ESR

SURVEILLANCE REPORT

Invasive pneumococcal disease in New Zealand 2012

Prepared as part of a Ministry of Health contract for scientific services by the Health Intelligence Team, Institute of Environmental Science and Research Limited

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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 2009–2012 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 488 cases of IPD notified in 2012, which equates to a rate of 11.0 per 100 000 population. A *S. pneumoniae* isolate from an invasive site was received at ESR for serotyping and antimicrobial susceptibility testing for 459 (94%) of the notified cases.

The rate of IPD in infants aged <2 years has decreased by 64% since the introduction of PCV7: from an average annual incidence of 100.3 cases per 100 000 population in 2006/2007 to 35.9 per 100 000 in 2012. The reduction in IPD caused by PCV7 serotypes in this age group is even more striking, with a 98% decrease from an average of 83.1 per 100 000 in 2006/2007 to 1.6 per 100 000 in 2012 (note that the 2012 rate was calculated based on 2 cases only). The rate of IPD has now also decreased significantly in the 2−4 years age group, with a 64% reduction from an average of 20.8 per 100 000 population in 2006/2007 to 7.4 per 100 000 in 2012. Again, the decrease in the subset of IPD caused by PCV7 types in this age group over the same time period was greater, with a 93% reduction from 15.5 to 1.1 per 100 000 (note that the 2012 rate was calculated based on 2 cases only).

By 2012 the indirect or herd immunity effects of routine infant PCV immunisation were evident, with significant 46% and 57% reductions in the rates of IPD due to PCV7 serotypes in the 5−64 years and ≥65 years age groups, respectively, between 2006/2007 and 2012. 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 years or ≥65 years age groups. This is probably due to PCV7 serotypes initially constituting a smaller proportion of the disease in these age groups than those groups directly targeted for vaccination and also some serotype replacement.

Rates of IPD for the Pacific Peoples and Māori ethnic groups were approximately 4-times and 3-times, respectively, the rate for the European or Other ethnic group. Since 2009, in the <2 years age group, there has been a significant decrease in the IPD rate for the Māori ethnic group, a non-significant decrease in the rate for the European or Other ethnic group, and a non-significant increase in the Pacific Peoples ethnic group.

In 2012, the all-age rate of pneumococcal meningitis was 1.0 per 100 000 population. The highest rate of meningitis occurred among those <1 year of age (16.5 per 100 000). The IPD case-fatality rate was 6.7%.

Among the 40 cases who had received at least 2 doses of PCV prior to onset of illness, and for whom the serotype causing disease was known, four were due to a PCV7 serotype, four were due to additional serotypes covered by PCV10, and the 32 were due to non-PCV10 serotypes.

Chronic illness was the most common risk factor reported (56% of cases for whom the information was recorded) followed by smoking in the household (44%).

The highest rate of IPD was in Wairarapa District Health Board (DHB) (24.6 per 100 000 population, 10 cases), followed by Bay of Plenty DHB (17.0 per 100 000, 36 cases). Between 2009 and 2012, rates of IPD decreased or remained similar across all DHBs.

In 2012, serotype 19A was the most prevalent serotype in all age groups. Since 2006/2007, there have been significant increases in the rate of 19A disease in the <2 years (5.1 to 10.6 per 100 000 population), 5−64 years (0.3 to 0.9 per 100 000), and ≥65 years (1.5 to 5.2 per 100 000) age groups. 2012 was the first year a significant increase in 19A disease was observed in the <2 years age group.

The other common non-PCV7 serotypes were 22F (40 cases) and 7F (37 cases). These serotypes are most commonly isolated from IPD cases ≥5 years of age, with only 0−2 cases reported annually in the <2 years and 2−4 years age groups.

As yet there is little change in the prevalence of antimicrobial resistance among isolates from IPD cases. In 2012, PCV7 serotypes accounted for a smaller proportion (44%) of the penicillin-resistant isolates than in previous years, whereas type 19A accounted for a larger proportion (39%). However, this increase in the proportion of penicillin-resistant isolates that are serotype 19A is mainly due to type 19A causing a greater proportion of the IPD cases rather than penicillin resistance becoming more prevalent among this serotype.

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 [2-4].

Prior to these annual reports, information from ESR's laboratory-based surveillance of IPD was published periodically [5-9]. 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 2012 is presented in this report, along with trend data for recent years.

METHODS

METHODS

Surveillance methods

In this report, data for 2009 to 2012 is based on invasive pneumococcal disease (IPD) case notifications, supplemented with serotype and antimicrobial susceptibility data from ESR's national laboratory-based surveillance of invasive *S. pneumoniae* isolates. Data for earlier years is solely from ESR's 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 [10]:

- isolation of *S. pneumoniae* from blood, CSF or another normally sterile site (eg, joint fluid, pleural fluid)
- detection of *S. pneumoniae* nucleic acid from blood, CSF or another normally sterile site
- a positive newer-generation *S. pneumoniae* antigen test on CSF in individuals from whom samples were obtained after antibiotic treatment.

Notification data is entered at each public health unit (PHU) via a secure web-based portal onto a computerised database (EpiSurv). The near 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. At ESR, all invasive isolates are serotyped and tested for susceptibility to a range of antibiotics. Further details are provided in the section below entitled *Laboratory methods*.

The notification data in this report is based on the information recorded on EpiSurv as at 7 February 2013. 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 age-eligible cases (ie, 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. Further details are provided in the section below entitled *Analytical methods*. The immunisation status of asplenic cases is based on the immunisation data reported with the case notification on EpiSurv.

Laboratory methods

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 [11]. The full range of factorised antisera is not held by ESR. Consequently the serotypes of some isolates could not be determined. In this report, isolates not able to be serotyped are described by their serogroup followed by the designation 'non-typable'. 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 [12]. Inducible clindamycin resistance is detected by the D-zone test [13]. All minimum inhibitory concentrations (MICs) and zone of inhibition diameters were interpreted according to the 2012 CLSI standards [13].

In this report, the CLSI 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 CLSI 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 CLSI 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 2012 mid-year population estimates published by Statistics New Zealand. Note that rates presented in this report for years prior to 2012 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 2012 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).

Socio-economic deprivation is based on the 2006 New Zealand Deprivation Index (NZDep06). The index, measuring relative socioeconomic deprivation, is derived from a weighted combination of nine variables from the 2006 census, each reflecting a different aspect of material and social deprivation. The deprivation score is calculated for each geographical meshblock in New Zealand. Quintiles of NZDep06, ranging from 1 (least deprived) to 5 (most deprived), are presented in this report. Approximately equal numbers of people reside in areas associated with each of the five deprivation levels. The deprivation index analysis was confined to those cases for which the accuracy of index designation was recorded as exact or nearest. Rates presented were calculated using population data derived from the usually resident 2006 census population.

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, detection of *S. pneumoniae* DNA in pleural fluid, culture of *S. pneumoniae* from joint fluid, and culture of *S. pneumoniae* from another normally sterile site.

IPD notifications were matched with relevant data in the NIR for cases born after 1 January 2008 only. The NIR data obtained included the dates of vaccination, the type of pneumococcal conjugate vaccine (PCV) administered (ie, PCV7, PCV10 or PCV13), and the batch number of the vaccine given. The batch numbers of all PCV issued from ESR's National Vaccine Store were obtained and were used to cross-check the NIR data on the type of vaccine administered. Any doses of PCV given within 14 days of disease onset were not counted in the analysis.

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. A discontinuous line is used in graphs that present both notification and laboratory-based surveillance data (ie, 2006−2012) to represent the change in the source of IPD data. 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.

PPV23: 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

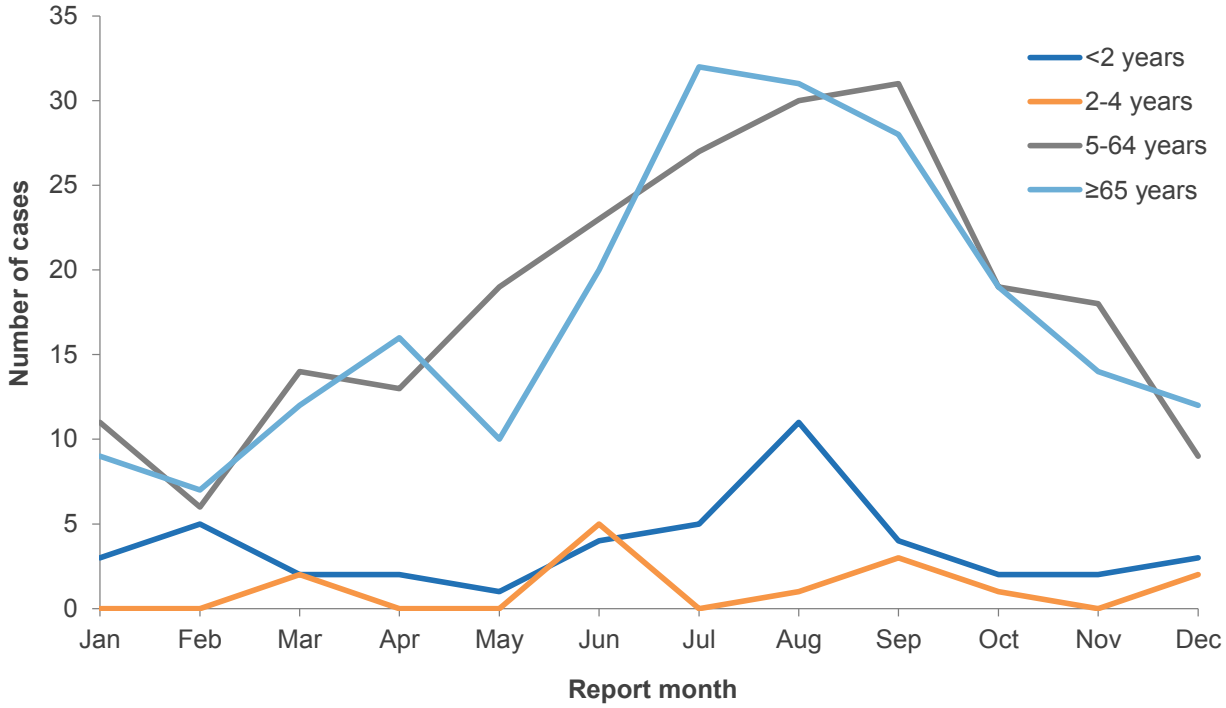
In 2012, 488 cases of IPD were notified. The 2012 notification rate for IPD was 11.0 per 100 000 population, a significant decrease from the 2011 rate (12.5 per 100 000, 552 cases) and the peak rate observed in 2009 (16.1 per 100 000, 697 cases).

A breakdown of the laboratory criteria upon which the IPD diagnosis was based is available in Table 12 (Appendix). Over 80% of cases in 2012 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 459 (94.1%) of the cases notified in 2012.

Disease incidence by season

During 2012, there was the usual marked peak of cases in the winter months, particularly among cases aged ≥5 years (Figure 1).

Figure 1. Number of invasive pneumococcal disease cases by age group and month, 2012



Disease incidence by age and sex

Age and sex were recorded for all IPD cases in 2012. The distribution of the 2012 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 of cases and rate per 100 000 of invasive pneumococcal disease by age group and sex, 2012

Age group (years)	Female		Male		Total		
	Cases	Rate	Cases	Rate	Cases	Rate	%[a]
<1	11	37.2	20	64.5	31	51.2	6.4
1	7	23.2	6	18.9	13	21.0	2.7
2−4	5	5.4	9	9.2	14	7.4	2.9
5−14	6	2.1	14	4.7	20	3.4	4.1
15−24	6	1.9	15	4.5	21	3.3	4.3
25−34	9	3.1	15	5.3	24	4.2	4.9
35−44	17	5.5	20	7.1	37	6.2	7.6
45−54	26	8.1	18	6.0	44	7.1	9.0
55−64	40	15.6	34	13.9	74	14.8	15.2
65−74	39	22.0	45	27.0	84	24.4	17.2
75−84	39	37.2	42	48.2	81	42.2	16.6
≥85	21	43.1	24	88.4	45	59.3	9.2
Aggregated age groups (years)							
<2[b]	18	30.1	26	41.4	44	35.9	9.0
<5	23	15.2	35	21.9	58	18.6	11.9
5−64	104	5.9	116	6.7	220	6.3	45.1
≥65	99	29.9	111	39.5	210	34.3	43.0
Total	**226**	**10.5**	**262**	**12.0**	**488**	**11.0**	**100.0**

[a] Percentage of cases in each age group.

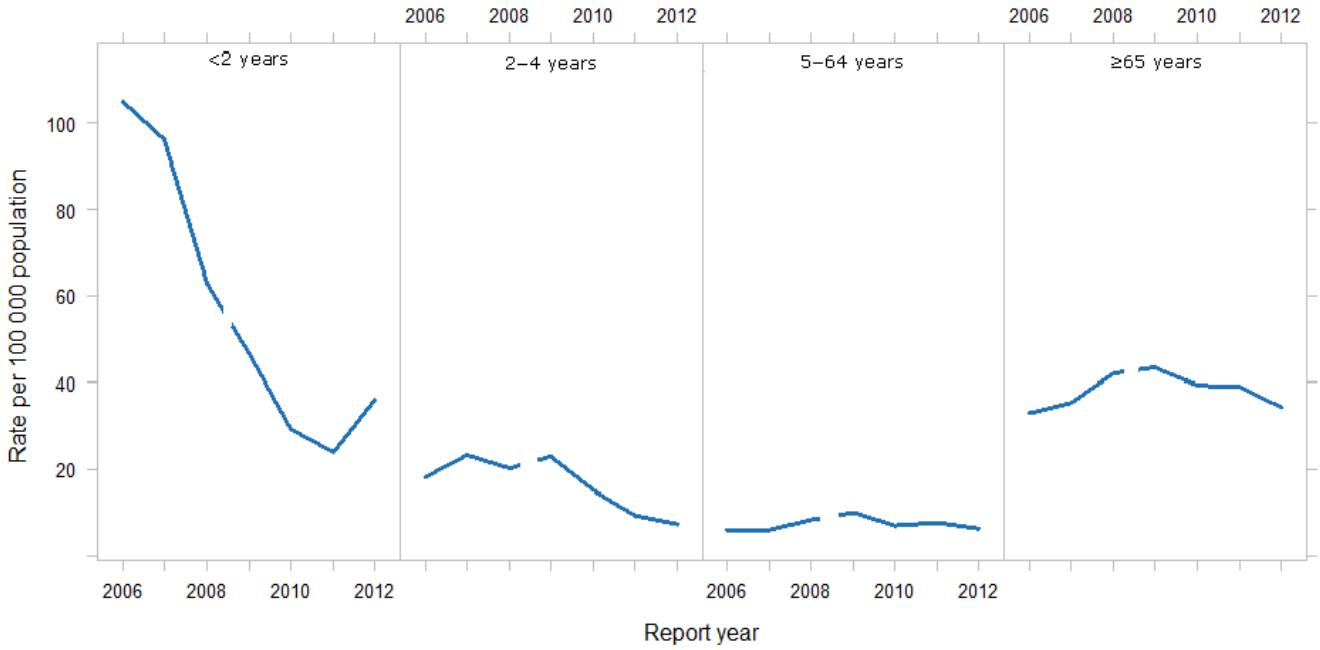
[b] The age in months of the cases <2 years of age is presented in Figure 10 (Appendix).

