	5	27.8	18
1	2	40.0	1	20.0	1	20.0	0	-	1	20.0	5
2–4	2	11.1	4	22.2	3	16.7	8	44.4	1	5.6	18
5–14	5	18.5	4	14.8	2	7.4	12	44.4	4	14.8	27
15–64	15	6.8	29	13.1	10	4.5	151	68.0	17	7.7	222
≥65	12	5.6	34	16.0	3	1.4	146	68.5	18	8.5	213
Aggregated age groups (years)											
<2	6	26.1	5	21.7	2	8.7	4	17.4	6	26.1	23
<5	8	19.5	9	22.0	5	12.2	12	29.3	7	17.1	41
Total[d]	**40**	**8.0**	**76**	**15.1**	**20**	**4.0**	**321**	**63.8**	**46**	**9.1**	**503**

[a] Number of cases with 'yes' recorded to the clinical presentation. Only one presentation was counted for each case, with presentations prioritised in the following order: meningitis, bacteraemia without focus, empyema, pneumonia and 'Other'. Non-prioritised data, with all presentations recorded for cases who had more than one presentation reported, is available in Table 14 (Appendix). Any cases for which *S. pneumoniae* was cultured from, or identified in, CSF were considered to be cases of pneumococcal meningitis.

[b] Percentage of cases within the age group with the clinical presentation.

[c] Number of cases with at least one clinical presentation recorded.

[d] At least one clinical presentation was recorded for 503 (91.1%) of cases notified in 2011.

Information on whether the patient survived or died was recorded for 505 (91.5%) of the IPD cases. There were 32 fatalities due to IPD, giving a case-fatality rate of 6.3% among the cases for whom this information was reported. In 2011, there were no deaths due to IPD in the <5 years age group. The case-fatality rates for each age group are presented in Table 15 (Appendix).

Among the 528 (95.7%) IPD cases for whom hospitalisation status was recorded, 511 (95.8%) cases were hospitalised. The case-fatality rate among hospitalised cases (5.9%, 30/511) was not significantly different to that among non-hospitalised cases (11.8%, 2/17).

Immunisation status

Among the 48 cases who were eligible for the pneumococcal conjugate vaccine (that is, cases born after 1 January 2008), 30 were recorded as having at least 1 dose of the pneumococcal conjugate vaccine (PCV) before the onset of their disease (Table 5). Four of these 30 cases were due to a PCV7 type, 24 cases were due to a non-PCV7 serotype, and serotype information was unavailable for two cases. The four cases due to a PCV7 serotype who had received one or more doses of vaccine were due to the following serotypes: 19F (2 cases), 6B and 18C (1 case each).

The five asplenic cases reported in 2011 ranged from 40 to 62 years in age and immunisation status was recorded for four of these cases. One case was reported to be immunised with a pneumococcal vaccine but dose details were not available, and the remaining three cases were not immunised.

Table 5. Immunisation status of the 2011 invasive pneumococcal disease cases who were born after 1 January 2008

Number of vaccine doses received[a]	Cases due to PCV7 type[b]		Cases due to non PCV7 type[b]		Total[b,c]	
	No	%	No	%	No	%
0	6	60.0	11	31.4	18	37.5
1	0	-	4	11.4	4	8.3
2	0	-	3	8.6	3	6.3
3	1[d]	10.0	11	31.4	13	27.1
4	3[e]	30.0	6	17.1	10	20.8
Total	**10**		**35**		**48**	

[a] Number of doses received prior to onset of IPD only. Where onset date was not available, the date the case was reported to the public health unit was used.

[b] Only IPD cases eligible for the PCV as part of the childhood immunisation schedule (born after 1 January 2008) are presented.

[c] The total number of cases includes three cases where serotype information was not available.

[d] Case was due to serotype 6B.

[e] Cases were due to serotypes 19F (2 cases) and 18C (1 case).

Risk factors

The risk factors reported among IPD cases in 2011 are presented in Table 6. The most common risk factor among all cases was chronic illness (53.7% of cases). Risk factors for cases in the <2 years, <5 years and ≥5 years age groups are presented in Table 16, Table 17 and Table 18 (Appendix), respectively. Smoking in the household and being born premature were the most common risk factors recorded for the <5 years age group whilst chronic illness was most commonly recorded for the ≥5 years age group.

Table 6. Exposure to risk factors associated with invasive pneumococcal disease for cases, 2011

Risk factor	No. of cases[a]	Total reported[b]	%[c]
Chronic illness[d]	264	492	53.7
Premature (<37 weeks gestation)[e]	5	13	38.5
Smoking in the household[f]	7	21	33.3
Current smoker[g]	81	323	25.1
Immunocompromised[h]	91	474	19.2
Chronic lung disease or cystic fibrosis	78	488	16.0
Attends childcare[f]	2	18	11.1
Resident in long-term or other chronic care facility[i]	42	498	8.4
Congenital and chromosomal abnormality	6	475	1.3
Cochlear implants	5	427	1.2
Anatomical or functional asplenia	5	454	1.1

[a] Number of cases with 'yes' recorded for each risk factor. Cases may record more than one risk factor.

[b] Number of cases for which information was recorded for each risk factor.

[c] Percentage of cases with the risk for which the information was recorded.

[d] Includes CSF leak, intracranial shunts, diabetes, cardiac disease, pulmonary disease, chronic liver disease, renal impairment and alcohol-related disease.

[e] Cases aged <1 year only.

[f] Cases aged <5 years only.

[g] Cases aged ≥18 years only.

[h] Includes HIV/AIDS, lymphoma, organ transplant, multiple myeloma, nephrotic syndrome, chronic drug therapy, dysgammaglobulinaemia and sickle cell anaemia.

[i] Among cases in the ≥75 years age group, 28.3% (36 cases out of 127 for whom the information was reported) were residents in a long-term or other chronic-care facility.

Disease incidence by District Health Board

In 2011, the highest rate of IPD was in Lakes District Health Board (DHB) (28.2 per 100 000 population, 29 cases), followed by Wairarapa (17.2 per 100 000, 7 cases) and Hawke's Bay (16.7 per 100 000, 26 cases) DHBs. Rates were similar across the four regions (11.1 to 14.3 per 100 000) in 2011. See Table 7 for number of cases by age group and rates for each DHB and region.

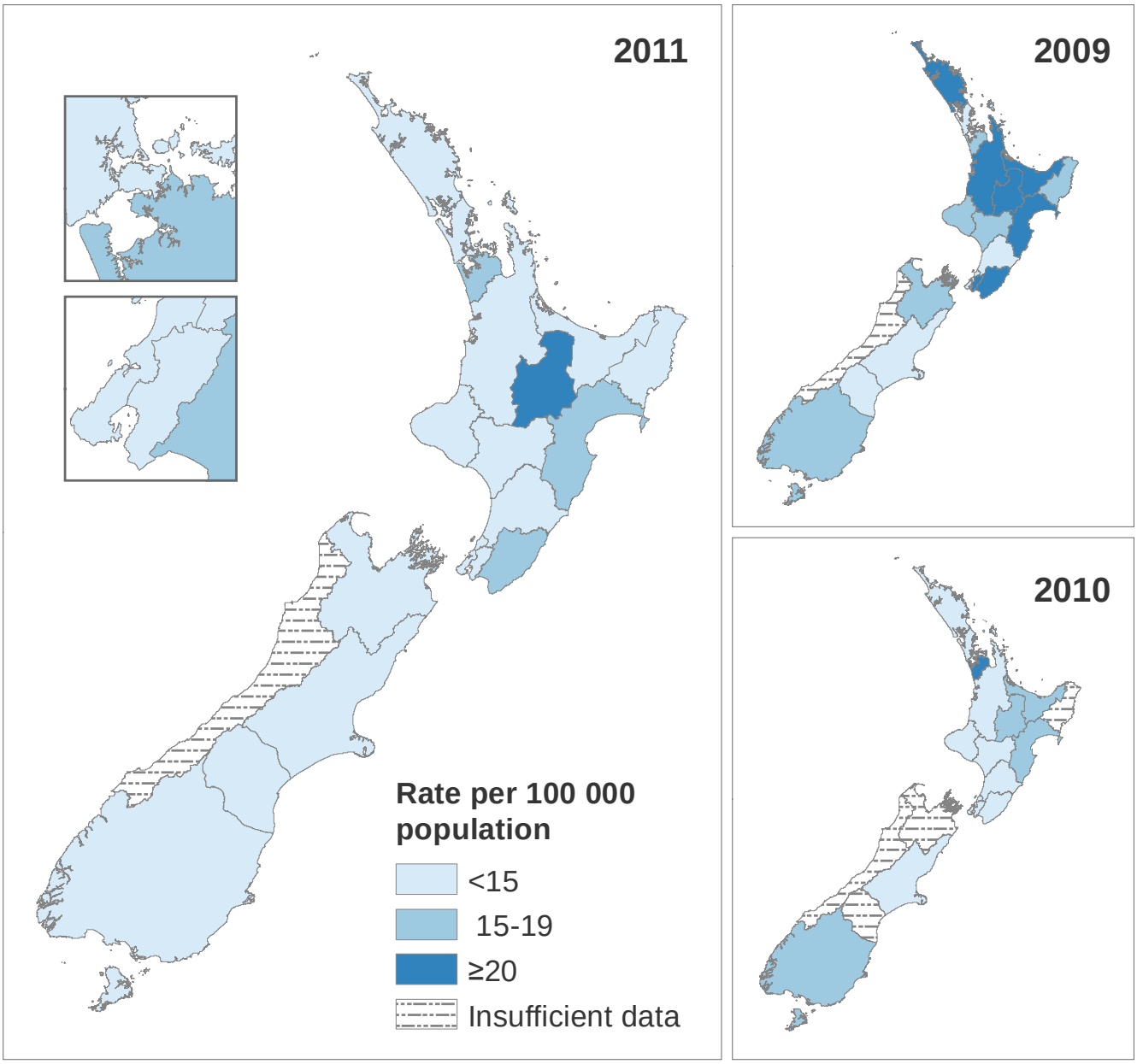
Between 2009 and 2011, rates of IPD have decreased across all DHBs (Figure 4), with the exception of West Coast DHB where there were no notified in 2009 and 2011. These decreases were significant in Waikato (22.8 to 12.5 per 100 000) and Bay of Plenty (24.1 to 13.7 per 100 000) DHBs.

Table 7. Number of invasive pneumococcal disease cases by age group and rate per 100 000 population for each District Health Board, 2011

District Health Board	Cases by age group (years)					Rate[a] (all ages)
	<2	<5	5–64	≥65	All ages	
Northern region	**15**	**23**	**122**	**63**	**208**	**12.5**
Northland	3	5	9	7	21	13.3
Waitemata	3	4	33	23	60	11.0
Auckland	4	7	32	13	52	11.4
Counties Manukau	5	7	48	20	75	15.0
Midland region	**11**	**13**	**50**	**57**	**120**	**14.3**
Waikato	6	7	18	21	46	12.5
Lakes	2	2	16	11	29	28.2
Bay of Plenty	2	3	8	18	29	13.7
Tairawhiti	1	1	3	1	5	10.7
Taranaki	0	0	5	6	11	10.0
Central region	**3**	**9**	**51**	**52**	**112**	**11.1**
Hawke's Bay	1	2	12	12	26	16.7
Whanganui	0	0	1	5	6	9.5
MidCentral	0	1	8	10	19	11.3
Hutt Valley	0	2	9	6	17	11.8
Capital and Coast	1	1	10	8	19	6.4
Wairarapa	1	1	3	3	7	17.2
Nelson Marlborough	0	2	8	8	18	12.9
Southern region	**1**	**3**	**51**	**58**	**112**	**12.5**
West Coast	0	0	0	0	0	-
Canterbury	1	3	32	32	67	13.3
South Canterbury	0	0	1	7	8	14.2
Southern	0	0	18	19	37	12.1
Total	**30**	**48**	**274**	**230**	**552**	**12.5**

[a] Rates were not calculated where there were fewer than five in any category.

