SURVEILLANCE REPORT
INVASIVE PNEUMOCOCCAL DISEASE IN NEW ZEALAND 2014

E/S/R

THE SCIENCE BEHIND THE TRUTH

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

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SUMMARY

E/S/R

THE SCIENCE BEHIND THE TRUTH

SUMMARY

In 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 a schedule change to the 10-valent conjugate vaccine (PCV10), Synflorix® in July 2011. In July 2014, Synflorix® was replaced by the 13-valent conjugate vaccine (PCV13), Prevenar13®.

Since 17 October 2008, invasive pneumococcal disease (IPD) has been a notifiable disease in New Zealand. In this report, the data presented for 2009–2014 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 489 cases of IPD notified in 2014, which equates to a rate of 10.8 cases per 100,000 population. A *S. pneumoniae* isolate from an invasive site was received at ESR for serotyping and antimicrobial susceptibility testing for 472 (96.5%) of the notified cases.

In children <5 years of age, the rate of IPD due to PCV10 serotypes has decreased 95.6% (44.2 to 1.9 per 100,000 population between 2006/7 and 2014). The overall rate of IPD (ie, disease due to any serotype) has decreased 66.7% (53.5 to 17.8 per 100,000 between 2006 and 2014) in these children.

Due to the indirect or herd immunity effects of routine infant PCV immunisation, there have also been significant 60.0% and 69.9% reductions in the rates of IPD due to PCV10 serotypes in the 5–64 years and ≥65 years age groups, respectively, between 2006/2007 and 2014. 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 since 2006. However, it is notable that the overall rates of IPD in the 5−64 years and ≥65 years age groups have decreased significantly over the period of notification-based surveillance of IPD (ie, since 2009).

In 2014, rates of IPD for the Pacific peoples and Māori ethnic groups were 4.5 times and 3.2 times higher, respectively, than the rate for the European or Other ethnic group. Twenty-two (64.7%) of the 34 cases in the <2 years age group were of Māori (16 cases) or Pacific peoples (6 cases) ethnicity.

The all-age rate of pneumococcal meningitis was 0.8 per 100,000. The highest rate of meningitis occurred among those <1 year of age (11.9 per 100,000). The IPD case-fatality rate was 4.9%.

There were two apparent PCV failures in 2014. These two cases had received at least two doses of a PCV that included the serotype responsible for their disease, but one of the cases was reported as being immunocompromised.

The highest rate of IPD was in Lakes District Health Board (DHB) (25.1 per 100,000, 26 cases), followed by Whanganui (16.1 per 100,000, 10 cases) and Northland (15.7 per 100,000, 26 cases) DHBs. Between 2009 and 2014, rates of IPD decreased or remained similar across most DHBs.

The most prevalent serotypes in 2014 were 19A (87 cases), 7F (54 cases), 3 (42 cases) and 22F (39 cases). These four types collectively accounted for 47.0% (222/472) of the culture-positive cases in 2014. The PCV13 serotype 19A has been the most common type among IPD cases since 2011, with significant increases in the 5–64 years and ≥65 years age groups since PCV was introduced. In addition to these increases in 19A disease in the older age groups, there have been two one-off annual increases in the <2 years age group - between 2011 and 2012 and again between 2013 and 2014.

The rates of IPD due to the PCV10 serotype 7F increased in the 5–64 years and ≥65 years age groups between 2011 and 2013. However in 2014, the rates of IPD due to type 7F decreased in both these age

groups. This decrease is probably an indication that the switch from PCV7 to PCV10 for routine infant immunisation in late 2011 is now having an indirect effect on type 7F disease in the older age groups.

The most notable change in serotype prevalence in 2014 was the increase in cases of IPD due to the PCV13 serotype 3, with total case numbers of this type increasing from 23 in 2013 to 42, with most of the increase in the <65 years age groups.

Based on the Clinical and Laboratory Standards Institute's meningitis breakpoints, 17.6% of isolates from IPD cases in 2014 were penicillin resistant and 3.8% were resistant to cefotaxime. Since the introduction of PCV there has been little change in the prevalence of antimicrobial resistance among invasive pneumococcal isolates, however, PCV7 types constitute a decreasing proportion of penicillin-resistant isolates and serotype 19A isolates an increasing proportion, as much as 51.8% in 2014.

In July 2014, the 13-valent conjugate vaccine (PCV13), Prevenar13®, replaced PCV10 on the childhood immunisation schedule in New Zealand. PCV13 will give additional coverage for serotypes 3, 6A and 19A. Hopefully the direct and indirect effects of PCV13 on serotype 19A, 7F and 3 disease will be realised given these three types now constitute a large proportion of IPD in this country.