Between 2006 and 2012, there was a significant decrease in the rate of IPD in the <2 years (104.8 to 35.9 per 100 000 population) and 2−4 years (18.3 to 7.4 per 100 000) age groups (Figure 2). However, the rate in the <2 years age group actually increased, albeit non-significantly, between 2011 and 2012 (23.8 to 35.9 per 100 000).

While rates in the older age groups (5−64 years and ≥65 years) in 2012 were similar to the rates in 2006, these results are hard to interpret due to the change in 2009 from laboratory-based to the more sensitive notification-based surveillance. However, it is notable that the rates in these age groups have decreased significantly over the period of notification-based surveillance of IPD (ie, since 2009).

A further breakdown of cases and rates by age group over the past seven years is available in Table 13 (Appendix).

Figure 2. Rate per 100 000 population of invasive pneumococcal disease by age group and year, 2006–2012



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 475 (97.3%) IPD cases in 2012. The age-standardised rates of IPD were highest for the Pacific Peoples (35.4 per 100 000 population, 59 cases) and Māori (26.1 per 100 000, 102 cases) ethnic groups. The rates for these two ethnic groups were approximately 4-times and 3-times, respectively, the rate for the European or Other ethnic group (8.4 per 100 000, 294 cases) (Table 2).

Among cases in the <2 years age group, rates were also highest for the Pacific Peoples and Māori ethnic groups, with rates being 3.4 and 1.8 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.

Between 2009 and 2012, the age-standardised IPD rates decreased in the European or Other (-28.6%), Māori (-27.4%), Asian (-18.2%), and Pacific Peoples (-16.2%) ethnic groups. Among cases in the <2 years age group, there was a significant decrease in the rate for the Māori (-50.0%) ethnic group, a non-significant decrease in the rate for the European or Other ethnic group (-12.7%), and a non-significant increase in the Pacific Peoples ethnic group (29.5%). Rates of IPD by ethnic group and age group for the years 2009 to 2012 are presented in Table 14 (Appendix).

Table 2. Number of cases, and age-specific and age-standardised rate per 100 000 population of invasive pneumococcal disease by ethnic group and age group, 2012

Age group (years)	Māori		Pacific Peoples		Asian		MELAA[a]		European or Other	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
<1	10	61.2	5	81.5	1	-	0	-	13	40.5
1	4	-	5	84.6	1	-	0	-	3	-
2–4	4	-	3	-	2	-	0	-	5	4.7
5–14	2	-	5	9.5	0	-	2	-	11	3.3
15–24	6	4.9	6	11.9	1	-	0	-	8	2.2
25–34	6	6.6	2	-	0	-	2	-	14	3.9
35–44	11	14.2	4	-	3	-	0	-	15	3.6
45–54	17	25.1	6	22.2	1	-	0	-	16	3.4
55–64	19	46.5	9	51.9	0	-	0	-	46	11.1
65–74	11	47.7	5	51.2	2	-	0	-	64	21.8
75–84	11	164.1	7	219.1	4	-	0	-	59	33.3
≥85	1	-	2	-	1	-	0	-	40	55.1
Aggregated age groups (years)										
<2	14	43.3	10	83.0	2	-	0	-	16	24.2
<5	18	22.6	13	42.1	4	-	0	-	21	12.2
5–64	61	11.2	32	14.2	5	1.4	4	-	110	4.7
≥65	23	74.9	14	103.4	7	31.6	0	-	163	30.0
All ages[b,c]	**102**	**26.1**	**59**	**35.4**	**16**	**8.3**	**4**	**8.0**	**294**	**8.4**

[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 475 (97.3%) cases notified in 2012.

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 2012 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

In 2012, 460 (94.3%) of the 488 IPD cases had a residential address recorded that could be assigned a 2006 New Zealand Deprivation Index (NZDep06) score. With the exception of the ≥65 years age group, approximately 60% of cases resided in the most deprived areas (NZDep06 quintile 4 or 5) (Table 3).

Rates of IPD within NZDep quintiles could only be calculated for all ages, as population data by NZDep06 quintile and age groups was not available. The rate of IPD in the most deprived areas (NZDep06 quintile 5) (15.3 per 100 000 population, 130 cases) was almost double that for the least deprived quintile (NZDep06 quintile 1) (8.8 per 100 000, 66 cases) (Table 3).

Between 2009 and 2012, rates of IPD decreased in all NZDep06 quintiles (Figure 3), with the largest decrease for NZDep06 quintile 5 (41.4%), followed by NZDep06 quintiles 3 (25.5%) and 4 (25.0%).

Table 3. Number and percentage of invasive pneumococcal disease cases by quintiles of the 2006 New Zealand deprivation index and age group, 2012

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	4	10.3	0	0.0	26	12.3	36	18.4	66	14.3	8.8
2	4	10.3	2	14.3	27	12.8	41	20.9	74	16.1	10.0
3	7	17.9	3	21.4	35	16.6	34	17.3	79	17.2	9.7
4	8	20.5	4	28.6	52	24.6	47	24.0	111	24.1	12.7
5	16	41.0	5	35.7	71	33.6	38	19.4	130	28.3	15.3
Total[d]	**39**		**14**		**211**		**196**		**460**		

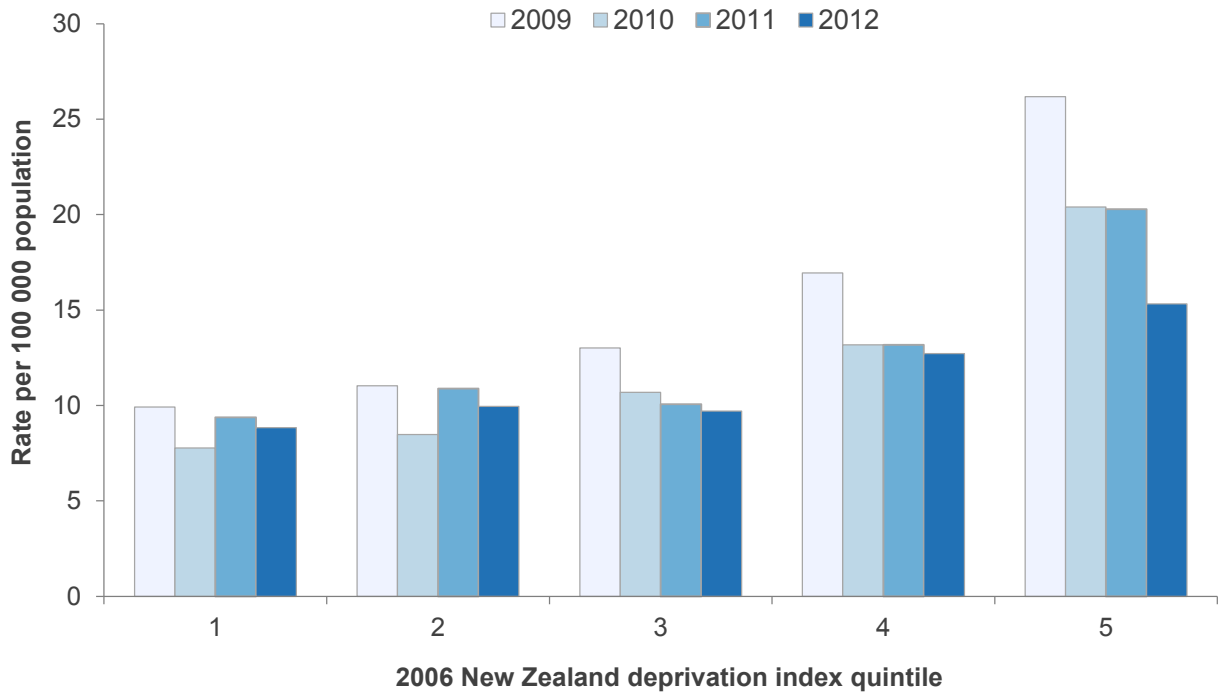
[a] Quintile of the 2006 New Zealand deprivation index.

[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 2012 mid-year population estimates from Statistics New Zealand.

[d] Accurate New Zealand deprivation (NZDep) index data was available for 460 (94.3%) cases notified in 2012.

Figure 3. Rate per 100 000 population of invasive pneumococcal disease by quintiles of the 2006 New Zealand deprivation index and year, 2009–2012



Disease presentation, hospitalisations and fatalities

In 2012, 467 (95.7%) of the 488 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 the most common for cases aged ≥2 years.

The rate of pneumococcal meningitis was 1.0 per 100 000 population for all ages, but 16.5 per 100 000 (10 cases) in the <1 year age group (Table 15 in the Appendix).

The 10 cases of pneumococcal meningitis aged <1 year were in the Māori (5 cases), European or Other (3 cases) and Pacific Peoples (1 case) ethnic groups, and the ethnic group was unknown for one case.

Table 4. Clinical presentation of invasive pneumococcal disease cases by age group, 2012

Age group (years)	Meningitis		Bacteraemia without focus		Empyema		Pneumonia		Other		Total[c]
	Cases[a]	%[b]	Cases[a]	%[b]	Cases[a]	%[b]	Cases[a]	%[b]	Cases[a]	%[b]	
<1	10	33.3	6	20.0	2	6.7	8	26.7	4	13.3	30
1	3	23.1	4	30.8	2	15.4	3	23.1	1	7.7	13
2–4	0	-	2	14.3	1	7.1	7	50.0	4	28.6	14
5–14	2	10.0	5	25.0	0	-	8	40.0	5	25.0	20
15–64	19	10.1	21	11.1	7	3.7	124	65.6	18	9.5	189
≥65	12	6.0	38	18.9	4	2.0	134	66.7	13	6.5	201
Aggregated age groups (years)											
<2	13	30.2	10	23.3	4	9.3	11	25.6	5	11.6	43
<5	13	22.8	12	21.1	5	8.8	18	31.6	9	15.8	57
≥5	33	8.0	64	15.6	11	2.7	266	64.9	36	8.8	410
Total[d]	**46**	**9.9**	**76**	**16.3**	**16**	**3.4**	**284**	**60.8**	**45**	**9.6**	**467**

[a] Number of cases with 'yes' recorded for 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 15 (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 467 (95.7%) of cases notified in 2012.

Information on whether the patient survived or died was recorded for 464 (95.1%) of the IPD cases. IPD was recorded as the primary cause of death for 31 cases, giving a case-fatality rate of 6.7% among the cases for whom this information was reported. The case-fatality rates for each age group are presented in Table 16 (Appendix). There were four deaths due to IPD in the <5 years age group in 2012, compared to no deaths recorded in 2011 and 2010, and one death in 2009.

Among the 472 (96.7%) IPD cases for whom hospitalisation status was recorded, 447 (94.7%) cases were hospitalised. The case-fatality rate among hospitalised cases (6.0%, 27/447) was not significantly different to that among non-hospitalised cases (16.0%, 4/25).

Immunisation status

Among the 58 cases who were age-eligible for the pneumococcal conjugate vaccine (ie, cases born after 1 January 2008), 44 were recorded as having at least 2 doses of the pneumococcal conjugate vaccine (PCV) before the onset of their disease (Table 5). Four of these 44 cases were due to a PCV7 type, four were due to additional serotypes covered by PCV10, 17 were due to additional serotypes covered by PCV13, 15 were due to non-PCV13 serotypes, and serotype information was unavailable for four cases. Among the 44 cases who had received at least 2 doses of vaccine, the most commonly identified serotype was 19A (14 cases).

The one asplenic case reported in 2012 was a female in the 50−59 years age group who had not been immunised.

Table 5. Immunisation status of the 2012 invasive pneumococcal disease cases who were born after 1 January 2008

Number of doses received[a]	Cases due to PCV7 serotypes: 4, 6B, 9V, 14, 18C, 19F or 23F[b]		Cases due to additional PCV10 serotypes: 1, 5 or 7F[b]		Cases due to additional PCV13 serotypes: 3, 6A or 19A[b]		Cases due to non-PCV13 serotypes[b]		Total[b,c]	
	No	%	No	%	No	%	No	%	No	%
0	0		0		2	9.1	4	19.0	7	12.1
1	0		1	20.0	3	13.6	2	9.5	7	12.1
2	1[d]	25.0	0		1[i]	4.5	6	28.6	9	15.5
3	1[e]	25.0	3[g]	60.0	11[j]	50.0	4	19.0	20	34.5
4	2[f]	50.0	1[h]	20.0	5[k]	22.7	5	23.8	15	25.9
Total	**4**		**5**		**22**		**21**		**58**	

[a] Number of doses received prior to 14 days before onset of IPD. Onset of IPD was determined using the earliest episode date available from onset of illness date, hospitalised date or date reported to the public health unit.

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

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

[d] Case due to serotype 19F.

[e] Case due to serotype 14.

[f] Cases due to serotype 9V and 14 (1 each).

[g] Cases due to serotypes 7F (2) and 1 (1).

[h] Case due to serotype 7F.

[i] Case due to serotype 6A.

[j] Cases due to serotypes 19A (9), 3 and 6A (1 each).

[k] Cases due to serotype 19A (5).

A case-by-case analysis was conducted to investigate any association between the increase in type 19A IPD cases in the <2 years age group in 2012 and the change from PCV7 to PCV10 for routine infant immunisation in late 2011. The results of this analysis, which included all cases of 19A IPD in cases <5 years old, are presented in Table 6.