Figure 4. Geographic distribution of invasive pneumococcal disease cases, 2009–2011



Serotype distribution

Table 8 shows by age group the number and proportion of the 533 culture-positive IPD cases in 2011 caused by each of the serotypes included in PCV7, PCV10 and PCV13, and any other serotypes that accounted for ≥10 cases. Table 19 (Appendix) presents the rates per 100 000 population of IPD caused by these same serotypes. A full list of the serotypes of all isolates from culture-positive IPD cases in 2011 is available in Table 20 (Appendix).

In 2011, only 10.7% (three cases) of disease in the <2 years age group was due to PCV7 serotypes (Table 8). These three cases were in the Māori, Asian, and European or Other (1 each) ethnic groups. Notably since 2009, when ethnicity data became available, there has not been a case of IPD due to a PCV7 serotype in a Pacific Peoples infant aged <2 years.

The proportion of IPD due to PCV7 types was higher in the older age groups in 2011: 35.0% in the 5-64 years and 33.8% in the ≥65 years age groups. 80.4% of IPD in the ≥65 years age group was due to a PPV-23 serotype.

Table 8. Number and percentage of invasive pneumococcal disease cases by serotype, vaccine coverage and age group, 2011

Serotype	<2 years		2–4 years		<5 years[a]		5–64 years		≥65 years[b]		Total	
	No	%[c]	No	%[c]	No	%[c]	No	%[c]	No	%[c]	No	%[c]
PCV7	**3**	**10.7**	**7**	**41.2**	**10**	**22.2**	**91**	**35.0**	**77**	**33.8**	**178**	**33.4**
4	0	-	1	5.9	1	2.2	30	11.5	15	6.6	46	8.6
6B	1	3.6	0	-	1	2.2	7	2.7	10	4.4	18	3.4
9V	1	3.6	0	-	1	2.2	10	3.8	3	1.3	14	2.6
14	0	-	1	5.9	1	2.2	18	6.9	9	3.9	28	5.3
18C	1	3.6	1	5.9	2	4.4	7	2.7	7	3.1	16	3.0
19F	0	-	3	17.6	3	6.7	14	5.4	22	9.6	39	7.3
23F	0	-	1	5.9	1	2.2	5	1.9	11	4.8	17	3.2
PCV10	**7**	**25.0**	**10**	**58.8**	**17**	**37.8**	**132**	**50.8**	**80**	**35.1**	**229**	**43.0**
1	2	7.1	1	5.9	3	6.7	30	11.5	2	0.9	35	6.6
5	0	-	0	-	0	-	0	-	0	-	0	-
7F	2	7.1	2	11.8	4	8.9	11	4.2	1	0.4	16	3.0
PCV13	**15**	**53.6**	**15**	**88.2**	**30**	**66.7**	**183**	**70.4**	**126**	**55.3**	**339**	**63.6**
3	0	-	0	-	0	-	22	8.5	17	7.5	39	7.3
6A	0	-	0	-	0	-	3	1.2	5	2.2	8	1.5
19A	8	28.6	5	29.4	13	28.9	26	10.0	24	10.5	63	11.8
Non-PCV[d]	**13**	**46.4**	**2**	**11.8**	**15**	**33.3**	**77**	**29.6**	**102**	**44.7**	**194**	**36.4**
6C	1	3.6	0	-	1	2.2	6	2.3	9	3.9	16	3.0
8	2	7.1	0	-	2	4.4	9	3.5	2	0.9	13	2.4
9N	1	3.6	0	-	1	2.2	3	1.2	11	4.8	15	2.8
10A	1	3.6	0	-	1	2.2	5	1.9	5	2.2	11	2.1
11A	1	3.6	0	-	1	2.2	5	1.9	8	3.5	14	2.6
22F	0	-	0	-	0	-	17	6.5	21	9.2	38	7.1
33F	1	3.6	0	-	1	2.2	2	0.8	8	3.5	11	2.1
35	3	10.7	0	-	3	6.7	3	1.2	5	2.2	11	2.1
Other	3	10.7	2	11.8	5	11.1	27	10.4	33	14.5	65	12.2
Total[e]	**28**		**17**		**45**		**260**		**228**		**533**	

[a] Aggregated age group.

[b] Among the cases in the ≥65 year age group, 80.4% were due to one of the serotypes included in PPV-23. Vaccination with PPV-23 is recommended for people in this age group.

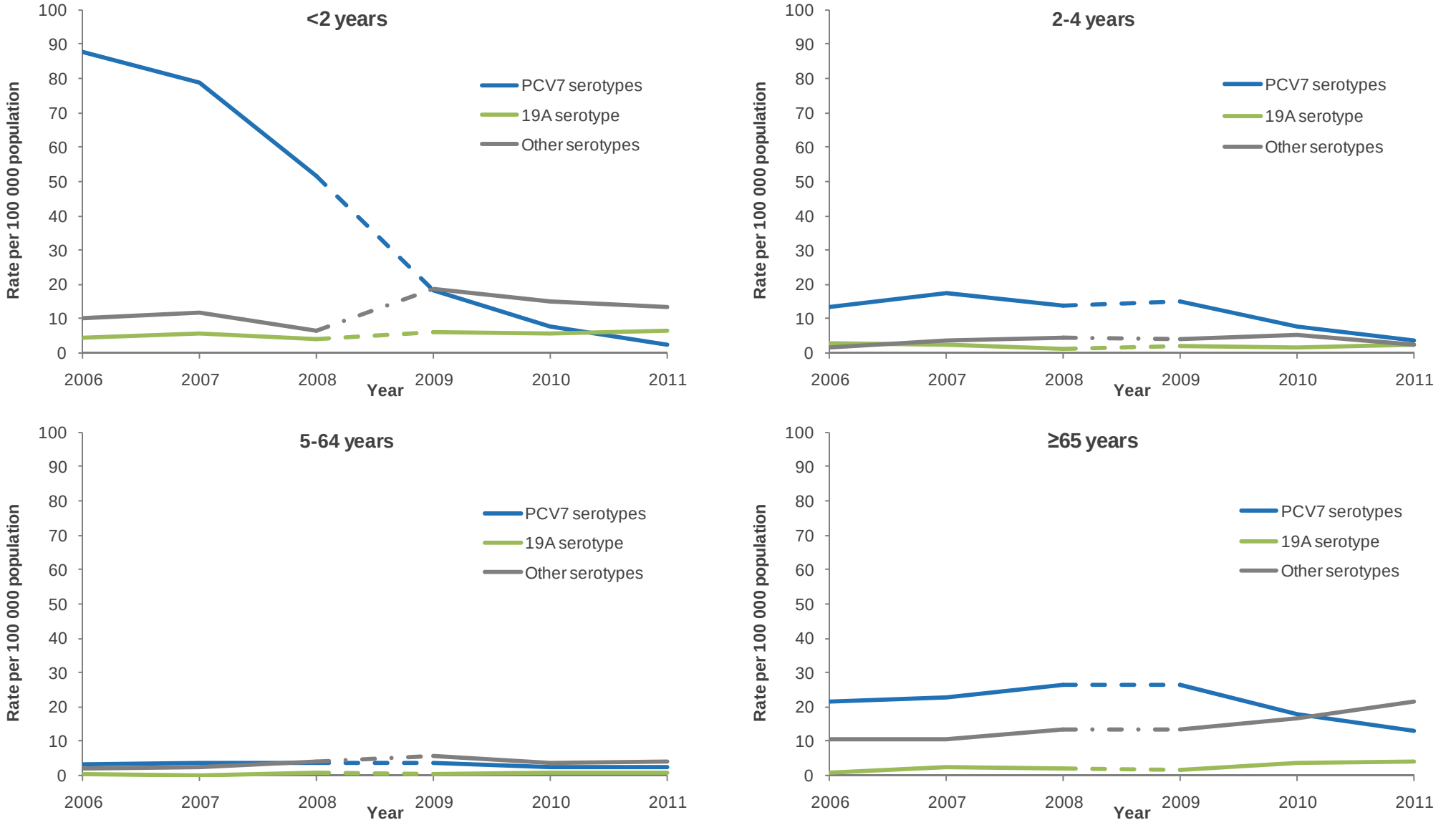
[c] Percentage of cases within the age group with the serotype.

[d] The specific serotypes listed are those that accounted for more than 10 cases of IPD in 2011.

[e] Culture-positive cases only.

Figure 5 shows the trends since 2006 in the rates of disease due to PCV7 serotypes, serotype 19A and all other serotypes (data also presented in Table 21, Table 22, Table 23, Table 24 and Table 25 in the Appendix). Since the introduction of PCV7, the largest decrease in the rate of IPD due to PCV7 serotypes has been in the <2 years age group (83.1 in 2006/2007 to 2.4 per 100 000 population in 2011, note that the 2011 rate was calculated based on 3 cases only). There have also been significant decreases in all other age groups between 2006/2007 and 2011: 2-4 years (15.5 to 3.7 per 100 000 population), 5-64 years (3.6 to 2.6 per 100 000), and ≥65 years (22.2 to 13.1 per 100 000).

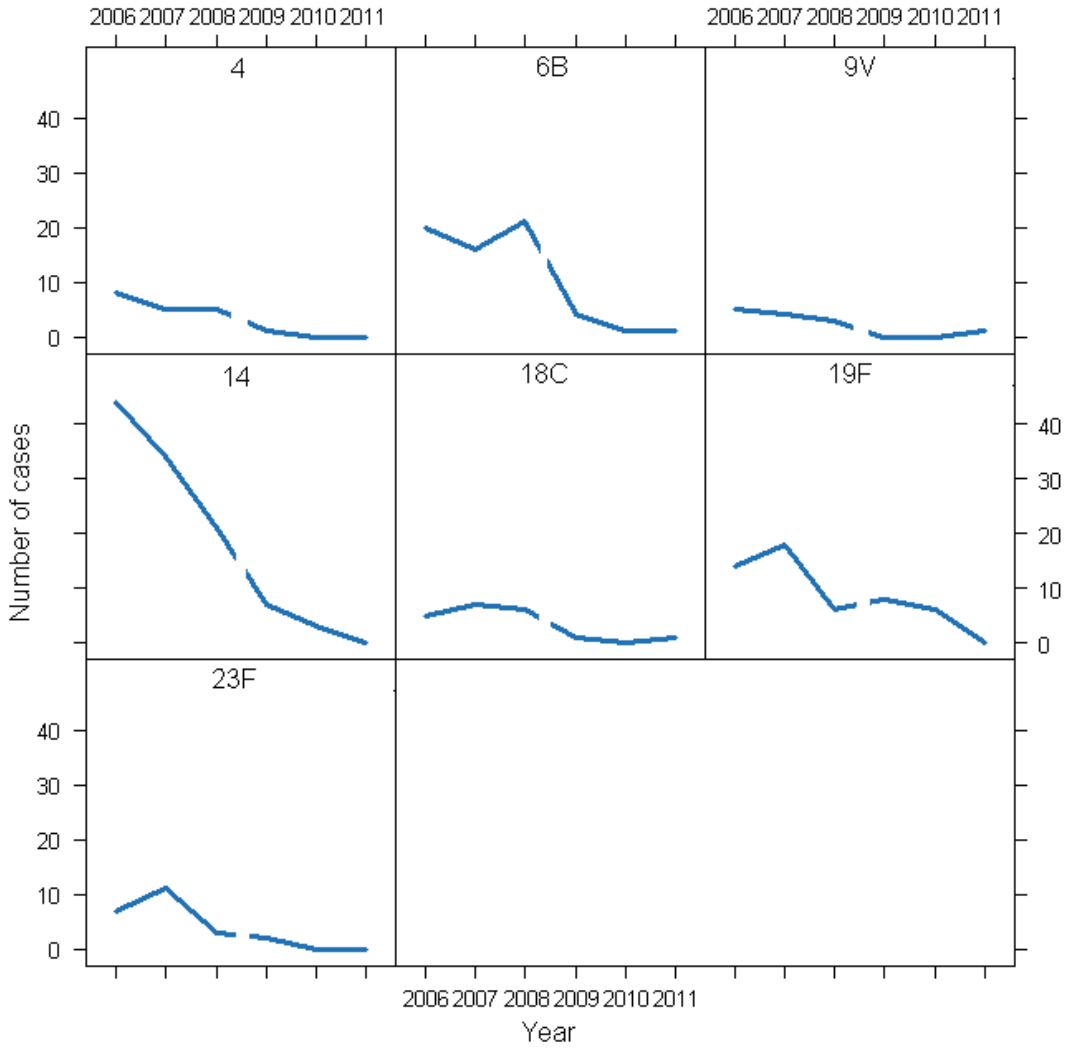
Figure 5. Rate per 100 000 of invasive pneumococcal disease due to PCV7, 19A and other serotypes by age group and year, 2006–2011



Note: 'PCV7 serotypes' includes cases due to serotypes covered by the 7-valent pneumococcal vaccine (PCV7), '19A serotype' includes cases due to serotype 19A, and 'Other serotypes' include all culture-positive IPD cases except serotype 19A and those covered by PCV7. Data presented from 2009 onwards is based on IPD notifications and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD.