INTRODUCTION

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INTRODUCTION

Since 17 October 2008, invasive pneumococcal disease (IPD) has been a notifiable disease in New Zealand. Prior to this date, national surveillance of IPD was solely laboratory-based, with diagnostic laboratories voluntarily 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, with a catch-up programme for all children born on or after 1 January 2008. Initially the 7-valent conjugate vaccine (PCV7), Prevenar®, was used. In July 2011, Prevenar® was replaced on the schedule with the 10-valent conjugate vaccine (PCV10), Synflorix®. In July 2014, Synflorix® was replaced by the 13-valent conjugate vaccine (PCV13), Prevenar13® [1]. With both the change to PCV10 in 2011 and the change to PCV13 in 2014, there was no catch-up programme for children fully or partially vaccinated with a lower valency PCV. Any child who was part-way through their 4-dose PCV course completed the course with the higher valency vaccine.

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 [2]. Subsequent annual reports have been based on IPD notifications, supplemented with serotype and antimicrobial susceptibility data from ESR's laboratory-based surveillance [3-7].

Prior to these annual reports, information from ESR's laboratory-based surveillance of IPD was published periodically [8-12]. 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.

This report presents information on cases of IPD that were notified in 2014, as well as trend data for recent years.

METHODS

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METHODS

Surveillance methods

In this report, data for 2009 to 2014 is based on 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 [13]:

- 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 *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 21 August 2015. 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 cases age-eligible for PCV (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 [14]. 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 NT (non-typable) or as 'Non-typable' if unable to be typed by any antisera.

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 [15]. Inducible clindamycin resistance is detected by the D-zone test [15]. All minimum inhibitory concentrations (MICs) and zone of inhibition diameters were interpreted according to the 2014 CLSI standards [16].

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.

In this report, 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 2014 mid-year population estimates published by Statistics New Zealand. All rates are presented as the number of cases per 100,000 population. Note that rates presented in this report for years prior to 2014 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 usually resident 2013 census population applied to the 2014 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 2013 New Zealand Deprivation Index (NZDep13). The index, measuring relative socioeconomic deprivation, is derived from a weighted combination of nine variables from the 2013 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 NZDep13, 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 2013 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, detection of *S. pneumoniae* DNA in CSF, positive pneumococcal antigen test on CSF, culture of *S. pneumoniae* from pleural fluid, culture of *S. pneumoniae* from joint fluid, and culture of *S. pneumoniae* from another normally sterile site.

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 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. Compared with notifications, laboratory-based surveillance is likely to underestimate the burden of IPD. In some time-series data presentations in the Appendix of this report, due to page-size limitations, the year 2009, which represents the first full year after the addition of PCV to the childhood immunisation schedule, has been omitted. However, the earlier years, 2006, 2007 and 2008, have been retained to represent the pre-PCV era. Data for 2009 can be obtained from earlier annual reports [3-7].