Nine (50.0%) of the 18 cases had received a primary course of 3 doses and another five (28.8%) cases had received 4 doses (ie, a primary series plus booster). Of the remaining four cases, two were new-borns and had therefore received no PCV vaccination and the other two cases had received only 1 dose.

Among the 14 cases who had received 3 or 4 doses, 11 had wholly received PCV7, two had wholly received PCV10 and one had received a mixed schedule of 2 doses of PCV7 followed by 1 dose of PCV10.

Table 6. Pneumococcal conjugate vaccination history of the serotype 19A invasive pneumococcal disease cases in the <5 years age group, 2012

Number of doses received	Case number	Age group	Number of PCV7 doses	Number of PCV10 doses	Comments
0	1	0–5 weeks	0	0	Not eligible for PCV vaccination
	2	0–5 weeks	0	0	Not eligible for PCV vaccination
1	3	3–4 months	0	1	
	4	3–4 months	0	1	
3	5	5–14 months	0	3	
	6	5–14 months	0	3	
	7	5–14 months	2	1	
	8	5–14 months	3	0	
	9	5–14 months	3	0	
	10	5–14 months	3	0	
	11	5–14 months	3	0	
	12	15–23 months	3	0	Not fully vaccinated for age
	13	15–23 months	3	0	Not fully vaccinated for age
4	14	2–4 years	4	0	
	15	2–4 years	4	0	
	16	2–4 years	4	0	
	17	2–4 years	4	0	
	18	2–4 years	4	0	

Risk factors

The risk factors reported among IPD cases in 2012 are presented in Table 7. The most common risk factor among all cases was chronic illness (56.0%). Risk factors for cases in the <2 years, <5 years and ≥5 years age groups are presented in Table 17, Table 18 and Table 19 (Appendix), respectively. Smoking in the household was the most common risk factor recorded for the <5 years age group while chronic illness was most commonly recorded for the ≥5 years age group.

Table 7. Exposure to risk factors associated with invasive pneumococcal disease for cases, 2012

Risk factor	Cases[a]	Total reported[b]	%[c]
Chronic illness[d]	246	439	56.0
Smoking in the household[e]	11	25	44.0
Current smoker[f]	85	333	25.5
Chronic lung disease or cystic fibrosis	70	438	16.0
Immunocompromised[g]	68	427	15.9
Premature (<37 weeks gestation)[h]	2	18	11.1
Attends childcare[e]	2	22	9.1
Resident in long-term or other chronic-care facility[i]	39	441	8.8
Congenital or chromosomal abnormality	7	422	1.7
Cochlear implants	2	406	0.5
Anatomical or functional asplenia	1	426	0.2

[a] Number of cases with 'yes' recorded for each risk factor. Some cases reported exposure to 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 supplied.

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

[e] Cases aged <5 years only.

[f] Cases aged ≥18 years only.

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

[h] Cases aged <1 year only.

[i] Among cases in the ≥75 years age group, 26.5% (31 cases out of 117 for whom the information was supplied) were residents in a long-term or other chronic-care facility.

Disease incidence by District Health Board

The highest rate of IPD was in Wairarapa District Health Board (DHB) (24.6 per 100 000 population, 10 cases), followed by Bay of Plenty DHB (17.0 per 100 000, 36 cases). Rates were similar across the four regions (9.1 to 12.9 per 100 000). See Table 8 for number of cases by age group and rates for each DHB and region in 2012.

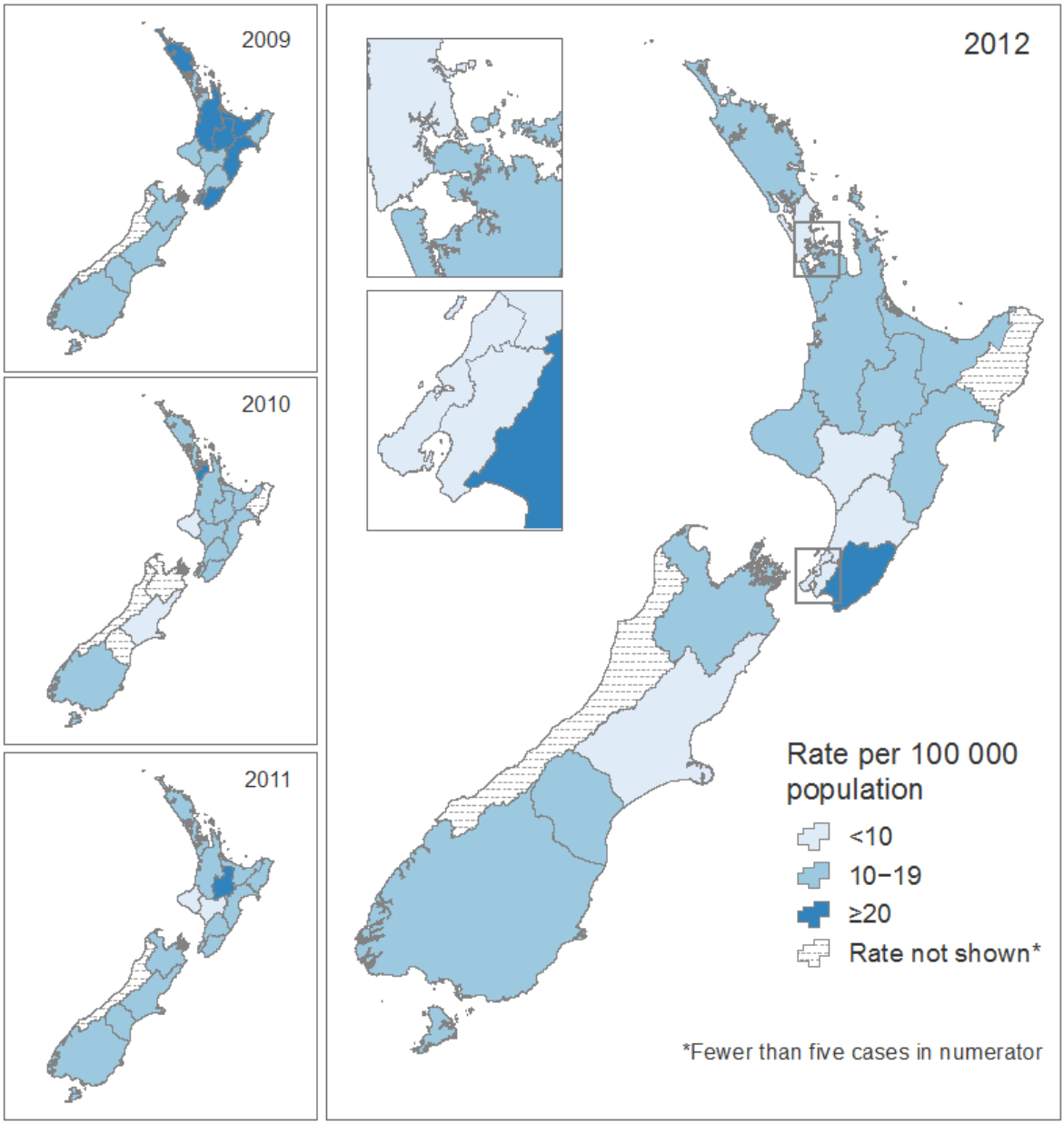
Between 2009 and 2012, rates of IPD decreased or remained similar across all DHBs (Figure 4). The decreases were significant for Waitemata (11.9 to 6.9 per 100 000 population), Waikato (22.8 to 11.3 per 100 000), Lakes (28.5 to 13.6 per 100 000) and Hutt Valley (21.0 to 8.3 per 100 000) DHBs.

Table 8. Number of cases of invasive pneumococcal disease by age group and rate per 100 000 population for each District Health Board, 2012

District Health Board	Cases by age group (years)					Rate[a] (all ages)
	<2	<5	5–64	≥65	All ages	
Northern region	**25**	**32**	**101**	**55**	**188**	**11.2**
Northland	6	6	10	7	23	14.5
Waitemata	1	2	23	13	38	6.9
Auckland	9	11	22	19	52	11.3
Counties Manukau	9	13	46	16	75	14.8
Midland region	**10**	**15**	**50**	**44**	**109**	**12.9**
Waikato	7	8	17	17	42	11.3
Lakes	2	2	10	2	14	13.6
Bay of Plenty	0	3	18	15	36	17.0
Tairawhiti	0	0	1	2	3	-
Taranaki	1	2	4	8	14	12.7
Central region	**5**	**6**	**40**	**63**	**109**	**10.8**
Hawke's Bay	1	1	10	10	21	13.5
Whanganui	0	0	2	4	6	9.6
MidCentral	0	0	6	5	11	6.5
Hutt Valley	0	0	5	7	12	8.3
Capital and Coast	2	2	8	19	29	9.8
Wairarapa	1	1	3	6	10	24.6
Nelson Marlborough	1	2	6	12	20	14.2
Southern region	**4**	**5**	**29**	**48**	**82**	**9.1**
West Coast	0	0	1	0	1	-
Canterbury	3	4	15	21	40	8.0
South Canterbury	0	0	3	3	6	10.6
Southern	1	1	10	24	35	11.4
Total	**44**	**58**	**220**	**210**	**488**	**11.0**

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

Figure 4. Geographic distribution of invasive pneumococcal disease cases, 2009–2012



Serotype distribution

In 2012 in the <2 years age group, only 5.0% (2 cases) of IPD were due to PCV7 serotypes and 12.5% (5 cases) were due to PCV10 serotypes (Table 9). The five cases due to PCV10 types were in the Pacific Peoples (2 cases), European or Other (2 cases), and Māori (1 case) ethnic groups. For the first time since ethnicity data became available in 2009, a case of IPD due to a PCV7 serotype (type 14) was notified in 2012 in a Pacific Peoples infant <2 years old. Among the four cases in the <5 years age group that died, three were due to serotypes 11A, 19A, and 35 (1 case each) and the serotype was unknown for the remaining case.

The proportion of IPD due to PCV7 types was higher in the older age groups: 33.3% in the 5−64 years and 28.6% in the ≥65 years age groups (Table 9). Among the ≥65 years age group, 81.0% of cases were due to PPV23 serotypes.

Table 9 shows by age group the number and proportion of the 459 culture-positive IPD cases in 2012 caused by each of the serotypes included in PCV7, PCV10 and PCV13, and any other serotypes that accounted for more than five cases. Table 20 (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 2012 is available in Table 21 (Appendix).

Table 9. Number and percentage of invasive pneumococcal disease cases by serotype, vaccine coverage and age group, 2012

Serotype	<2 years		2–4 years		<5 years[a]		5–64 years		≥65 years[b]		Total	
	Cases	%[c]	Cases	%[c]	Cases	%[c]	Cases	%[c]	Cases	%[c]	Cases	%[c]
PCV7	**2**	**5.0**	**2**	**16.7**	**4**	**7.7**	**68**	**33.3**	**58**	**28.6**	**130**	**28.3**
4	0	-	0	-	0	-	26	12.7	22	10.8	48	10.5
6B	0	-	0	-	0	-	3	1.5	5	2.5	8	1.7
9V	0	-	1	8.3	1	1.9	5	2.5	7	3.4	13	2.8
14	1	2.5	1	8.3	2	3.8	11	5.4	5	2.5	18	3.9
18C	0	-	0	-	0	-	5	2.5	4	2.0	9	2.0
19F	1	2.5	0	-	1	1.9	13	6.4	11	5.4	25	5.4
23F	0	-	0	-	0	-	5	2.5	4	2.0	9	2.0
PCV10	**5**	**12.5**	**4**	**33.3**	**9**	**17.3**	**93**	**45.6**	**73**	**36.0**	**175**	**38.1**
1	1	2.5	0	-	1	1.9	7	3.4	0	-	8	1.7
5	0	-	0	-	0	-	0	-	0	-	0	-
7F	2	5.0	2	16.7	4	7.7	18	8.8	15	7.4	37	8.1
PCV13	**22**	**55.0**	**9**	**75.0**	**31**	**59.6**	**133**	**65.2**	**123**	**60.6**	**287**	**62.5**
3	2	5.0	0	-	2	3.8	9	4.4	14	6.9	25	5.4
6A	2	5.0	0	-	2	3.8	1	0.5	4	2.0	7	1.5
19A	13	32.5	5	41.7	18	34.6	30	14.7	32	15.8	80	17.4
Non-PCV[d]	**18**	**45.0**	**3**	**25.0**	**21**	**40.4**	**71**	**34.8**	**80**	**39.4**	**172**	**37.5**
6C	2	5.0	0	-	2	3.8	5	2.5	8	3.9	15	3.3
8	2	5.0	0	-	2	3.8	11	5.4	5	2.5	18	3.9
9N	0	-	0	-	0	-	5	2.5	3	1.5	8	1.7
10A	3	7.5	1	8.3	4	7.7	2	1.0	4	2.0	10	2.2
11A	2	5.0	0	-	2	3.8	5	2.5	7	3.4	14	3.1
15B	4	10.0	2	16.7	6	11.5	2	1.0	2	1.0	10	2.2
22F	0	-	0	-	0	-	19	9.3	21	10.3	40	8.7
23B	0	-	0	-	0	-	5	2.5	2	1.0	7	1.5
33F	0	-	0	-	0	-	1	0.5	8	3.9	9	2.0
Other	5	12.5	0	-	5	9.6	16	7.8	20	9.9	41	8.9
Total[e]	**40**		**12**		**52**		**204**		**203**		**459**	

[a] Aggregated age group.

[b] Among the cases in the ≥65 year age group, 81.0% were due to one of the serotypes included in PPV23. Vaccination with PPV23 is recommended for people in this age group.