Figure 6 shows the trends since 2006 in IPD cases due to each PCV7 serotype for the <2 years age group. There was a decreasing trend in the number of cases for all serotypes included in PCV7 between 2006 and 2011, particularly for types 6B and 14. Notably in 2011, there was no disease due to PCV7 types 4, 14, 19F and 23F in this age group.

Figure 6. Number of invasive pneumococcal disease cases due to each PCV7 serotype in the less than 2 years age group by year, 2006–2011

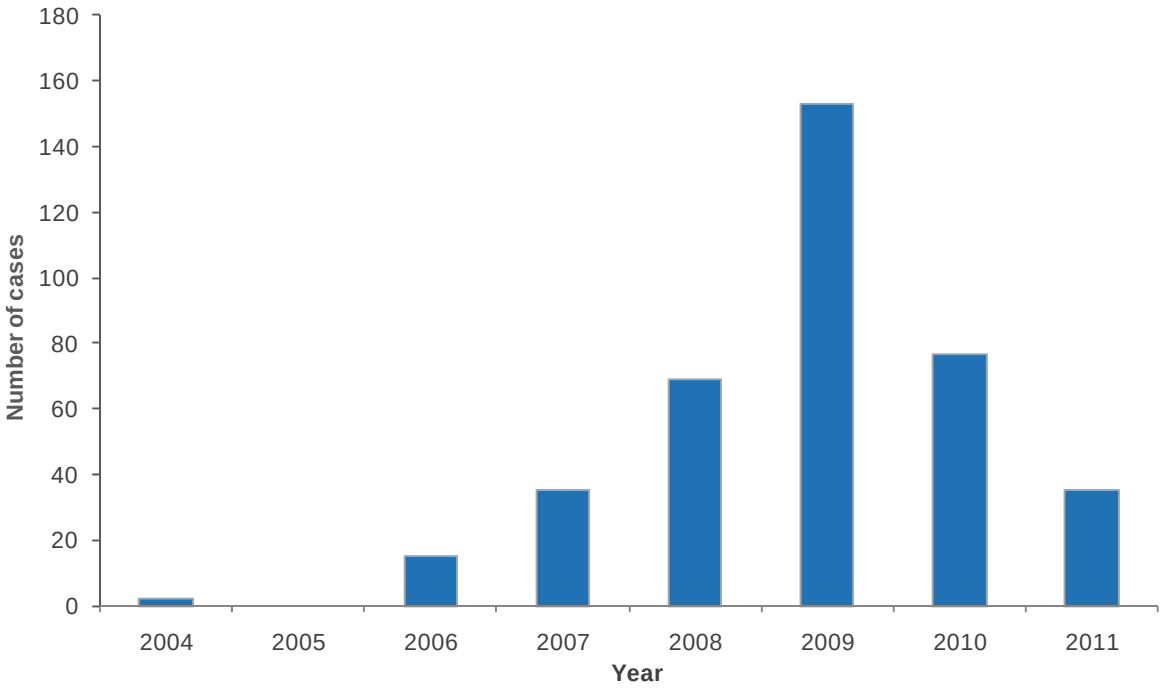


Note: Data presented from 2009 onwards is based on IPD notifications and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD.

In 2011, the non-PCV7 serotype 19A was the most prevalent serotype overall and also among cases aged <5 years and cases aged ≥65 years (Table 8). While the proportion of IPD caused by serotype 19A has increased in the <5 year old age group since the introduction of PCV7, the rate of 19A disease in this age group has remained fairly stable (Figure 5 and Table 26 in the Appendix). Rates of serotype 19A disease have also remained stable among those aged 5-64 years. In contrast to the situation in the younger age groups, there has been a significant increase in the rate of 19A disease in the ≥65 years age group between 2009 and 2011 (from 1.6 to 4.1 per 100 000) (Figure 5 and Table 26 in the Appendix).

Three other non-PCV7 serotypes were prevalent in 2011: 1, 3 and 22F (Table 8). IPD due to serotype 1 increased between 2006 and 2009, when it was the most common serotype, but has decreased in each of the last two years (Figure 7 and Table 27 in the Appendix). The majority of type 1 disease since 2006 has been in older children and young adults in the Māori and Pacific Peoples ethnic groups. Serotypes 3 and 22F are also most commonly isolated from IPD cases ≥5 years of age, and there were no cases of either of these serotypes in cases <5 years in 2011.

Figure 7. Number of invasive pneumococcal disease cases due to serotype 1 by year, 2004–2011



Note: Data presented from 2009 onwards is based on IPD notifications and data prior to 2009 is solely from ESR's national laboratory-based surveillance.

Antimicrobial susceptibility

Table 9 shows the antimicrobial susceptibility of the isolates from the 533 culture-positive IPD cases in 2011. The penicillin and cefotaxime MICs displayed the typical bimodal distribution (Table 28 in the Appendix).

7.1% of isolates had combined penicillin (meningitis interpretation) and erythromycin resistance, and 0.2% had combined penicillin (non-meningitis interpretation) and erythromycin resistance. Among the penicillin-resistant isolates (meningitis interpretation), 41.3% (31/75) were multiresistant to at least 3 additional antibiotics, commonly co-trimoxazole, erythromycin and tetracycline with or without cefotaxime resistance.

Table 9. Antimicrobial susceptibility among isolates from invasive pneumococcal disease cases, 2011

Antibiotic	Interpretive standards			Percent		
	S[a]	I[a]	R[a]	S[a]	I[a]	R[a]
	MIC (mg/L)					
penicillin						
meningitis	≤0.06	-	≥0.12	85.9	-	14.1
non-meningitis	≤2	4	≥8	99.1	0.8	0.2
oral treatment	≤0.06	0.12-1	≥2	85.9	9.4	4.7
cefotaxime						
meningitis	≤0.5	1	≥2	93.4	3.6	3.0
non-meningitis	≤1	2	≥4	97.0	1.1	1.9
	Zone diameter (mm)					
chloramphenicol	≥21	-	≤20	99.1	-	0.9
clindamycin[b]	≥19	16-18	≤15	93.4	0.0	6.6
co-trimoxazole	≥19	16-18	≤15	78.4	0.8	20.8
erythromycin	≥21	16-20	≤15	88.7	0.0	11.3
moxifloxacin	≥18	15-17	≤14	100.0	0.0	0.0
rifampicin	≥19	17-18	≤16	100.0	0.0	0.0
tetracycline	≥23	19-22	≤18	90.6	0.6	8.8
vancomycin	≥17	-	-	100.0	-	-

[a] S: susceptible, I: intermediate, and R: resistant.

[b] The percentage resistant given is for constitutive clindamycin resistance. No isolates had inducible clindamycin resistance.

Trends in penicillin resistance, cefotaxime resistance and multidrug resistance over the last 10 years (2002-2011) are shown in Table 29 (Appendix). The rate of penicillin resistance, based on the meningitis interpretive standards (14.1%), was the lowest recorded in the last 10 years. However, the rates of cefotaxime resistance, based on the meningitis interpretive standards (3.0%), and multiresistance (5.8%) were similar to rates recorded in other years during the last decade.

Trends in resistance to the non-β-lactam antibiotics over the last 10 years are shown in Table 30 (Appendix). All isolates remain susceptible to vancomycin. Moxifloxacin susceptibility has been tested since 2005, with no resistance identified and a maximum of one isolate per year with intermediate resistance. Chloramphenicol resistance is uncommon and has varied between 0.9% and 3.4% during the last 10 years.

Penicillin and cefotaxime resistance in each region and DHB is shown in Table 31 (Appendix). There were no significant differences in resistance between the four regions.

Penicillin and cefotaxime resistance among isolates from the different age groups is shown in Table 10. There were no significant differences in resistance between the age groups.

Table 10. Penicillin and cefotaxime resistance among isolates from invasive pneumococcal disease

Age group (years)	Penicillin		Cefotaxime			
	Resistant[a] MIC ≥0.12 mg/L		Intermediate[a] MIC 1 mg/L		Resistant[a] MIC ≥2 mg/L	
	No[b]	%[c]	No[b]	%[c]	No[b]	%[c]
<2 (n=28)	1	3.6	0	-	0	-
2-4 (n=17)	2	11.8	0	-	0	-
5-64 (n=260)	38	14.6	10	3.9	8	3.1
≥65 (n=228)	34	14.9	9	4.0	8	3.5
All ages (n=533)	**75**	**14.1**	**19**	**3.6**	**16**	**3.0**

[a] Meningitis interpretations; no intermediate category for penicillin.

[b] Number of isolates.

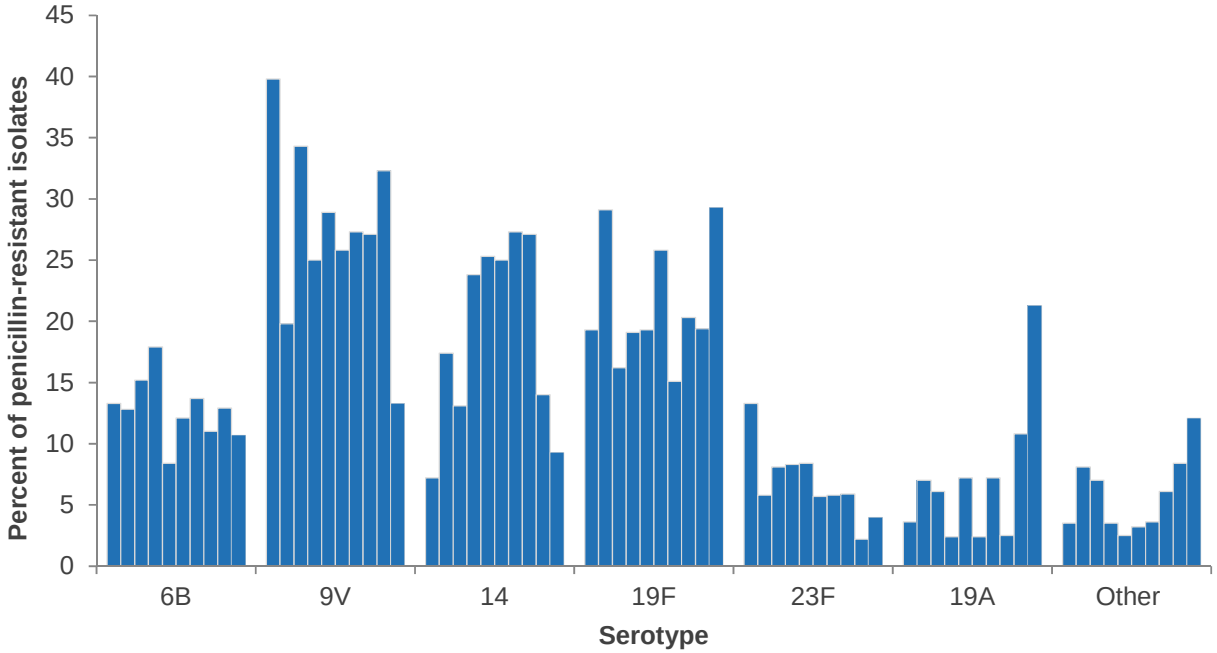
[c] Percentage of the isolates from the cases within the age group.

The majority of the penicillin-resistant (meningitis interpretation) invasive pneumococci were one of the serotypes usually associated with penicillin resistance. 66.7% of the penicillin-resistant isolates and 93.8% of cefotaxime-resistant isolates were serotypes included in PCV7 (Table 32 in the Appendix).