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

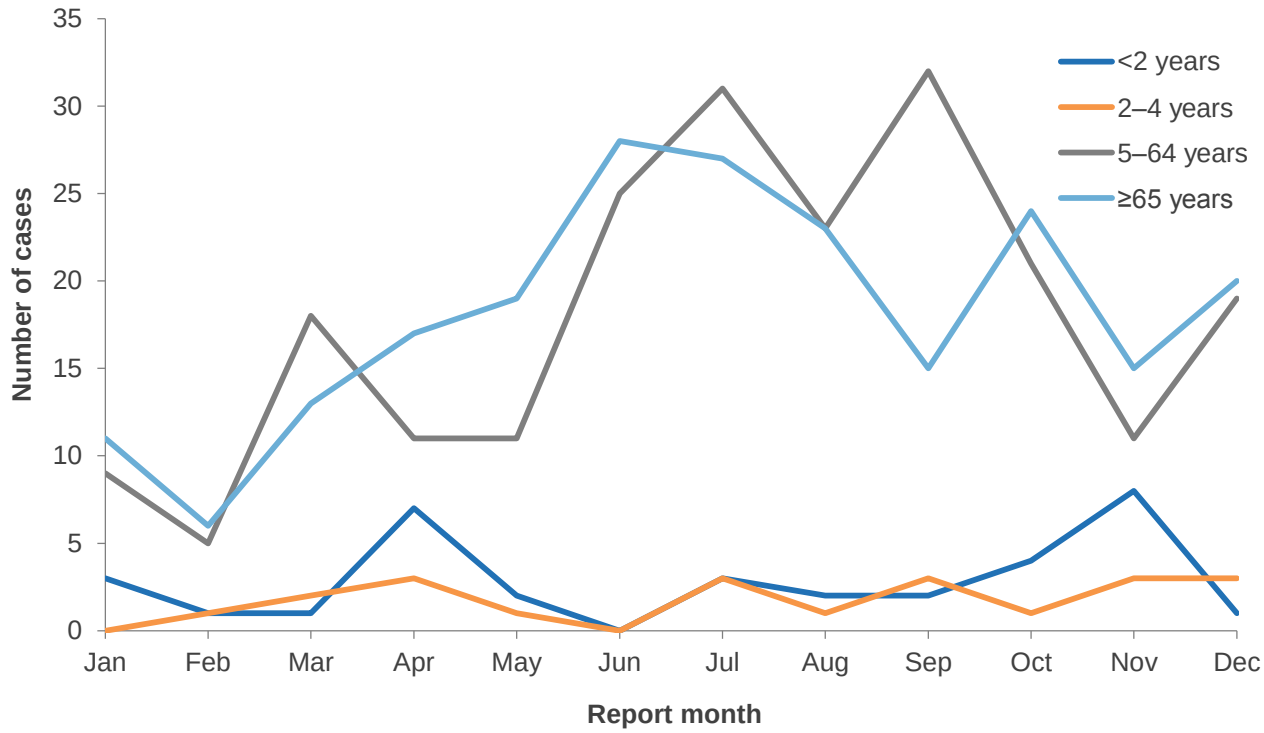
In 2014, 489 cases of IPD were notified. The 2014 notification rate for IPD was 10.8 cases per 100,000 population, the same as the 2013 rate (479 cases) and significantly lower than the peak rate observed in 2009 (16.2 per 100,000, 697 cases).

A breakdown of the laboratory criteria upon which the IPD diagnosis was based is available in Table 12 (Appendix). In 2014, 88.5% of cases 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 472 (96.5%) of the 489 cases notified in 2014.

Disease incidence by season

During 2014 there was the usual marked peak of cases in the winter months among cases aged ≥5 years (Figure 1).

Figure 1. Number of invasive pneumococcal disease cases by age group and month, 2014



Disease incidence by age and sex

Age and sex were recorded for all IPD cases in 2014. The distribution of the 2014 cases by age group and sex is presented in Table 1. The rates of IPD were generally higher among males than females. The highest rates were in the elderly aged ≥85 years and in infants aged <1 year. Rates of IPD showed an increasing trend with age from 25 years onwards.

Table 1. Number of cases and rate per 100,000 population of invasive pneumococcal disease by age group and sex, 2014

Age group (years)	Female		Male		Total		
	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]	%[b]
<1	6	21.0	16	52.8	22	37.4	4.5
1	2	-	10	32.2	12	19.8	2.5
2–4	11	11.9	10	10.3	21	11.1	4.3
5–14	7	2.4	11	3.6	18	3.0	3.7
15–24	8	2.6	11	3.4	19	3.0	3.9
25–34	11	3.8	13	4.7	24	4.2	4.9
35–44	19	6.2	17	6.1	36	6.1	7.4
45–54	24	7.4	26	8.6	50	8.0	10.2
55–64	36	13.4	33	12.9	69	13.1	14.1
65–74	45	23.3	60	32.8	105	27.9	21.5
75–84	41	38.4	26	29.1	67	34.1	13.7
≥85	18	36.6	28	98.3	46	59.2	9.4
Aggregated age groups (years)							
<2[c]	8	13.8	26	42.3	34	28.5	7.0
<5	19	12.6	36	22.7	55	17.8	11.2
5–64	105	5.8	111	6.3	216	6.1	44.2
≥65	104	29.8	114	37.9	218	33.5	44.6
Total	**228**	**9.9**	**261**	**11.8**	489	**10.8**	**100.0**

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

[b] Percentage of cases in each age group.