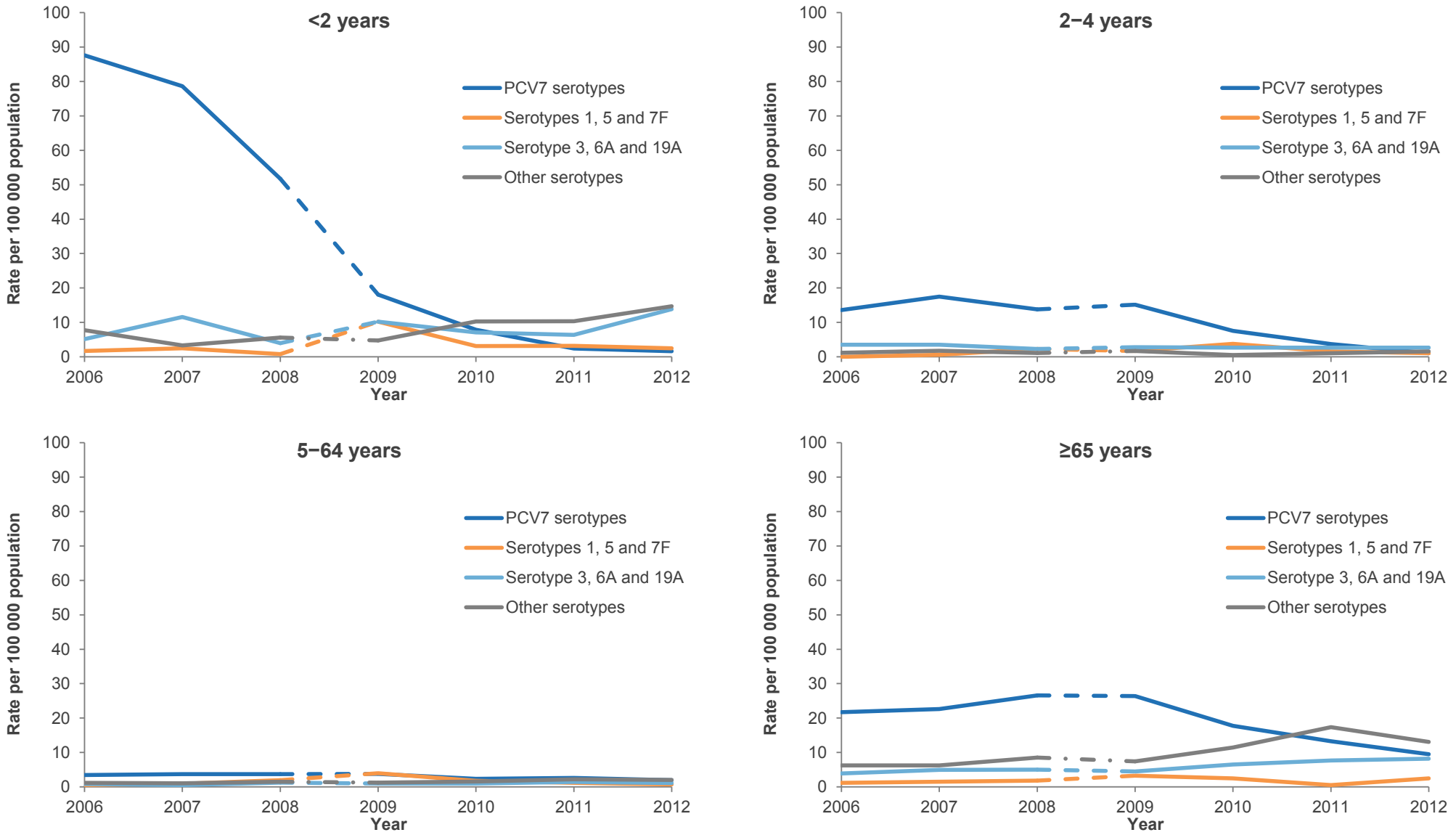
[c] Percentage of cases within the age group with the serotype.

[d] The specific serotypes listed are those that accounted for more than five cases of IPD in 2012.

[e] Culture-positive cases only.

The trends in the rates of disease due to PCV7 serotypes, the additional serotypes covered by PCV10 (1, 5 and 7F) and PCV13 (3, 6A and 19A), and all other serotypes for the different age groups are presented in Figure 5. Since the introduction of PCV to the national immunisation schedule, there have been significant decreases in IPD rates due to PCV7 serotypes in all age groups. The largest decreases have been in the <2 years and 2−4 years age groups, with 98.0% and 93.2% reductions in the rates between 2006/2007 and 2012, respectively, in these two age groups. The reductions over the same time period in the older age groups have been smaller at 45.6% in the 5−64 years age group and 57.2% in the ≥65 years group. Data is presented for each of the age groups in Table 22, Table 23, Table 24 and Table 25 (Appendix) and for all cases in Table 26 (Appendix).

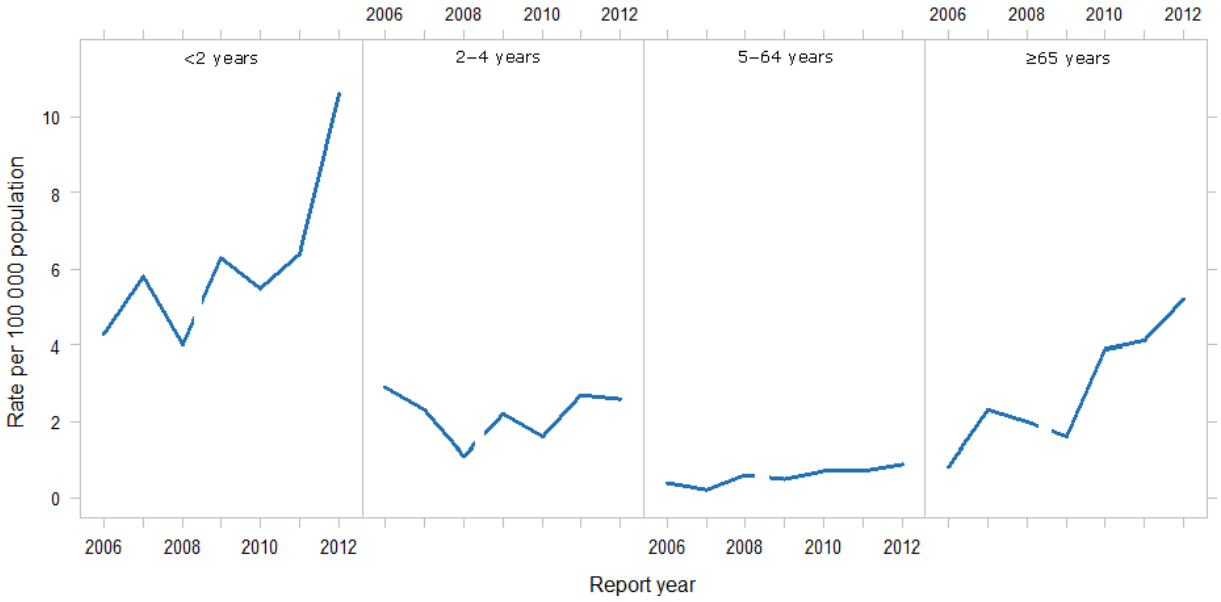
Figure 5. Rate per 100 000 of invasive pneumococcal disease by vaccine coverage, age group and year, 2006–2012



Note: 'PCV7 serotypes' are cases due to serotypes covered by PCV7 (4, 6B, 9V, 14, 18C, 19F and 23F); 'Serotypes 1, 5 and 7F' are cases due to the additional serotypes covered by PCV10; 'Serotypes 3, 6A and 19A' are cases due to the additional serotypes covered by PCV13; and 'Other serotypes' are all other culture-positive IPD cases. 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 2012, the non-PCV7 serotype 19A was the most prevalent serotype for all age groups (Table 9). Since 2006/2007, there have been significant increases in the rate of 19A disease in the <2 years (5.1 to 10.6 per 100 000 population), 5−64 years (0.3 to 0.9 per 100 000), and ≥65 years (1.5 to 5.2 per 100 000) age groups (Figure 6 and Table 27 in the Appendix). While there has been a trend of increasing rates of 19A IPD in the 5−64 years and ≥65 years age groups over the last 3−4 years, 2012 was the first year a significant increase was observed in the <2 years age group.

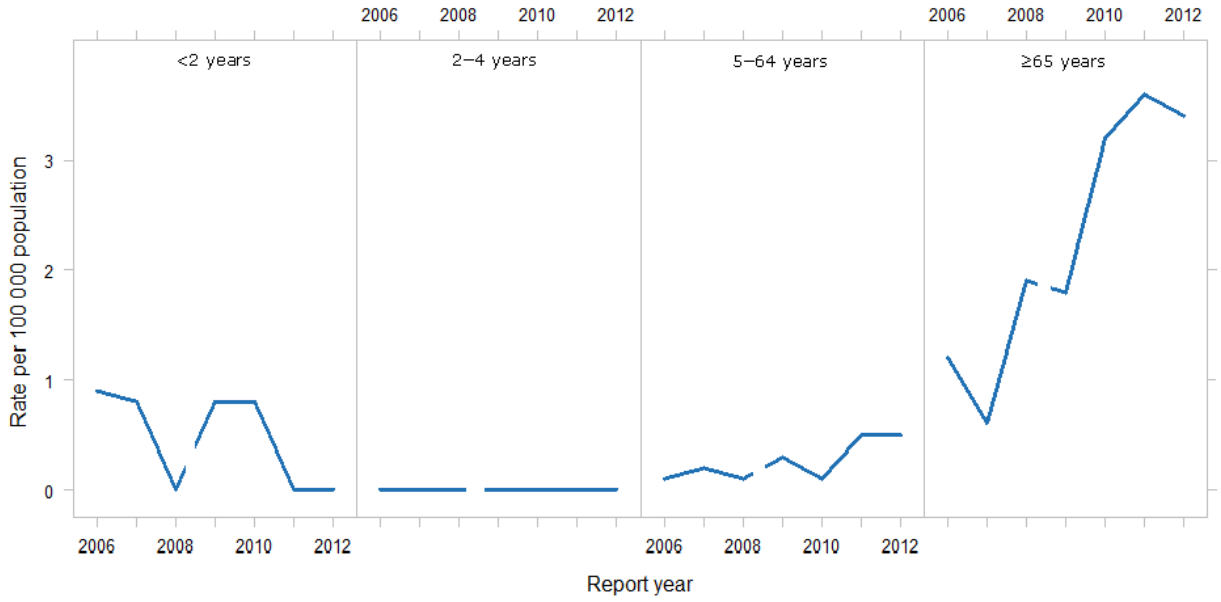
Figure 6. Rate per 100 000 of invasive pneumococcal disease due to serotype 19A by age group and year, 2006–2012



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.

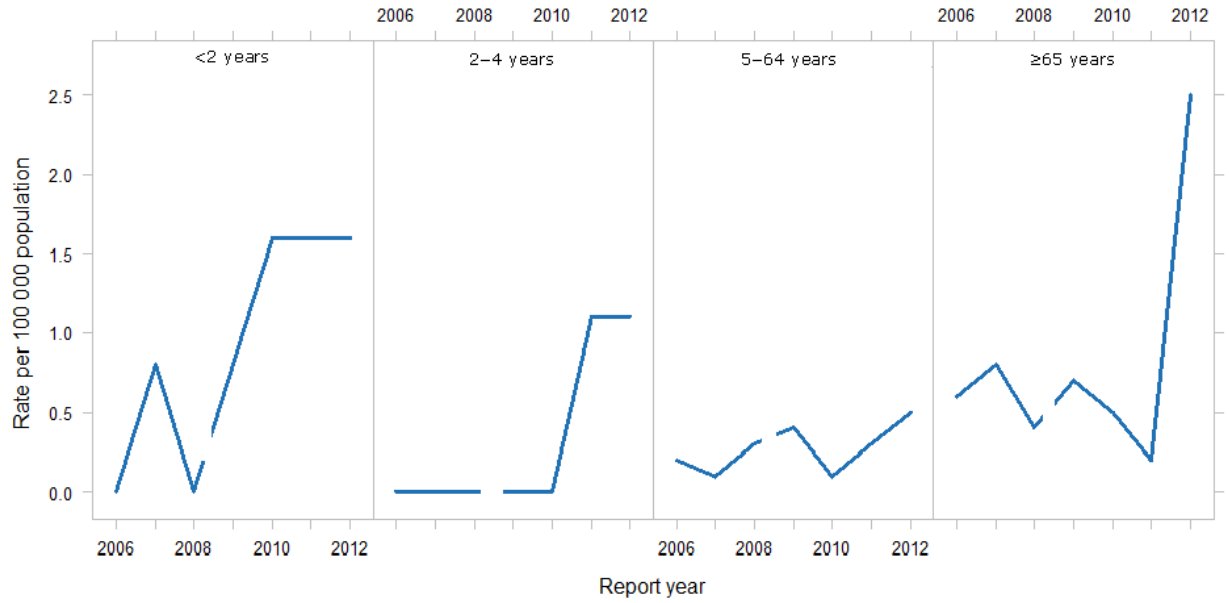
The other common non-PCV7 serotypes in 2012 were 22F (40 cases) and 7F (37 cases) (Table 9). These two serotypes are most commonly isolated from IPD cases ≥5 years of age, with only 0−2 cases reported annually for the <2 years and 2−4 years age groups. Between 2006 and 2012, the rate of IPD due to serotype 22F increased from 1.2 to 3.4 per 100 000 population in the ≥65 years age group (Figure 7). Rates of serotype 7F IPD have fluctuated over the same period, but between 2011 and 2012, there was a large increase in the rate in the ≥65 years age group (Figure 8).

Figure 7. Rate per 100 000 of invasive pneumococcal disease due to serotype 22F by age group and year, 2006–2012



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.

Figure 8. Rate per 100 000 of invasive pneumococcal disease due to serotype 7F by age group and year, 2006–2012



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.

Antimicrobial susceptibility

Table 10 shows the antimicrobial susceptibility of the isolates from the 459 culture-positive IPD cases in 2012. The penicillin and cefotaxime MICs displayed the typical bimodal distribution (Table 28 in the Appendix).

7.4% of isolates had combined penicillin (meningitis interpretation) and erythromycin resistance, and 0.7% had combined penicillin (non-meningitis interpretation) and erythromycin resistance. Among the penicillin-resistant isolates (meningitis interpretation), 36.7% (29/79) were multiresistant to at least 3 additional antibiotics, commonly co-trimoxazole, erythromycin and tetracycline with or without cefotaxime resistance.

Trends in penicillin resistance, cefotaxime resistance and multidrug resistance over the last 10 years (2003−2012) are shown in Table 29 (Appendix). The rate of penicillin resistance, based on the meningitis interpretive standards, has varied year-to-year over these 10 years from a high of 22.3% in 2007 to a low of 14.1% in 2011. The 2012 rate (17.2%) was near the median rate for the decade. Similarly, the rates of cefotaxime resistance, based on the meningitis interpretive standards (4.1%), and multiresistance (6.3%) in 2012 were within the range of rates recorded for 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. Rifampicin susceptibility has been tested since 2010, with no resistance identified.