In recent years, serotype 9V has been the prevalent serotype among penicillin-resistant invasive pneumococci, with types 19F and 14 being the other two prevalent serotypes (Figure 8). However, in 2011, serotype 19F was the most common type among penicillin-resistant isolates and accounted for 29.3% of these isolates. After serotype 19F, type 19A accounted for the next largest proportion (21.3%) of penicillin-resistant isolates (Table 32). However, while there has been an increase in the proportion of penicillin-resistant isolates that are serotype 19A, there have been no significant changes in the rates of penicillin, cefotaxime or multidrug resistance among invasive type 19A isolates over the last 10 years (Table 33 in the Appendix).

Serotype 19F was the most common multiresistant serotype (Table 32), accounting for 64.5% of multiresistant isolates. In recent years, the multiresistant type 19F isolates from IPD cases have most commonly been resistant to penicillin, cefotaxime, co-trimoxazole, erythromycin and tetracycline, and, in 2011, 70.0% (14/20) of the multiresistant type 19F isolates had this resistance pattern.

Figure 8. Serotype distribution among penicillin-resistant (meningitis interpretation) pneumococci from invasive disease, 2002–2011



Note: the series of bars for each serotype represent the individual years 2002 to 2011 from left to right

DISCUSSION

DISCUSSION

A 4-dose schedule of PCV7 (3-dose primary series plus booster) was added to the New Zealand childhood immunisation schedule in June 2008, with a catch-up programme for all children born on or after 1 January 2008. In late 2011, PCV10 replaced PCV7 as supplies of the latter were depleted.

In 2011, the third full year after the introduction of PCV into the schedule, the impact of routine infant immunisation is very evident among those children age-eligible for vaccination. The rate of IPD in the <2 years age group has declined by 76% since the introduction of PCV7: from an average of 100.3 per 100 000 population in 2006/2007 to 23.8 per 100 000 in 2011. The reduction in IPD caused by PCV7 serotypes in this age group is even more striking than the reduction in all IPD, with a 97% decrease from an average of 83.1 per 100 000 population in 2006/2007 to 2.4 per 100 000 in 2011 (note that the 2011 rate was calculated based on 3 cases only). The actual reductions in disease rates may be greater than these figures indicate, as the 2011 rates are based on IPD notifications whereas the rates for 2006/2007 are based on case numbers captured by laboratory-based surveillance, which, compared with notifications, is likely to underestimate the burden of IPD.

The rate of IPD has now also decreased significantly in the 2-4 years age group, with a 54% reduction from an average of 20.8 per 100 000 population in 2006/2007 to 9.6 per 100 000 in 2011. Again, the decrease in the subset of IPD caused by PCV7 types over the same time period was greater, with a 76% reduction from 15.5 to 3.7 per 100 000. This is as expected, as some vaccine-eligible children (ie, those born in 2008 and 2009) were in this age group in 2011.

These dramatic reductions in the incidence of IPD in the vaccine-eligible age groups in New Zealand mirror the global experience following the introduction of infant PCV immunisation. Global experience has also shown that, within a year or two of the introduction of infant PCV immunisation, the incidence of pneumococcal disease in non-vaccinated children and adults also begins to fall due to indirect or herd immunity [12, 13]. In New Zealand, such an indirect effect was evident by 2010, when a significant decrease in the rate of IPD due to PCV7 serotypes in the ≥65 year age group was first observed [3]. By 2011, the rate of IPD due to PCV7 types in this age group had decreased 41%: from an average of 22.2 per 100 000 population in 2006/2007 to 13.1 per 100 000. In 2011, the indirect effects of routine infant immunisation extended to the 5-64 year age group, in which there was a 28% decrease between 2006/2007 and 2011 (3.6 to 2.6 per 100 000). These results mean there have now been significant reductions in IPD due to PCV7 serotypes in all age groups. However, unlike the situation in the <5 year olds, there have been no corresponding significant decreases in the overall rate of IPD in either the 5-64 or ≥65 year age groups. This is probably due to PCV7 serotypes constituting a smaller proportion of the disease in these age groups than those groups directly targeted for vaccination and also some serotype replacement in the older age groups (see discussion below) [8].

Data on IPD among the different ethnic groups is only available since 2009, that is, since IPD became a notifiable disease. In 2011, as was observed in 2009 and 2010, the age-standardised rates of IPD in Māori and Pacific Peoples were at least 3 times that in Europeans. This unequal burden of IPD in Māori and Pacific Peoples is consistent with ethnic group disparities identified generally for infectious diseases in New Zealand [14]. However, between 2009 and 2011, among infants <2 years of age there has been a significant decrease in IPD rates in Māori (86.6 to 45.2 per 100 000 population) as well as the European or Other ethnic group (27.7 to 7.4 per 100 000), but only a small and insignificant decrease among Pacific infants (64.0 to 56.6 per 100 000). These decreases between 2009 and 2011 will be underestimates, at least for some ethnic groups, of the real impact of vaccination, as by 2009 the rate of IPD had already decreased by 54% in this age group compared with the pre-vaccine years of 2006/2007 [2]. The relatively small decrease in IPD rates among Pacific infants is notable and may be because IPD in this ethnic group was less commonly caused by vaccine types. Unfortunately, due the lack of pre-vaccine era ethnicity data, the serotypes prevalent in this ethnic group before the introduction of PCV are not known. However, it is interesting that in the 3 years that ethnicity data has been available, there have been no cases of IPD due to a PCV7 type in a Pacific infant <2 years of age.

As with all vaccines that target only specific types, there is concern that pneumococcal serotypes not included in PCV7 will increase and essentially 'replace' vaccine types as the principal cause of IPD. This appears to have happened to some extent in several countries, although any increases in disease due to non-vaccine types have usually been somewhat smaller than the reductions in disease due to vaccine types [12, 13, 15]. Serotype 19A is the non-PCV7 type most frequently reported to have increased [12, 15], but increases in other non-PCV7 serotypes, for example 7F and 22F in England and Wales, have also been reported [13].

Increases in type 19A disease have been of special concern as this serotype is often associated with antibiotic resistance [16, 17]. There have been recent reports of increasing rates of resistance among invasive serotype 19A isolates associated with shifts in the genetic structure of the isolates and the expansion of particular resistant clonal complexes [18]. In 2011, for the first time there was a significant increase in the rate of 19A disease in New Zealand, but only in the ≥65 year age group with a rise from 1.6 to 4.1 per 100 000 population between 2009 and 2011. However, invasive serotype 19A isolates in this country are not especially associated with resistance and there have been no significant changes in resistance among this type over the last 10 years.

While there has been very little change in the rates of IPD due to serotype 19A in <5 year olds since the introduction of PCV, this does not discount the importance of 19A in this age group. This type now accounts for the largest proportion (29%) of the remaining disease in this age group. Therefore, given the significant increase in the rate of 19A IPD in ≥65 year olds and the large proportion of remaining disease this type is responsible for in the younger age groups, close monitoring of trends in this serotype will be important to assist with decisions on the selection of vaccines for the schedule. This serotype is included in PCV13 but not PCV10, however, the 19F conjugated polysaccharide in PCV10 appears to induce antibody that confers some cross-protection against serotype 19A [19]. Given that PCV10 was only introduced in late 2011, it is too soon to judge whether cross-protection for 19A is occurring in New Zealand.

Serotype 22F has also been implicated in serotype replacement following the introduction of PCV [13]. In New Zealand in 2011, type 22F was a common non-PCV7 or non-PCV10 type, but it was only identified among cases in the older age groups. Unlike the situation for serotype 19A, type 22F is not included in any of the currently available pneumococcal conjugate vaccines, although it is in PPV23.

It is now clear that New Zealand has experienced a recent 'outbreak' of serotype 1 disease which started in 2006, peaked in 2009 with 153 cases, and then declined to 35 cases in 2011. These serotype 1 cases were strongly associated with IPD in Māori and Pacific school-age children and young adults. However, this increase in serotype 1 disease is unlikely to be a result of serotype replacement following the introduction of PCV7 since the increase in this type commenced before the introduction of the vaccine. This pattern of serotype 1 disease fits with that observed globally for this serotype, that is, outbreaks that occur cyclically every few years [20].

In 2011, most (86%) of the IPD cases in infants who had received ≥1 dose of PCV7 were due to a non-PCV7 type. Among the four cases who had received ≥1 dose of PCV7 and had disease due to a PCV7 type, two had serotype 19F disease, one had type 6B disease and one had type 18C disease. Serotypes 19F and 6B were found to be the most common types associated with vaccine breakthrough cases in a United States study [21].

As most antimicrobial-resistant invasive pneumococci belong to one of the serotypes included in PCV7, a decrease in IPD caused by vaccine types would be expected, and has been observed in other countries, to have the concomitant effect of reducing the incidence of IPD caused by resistant pneumococci [22]. As yet there is little change in the prevalence of resistance among isolates from IPD cases in New Zealand, although the rate of penicillin resistance in 2011 (14.1%) was the lowest recorded in the last 10 years. In 2011, PCV7 serotypes accounted for a smaller proportion (67%) of the penicillin-resistant isolates than in previous years, whereas type 19A accounted for a larger proportion (21%) than in previous years (3% and 11% in 2009 and 2010, respectively) [2, 3]. However, this increase in the proportion of penicillin-resistant isolates that were serotype 19A was not due to penicillin resistance becoming more prevalent among this serotype but rather due to type 19 causing a greater proportion of the IPD cases.

In late 2011, PCV10 (Synflorix®) replaced PCV7 on the childhood immunisation schedule. PCV10 will give additional coverage for serotypes 1, 5 and 7F. Hopefully, the serotype 1 coverage will prevent future outbreaks of this serotype such as that we have recently experienced in New Zealand. As the main protein carrier in Synflorix is protein D, an immunogenic protein on the surface of non-typable *Haemophilus influenzae*, this vaccine should also provide some protection against non-typable *H. influenzae* infections [23].

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APPENDIX

APPENDIX

Table 11. Laboratory criteria upon which invasive pneumococcal disease diagnosis based, as recorded in the case notification, 2011

Basis of diagnosis	Prioritised[a]		Total response	
	No.	%	No.	%
Culture of *S. pneumoniae* from:	**551**	**99.8**	**551**	**99.8**
Blood	492	89.1	498	90.2
CSF	15	2.7	15	2.7
Pleural fluid	9	1.6	10	1.8
Joint fluid	4	0.7	5	0.9
Other	31	5.6	36	6.5
Positive pneumococcal antigen test on CSF[b]	**1**	**0.2**	**3**	**0.5**
Detection of pneumococcal DNA	**0**	**-**	**0**	**-**

[a] For several cases, more than one method of laboratory confirmation was recorded. In the prioritised analysis, only one method of laboratory confirmation was counted for each case, with methods prioritised in the following order: culture of *S. pneumoniae* from CSF, culture of *S. pneumoniae* from blood, positive pneumococcal antigen test on CSF, culture of *S. pneumoniae* from pleural fluid, culture of *S. pneumoniae* from joint fluid, and culture of *S. pneumoniae* from another normally sterile site.

[b] All cases notified as being diagnosed on the basis of a positive antigen test on CSF also had a positive CSF or blood culture.