Table 10. Antimicrobial susceptibility among isolates from invasive pneumococcal disease cases, 2012

Antibiotic	CLSI interpretive standards[a]			Susceptibility (%)		
	S[b]	I[b]	R[b]	S[b]	I[b]	R[b]
	MIC (mg/L)					
penicillin						
meningitis	≤0.06	-	≥0.12	82.8	-	17.2
non-meningitis	≤2	4	≥8	98.0	1.3	0.7
oral treatment	≤0.06	0.12-1	≥2	82.8	9.4	7.8
cefotaxime						
meningitis	≤0.5	1	≥2	92.4	3.5	4.1
non-meningitis	≤1	2	≥4	95.9	2.8	1.3
	Zone diameter (mm)					
chloramphenicol	≥21	-	≤20	99.6	-	0.4
clindamycin[c]	≥19	16-18	≤15	94.3	0.0	5.7
co-trimoxazole	≥19	16-18	≤15	77.3	1.3	21.4
erythromycin	≥21	16-20	≤15	91.3	0.0	8.7
moxifloxacin	≥18	15-17	≤14	99.8	0.2	0.0
rifampicin	≥19	17-18	≤16	100.0	0.0	0.0
tetracycline	≥23	19-22	≤18	91.9	0.0	8.1
vancomycin	≥17	-	-	100.0	-	-

[a] Clinical and Laboratory Standards Institute [13]

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

[c] The percentage resistant given is for constitutive clindamycin resistance. One isolate had inducible clindamycin resistance.

Penicillin and cefotaxime resistance in each region and DHB is shown in Table 31 (Appendix). There were significant differences in penicillin, but not cefotaxime, resistance between the four regions, with penicillin resistance ranging from 10.6% in the Central region to 22.5% in the Northern region.

Penicillin and cefotaxime resistance among isolates from the different age groups is shown in Table 11. There were no significant differences in resistance between the age groups.

Table 11. Penicillin and cefotaxime resistance among isolates from invasive pneumococcal disease cases, 2012

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=40)	7	17.5	2	5.0	0	-
2−4 (n=12)	3	25.0	0	-	1	8.3
5−64 (n=204)	32	15.7	8	3.9	10	4.9
≥65 (n=203)	37	18.2	6	3.0	8	3.9
All ages (n=459)	**79**	**17.2**	**16**	**3.5**	**19**	**4.1**

[a] CLSI meningitis interpretations; no intermediate category for penicillin [13].

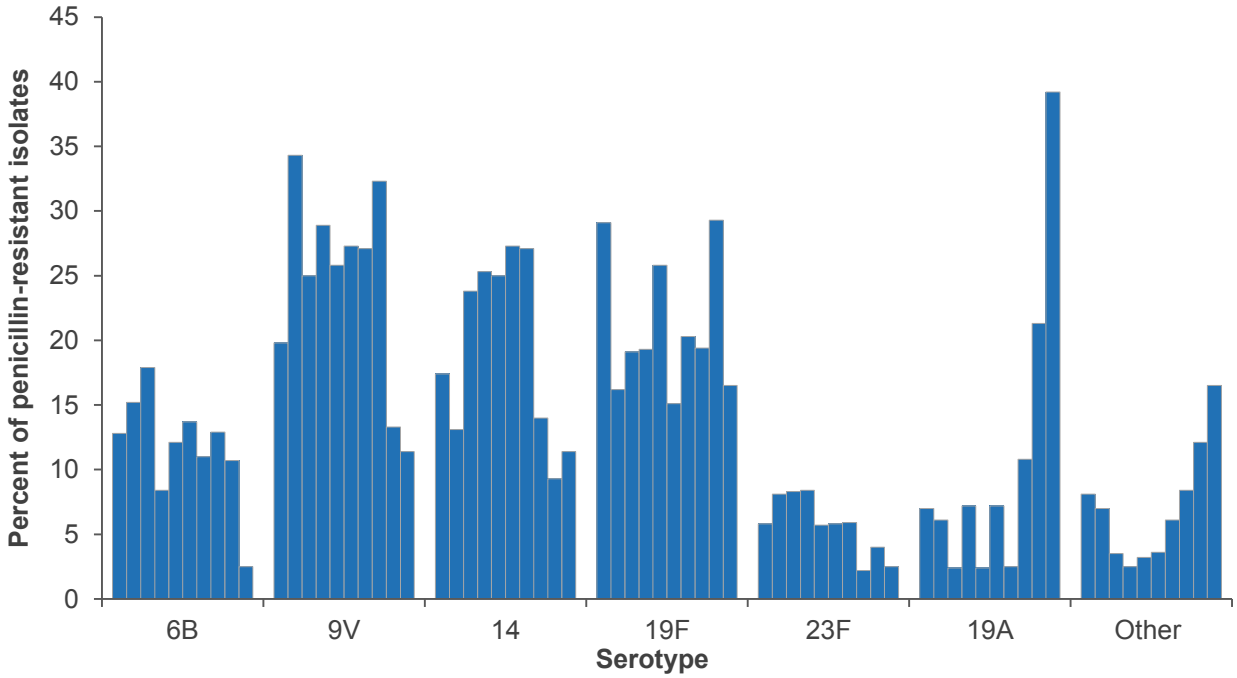
[b] Number of isolates.

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

In 2012, 44.3% of penicillin-resistant isolates and 73.7% of cefotaxime-resistant isolates were serotypes included in PCV10 (Table 32 in the Appendix). The serotypes most commonly associated with penicillin-resistant invasive pneumococci over the last 10 years are shown in Figure 9. Until 2010, serotypes 9V, 14 and 19F were the most prevalent serotypes among penicillin-resistant isolates. However since 2010, serotype 19A has constituted an increasing proportion of the penicillin-resistant isolates, and, in 2012, was the most prevalent serotype and accounted for 39.2% of penicillin-resistant isolates. In contrast serotype 19F was the most prevalent cefotaxime-resistant type (Table 32). Serotypes 19A and 19F were the most common types among multiresistant isolates, and collectively accounted for 79.3% of these isolates (Table 32). Both types 19A and 19F multiresistant isolates were commonly resistant to co-trimoxazole, erythromycin and tetracycline, and in addition multiresistant 19F isolates were usually also resistant to cefotaxime.

However, while there has been a marked 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).

Figure 9. Serotype distribution among penicillin-resistant pneumococci from invasive disease cases, 2003–2012



Note: The series of bars for each serotype represent the individual years 2003 to 2012 from left to right. Penicillin resistance according to CLSI meningitis interpretation [13].

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 2012, the fourth full year after the introduction of PCV into the schedule, the impact of routine infant immunisation is evident among all age groups, but particularly among children age-eligible for vaccination. The rate of IPD in the <2 years age group has declined 64% since the introduction of PCV: from an average of 100.3 cases per 100 000 population in 2006/2007 to 35.9 per 100 000 in 2012. The reduction in IPD caused by PCV7 serotypes in this age group is even more striking, with a 98% decrease from an average of 83.1 per 100 000 in 2006/2007 to 1.6 per 100 000 in 2012 (note that the 2012 rate was calculated based on 2 cases only). The actual reductions in disease rates may be greater than these figures indicate, as the 2012 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 also decreased significantly in the 2−4 years age group, with a 64% reduction from an average of 20.8 cases per 100 000 population in 2006/2007 to 7.4 per 100 000 in 2012. Again, the decrease in the subset of IPD caused by PCV7 types over the same time period was greater, with a 93% reduction from 15.5 to 1.1 per 100 000 (note that the 2012 rate was calculated based on 2 cases only). This is as expected, as the majority of children in this age group in 2012 would have been vaccine-eligible.

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 [14, 15]. In New Zealand such an indirect effect, as measured by significant decreases in the rate of IPD due to PCV7 serotypes, was first evident in the ≥65 years age group in 2010 and a year later was also observed in the 5−64 years age group [3, 4]. By 2012, the rate of IPD due to PCV7 types in these two older age groups had decreased 57% (22.2 to 9.5 per 100 000 population) and 46% (3.6 to 1.9 per 100 000), respectively, since 2006/2007. 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 years or ≥65 years age groups. This is probably due to PCV7 serotypes initially constituting a smaller proportion of the disease in these age groups than those groups directly targeted for vaccination and also some serotype replacement (see discussion below) [9].

Data on IPD among the different ethnic groups is only available since 2009, that is, since IPD became a notifiable disease. In 2012, as has been observed since 2009, the age-standardised rates of IPD in the Māori and Pacific Peoples ethnic groups were at least 3 times that in the European or Other ethnic group. This unequal burden of IPD in Māori and Pacific Peoples is consistent with ethnic group disparities identified generally for infectious diseases in New Zealand [16]. While between 2009 and 2012 among infants <2 years of age, there has been a significant decrease in IPD rates in Māori (86.6 to 43.3 per 100 000 population), in Pacific infants there has been an increase, albeit small and insignificant, in rates (64.0 to 83.0 per 100 000). The decrease in the rate in Māori infants is likely to be an underestimate of the real impact of vaccination, as by 2009 the rate of IPD had already decreased by 54% in the <2 years age group compared with the pre-vaccine years of 2006/2007 [2]. The apparent lack of an impact of PCV vaccination on IPD rates among Pacific infants is notable and may be due, at least in part, to IPD in this ethnic group being less commonly caused by vaccine types. Unfortunately, due to 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 4 years that ethnicity data has been available, there has only been one case 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 [14, 15, 17]. Serotype 19A is the non-PCV7 type most frequently reported to have increased [14, 17], but increases in other non-PCV7 serotypes, for example 7F and 22F in England and Wales, have also been reported [15].

Increases in type 19A disease have been of special concern as this serotype is often associated with antibiotic resistance [18, 19]. The increasing rates of resistance among invasive serotype 19A isolates are reported to be associated with shifts in the genetic structure of the isolates and also with the expansion of particular resistant clonal complexes [20]. Encouragingly, there have been recent reports from the United States that the increases in 19A disease, observed after the use of PCV7, have halted, and rates are even decreasing, within a year or two of the switch from PCV7 to PCV13, which includes serotype 19A [21, 22].

A significant increase in serotype 19A IPD was observed for the first time in New Zealand in 2011, but occurred only in the ≥65 years age group [4]. Worryingly by 2012, rates of 19A disease had also increased significantly in the <2 years and the 5−64 years age groups. In fact, in large part due to cases of 19A disease, the overall rate of IPD in the <2 years age group increased for the first time since the introduction of PCV into the immunisation schedule, with the rate in this age group being 51% higher in 2012 than in 2011.

In 2012, 19A was the most prevalent serotype in all age groups. Given the now significant increases in the rate of 19A disease in most age groups and the large proportion of remaining disease that this type accounts for, close monitoring of this serotype is important to assist with decisions on the selection of vaccines for the schedule. As 2012 was the first year that an increase in serotype 19A cases had been observed in the vaccine-eligible age group, there was some concern that this increase may have been associated with the immunisation schedule change from PCV7 to PCV10 in late 2011. However, an analysis of the vaccination history of the 18 cases of type 19A IPD notified in children <5 years of age in 2012 provided no evidence that the change to PCV10 accounted for the increase. Conversely, there is some evidence that the 19F conjugated polysaccharide in PCV10 appears to induce antibody that confers some cross-protection against serotype 19A [23]. Since PCV10 was only introduced in late 2011, it is too soon to judge whether cross-protection for 19A is occurring in New Zealand.

Serotypes 7F and 22F have also been implicated in serotype replacement following the introduction of PCV [15]. In New Zealand in 2012, after 19A, these two serotypes were the most common non-PCV7 types, and were mainly identified among IPD cases in the older age groups. With the introduction of PCV10, which covers serotype 7F, rates of IPD due to this type are likely to decrease. However, unlike the situation for serotype 7F and 19A, type 22F is not included in any of the currently available pneumococcal conjugate vaccines, although it is in PPV23.

In 2012, most (90%) of the IPD cases in infants who had received at least 2 doses of PCV were due to a non-PCV7 type. Among the four cases who had received at least 2 doses of PCV and had disease due to a PCV7 type, two had serotype 14 disease, one had type 9V disease and one had type 19F disease. Serotypes 19F and 6B were found to be the most common types associated with vaccine breakthrough cases in a United States study [24].

In the pre-PCV era, most antimicrobial-resistant invasive pneumococci belonged to one of the serotypes included in PCV7. Therefore it could be expected that a decrease in IPD caused by PCV7 types following the introduction of the vaccine would have the concomitant effect of reducing the incidence of IPD caused by resistant pneumococci. Such an effect on resistance had been observed in other countries, but has been off-set to some extent by high or increasing levels of resistance among some serotypes, especially 19A, that have replaced vaccine types [19, 25].

As yet there is little change in the prevalence of resistance among isolates from IPD cases in New Zealand. While PCV7 serotypes are now accounting for a smaller proportion of the penicillin-resistant isolates than in previous years, conversely serotype 19A is accounting for a much greater proportion: 39% in 2012 vs 3% in 2009 [2, 3]. However, this increase in the proportion of penicillin-resistant isolates that are serotype 19A is mainly due to type 19A causing a greater proportion of the IPD cases rather than penicillin resistance becoming more prevalent among this serotype.

In late 2011, PCV10 (Synflorix®) replaced PCV7 on the childhood immunisation schedule. PCV10 will give additional coverage for serotypes 1, 5 and 7F. Hopefully, as herd immunity confers protection to older age groups, the recent increases in 7F IPD in these age groups will be turned around.

REFERENCES

REFERENCES

1. Heffernan H, Martin D. Invasive pneumococcal disease in New Zealand, 2008. Porirua, NZ: Institute of Environmental Science and Research Ltd (ESR); 2009.

2. Heffernan H, Morgan J, Woodhouse R, et al. Invasive pneumococal disease in New Zealand, 2009. Porirua, NZ: Institute of Environmental Science and Research Ltd (ESR); 2010.

3. Heffernan H, Morgan J, Woodhouse R. Invasive pneumococcal disease in New Zealand, 2010. Porirua, NZ: Institute of Environmental Science and Research Ltd (ESR); 2011.

4. Lim E, Heffernan H. Invasive pneumococcal disease in New Zealand, 2011. Porirua, NZ: Institute of Environmental Science and Research Ltd (ESR); 2012.