Figure 9. Number of invasive pneumococcal disease cases in the less than 2 years age group by age (in months), 2011

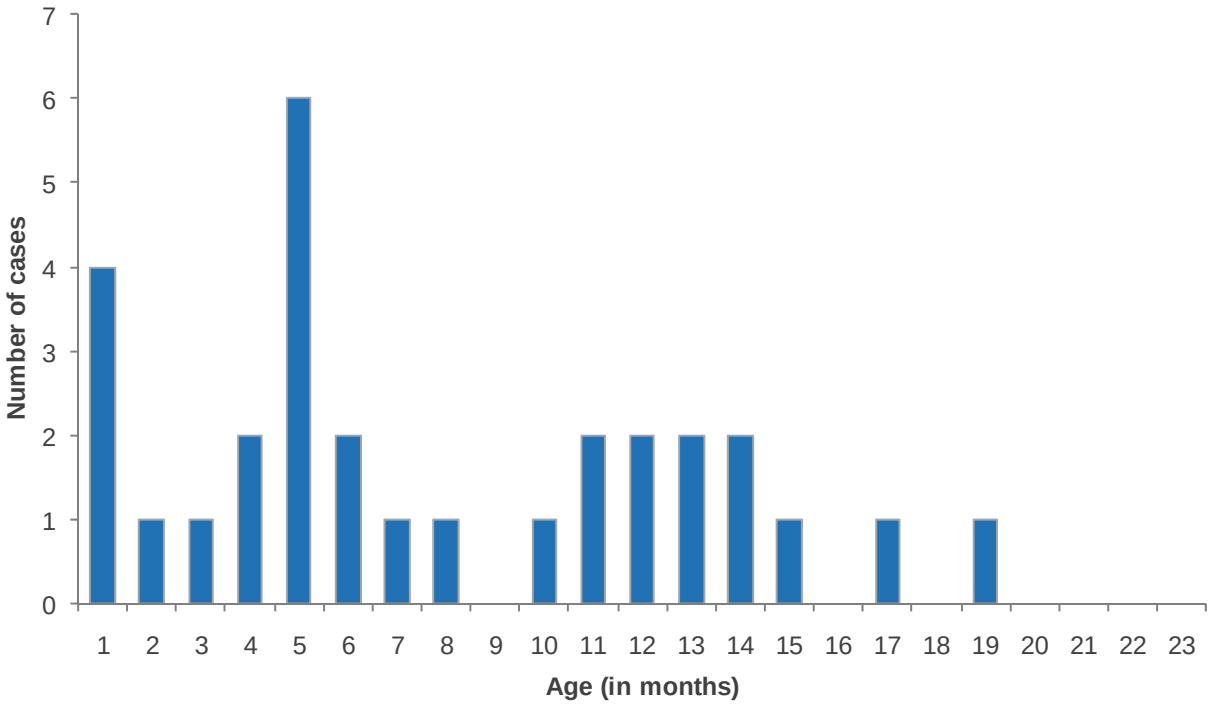

Table 12. Number of cases and rate per 100 000 population of invasive pneumococcal disease by age group and year, 2006–2011

Age group (years)	2006		2007		2008		2009		2010		2011	
	No	Rate	No	Rate	No	Rate	No	Rate	No	Rate	No	Rate
<1	71	120.2	48	77.7	37	57.7	34	53.9	22	34.5	23	36.9
1	51	88.9	68	115.3	42	68.2	25	39.1	15	23.8	7	11.0
2-4	31	18.3	40	23.3	35	20.1	41	23.0	28	15.1	18	9.6
5-14	20	3.3	29	4.9	35	5.9	58	9.9	23	3.9	29	5.0
15-24	15	2.5	19	3.1	29	4.7	53	8.4	25	3.9	27	4.2
25-34	16	2.9	24	4.4	32	5.9	53	9.6	25	4.5	40	7.1
35-44	54	8.5	41	6.5	53	8.5	68	11.0	39	6.4	36	6.0
45-54	42	7.4	37	6.3	55	9.2	55	9.1	59	9.6	55	8.9
55-64	56	13.0	63	14.3	87	19.1	69	14.7	75	15.6	87	17.6
65-74	67	24.3	87	30.5	87	29.8	94	31.1	80	25.5	84	25.8
75-84	68	38.2	73	40.5	88	48.3	94	51.1	87	46.8	88	46.7
≥85	34	58.5	26	42.6	51	80.0	53	79.6	57	81.3	58	79.3
Aggregated age groups (years)												
<2	122	104.8	116	96.1	79	62.9	59	46.4	37	29.2	30	23.8
<5	153	53.5	156	53.4	114	38.0	100	32.7	65	20.8	48	15.3
5-64	203	6.0	213	6.2	291	8.5	356	10.3	246	7.1	274	7.8
≥65	169	33.0	186	35.3	226	42.0	241	43.6	224	39.4	230	39.2
Total	**525**	**12.5**	**555**	**13.1**	**631**	**14.8**	**697**	**16.1**	**535**	**12.2**	**552**	**12.5**

Note Data presented from 2009 onwards is based on IPD notifications and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD.

Table 13. Rate per 100 000 population of invasive pneumococcal disease by ethnic group, age group and year, 2009–2011

Age group (years)	Ethnic group[a]											
	Māori			Pacific Peoples			Asian			European or Other		
	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
<2	86.6	62.8	45.2	64.0	48.1	56.6	-	-	-	27.7	13.1	7.4
<5	50.0	38.9	24.9	49.6	35.6	25.7	19.5	26.8	22.8	23.2	9.3	6.9
5-64	21.1	13.9	12.0	28.0	25.5	18.7	3.7	2.2	2.0	7.0	4.3	6.4
≥65	97.2	80.4	98.3	106.2	150.8	92.3	30.0	-	-	37.4	35.0	34.7
All ages[b,c]	**35.9**	**27.9**	**29.4**	**42.3**	**48.0**	**32.4**	**10.1**	**7.6**	**5.6**	**11.8**	**8.3**	**9.8**

[a] Rates were not calculated for the Middle Eastern/Latin American/African (MELAA) ethnic group as there were less than five cases reported each year for this ethnic group (2009, 1 case; 2010, 3 cases; 2011, 3 cases).

[b] The all-ages rates presented were calculated using direct-standardisation to the age distribution of the total New Zealand population.

[c] Ethnicity was recorded for 538 (97.5%) cases notified in 2011, 532 (99.4%) cases in 2010, and 680 (97.6%) cases in 2009.

Note:

Ethnicity data is not available for the years prior to 2009 (when IPD surveillance was laboratory-based).

Denominator data used to determine disease rates for ethnic groups is based on the proportion of people in each ethnic group from the estimated resident 2006 census population applied to the 2011 mid-year population estimates from Statistics New Zealand. Ethnicity is prioritised in the following order: Māori, Pacific Peoples, Asian, MELAA and European or Other Ethnicity (including New Zealander). Where there are fewer than five cases in any category, a rate has not been calculated.

Table 14. Number of cases and rate per 100 000 population of invasive pneumococcal disease by clinical presentation and age group, 2011

Age group (years)	Meningitis		Bacteraemia without focus		Empyema		Pneumonia		Other	
	No[a]	Rate[b]	No[a]	Rate[b]	No[a]	Rate[b]	No[a]	Rate[b]	No[a]	Rate[b]
<1	4	-	4	-	1	-	6	9.6	6	9.6
1	2	-	1	-	1	-	1	-	1	-
2-4	2	-	4	-	3	-	12	6.4	5	2.7
5-14	5	0.9	4	-	2	-	14	2.4	6	1.0
15-64	15	0.5	30	1.0	10	0.3	176	6.0	31	1.1
≥65	12	2.0	37	6.3	3	0.5	173	29.5	31	5.3
Total[c]	**40**	**0.9**	**80**	**1.8**	**20**	**0.5**	**382**	**8.7**	**80**	**1.8**

[a] Number of cases with 'yes' recorded to each clinical presentation. Cases may have more than one clinical presentation recorded. Any case for which *S. pneumoniae* was identified by CSF were considered to be cases of pneumococcal meningitis.

[b] Where there are fewer than five cases, a rate has not been calculated.

[c] At least one clinical presentation was recorded for 503 (91.1%) of cases notified in 2011.

Table 15. Case-fatality rates for invasive pneumococcal disease cases by age group, 2011

Age group (years)	No. died[a]	No. reported[b]	Case-fatality rate[b] (%)
<1	0	19	-
1	0	6	-
2-4	0	18	-
5-14	0	28	-
15-64	7	224	3.1
≥65	25	210	11.9
Total	**32**	**505**	**6.3**

[a] Number of cases where IPD was recorded as the primary cause of death.

[b] Number of cases where information on whether they survived or died was recorded.

[c] Calculated on the basis of the number of cases for whom the information on outcomes was recorded. Information on whether the case survived or died was recorded for 505 (91.5%) of cases notified in 2011.

Table 16. Exposure to risk factors associated with invasive pneumococcal disease for cases aged less than two years, 2011

Risk factor	No. of cases[a]	Total reported[b]	%[c]
Smoking in the household	7	11	63.6
Premature (<37 weeks gestation)[d]	5	13	38.5
Chronic illness	2	26	7.7
Attends childcare	1	16	6.3
Chronic lung disease or cystic fibrosis	1	26	3.8
Cochlear implants	1	26	3.8
Resident in long-term or other chronic care facility	1	27	3.7

[a] Number of cases with 'yes' recorded for each risk factor. Cases may record more than one risk factor.

[b] Number of cases where information was recorded for each risk factor.

[c] Percentage of cases with the risk for which the information was supplied.

[d] Cases aged <1 year only.

Note: No cases aged <2 years were reported as having congenital and chromosomal abnormality, having anatomical or functional asplenia, or being immunocompromised.

Table 17. Exposure to risk factors associated with invasive pneumococcal disease for cases aged less than five years, 2011

Risk factor	No. of cases[a]	Total reported[b]	%[c]
Premature (<37 weeks gestation)[d]	5	13	38.5
Smoking in the household	7	21	33.3
Attends childcare	2	18	11.1
Chronic illness[e]	3	44	6.8
Chronic lung disease or cystic fibrosis	2	44	4.5
Congenital or chromosomal abnormality	1	42	2.4
Cochlear implants	1	43	2.3
Resident in long-term or other chronic care facility	1	45	2.2

[a] Number of cases with 'yes' recorded for each risk factor. Cases may record more than one risk factor.

[b] Number of cases where information was recorded for each risk factor.

[c] Percentage of cases with the risk for which the information was supplied.

[d] Cases aged <1 year only.

[e] Includes CSF leak, intracranial shunts, diabetes, cardiac disease, pulmonary disease, chronic liver disease, renal impairment and alcohol-related disease.

Note: No cases aged <5 years were reported as having anatomical or functional asplenia or being immunocompromised.

Table 18. Exposure to risk factors associated with invasive pneumococcal disease for cases aged 5 years and over, 2011

Risk factor	No. of cases[a]	Total reported[b]	%[c]
Chronic illness[d]	261	448	58.3
Current smoker[e]	81	323	25.1
Immunocompromised[f]	91	432	21.1
Chronic lung disease or cystic fibrosis	76	444	17.1
Resident in long-term or other chronic care facility[g]	41	453	9.1
Anatomical or functional asplenia	5	411	1.2
Congenital and chromosomal abnormality	5	433	1.2
Cochlear implants	4	384	1.0

[a] Number of cases with 'yes' recorded for each risk factor. Cases may record more than one risk factor.

[b] Number of cases where information was recorded for each risk factor.

[c] Percentage of cases with the risk for which the information was supplied.

[d] Includes CSF leak, intracranial shunts, diabetes, cardiac disease, pulmonary disease, chronic liver disease, renal impairment and alcohol-related disease.

[e] Cases aged ≥18 years only.

[f] Includes HIV/AIDS, lymphoma, organ transplant, multiple myeloma, nephrotic syndrome, chronic drug therapy, dysgammaglobulinaemia and sickle cell anaemia.

[g] Among cases in the ≥75 years age group, 28.3% (36 cases out of 127 for whom the information was reported) were residents in a long-term or other chronic-care facility.

Table 19. Number and rate per 100 000 population of invasive pneumococcal disease cases by serotype for each age group, 2011

Serotype	<2 years		2–4 years		<5 years[a]		5–64 years		≥65 years[b]		Total	
	No	Rate[c]	No	Rate[c]	No	Rate[c]	No	Rate[c]	No	Rate[c]	No	Rate[c]
PCV7	**3**	**-**	**7**	**3.7**	**10**	**3.2**	**91**	**2.6**	**77**	**13.1**	**178**	**4.0**
4	0	-	1	-	1	-	30	0.9	15	2.6	46	1.0
6B	1	-	0	-	1	-	7	0.2	10	1.7	18	0.4
9V	1	-	0	-	1	-	10	0.3	3	-	14	0.3
14	0	-	1	-	1	-	18	0.5	9	1.5	28	0.6
18C	1	-	1	-	2	-	7	0.2	7	1.2	16	0.4
19F	0	-	3	-	3	-	14	0.4	22	3.7	39	0.9
23F	0	-	1	-	1	-	5	0.1	11	1.9	17	0.4
PCV10	**7**	**5.6**	**10**	**5.3**	**17**	**5.4**	**132**	**3.8**	**80**	**13.6**	**229**	**5.2**
1	2	-	1	-	3	-	30	0.9	2	-	35	0.8
5	0	-	0	-	0	-	0	-	0	-	0	-
7F	2	-	2	-	4	-	11	0.3	1	-	16	0.4
PCV13	**15**	**11.9**	**15**	**8.0**	**30**	**9.5**	**183**	**5.2**	**126**	**21.5**	**339**	**7.7**
3	0	-	0	-	0	-	22	0.6	17	2.9	39	0.9
6A	0	-	0	-	0	-	3	-	5	0.9	8	0.2
19A	8	6.4	5	2.7	13	4.1	26	0.7	24	4.1	63	1.4
Non-PCV[d]	**13**	**10.3**	**2**	**-**	**15**	**4.8**	**77**	**2.2**	**102**	**17.4**	**194**	**4.4**
6C	1	-	0	-	1	-	6	0.2	9	1.5	16	0.4
8	2	-	0	-	2	-	9	0.3	2	-	13	0.3
9N	1	-	0	-	1	-	3	-	11	1.9	15	0.3
10A	1	-	0	-	1	-	5	0.1	5	0.9	11	0.2
11A	1	-	0	-	1	-	5	0.1	8	1.4	14	0.3
22F	0	-	0	-	0	-	17	0.5	21	3.6	38	0.9
33F	1	-	0	-	1	-	2	-	8	1.4	11	0.2
35	3	-	0	-	3	-	3	-	5	0.9	11	0.2
Other	3	-	2	-	5	1.6	27	0.8	33	5.6	65	1.5
Total[e]	**28**	**22.2**	**17**	**9.6**	**45**	**14.3**	**260**	**7.4**	**228**	**38.8**	**533**	**12.1**

[a] Rate per 100 000 population. Rates were not calculated where there were fewer than five in any category.

[b] Among the cases in the ≥65 year age group, 80.4% were due to one of the serotypes included in PPV-23. Vaccination with PPV-23 is recommended for people in this age group.

[c] Aggregated age group.

[d] The specific serotypes listed are those that accounted for more than 10 cases of IPD in 2011.

[e] Culture-positive cases only.

Table 20. Number and percentage of cases among invasive pneumococcal disease cases by serotype for each age group, 2011

Serotype	<2 years		<5 years		5-64 years		≥65 years		All ages	
	No	%[a]	No	%[a]	No	%[a]	No	%[a]	No	%[a]
1	2	7.1	3	6.7	30	11.5	2	0.9	35	6.6
3	0	-	0	-	22	8.5	17	7.5	39	7.3
4	0	-	1	2.2	30	11.5	15	6.6	46	8.6
6A	0	-	0	-	3	1.2	5	2.2	8	1.5
6B	1	3.6	1	2.2	7	2.7	10	4.4	18	3.4
6C	1	3.6	1	2.2	6	2.3	9	3.9	16	3.0
8	2	7.1	2	4.4	9	3.5	2	0.9	13	2.4
9N	1	3.6	1	2.2	3	1.2	11	4.8	15	2.8
9V	1	3.6	1	2.2	10	3.8	3	1.3	14	2.6
10A	1	3.6	1	2.2	5	1.9	5	2.2	11	2.1
11	0	-	0	-	1	0.4	0	-	1	0.2
11A	1	3.6	1	2.2	5	1.9	8	3.5	14	2.6
12F	0	-	0	-	2	0.8	0	-	2	0.4
13	0	-	0	-	1	0.4	0	-	1	0.2
14	0	-	1	2.2	18	6.9	9	3.9	28	5.3
15B	0	-	2	4.4	2	0.8	1	0.4	5	0.9
15 (not 15B)	0	-	0	-	0	-	2	0.9	2	0.4
16	0	-	0	-	0	-	2	0.9	2	0.4
17F	0	-	0	-	3	1.2	4	1.8	7	1.3
18A	0	-	0	-	1	0.4	0	-	1	0.2
18C	1	3.6	2	4.4	7	2.7	7	3.1	16	3.0
19A	8	28.6	13	28.9	26	10.0	24	10.5	63	11.8
19F	0	-	3	6.7	14	5.4	22	9.6	39	7.3
20	0	-	0	-	3	1.2	4	1.8	7	1.3
21	1	3.6	1	2.2	1	0.4	1	0.4	3	0.6
22A	0	-	0	-	1	0.4	2	0.9	3	0.6
22F	0	-	0	-	17	6.5	21	9.2	38	7.1
22 (not 22A or 22F)	0	-	0	-	1	0.4	1	0.4	2	0.4
23A	0	-	0	-	2	0.8	1	0.4	3	0.6
23B	0	-	0	-	1	0.4	1	0.4	2	0.4
23F	0	-	1	2.2	5	1.9	11	4.8	17	3.2
31	0	-	0	-	0	-	3	1.3	3	0.6
33F	1	3.6	1	2.2	2	0.8	8	3.5	11	2.1
34	0	-	0	-	1	0.4	2	0.9	3	0.6
35	3	10.7	3	6.7	3	1.2	5	2.2	11	2.1
37	0	-	0	-	0	-	2	0.9	2	0.4
38	1	3.6	1	2.2	1	0.4	3	1.3	5	0.9
7A	1	3.6	1	2.2	4	1.5	3	1.3	8	1.5
7F	2	7.1	4	8.9	11	4.2	1	0.4	16	3.0
7 (not 7A or 7F)	0	-	0	-	1	0.4	0	-	1	0.2
Non-typable	0	-	0	-	1	0.4	1	0.4	2	0.4
Total[b]	**28**		**45**		**260**		**228**		**533**	

[a] Percentage of cases due to each serotype out of the total number of culture-positive cases within the age group.

[b] Total number of culture-positive cases for each age group.

Table 21. Number and rate per 100 000 population among invasive pneumococcal disease cases in the less than 2 years age group by serotype, 2006/2007–2011

Serotype	2006/2007		2008		2009		2010		2011	
	Cases[a]	Rate[b]	Cases[c]	Rate[d]	Cases[c]	Rate[d]	Cases[c]	Rate[d]	Cases[c]	Rate[d]
PCV7	**98.5**	**83.1**	**65**	**51.7**	**23**	**18.1**	**10**	**7.9**	**3**	**-**
4	6.5	5.5	5	4.0	1	-	0	-	0	-
6B	18.0	15.2	21	16.7	4	-	1	-	1	-
9V	4.5	3.8	3	-	0	-	0	-	1	-
14	39.0	32.9	21	16.7	7	5.5	3	-	0	-
18C	6.0	5.1	6	4.8	1	-	0	-	1	-
19F	15.5	13.1	6	4.8	8	6.3	6	4.7	0	-
23F	9.0	7.6	3	-	2	-	0	-	0	-
PCV10	**101**	**85.2**	**66**	**52.5**	**36**	**28.3**	**14**	**11.0**	**7**	**5.6**
1	2.0	-	1	-	12	9.4	2	-	2	-
5	0.0	-	0	-	0	-	0	-	0	-
7F	0.5	-	0	-	1	-	2	-	2	-
PCV13	**111**	**93.6**	**71**	**56.5**	**49**	**38.6**	**25**	**19.7**	**16**	**12.7**
3	1.0	-	0	-	3	-	2	-	0	-
6A/6C[e]	3.0	-	0	-	2	-	2	-	1	-
19A	6.0	5.1	5	4.0	8	6.3	7	5.5	8	6.4
Non-PCV[f]	**6.5**	**5.5**	**7**	**5.6**	**6**	**4.7**	**11**	**8.7**	**12**	**9.5**
8	0.0	-	2	-	0	-	0	-	2	-
9N	0.0	-	0	-	0	-	0	-	1	-
10A	0.5	-	1	-	0	-	1	-	1	-
11A	0.5	-	0	-	1	-	0	-	1	-
22F	1.0	-	0	-	1	-	1	-	0	-
33F	0.5	-	1	-	0	-	4	-	1	-
35	0.0	-	1	-	0	-	1	-	3	-
Other	4.0	-	2	-	4	-	4	-	3	-

[a] Average number of cases during 2006/2007.
[b] Average rate per 100 000 population during 2006/2007.
[c] Number of cases reported.
[d] Rate per 100 000 population.
[e] Serotypes 6A and 6C were only distinguished from 2010 onwards; therefore they have been combined for this analysis.
[f] Specific serotypes listed are those that accounted for ≥10 cases in 2011.

Note: Data presented from 2009 onwards is based on IPD notifications and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD.

Table 22. Number and rate per 100 000 population among invasive pneumococcal disease cases in the less than 5 years age group by serotype, 2006/2007–2011

Serotype	2006/2007		2008		2009		2010		2011	
	Cases[a]	Rate[b]	Cases[c]	Rate[d]	Cases[c]	Rate[d]	Cases[c]	Rate[d]	Cases[c]	Rate[d]
PCV7	**125.0**	**43.2**	**89**	**29.7**	**50**	**16.4**	**24**	**7.7**	**10**	**3.2**
4	8.0	2.8	7	2.3	2	-	2	-	1	-
6B	23.5	8.1	25	8.3	8	2.6	2	-	1	-
9V	7.0	2.4	4	-	1	-	2	-	1	-
14	47.5	16.4	31	10.3	17	5.6	7	2.2	1	-
18C	10.5	3.6	6	2.0	4	-	0	-	2	-
19F	19.0	6.6	11	3.7	13	4.3	9	2.9	3	-
23F	9.5	3.3	5	1.7	5	1.6	2	-	1	-
PCV10	**128.0**	**44.3**	**94**	**31.3**	**66**	**21.6**	**35**	**11.2**	**17**	**5.4**
1	2.5	-	5	1.7	15	4.9	9	2.9	3	-
5	0.0	-	0	-	0	-	0	-	0	-
7F	0.5	-	0	-	1	-	2	-	4	-
PCV13	**144.0**	**49.8**	**103**	**34.3**	**84**	**27.5**	**51**	**16.4**	**31**	**9.9**
3	1.0	-	0	-	3	-	4	-	0	-
6A/6C[e]	4.5	1.6	2	-	3	-	2	-	1	-
19A	10.5	3.6	7	2.3	12	3.9	10	3.2	13	4.1
Non-PCV[f]	**9.0**	**3.1**	**9**	**3.0**	**9**	**2.9**	**12**	**3.8**	**14**	**4.5**
8	0.0	-	2	-	0	-	0	-	2	-
9N	0.0	-	0	-	2	-	0	-	1	-
10A	1.0	-	2	-	0	-	1	-	1	-
11A	0.5	-	0	-	1	-	0	-	1	-
22F	1.0	-	0	-	1	-	1	-	0	-
33F	1.0	-	1	-	0	-	4	-	1	-
35	0.0	-	1	-	0	-	1	-	3	-
Other	5.5	1.9	3	-	5	1.6	5	1.6	5	1.6

[a] Average number of cases during 2006/2007.
[b] Average rate per 100 000 population during 2006/2007.
[c] Number of cases reported.
[d] Rate per 100 000 population.
[e] Serotypes 6A and 6C were only distinguished from 2010 onwards; therefore they have been combined for this analysis.
[f] Specific serotypes listed are those that accounted for ≥10 cases in 2011.

Note: Data presented from 2009 onwards is based on IPD notifications and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD.