5. Green MJ, Cawley PF. In vitro antimicrobial susceptibility of *Streptococcus pneumoniae* in New Zealand. NZ Med J 1979; 90: 53-5.

6. Heffernan H. Antimicrobial susceptibility of clinically significant *Streptococcus pneumoniae* isolates. NZ Med J 1987; 100: 327.

7. Martin D, Brett M. Pneumococci causing invasive disease in New Zealand, 1987-94: serogroup and serotype coverage and antibiotic resistances. NZ Med J 1996; 109: 288-90.

8. Brett M, Martin D. A significant increase in antimicrobial resistance among pneumococci causing invasive disease in New Zealand. NZ Med J 1999; 112: 113-5.

9. Heffernan H, Martin D, Woodhouse R, et al. Invasive pneumococcal disease in New Zealand 1998-2005: capsular serotypes and antimicrobial resistance. Epidemiol Infect 2008; 136: 352-9.

10. Ministry of Health. Communicable Disease Control Manual 2012. Wellington, NZ: Ministry of Health; 2012.

11. Lund E, Henrichsen J. Laboratory diagnosis, serology and epidemiology of *Streptococcus pneumoniae*. In: Bergan T, Norris R, editors. Methods in microbiology. 12th ed. London: Academic Press; 1978. p. 241-62.

12. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial disk susceptibility tests; approved standard - eleventh edition. Wayne, PA, USA: CLSI; 2012. CLSI document M02-A11.

13. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing; twenty-second informational supplement. Wayne, PA, USA: CLSI; 2012. CLSI document M100-S22.

14. Pilishvili T, Lexau C, Farley MM, et al. Sustained reductions in invasive pneumococcal disease in the era of conjugate vaccine. J Infect Dis 2010; 201: 32-41.

15. Miller E, Andrews NJ, Waight PA, et al. Herd immunity and serotype replacement 4 years after seven-valent pneumococcal conjugate vaccination in England and Wales: an observational cohort study. Lancet Infect Dis 2011; 11: 760-8.

16. Baker MG, Barnard LT, Kvalsvig A, et al. Increasing incidence of serious infectious diseases and inequalities in New Zealand: a national epidemiological study. Lancet 2012; 379: 1112-9.

17. Weinberger DM, Malley R, Lipsitch M. Serotype replacement in disease after pneumococcal vaccination. Lancet 2011; 378: 1962-73.

18. Pelton SI, Huot H, Finkelstein JA, et al. Emergence of 19A as virulent and multidrug resistant pneumococcus in Massachusetts following universal immunization of infants with pneumococcal conjugate vaccine. Pediatr Infect Dis 2007; 26: 468-72.

19. Dagan R, Klugman KP. Impact of conjugate pneumococcal vaccines on antibiotic resistance. Lancet Infect Dis 2008; 8: 785-95.

20. Beall BW, Gertz RE, Hulkower RL, et al. Shifting genetic structure of invasive serotype 19A pneumococci in the United States. J Infect Dis 2011; 203: 1360-8.

21. Richter SS, Heilmann KP, Dohrn CL, et al. Pneumococcal serotypes before and after introduction of conjugate vaccines, United States, 1999–2011. Emerg Infect Dis 2013; 19: 1074-83.

22. Kaplan SL, Barson WJ, Lin PL, et al. Early trends for invasive pneumococcal infections in children after the introduction of the 13-valent pneumococcal conjugate vaccine. Pediatr Infect Dis J 2013; 32: 203-7.

23. De Wals P, Lefebvre B, Defay F, et al. Invasive pneumococcal diseases in birth cohorts vaccinated with PCV-7 and/or P*Hi*D-CV in the province of Quebec, Canada. Vaccine 2012; 30: 6416-20.

24. Park SY, Van Beneden CA, Pilishvili T, et al. Invasive pneumococcal infections among vaccinated children in the United States. J Pediatr 2010; 156: 478-83.e2.

25. Tan TQ. Pediatric invasive pneumococcal disease in the United States in the era of pneumococcal conjugate vaccines. Clin Microbiol Rev 2012; 25: 409-19.

APPENDIX

APPENDIX

Table 12. Laboratory criteria upon which invasive pneumococcal disease diagnosis based, as recorded in the case notification, 2012

Basis of diagnosis	Prioritised[a]		Total response	
	Cases	%	Cases	%
Culture of *S. pneumoniae* from:	**487**	**99.8**	**487**	**99.8**
Blood	418	85.7	425	87.1
CSF	26	5.3	26	5.3
Pleural fluid	17	3.5	20	4.1
Joint fluid	5	1.0	5	1.0
Other	21	4.3	23	4.7
Positive pneumococcal antigen test on CSF	**1**	**0.2**	**2**	**0.4**
Detection of pneumococcal DNA	**0**	**-**	**1**	**0.2**

[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, detection of *S. pneumoniae* DNA in pleural fluid, culture of *S. pneumoniae* from joint fluid, and culture of *S. pneumoniae* from another normally sterile site.

Figure 10. Number of invasive pneumococcal disease cases in the less than 2 years age group by age (in months), 2012

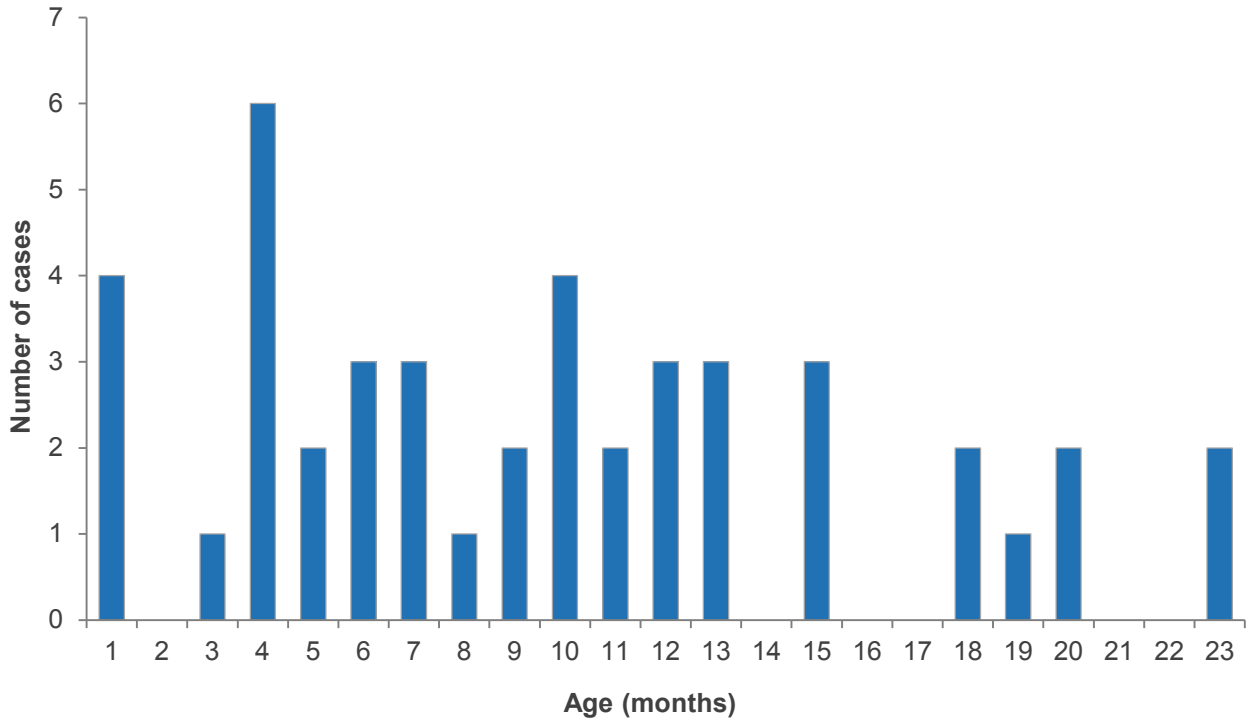


Table 13. Number of cases and rate per 100 000 population of invasive pneumococcal disease by age group and year, 2006–2012

Age group (years)	2006		2007		2008		2009		2010		2011		2012	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
<1	71	120.2	48	77.7	37	57.7	34	53.9	22	34.5	23	36.9	31	51.2
1	51	88.9	68	115.3	42	68.2	25	39.1	15	23.8	7	11.0	13	21.0
2–4	31	18.3	40	23.3	35	20.1	41	23.0	28	15.1	18	9.6	14	7.4
5–14	20	3.3	29	4.9	35	5.9	58	9.9	23	3.9	29	5.0	20	3.4
15–24	15	2.5	19	3.1	29	4.7	53	8.4	25	3.9	27	4.2	21	3.3
25–34	16	2.9	24	4.4	32	5.9	53	9.6	25	4.5	40	7.1	24	4.2
35–44	54	8.5	41	6.5	53	8.5	68	11.0	39	6.4	36	6.0	37	6.2
45–54	42	7.4	37	6.3	55	9.2	55	9.1	59	9.6	55	8.9	44	7.1
55–64	56	13.0	63	14.3	87	19.1	69	14.7	75	15.6	87	17.6	74	14.8
65–74	67	24.3	87	30.5	87	29.8	94	31.1	80	25.5	84	25.8	84	24.4
75–84	68	38.2	73	40.5	88	48.3	94	51.1	87	46.8	88	46.7	81	42.2
≥85	34	58.5	26	42.6	51	80.0	53	79.6	57	81.3	58	79.3	45	59.3
Aggregated age groups (years)														
<2	122	104.8	116	96.1	79	62.9	59	46.4	37	29.2	30	23.8	44	35.9
<5	153	53.5	156	53.4	114	38.0	100	32.7	65	20.8	48	15.3	58	18.6
5–64	203	6.0	213	6.2	291	8.5	356	10.3	246	7.1	274	7.8	220	6.3
≥65	169	33.0	186	35.3	226	42.0	241	43.6	224	39.4	230	39.2	210	34.3
Total	**525**	**12.5**	**555**	**13.1**	**631**	**14.8**	**697**	**16.1**	**535**	**12.2**	**552**	**12.5**	**488**	**11.0**

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 14. Rate per 100 000 population of invasive pneumococcal disease by ethnic group, age group and year, 2009–2012

Age group (years)	Ethnic group[a]															
	Māori				Pacific Peoples				Asian				European or Other			
	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012	2009	2010	2011	2012
<2	86.6	62.8	45.2	43.3	64.0	48.1	56.6	83.0	-	-	-	-	27.7	13.1	7.4	24.2
<5	50.0	38.9	24.9	22.6	49.6	35.6	25.7	42.1	19.5	26.8	22.8	-	23.2	9.3	6.9	12.2
5−64	21.1	13.9	12.0	11.2	28.0	25.5	18.7	14.2	3.7	2.2	2.0	1.4	7.0	4.3	6.4	4.7
≥65	97.2	80.4	98.3	74.9	106.2	150.8	92.3	103.4	30.0	-	-	31.6	37.4	35.0	35.1	30.0
All ages[b,c]	**35.9**	**27.9**	**29.4**	**26.1**	**42.3**	**48.0**	**32.4**	**35.4**	**10.1**	**7.6**	**5.6**	**8.3**	**11.8**	**8.3**	**9.9**	**8.4**

[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; 2012, 4 cases).

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

[c] Ethnicity was recorded for 475 (97.3%) cases notified in 2012, 540 (97.8%) cases 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 2012 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 15. Number of cases and rate per 100 000 population of invasive pneumococcal disease by clinical presentation and age group, 2012

Age group (years)	Meningitis		Bacteraemia without focus		Empyema		Pneumonia		Other	
	Cases[a]	Rate[b]	Cases[a]	Rate[b]	Cases[a]	Rate[b]	Cases[a]	Rate[b]	Cases[a]	Rate[b]
<1	10	16.5	6	9.9	2	-	13	21.5	6	9.9
1	3	-	5	8.1	3	-	8	12.9	3	-
2–4	0	-	2	-	1	-	8	4.2	5	2.6
5–14	2	-	5	0.9	0	-	10	1.7	9	1.6
15–64	19	0.6	24	0.8	7	0.2	143	4.9	31	1.1
≥65	12	2.0	38	6.2	5	0.8	172	28.1	25	4.1
Total[c]	**46**	**1.0**	**80**	**1.8**	**18**	**0.4**	**354**	**8.0**	**79**	**1.8**

[a] Number of cases with 'yes' recorded for each clinical presentation. Some cases reported having more than one clinical presentation. Any case for which *S. pneumoniae* was identified in 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 467 (95.7%) of cases notified in 2012.

Table 16. Case-fatality rates for invasive pneumococcal disease cases by age group, 2012

Age group (years)	Cases died[a]	Total reported[b]	Case-fatality rate[c] (%)
<1	1	30	3.3
1	2	13	15.4
2–4	1	13	7.7
5–14	0	20	-
15–64	7	187	3.7
≥65	20	201	10.0
Total	**31**	**464**	**6.7**

[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 464 (95.1%) of cases notified in 2012.

Table 17. Exposure to risk factors associated with invasive pneumococcal disease for cases aged less than two years, 2012

Risk factor	Cases[a]	Total reported[b]	%[c]
Smoking in the household	7	18	38.9
Premature (<37 weeks gestation)[d]	2	18	11.1
Chronic illness[e]	2	41	4.9
Immunocompromised[f]	1	41	2.4

[a] Number of cases with 'yes' recorded for each risk factor. Some cases reported exposure to 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 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.

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

Note: No cases aged <2 years were reported as having anatomical or functional asplenia, chronic lung disease or cystic fibrosis, cochlear implants, or congenital or chromosomal abnormality; or attending childcare; or being a resident in a long-term or other chronic-care facility.

Table 18. Exposure to risk factors associated with invasive pneumococcal disease for cases aged less than five years, 2012

Risk factor	Cases[a]	Total reported[b]	%[c]
Smoking in the household	11	25	44.0
Premature (<37 weeks gestation)[d]	2	18	11.1
Attends childcare	2	22	9.1
Chronic illness[e]	4	55	7.3
Immunocompromised[f]	3	55	5.5
Chronic lung disease or cystic fibrosis	1	53	1.9
Cochlear implants	1	55	1.8
Resident in long-term or other chronic-care facility	1	57	1.8

[a] Number of cases with 'yes' recorded for each risk factor. Some cases reported exposure to 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 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.