Table 23. Number and rate per 100 000 population among invasive pneumococcal disease cases in the 5–64 years age group by serotype, 2006/2007–2011

Serotype	2006/2007		2008		2009		2010		2011	
	Cases[a]	Rate[b]	Cases[c]	Rate[d]	Cases[c]	Rate[d]	Cases[c]	Rate[d]	Cases[c]	Rate[d]
PCV7	**121.0**	**3.6**	**128**	**3.7**	**130**	**3.8**	**83**	**2.4**	**91**	**2.6**
4	38.0	1.1	33	1.0	32	0.9	26	0.7	30	0.9
6B	11.5	0.3	9	0.3	8	0.2	4	-	7	0.2
9V	11.0	0.3	19	0.6	15	0.4	13	0.4	10	0.3
14	31.0	0.9	29	0.8	23	0.7	15	0.4	18	0.5
18C	5.5	0.2	8	0.2	10	0.3	4	-	7	0.2
19F	12.0	0.4	15	0.4	26	0.8	12	0.3	14	0.4
23F	12.0	0.4	15	0.4	16	0.5	9	0.3	5	0.1
PCV10	**146.0**	**4.3**	**196**	**5.7**	**267**	**7.7**	**145**	**4.2**	**132**	**3.8**
1	19.0	0.6	56	1.6	124	3.6	58	1.7	30	0.9
5	0.0	-	0	-	0	-	0	-	0	-
7F	6.0	0.2	12	0.3	13	0.4	4	-	11	0.3
PCV13	**169.5**	**5.0**	**239**	**7.0**	**300**	**8.7**	**183**	**5.2**	**189**	**5.4**
3	8.5	0.3	16	0.5	12	0.3	9	0.3	22	0.6
6A/6C[e]	5.0	0.1	5	0.1	5	0.1	6	0.2	9	0.3
19A	10.0	0.3	22	0.6	16	0.5	23	0.7	26	0.7
Non-PCV[f]	**38.0**	**1.1**	**52**	**1.5**	**42**	**1.2**	**51**	**1.5**	**71**	**2.0**
8	12.0	0.4	11	0.3	8	0.2	7	0.2	9	0.3
9N	4.0	-	6	0.2	4	-	7	0.2	3	-
10A	3.0	-	0	-	2	-	2	-	5	0.1
11A	3.5	-	5	0.1	2	-	8	0.2	5	0.1
22F	5.0	0.1	5	0.1	11	0.3	4	-	17	0.5
33F	0.0	-	2	-	1	-	5	0.1	2	-
35	1.0	-	1	-	1	-	0	-	3	-
Other	9.5	0.3	22	0.6	13	0.4	18	0.5	27	0.8

[a] Average number of cases during 2006/2007.
[b] Average rate per 100 000 population during 2006/2007.
[c] Number of cases reported.
[d] Rate per 100 000 population.
[e] Serotypes 6A and 6C were only distinguished from 2010 onwards; therefore they have been combined for this analysis.
[f] Specific serotypes listed are those that accounted for ≥10 cases in 2011.

Note: Data presented from 2009 onwards is based on IPD notifications and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD.

Table 24. Number and rate per 100 000 population among invasive pneumococcal disease cases in the 65 years and over age group by serotype, 2006/2007–2011

Serotype	2006/2007		2008		2009		2010		2011	
	Cases[a]	Rate[b]	Cases[c]	Rate[d]	Cases[c]	Rate[d]	Cases[c]	Rate[d]	Cases[c]	Rate[d]
PCV7	**115.0**	**22.2**	**143**	**26.6**	**146**	**26.4**	**101**	**17.7**	**77**	**13.1**
4	19.5	3.8	21	3.9	23	4.2	18	3.2	15	2.6
6B	11.0	2.1	16	3.0	17	3.1	15	2.6	10	1.7
9V	14.5	2.8	18	3.3	19	3.4	16	2.8	3	-
14	35.5	6.8	48	8.9	35	6.3	18	3.2	9	1.5
18C	3.0	-	8	1.5	6	1.1	5	0.9	7	1.2
19F	16.5	3.2	16	3.0	19	3.4	15	2.6	22	3.7
23F	15.0	2.9	16	3.0	27	4.9	14	2.5	11	1.9
PCV10	**122.0**	**23.5**	**153**	**28.4**	**164**	**29.7**	**115**	**20.2**	**80**	**13.6**
1	3.5	-	8	1.5	14	2.5	10	1.8	2	-
5	0.0	-	0	-	0	-	1	-	0	-
7F	3.5	-	2	-	4	-	3	-	1	-
PCV13	**145.0**	**27.9**	**180**	**33.5**	**189**	**34.2**	**158**	**27.8**	**135**	**23.0**
3	12.5	2.4	12	2.2	11	2.0	8	1.4	17	2.9
6A/6C[e]	2.5	-	4	-	5	0.9	13	2.3	14	2.4
19A	8.0	1.5	11	2.0	9	1.6	22	3.9	24	4.1
Non-PCV[f]	**32.5**	**6.3**	**46**	**8.6**	**41**	**7.4**	**59**	**10.4**	**93**	**15.8**
8	3.5	-	4	-	4	-	0	-	2	-
9N	4.0	-	5	0.9	2	-	8	1.4	11	1.9
10A	2.0	-	0	-	2	-	3	-	5	0.9
11A	3.5	-	2	-	3	-	5	0.9	8	1.4
22F	4.5	0.9	10	1.9	10	1.8	18	3.2	21	3.6
33F	1.5	-	7	1.3	3	-	4	-	8	1.4
35	1.0	-	1	-	1	-	1	-	5	0.9
Other	12.5	2.4	17	3.2	16	2.9	20	3.5	33	5.6

[a] Average number of cases during 2006/2007.
[b] Average rate per 100 000 population during 2006/2007.
[c] Number of cases reported.
[d] Rate per 100 000 population.
[e] Serotypes 6A and 6C were only distinguished from 2010 onwards; therefore they have been combined for this analysis.
[f] Specific serotypes listed are those that accounted for ≥10 cases in 2011.

Note: Data presented from 2009 onwards is based on IPD notifications and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD.

Table 25. Number and rate per 100 000 population among invasive pneumococcal disease cases by serotype, 2006/2007–2011

Serotype	2006/2007		2008		2009		2010		2011	
	Cases[a]	Rate[b]	Cases[c]	Rate[d]	Cases[c]	Rate[d]	Cases[c]	Rate[d]	Cases[c]	Rate[d]
PCV7	**361.0**	**8.6**	**360**	**8.4**	**326**	**7.6**	**208**	**4.8**	**178**	**4.0**
4	65.5	1.6	61	1.4	57	1.3	46	1.1	46	1.0
6B	46.0	1.1	50	1.2	33	0.8	21	0.5	18	0.4
9V	32.5	0.8	41	1.0	35	0.8	31	0.7	14	0.3
14	114.0	2.7	108	2.5	75	1.7	40	0.9	28	0.6
18C	19.0	0.5	22	0.5	20	0.5	9	0.2	16	0.4
19F	47.5	1.1	42	1.0	58	1.3	36	0.8	39	0.9
23F	36.5	0.9	36	0.8	48	1.1	25	0.6	17	0.4
PCV10	**396.0**	**9.4**	**443**	**10.4**	**497**	**11.5**	**295**	**6.8**	**229**	**5.2**
1	25.0	0.6	69	1.6	153	3.5	77	1.8	35	0.8
5	0.0	-	0	-	0	-	1	-	0	-
7F	10.0	0.2	14	0.3	18	0.4	9	0.2	16	0.4
PCV13	**458.5**	**10.9**	**522**	**12.2**	**573**	**13.3**	**392**	**9.0**	**355**	**8.1**
3	22.0	0.5	28	0.7	26	0.6	21	0.5	39	0.9
6A/6C[e]	12.0	0.3	11	0.3	13	0.3	21	0.5	24	0.5
19A	28.5	0.7	40	0.9	37	0.9	55	1.3	63	1.4
Non-PCV[f]	**79.5**	**1.9**	**107**	**2.5**	**92**	**2.1**	**122**	**2.8**	**178**	**4.0**
8	15.5	0.4	17	0.4	12	0.3	7	0.2	13	0.3
9N	8.0	0.2	11	0.3	8	0.2	15	0.3	15	0.3
10A	6.0	0.1	2	-	4	-	6	0.1	11	0.2
11A	7.5	0.2	7	0.2	6	0.1	13	0.3	14	0.3
22F	10.5	0.2	15	0.4	22	0.5	23	0.5	38	0.9
33F	2.5	-	10	0.2	4	-	13	0.3	11	0.2
35	2.0	-	3	-	2	-	2	-	11	0.2
Other	27.5	0.7	42	1.0	34	0.8	43	1.0	65	1.5

[a] Average number of cases during 2006/2007.
[b] Average rate per 100 000 population during 2006/2007.
[c] Number of cases reported.
[d] Rate per 100 000 population.
[e] Serotypes 6A and 6C were only distinguished from 2010 onwards; therefore they have been combined for this analysis.
[f] Specific serotypes listed are those that accounted for ≥10 cases in 2011.

Note: IPD became a notifiable disease on 17 October 2008. Data presented from 2009 onwards is based on IPD notifications and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD.

Table 26. Serotype 19A invasive pneumococcal disease case numbers, proportions and rates per 100 000 population, by age group, 2004–2011

Year	<2 years			<5 years			5–64 years			≥65 years			All ages		
	No. type 19A cases[a]	% of cases due to type 19A[b]	Rate of type 19A cases[c]	No. type 19A cases[a]	% of cases due to type 19A[b]	Rate of type 19A cases[c]	No. type 19A cases[a]	% of cases due to type 19A[b]	Rate of type 19A cases[c]	No. type 19A cases[a]	% of cases due to type 19A[b]	Rate of type 19A cases[c]	No. type 19A cases[a]	% of cases due to type 19A[b]	Rate of type 19A cases[c]
2004	8	6.3	7.0	10	6.2	3.5	5	2.6	0.2	8	4.2	1.7	23	4.2	0.6
2005	6	5.3	5.2	8	5.3	2.8	10	5.6	0.3	9	5.5	1.8	27	5.5	0.7
2006	5	4.2	4.3	10	6.6	3.5	13	6.4	0.4	4	2.4	-	27	5.2	0.6
2007	7	6.0	5.8	11	7.1	3.8	7	3.3	0.2	12	6.5	2.3	30	5.4	0.7
2008	5	6.4	4.0	7	6.3	2.3	22	7.6	0.6	11	4.8	2.0	40	6.3	0.9
2009	8	14.5	6.3	12	12.9	3.9	16	4.7	0.5	9	3.9	1.6	37	5.6	0.9
2010	7	19.4	5.5	10	15.9	3.2	23	9.8	0.7	22	10.1	3.9	55	10.7	1.3
2011	8	28.6	6.4	13	28.9	4.1	26	10.0	0.7	24	10.5	4.1	63	11.8	1.4

[a] Number of cases due to serotype 19A.
[b] Percentage of cases within the age group due to serotype 19A.
[c] Rate per 100 000 population for IPD due to serotype 19A.

Note: Data presented from 2009 onwards is based on IPD notifications and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD.

Table 27. Serotype 1 invasive pneumococcal disease case numbers, proportions and rates per 100 000 population, by age group, 2004–2011

Year	<2 years			<5 years			5–64 years			≥65 years			All ages		
	No. type 1 cases[a]	% of cases due to type 1[b]	Rate of type 1 cases[c]	No. type 1 cases[a]	% of cases due to type 1[b]	Rate of type 1 cases[c]	No. type 1 cases[a]	% of cases due to type 1[b]	Rate of type 1 cases[c]	No. type 1 cases[a]	% of cases due to type 1[b]	Rate of type 1 cases[c]	No. type 1 cases[a]	% of cases due to type 1[b]	Rate of type 1 cases[c]
2004	0	-	-	0	-	-	2	1.0	-	0	-	-	2	0.4	-
2005	0	-	-	0	-	-	0	-	-	0	-	-	0	-	-
2006	2	1.7	-	2	1.3	-	10	5.0	0.5	3	1.8	-	15	2.9	0.4
2007	2	1.7	-	3	1.9	-	28	13.1	0.8	4	2.2	-	35	6.3	0.8
2008	1	1.3	-	5	4.5	0.2	56	19.2	1.6	8	3.5	1.5	69	11.0	1.6
2009	12	21.8	9.4	15	16.1	0.7	124	36.3	3.6	14	6.1	2.5	153	23.0	3.5
2010	2	5.6	-	9	14.3	0.4	58	24.8	1.7	10	4.6	1.8	77	15.0	1.8
2011	2	7.1	-	3	6.7	-	30	11.5	0.9	2	0.9	-	35	6.6	0.8

[a] Number of cases due to serotype 1.
[b] Percentage of cases within the age group due to serotype 1.
[c] Rate per 100 000 population for IPD due to serotype 1.