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

Note: No cases aged <5 years were reported as having anatomical or functional asplenia, or congenital or chromosomal abnormality.

Table 19. Exposure to risk factors associated with invasive pneumococcal disease for cases aged 5 years and over, 2012

Risk factor	Cases[a]	Total reported[b]	%[c]
Chronic illness[d]	242	384	63.0
Current smoker[e]	85	333	25.5
Chronic lung disease or cystic fibrosis	65	385	17.9
Immunocompromised[f]	69	372	17.5
Resident in long-term or other chronic-care facility[g]	39	390	10.0
Anatomical or functional asplenia	6	367	1.6
Congenital or chromosomal abnormality	1	349	0.3
Cochlear implants	1	373	0.3

[a] Number of cases with 'yes' recorded for each risk factor. Some cases reported exposure to 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 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, 26.5% (31 cases out of 117 for whom the information was supplied) were residents in a long-term or other chronic-care facility.

Table 20. Number of cases and rate per 100 000 population of invasive pneumococcal disease by serotype for each age group, 2012

Serotype	<2 years		2–4 years		<5 years[a]		5–64 years		≥65 years[b]		Total	
	Cases	Rate[c]	Cases	Rate[c]	Cases	Rate[c]	Cases	Rate[c]	Cases	Rate[c]	Cases	Rate[c]
PCV7	**2**	**-**	**2**	**-**	**4**	**-**	**68**	**1.9**	**58**	**9.5**	**130**	**2.9**
4	0	-	0	-	0	-	26	0.7	22	3.6	48	1.1
6B	0	-	0	-	0	-	3	-	5	0.8	8	0.2
9V	0	-	1	-	1	-	5	0.1	7	1.1	13	0.3
14	1	-	1	-	2	-	11	0.3	5	0.8	18	0.4
18C	0	-	0	-	0	-	5	0.1	4	-	9	0.2
19F	1	-	0	-	1	-	13	0.4	11	1.8	25	0.6
23F	0	-	0	-	0	-	5	0.1	4	-	9	0.2
PCV10	**5**	**4.1**	**4**	**-**	**9**	**2.9**	**93**	**2.6**	**73**	**11.9**	**175**	**3.9**
1	1	-	0	-	1	-	7	0.2	0	-	8	0.2
5	0	-	0	-	0	-	0	-	0	-	0	-
7F	2	-	2	-	4	-	18	0.5	15	2.5	37	0.8
PCV13	**22**	**17.9**	**9**	**4.8**	**31**	**9.9**	**133**	**3.8**	**123**	**20.1**	**287**	**6.5**
3	2	-	0	-	2	-	9	0.3	14	2.3	25	0.6
6A	2	-	0	-	2	-	1	-	4	-	7	0.2
19A	13	10.6	5	2.6	18	5.8	30	0.9	32	5.2	80	1.8
Non-PCV[d]	**18**	**14.7**	**3**	**-**	**21**	**6.7**	**71**	**2.0**	**80**	**13.1**	**172**	**3.9**
6C	2	-	0	-	2	-	5	0.1	8	1.3	15	0.3
8	2	-	0	-	2	-	11	0.3	5	0.8	18	0.4
9N	0	-	0	-	0	-	5	0.1	3	-	8	0.2
10A	3	-	1	-	4	-	2	-	4	-	10	0.2
11A	2	-	0	-	2	-	5	0.1	7	1.1	14	0.3
15B	4	-	2	-	6	1.9	2	-	2	-	10	0.2
22F	0	-	0	-	0	-	19	0.5	21	3.4	40	0.9
23B	0	-	0	-	0	-	5	0.1	2	-	7	0.2
33F	0	-	0	-	0	-	1	-	8	1.3	9	0.2
Other	5	4.1	0	-	5	1.6	16	0.5	20	3.3	41	0.9
Total[e]	**40**	**32.6**	**12**	**6.3**	**52**	**16.7**	**204**	**5.8**	**203**	**33.2**	**459**	**10.4**

[a] Aggregated age group.

[b] Among the cases in the ≥65 year age group, 81.0% were due to one of the serotypes included in PPV23. Vaccination with PPV23 is recommended for people in this age group.

[c] Rate per 100 000 population. Rates were not calculated where there were fewer than five cases.

[d] The specific serotypes listed are those that accounted for more than five cases of IPD in 2012.

[e] Culture-positive cases only.

Table 21. Number and percentage of invasive pneumococcal disease cases by serotype for each age group, 2012

Serotype	<2 years		<5 years		5–64 years		≥65 years		All ages	
	Cases	%[a]	Cases	%[a]	Cases	%[a]	Cases	%[a]	Cases	%[a]
1	1	2.5	1	1.9	7	3.4	0	-	8	1.7
3	2	5.0	2	3.8	9	4.4	14	6.9	25	5.4
4	0	-	0	-	26	12.7	22	10.8	48	10.5
6A	2	5.0	2	3.8	1	0.5	4	2.0	7	1.5
6B	0	-	0	-	3	1.5	5	2.5	8	1.7
6C	2	5.0	2	3.8	5	2.5	8	3.9	15	3.3
7A	0	-	0	-	1	0.5	0	-	1	0.2
7F	2	5.0	4	7.7	18	8.8	15	7.4	37	8.1
7 non-typable[b]	1	2.5	1	1.9	0	-	1	0.5	2	0.4
8	2	5.0	2	3.8	11	5.4	5	2.5	18	3.9
9N	0	-	0	-	5	2.5	3	1.5	8	1.7
9V	0	-	1	1.9	5	2.5	7	3.4	13	2.8
9 non-typable[b]	0	-	0	-	0	-	1	0.5	1	0.2
10A	3	7.5	4	7.7	2	1.0	4	2.0	10	2.2
10 non-typable[b]	0	-	0	-	2	1.0	1	0.5	3	0.7
11A	2	5.0	2	3.8	5	2.5	7	3.4	14	3.1
11 non-typable[b]	0	-	0	-	0	-	1	0.5	1	0.2
12F	0	-	0	-	1	0.5	1	0.5	2	0.4
13	0	-	0	-	1	0.5	2	1.0	3	0.7
14	1	2.5	2	3.8	11	5.4	5	2.5	18	3.9
15B	4	10.0	6	11.5	2	1.0	2	1.0	10	2.2
15 non-typable[b]	0	-	0	-	1	0.5	1	0.5	2	0.4
17F	1	2.5	1	1.9	2	1.0	0	-	3	0.7
17 non-typable[b]	0	-	0	-	0	-	2	1.0	2	0.4
18C	0	-	0	-	5	2.5	4	2.0	9	2.0
19A	13	32.5	18	34.6	30	14.7	32	15.8	80	17.4
19F	1	2.5	1	1.9	13	6.4	11	5.4	25	5.4
20	0	-	0	-	3	1.5	0	-	3	0.7
22A	0	-	0	-	0	-	1	0.5	1	0.2
22F	0	-	0	-	19	9.3	21	10.3	40	8.7
22 non-typable[b]	0	-	0	-	0	-	1	0.5	1	0.2
23A	0	-	0	-	4	2.0	1	0.5	5	1.1
23B	0	-	0	-	5	2.5	2	1.0	7	1.5
23F	0	-	0	-	5	2.5	4	2.0	9	2.0
24 non-typable[b]	0	-	0	-	1	0.5	0	-	1	0.2
31	0	-	0	-	0	-	1	0.5	1	0.2
33F	0	-	0	-	1	0.5	8	3.9	9	2.0
35 non-typable[b]	2	5.0	2	3.8	0	-	3	1.5	5	1.1
38	0	-	0	-	0	-	2	1.0	2	0.4
Non-typable	1	2.5	1	1.9	0	-	1	0.5	2	0.4
Total[c]	**40**		**52**		**204**		**203**		**459**	

[a] Percentage of cases due to each serotype out of the total number of culture-positive cases within the age group.
[b] Not typable with the range of factorised antisera used at ESR.
[c] Total number of culture-positive cases for each age group.

Table 22. Number of cases and rate per 100 000 population of invasive pneumococcal disease in the less than 2 years age group by serotype, 2006/2007–2012

Serotype	2006/2007		2008		2009		2010		2011		2012	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
PCV7	**98.5**	**83.1**	**65**	**51.7**	**23**	**18.1**	**10**	**7.9**	**3**	**-**	**2**	**-**
4	6.5	5.5	5	4.0	1	-	0	-	0	-	0	-
6B	18.0	15.2	21	16.7	4	-	1	-	1	-	0	-
9V	4.5	3.8	3	-	0	-	0	-	1	-	0	-
14	39.0	32.9	21	16.7	7	5.5	3	-	0	-	1	-
18C	6.0	5.1	6	4.8	1	-	0	-	1	-	0	-
19F	15.5	13.1	6	4.8	8	6.3	6	4.7	0	-	1	-
23F	9.0	7.6	3	-	2	-	0	-	0	-	0	-
PCV10	**101.0**	**85.2**	**66**	**52.5**	**36**	**28.3**	**14**	**11.0**	**7**	**5.6**	**5**	**4.1**
1	2.0	-	1	-	12	9.4	2	-	2	-	1	-
5	0.0	-	0	-	0	-	0	-	0	-	0	-
7F	0.5	-	0	-	1	-	2	-	2	-	2	-
PCV13	**111.0**	**93.6**	**71**	**56.5**	**49**	**38.6**	**25**	**19.7**	**16**	**12.7**	**24**	**19.6**
3	1.0	-	0	-	3	-	2	-	0	-	2	-
6A/6C[e]	3.0	-	0	-	2	-	2	-	1	-	4	-
19A	6.0	5.1	5	4.0	8	6.3	7	5.5	8	6.4	13	10.6
Non-PCV[f]	**6.5**	**5.5**	**7**	**5.6**	**6**	**4.7**	**11**	**8.7**	**12**	**9.5**	**16**	**13.1**
8	0.0	-	2	-	0	-	0	-	2	-	2	-
9N	0.0	-	0	-	0	-	0	-	1	-	0	-
10A	0.5	-	1	-	0	-	1	-	1	-	3	-
11A	0.5	-	0	-	1	-	0	-	1	-	2	-
15B	0.5	-	0	-	0	-	0	-	0	-	4	-
22F	1.0	-	0	-	1	-	1	-	0	-	0	-
23B	0.5	-	0	-	0	-	0	-	0	-	0	-
33F	0.5	-	1	-	0	-	4	-	1	-	0	-
Other	3.0	-	3	-	4	-	5	3.9	6	4.8	5	4.1

[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. Rates were not calculated where there were fewer than five cases.
[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 more than five cases in 2012.

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 of cases and rate per 100 000 population of invasive pneumococcal disease in the less than 5 years age group by serotype, 2006/2007–2012

Serotype	2006/2007		2008		2009		2010		2011		2012	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
PCV7	**125.0**	**43.2**	**89**	**29.7**	**50**	**16.4**	**24**	**7.7**	**10**	**3.2**	**4**	**-**
4	8.0	2.8	7	2.3	2	-	2	-	1	-	0	-
6B	23.5	8.1	25	8.3	8	2.6	2	-	1	-	0	-
9V	7.0	2.4	4	-	1	-	2	-	1	-	1	-
14	47.5	16.4	31	10.3	17	5.6	7	2.2	1	-	2	-
18C	10.5	3.6	6	2.0	4	-	0	-	2	-	0	-
19F	19.0	6.6	11	3.7	13	4.3	9	2.9	3	-	1	-
23F	9.5	3.3	5	1.7	5	1.6	2	-	1	-	0	-
PCV10	**128.0**	**44.3**	**94**	**31.3**	**66**	**21.6**	**35**	**11.2**	**17**	**5.5**	**9**	**2.9**
1	2.5	-	5	1.7	15	4.9	9	2.9	3	-	1	-
5	0.0	-	0	-	0	-	0	-	0	-	0	-
7F	0.5	-	0	-	1	-	2	-	4	-	4	-
PCV13	**144.0**	**49.8**	**103**	**34.3**	**84**	**27.5**	**51**	**16.4**	**31**	**9.9**	**33**	**10.6**
3	1.0	-	0	-	3	-	4	-	0	-	2	-
6A/6C[e]	4.5	1.6	2	-	3	-	2	-	1	-	4	-
19A	10.5	3.6	7	2.3	12	3.9	10	3.2	13	4.2	18	5.8
Non-PCV[f]	**9.0**	**3.1**	**9**	**3.0**	**9**	**2.9**	**12**	**3.8**	**14**	**4.5**	**19**	**6.1**
8	0.0	-	2	-	0	-	0	-	2	-	2	-
9N	0.0	-	0	-	2	-	0	-	1	-	0	-
10A	1.0	-	2	-	0	-	1	-	1	-	4	-
11A	0.5	-	0	-	1	-	0	-	1	-	2	-
15B	1.0	-	0	-	0	-	0	-	2	-	6	1.9
22F	1.0	-	0	-	1	-	1	-	0	-	0	-
23B	0.5	-	0	-	0	-	0	-	0	-	0	-
33F	1.0	-	1	-	0	-	4	-	1	-	0	-
Other	4.0	-	4	-	5	1.6	6	1.9	6	1.9	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. Rates were not calculated where there were fewer than five cases.
[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 more than five cases in 2012.