Note: Data presented from 2009 onwards is based on IPD notifications and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD.

Table 28. Penicillin and cefotaxime MIC distribution of pneumococci from invasive disease, 2011

Antibiotic	Percent of isolates with an MIC (mg/L) of:[a]										
	0.008	0.016	0.03	0.06	0.12	0.25	0.5	1	2	4	8
penicillin	1.3	58.0	24.6	2.1	2.1	1.9	0.8	4.7	3.8	0.8	0.2
cefotaxime	2.6	64.0	17.5	3.2	2.1	0.8	3.4	3.6	1.1	1.1	0.8

[a] Shaded cells represent MICs that are categorised as penicillin resistant or cefotaxime non-susceptible (intermediate and resistant), based on the meningitis interpretations: penicillin resistant, MIC ≥0.12 mg/L; cefotaxime intermediate, MIC 1 mg/L; and cefotaxime resistant, MIC ≥2 mg/L.

Table 29. Trends in penicillin resistance, cefotaxime resistance and multidrug resistance among pneumococci from invasive disease, 2002-2011

Year	Number of isolates	Penicillin								Cefotaxime						MDR[f]
		Meningitis[a]		Non-meningitis[b]			Oral[c]			Meningitis[d]			Non-meningitis[e]			
		%S	%R	%S	%I	%R	%S	%I	%R	%S	%I	%R	%S	%I	%R	
2002	490	83.1	16.9	99.6	0.4	0.0	83.1	13.5	3.5	94.9	3.1	2.0	98.0	0.4	1.6	5.1
2003	523	83.6	16.4	98.9	1.2	0.0	83.6	9.0	7.5	88.0	8.4	3.6	96.4	1.9	1.7	7.1
2004	545	81.8	18.2	98.5	1.5	0.0	81.8	8.1	10.1	87.2	9.7	3.1	96.9	2.4	0.7	5.3
2005	492	82.9	17.1	98.6	1.4	0.0	82.9	10.0	7.1	90.5	6.5	3.1	97.0	1.7	1.4	6.7
2006	522	84.1	15.9	98.9	1.0	0.2	84.1	8.1	7.9	90.0	7.3	2.7	97.3	1.7	1.0	4.4
2007	555	77.7	22.3	99.1	0.7	0.2	77.7	16.0	6.3	86.0	11.4	2.7	97.3	1.1	1.6	6.1
2008	630	77.9	22.1	99.5	0.5	0.0	77.9	14.6	7.5	84.9	10.0	5.1	94.9	3.0	2.1	5.9
2009	665	82.3	17.7	99.7	0.3	0.0	82.3	12.3	5.4	91.1	6.9	2.0	98.1	1.4	0.6	5.3
2010	514	81.9	18.1	99.0	1.0	0.0	81.9	12.1	6.0	91.8	6.2	1.9	98.1	0.4	1.6	5.4
2011	533	85.9	14.1	99.1	0.8	0.2	85.9	9.4	4.7	93.4	3.6	3.0	97.0	1.1	1.9	5.8

[a] Penicillin meningitis interpretations: susceptible (S), MIC ≤0.06 mg/L; resistant (R), MIC ≥0.12 mg/L; no intermediate category.
[b] Penicillin non-meningitis (parenteral treatment) interpretations: susceptible (S), MIC ≤2 mg/L; intermediate (I), MIC 4 mg/L; resistant (R), MIC ≥8 mg/L.
[c] Penicillin non-meningitis (oral treatment) interpretations: susceptible (S), MIC ≤0.06 mg/L; intermediate (I), MIC 0.12-1 mg/L; resistant (R), MIC ≥2 mg/L.
[d] Cefotaxime meningitis interpretations: susceptible (S), MIC ≤0.5 mg/L; intermediate (I), MIC 1 mg/L; resistant (R), MIC ≥2 mg/L.
[e] Cefotaxime non-meningitis interpretations: susceptible (S), MIC ≤1 mg/L; intermediate (I), MIC 2 mg/L; resistant (R), MIC ≥4 mg/L.
[f] Multidrug resistant, that is, resistant to penicillin (meningitis interpretation) and three additional antibiotics.

Table 30. Trends in resistance to non-β-lactam antibiotics, among pneumococci from invasive disease, 2002-2011

Year	Number of isolates	Chloramphenicol		Clindamycin[a]			Co-trimoxazole			Erythromycin			Tetracycline		
		%S	%R	%S	%I	%R[b]	%S	%I	%R	%S	%I	%R	%S	%I	%R
2002	490	97.6	2.5				62.5	1.4	36.1	90.6	0.4	9.0	93.1	0.0	6.9
2003	523	96.6	3.4				64.4	1.7	33.8	90.1	0.6	9.4	91.0	0.4	8.6
2004	545	97.3	2.8				61.1	0.2	38.7	91.4	0.2	8.4	91.9	0.2	7.9
2005	492	96.8	3.3				67.3	0.6	32.1	87.8	0.0	12.2	90.9	0.6	8.5
2006	522	98.5	1.5				65.7	1.5	32.8	88.7	0.2	11.1	92.5	0.4	7.1
2007	555	97.7	2.3	93.7	0.0	6.3	63.2	1.8	35.0	86.0	0.4	13.7	90.8	0.7	8.5
2008	630	97.6	2.4	94.6	0.0	5.4	67.6	2.2	30.2	87.8	0.3	11.9	91.9	0.5	7.6
2009	665	98.8	1.2	95.3	0.2	4.5	72.6	2.1	25.3	90.2	0.2	9.6	92.5	0.3	7.2
2010	514	98.1	2.0	94.7	0.0	5.3	73.5	2.1	24.3	91.1	0.0	9.0	91.6	0.8	7.6
2011	533	99.1	0.9	93.4	0.0	6.6	78.4	0.8	20.8	88.7	0.0	11.3	90.6	0.6	8.8

[a] Clindamycin susceptibility tested since 2007.

[b] Includes isolates with inducible clindamycin resistance.

Note:

S: susceptible; I: intermediate and R: resistant.

All isolates susceptible to vancomycin. Moxifloxacin susceptibility tested since 2005, with no resistance identified and a maximum of one isolate per annum with intermediate resistance. Rifampicin susceptibility tested since 2010, with no resistance identified.

Table 31. Penicillin and cefotaxime resistance among isolates from invasive pneumococcal disease by region and district health board (DHB), 2011

Region / DHB	Number of isolates	Penicillin	Cefotaxime	
		% resistant[a] MIC ≥0.12 mg/L	% intermediate[a] MIC 1 mg/L	% resistant[a] MIC ≥2 mg/L
Northland region	**202**	**15.4**	**3.5**	**3.5**
Northland	21	0.0	0.0	0.0
Waitemata	58	22.4	5.2	5.2
Auckland	50	18.0	4.0	4.0
Counties Manukau	73	12.3	2.7	2.7
Midland region	**118**	**11.9**	**2.5**	**2.5**
Waikato	45	11.1	0.0	2.2
Lakes	29	10.3	0.0	0.0
Bay of Plenty	29	10.3	6.9	0.0
Tairawhiti	5	0.0	0.0	0.0
Taranaki	10	30.0	10.0	20.0
Central region	**104**	**16.4**	**3.9**	**2.9**
Hawke's Bay	23	21.7	13.0	4.4
Whanganui	6	16.7	0.0	0.0
MidCentral	18	11.1	0.0	5.6
Hutt Valley	17	0.0	0.0	0.0
Capital and Coast	18	16.7	0.0	0.0
Wairarapa	7	42.9	14.3	14.3
Nelson Marlborough	15	20.0	0.0	0.0
Southern region	**109**	**11.9**	**4.6**	**2.8**
West Coast	0	-	-	-
Canterbury	64	12.5	1.6	3.1
South Canterbury	8	12.5	0.0	12.5
Southern	37	10.8	10.8	0.0
New Zealand	**533**	**14.1**	**3.6**	**3.0**

[a] Meningitis interpretations; no intermediate category for penicillin.

Table 32. Serotypes among penicillin resistant, cefotaxime resistant and intermediate, and multiresistant isolates from invasive pneumococcal disease cases, 2011

Serotype	Penicillin		Cefotaxime				Multi-resistant[b]	
	Resistant[a] MIC ≥0.12 mg/L		Intermediate[a] MIC 1 mg/L		Resistant[a] MIC ≥2 mg/L			
	No	%[c]	No	%[c]	No	%[c]	No	%[c]
PCV7 serotypes	**50**	**66.7**	**19**	**100.0**	**15**	**93.8**	**28**	**90.3**
4	0	-	0	-	0	-	0	-
6B	8	10.7	5	26.3	0	-	5	16.1
9V	10	13.3	1	5.3	0	-	0	-
14	7	9.3	4	21.1	0	-	1	3.2
18C	0	-	0	-	0	-	0	-
19F	22	29.3	7	36.8	15	93.8	20	64.5
23F	3	4.0	2	10.5	0	-	2	6.5
PCV10 serotypes	**50**	**66.7**	**19**	**100.0**	**15**	**93.8**	**28**	**90.3**
1	0	-	0	-	0	-	0	-
5	0	-	0	-	0	-	0	-
7F	0	-	0	-	0	-	0	-
PCV13 serotypes	**68**	**90.7**	**19**	**100.0**	**16**	**100.0**	**30**	**96.8**
3	0	-	0	-	0	-	0	-
6A	2	2.7	0	-	0	-	0	-
19A	16	21.3	0	-	1	6.3	2	6.5
Non-PCV serotypes								
11A	1	1.3	0	-	0	-	0	-
15B	1	1.3	0	-	0	-	1	3.2
15 non-typable	1	1.3	0	-	0	-	0	-
23B	1	1.3	0	-	0	-	0	-
34	1	1.3	0	-	0	-	0	-
35 non-typable	2	2.7	0	-	0	-	0	-
Total	**75**		**19**		**16**		**31**	

[a] Meningitis interpretations; no intermediate category for penicillin.
[b] Resistant to penicillin (meningitis interpretation) and three additional antibiotics.
[c] Percentage of the intermediate or resistant isolates.

Table 33. Trends in penicillin resistance, cefotaxime resistance and multidrug resistance among serotype 19A pneumococci from invasive disease, 2002-2011

Year	Number of isolates	Penicillin resistant[a]		Cefotaxime resistant[b]		Multiresistant[c]	
		No	Percent (95% CI)	No	Percent (95% CI)	No	Percent (95% CI)
2002	18	3	16.7 (3.6-41.4)	0	0.0 (0.0-18.5)	0	0.0 (0.0-18.5)
2003	22	6	27.3 (10.7-50.2)	1	4.6 (0.1-22.8)	1	4.6 (0.1-22.8)
2004	23	6	26.1 (10.2-48.4)	1	4.4 (0.1-21.9)	1	4.4 (0.1-21.9)
2005	27	2	7.4 (0.9-24.3)	0	0.0 (0.0-12.7)	0	0.0 (0.0-12.7)
2006	27	6	22.2 (8.6-42.3)	0	0.0 (0.0-12.7)	0	0.0 (0.0-12.7)
2007	30	3	10.0 (2.1-26.5)	0	0.0 (0.0-11.6)	1	3.3 (0.1-17.2)
2008	40	10	25.0 (12.7-41.2)	1	2.5 (0.1-13.2)	3	7.5 (1.6-20.4)
2009	37	3	8.1 (1.7-21.9)	0	0.0 (0.0-9.5)	0	0.0 (0.0-9.5)
2010	54	10	18.5 (9.3-31.4)	0	0.0 (0.0-6.6)	4	7.4 (2.1-17.9)
2011	63	16	25.4 (15.3-37.9)	1	1.6 (0.04-8.5)	2	3.2 (0.4-11.0)

[a] Penicillin resistant using meningitis interpretations, that is, MIC ≥0.12 mg/L.
[b] Cefotaxime resistant using meningitis interpretations, that is, MIC ≥2 mg/L.
[c] Resistant to penicillin (meningitis interpretation) and three additional antibiotics.

Note: There were no significant differences (P≤0.05) in penicillin, cefotaxime or multidrug resistance over the 10 year period.