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 of cases and rate per 100 000 population of invasive pneumococcal disease in the 5–64 years age group by serotype, 2006/2007–2012

Serotype	2006/2007		2008		2009		2010		2011		2012	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
PCV7	**121.0**	**3.6**	**128**	**3.7**	**130**	**3.8**	**83**	**2.4**	**91**	**2.6**	**68**	**1.9**
4	38.0	1.1	33	1.0	32	0.9	26	0.7	30	0.9	26	0.7
6B	11.5	0.3	9	0.3	8	0.2	4	-	7	0.2	3	-
9V	11.0	0.3	19	0.6	15	0.4	13	0.4	10	0.3	5	0.1
14	31.0	0.9	29	0.8	23	0.7	15	0.4	18	0.5	11	0.3
18C	5.5	0.2	8	0.2	10	0.3	4	-	7	0.2	5	0.1
19F	12.0	0.4	15	0.4	26	0.8	12	0.3	14	0.4	13	0.4
23F	12.0	0.4	15	0.4	16	0.5	9	0.3	5	0.1	5	0.1
PCV10	**146.0**	**4.3**	**196**	**5.7**	**267**	**7.7**	**145**	**4.2**	**132**	**3.8**	**93**	**2.6**
1	19.0	0.6	56	1.6	124	3.6	58	1.7	30	0.9	7	0.2
5	0.0	-	0	-	0	-	0	-	0	-	0	-
7F	6.0	0.2	12	0.3	13	0.4	4	-	11	0.3	18	0.5
PCV13	**169.5**	**5.0**	**239**	**7.0**	**300**	**8.7**	**183**	**5.2**	**189**	**5.4**	**138**	**3.9**
3	8.5	0.3	16	0.5	12	0.3	9	0.3	22	0.6	9	0.3
6A/6C[e]	5.0	0.1	5	0.1	5	0.1	6	0.2	9	0.3	6	0.2
19A	10.0	0.3	22	0.6	16	0.5	23	0.7	26	0.7	30	0.9
Non-PCV[f]	**38.0**	**1.1**	**52**	**1.5**	**42**	**1.2**	**51**	**1.5**	**71**	**2.0**	**66**	**1.9**
8	12.0	0.4	11	0.3	8	0.2	7	0.2	9	0.3	11	0.3
9N	4.0	-	6	0.2	4	-	7	0.2	3	-	5	0.1
10A	3.0	-	0	-	2	-	2	-	5	0.1	2	-
11A	3.5	-	5	0.1	2	-	8	0.2	5	0.1	5	0.1
15B	0.5	-	0	-	0	-	0	-	2	-	2	-
22F	5.0	0.1	5	0.1	11	0.3	4	-	17	0.5	19	0.5
23B	0.5	-	0	-	0	-	1	-	1	-	5	0.1
33F	0.0	-	2	-	1	-	5	0.1	2	-	1	-
Other	9.5	0.3	23	0.7	14	0.4	17	0.5	27	0.8	16	0.5

[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. Rates were not calculated where there were fewer than five cases.

[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 more than five cases in 2012.

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 of cases and rate per 100 000 population of invasive pneumococcal disease in the 65 years and over age group by serotype, 2006/2007–2012

Serotype	2006/2007		2008		2009		2010		2011		2012	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
PCV7	**115.0**	**22.2**	**143**	**26.6**	**146**	**26.4**	**101**	**17.7**	**78**	**13.3**	**58**	**9.5**
4	19.5	3.8	21	3.9	23	4.2	18	3.2	15	2.6	22	3.6
6B	11.0	2.1	16	3.0	17	3.1	15	2.6	10	1.7	5	0.8
9V	14.5	2.8	18	3.3	19	3.4	16	2.8	4	-	7	1.1
14	35.5	6.8	48	8.9	35	6.3	18	3.2	9	1.5	5	0.8
18C	3.0	-	8	1.5	6	1.1	5	0.9	7	1.2	4	-
19F	16.5	3.2	16	3.0	19	3.4	15	2.6	22	3.7	11	1.8
23F	15.0	2.9	16	3.0	27	4.9	14	2.5	11	1.9	4	-
PCV10	**122.0**	**23.5**	**153**	**28.4**	**164**	**29.7**	**115**	**20.2**	**81**	**13.8**	**73**	**11.9**
1	3.5	-	8	1.5	14	2.5	10	1.8	2	-	0	-
5	0.0	-	0	-	0	-	1	-	0	-	0	-
7F	3.5	-	2	-	4	-	3	-	1	-	15	2.5
PCV13	**145.0**	**27.9**	**180**	**33.5**	**189**	**34.2**	**158**	**27.8**	**135**	**23.0**	**131**	**21.4**
3	12.5	2.4	12	2.2	11	2.0	8	1.4	16	2.7	14	2.3
6A/6C[e]	2.5	-	4	-	5	0.9	13	2.3	14	2.4	12	2.0
19A	8.0	1.5	11	2.0	9	1.6	22	3.9	24	4.1	32	5.2
Non-PCV[f]	**32.5**	**6.3**	**46**	**8.6**	**41**	**7.4**	**59**	**10.4**	**93**	**15.8**	**72**	**11.8**
8	3.5	-	4	-	4	-	0	-	2	-	5	0.8
9N	4.0	-	5	0.9	2	-	8	1.4	11	1.9	3	-
10A	2.0	-	0	-	2	-	3	-	5	0.9	4	-
11A	3.5	-	2	-	3	-	5	0.9	8	1.4	7	1.1
15B	1.0	-	0	-	2	-	0	-	1	-	2	-
22F	4.5	0.9	10	1.9	10	1.8	18	3.2	21	3.6	21	3.4
23B	0.5	-	0	-	0	-	1	-	1	-	2	-
33F	1.5	-	7	1.3	3	-	4	-	8	1.4	8	1.3
Other	12.0	2.3	18	3.3	15	2.7	20	3.5	36	6.1	20	3.3

[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. Rates were not calculated where there were fewer than five cases.
[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 more than five cases in 2012.

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 26. Number of cases and rate per 100 000 population of invasive pneumococcal disease by serotype, all ages, 2006/2007–2012

Serotype	2006/2007		2008		2009		2010		2011		2012	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
PCV7	**361.0**	**8.6**	**360**	**8.4**	**326**	**7.6**	**208**	**4.8**	**179**	**4.1**	**130**	**2.9**
4	65.5	1.6	61	1.4	57	1.3	46	1.1	46	1.0	48	1.1
6B	46.0	1.1	50	1.2	33	0.8	21	0.5	18	0.4	8	0.2
9V	32.5	0.8	41	1.0	35	0.8	31	0.7	15	0.3	13	0.3
14	114.0	2.7	108	2.5	75	1.7	40	0.9	28	0.6	18	0.4
18C	19.0	0.5	22	0.5	20	0.5	9	0.2	16	0.4	9	0.2
19F	47.5	1.1	42	1.0	58	1.3	36	0.8	39	0.9	25	0.6
23F	36.5	0.9	36	0.8	48	1.1	25	0.6	17	0.4	9	0.2
PCV10	**396.0**	**9.4**	**443**	**10.4**	**497**	**11.5**	**295**	**6.8**	**230**	**5.2**	**175**	**3.9**
1	25.0	0.6	69	1.6	153	3.5	77	1.8	35	0.8	8	0.2
5	0.0	-	0	-	0	-	1	-	0	-	0	-
7F	10.0	0.2	14	0.3	18	0.4	9	0.2	16	0.4	37	0.8
PCV13	**458.5**	**10.9**	**522**	**12.2**	**573**	**13.3**	**392**	**9.0**	**355**	**8.1**	**302**	**6.8**
3	22.0	0.5	28	0.7	26	0.6	21	0.5	38	0.9	25	0.6
6A/6C[e]	12.0	0.3	11	0.3	13	0.3	21	0.5	24	0.5	22	0.5
19A	28.5	0.7	40	0.9	37	0.9	55	1.3	63	1.4	80	1.8
Non-PCV[f]	**79.5**	**1.9**	**107**	**2.5**	**92**	**2.1**	**122**	**2.8**	**178**	**4.0**	**157**	**3.5**
8	15.5	0.4	17	0.4	12	0.3	7	0.2	13	0.3	18	0.4
9N	8.0	0.2	11	0.3	8	0.2	15	0.3	15	0.3	8	0.2
10A	6.0	0.1	2	-	4	-	6	0.1	11	0.2	10	0.2
11A	7.5	0.2	7	0.2	6	0.1	13	0.3	14	0.3	14	0.3
15B	2.5	-	0	-	2	-	0	-	5	0.1	10	0.2
22F	10.5	0.2	15	0.4	22	0.5	23	0.5	38	0.9	40	0.9
23B	1.5	-	0	-	0	-	2	-	2	-	7	0.2
33F	2.5	-	10	0.2	4	-	13	0.3	11	0.2	9	0.2
Other	25.5	0.6	45	1.1	34	0.8	43	1.0	69	1.6	41	0.9

[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. Rates were not calculated where there were fewer than five cases.

[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 more than five cases in 2012.

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 19A invasive pneumococcal disease case numbers, proportions and rates per 100 000 population, by age group, 2004–2012

Year	<2 years			<5 years			5–64 years			≥65 years			All ages		
	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[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
2012	13	32.5	10.6	18	34.6	5.8	30	14.7	0.9	32	15.8	5.2	80	17.4	1.8

[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. Rates were not calculated where there were fewer than five cases.

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 among isolates from invasive pneumococcal disease cases, 2012

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	0.7	36.0	44.4	1.7	3.1	3.7	1.1	1.5	5.9	1.3	0.7
cefotaxime	1.3	58.0	21.8	2.6	4.8	2.2	1.7	3.5	2.8	0.7	0.7

[a] Shaded cells represent MICs that are categorised as penicillin resistant or cefotaxime non-susceptible (intermediate and resistant), based on the CLSI meningitis interpretations: penicillin resistant, MIC ≥0.12 mg/L; cefotaxime intermediate, MIC 1 mg/L; and cefotaxime resistant, MIC ≥2 mg/L [13].

Table 29. Trends in penicillin resistance, cefotaxime resistance and multidrug resistance among isolates from invasive pneumococcal disease cases, 2003–2012

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	
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
2012	459	82.8	17.2	98.0	1.3	0.7	82.8	9.4	7.8	92.4	3.5	4.1	95.9	2.8	1.3	6.3

[a] CLSI penicillin meningitis interpretations: susceptible (S), MIC ≤0.06 mg/L; resistant (R), MIC ≥0.12 mg/L; no intermediate category.
[b] CLSI 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] CLSI 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] CLSI cefotaxime meningitis interpretations: susceptible (S), MIC ≤0.5 mg/L; intermediate (I), MIC 1 mg/L; resistant (R), MIC ≥2 mg/L.
[e] CLSI 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 − resistant to penicillin (CLSI meningitis interpretation) and three additional antibiotics.
CLSI: Clinical and Laboratory Standards Institute [13].

Table 30. Trends in resistance to non-β-lactam antibiotics among isolates from invasive pneumococcal disease cases, 2003−2012

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
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
2012	459	99.6	0.4	94.1	0.0	5.9	77.3	1.3	21.4	91.3	0.0	8.7	91.9	0.0	8.1

[a] Clindamycin susceptibility tested since 2007.
[b] Includes isolates with inducible clindamycin resistance.

Note:
S: susceptible; I: intermediate and R: resistant.
All isolates were 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 cases by region and District Health Board, 2012

Region / District Health Board	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	**173**	**22.5**	**3.5**	**8.7**
Northland	23	8.7	0.0	4.4
Waitemata	38	26.3	5.3	7.9
Auckland	49	20.4	2.0	6.1
Counties Manukau	63	27.0	4.8	12.7
Midland region	**103**	**14.6**	**2.9**	**1.9**
Waikato	38	23.7	5.3	2.6
Lakes	13	0.0	0.0	0.0
Bay of Plenty	36	16.7	2.8	2.8
Tairawhiti	3	0.0	0.0	0.0
Taranaki	13	0.0	0.0	0.0
Central region	**104**	**10.6**	**2.9**	**1.9**
Hawke's Bay	20	15.0	0.0	0.0
Whanganui	6	16.7	0.0	0.0
MidCentral	10	0.0	0.0	0.0
Hutt Valley	12	8.3	0.0	0.0
Capital and Coast	29	10.3	6.9	3.5
Wairarapa	10	10.0	0.0	0.0
Nelson Marlborough	17	11.8	5.9	5.9
Southern region	**79**	**17.7**	**5.1**	**0.0**
West Coast	1	0.0	0.0	0.0
Canterbury	38	18.4	0.0	0.0
South Canterbury	6	16.7	16.7	0.0
Southern	34	17.7	8.8	0.0
New Zealand	**459**	**17.2**	**3.5**	**4.1**

[a] CLSI meningitis interpretations; no intermediate category for penicillin [13].

Table 32. Serotypes among penicillin-resistant, cefotaxime-resistant and -intermediate, and multiresistant isolates from invasive pneumococcal disease cases, 2012

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	**35**	**44.3**	**14**	**87.5**	**14**	**73.7**	**15**	**51.7**
4	0	-	0	-	0	-	0	-
6B	2	2.5	2	12.5	0	-	1	3.5
9V	9	11.4	6	37.5	0	-	0	-
14	9	11.4	4	25.0	5	26.3	1	3.5
18C	0	-	0	-	0	-	0	-
19F	13	16.5	2	12.5	9	47.4	11	37.9
23F	2	2.5	0	-	0	-	2	6.9
PCV10 serotypes	**35**	**44.3**	**14**	**87.5**	**14**	**73.7**	**15**	**51.7**
1	0	-	0	-	0	-	0	-
5	0	-	0	-	0	-	0	-
7F	0	-	0	-	0	-	0	-
PCV13 serotypes	**70**	**88.6**	**16**	**100.0**	**19**	**100.0**	**28**	**96.6**
3	1	1.3	0	-	0	-	1	3.5
6A	3	3.8	0	-	0	-	0	-
19A	31	39.2	2	12.5	5	26.3	12	41.4
Non-PCV serotypes								
6C	2	2.5	0	-	0	-	1	3.5
9 non-typable	1	1.3	0	-	0	-	0	-
15B	1	1.3	0	-	0	-	0	-
23A	1	1.3	0	-	0	-	0	-
23B	3	3.8	0	-	0	-	0	-
35 non-typable	1	1.3	0	-	0	-	0	-
Total	**79**		**16**		**19**		**29**	

[a] CLSI meningitis interpretations; no intermediate category for penicillin [13].
[b] Resistant to penicillin (CLSI meningitis interpretation) and three additional antibiotics [13].
[c] Percentage of the intermediate or resistant isolates.

Table 33. Trends in penicillin resistance, cefotaxime resistance and multidrug resistance among serotype 19A isolates from invasive pneumococcal disease cases, 2003−2012

Year	Number of isolates	Penicillin resistant[a] MIC ≥0.12 mg/L		Cefotaxime resistant[b] MIC ≥2 mg/L		Multiresistant[c]	
		No	Percent (95% CI)	No	Percent (95% CI)	No	Percent (95% CI)
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)
2012	80	31	38.8 (28.1-50.3)	5	6.3 (2.1-14.0)	12	15.0 (8.0-24.8)

[a] Penicillin resistant using CLSI meningitis interpretation.
[b] Cefotaxime resistant using CLSI meningitis interpretation.
[c] Resistant to penicillin (CLSI meningitis interpretation) and three additional antibiotics.
CLSI: Clinical and Laboratory Standards Institute [13].