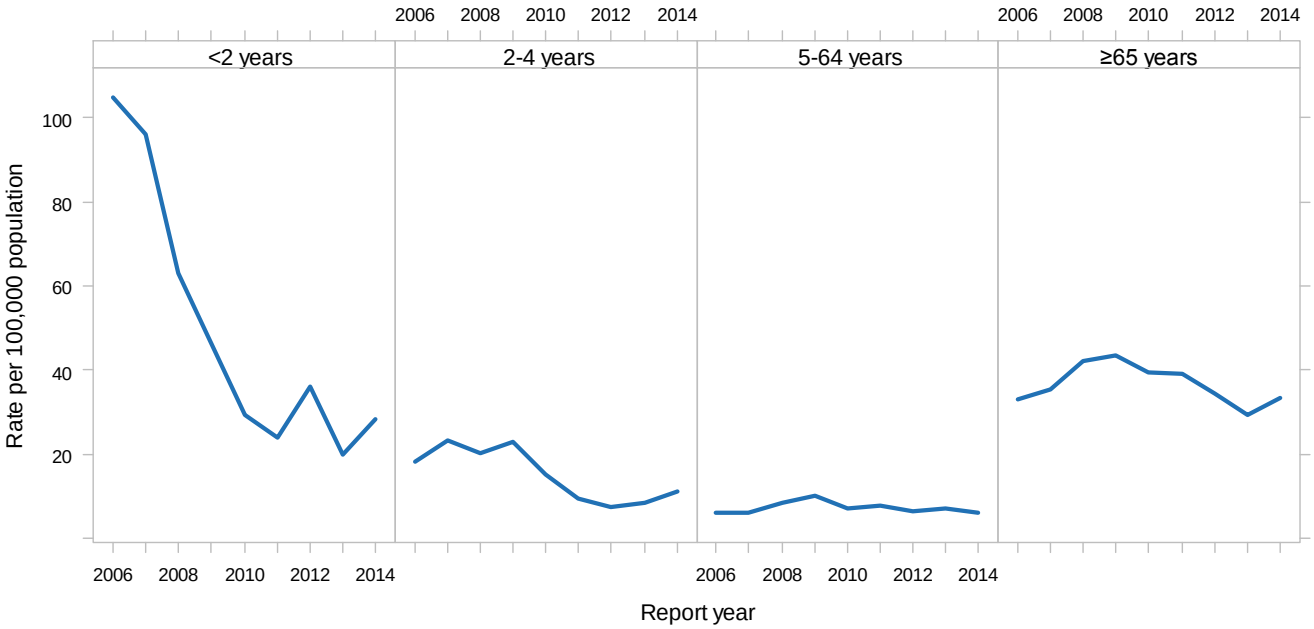
[c] The age in months of the cases <2 years of age is presented in Figure 10 (Appendix).

Between 2006 and 2014, there was a significant 66.7% decrease in the rate of IPD in the <5 years age group (53.5 to 17.8 per 100,000) (Figure 2). The actual reductions in disease rates in this age group may be greater than these figures indicate due to the change in 2009 from laboratory-based surveillance to the more sensitive notification-based surveillance.

While rates in the older age groups (5–64 years and ≥65 years) in 2014 were similar to the rates in 2006, these results are hard to interpret due to the change during this period from laboratory-based to notification-based surveillance. However, it is notable that the rates in both these older 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 nine years is available in Table 13 (Appendix).

Figure 2. Rate per 100,000 population of invasive pneumococcal disease by age group and year, 2006–2014



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 465 (95.1%) of the 489 IPD cases in 2014. The age-standardised rates of IPD were highest for the Pacific peoples (35.0 per 100,000, 61 cases) and Māori (24.6 per 100,000, 115 cases) ethnic groups. The rates for these two ethnic groups were, respectively, 4.5 and 3.2 times higher than the rate for the European or Other ethnic group (7.8 per 100,000, 265 cases) (Table 2).

Twenty-two (64.7%) of the 34 cases in the <2 years age group were of Māori (16 cases) or Pacific peoples (6 cases) ethnicity.

Between 2009 and 2014, the age-standardised IPD rates decreased significantly in the European or Other (-37.3%), Māori (-26.0%), and Pacific peoples (-12.3%) ethnic groups (Figure 3). Over the same time period among <5 year olds, the only ethnic group in which there was a significant decrease in rates (-51.6%) was in the European or Other group. Rates of IPD by ethnic group and age group for the years 2009 to 2014 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, 2014

Age group (years)	Māori		Pacific peoples		Asian		MELAA[a]		European or Other	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
<1	12	78.8	6	109.4	0	-	0	-	4	-
1	4	-	0	-	1	-	0	-	7	22.3
2–4	9	18.5	3	-	1	-	0	-	8	8.1
5–14	7	4.8	4	-	1	-	1	-	6	1.8
15–4	4	-	3	-	0	-	0	-	10	2.8
25–34	5	5.9	4	-	2	-	0	-	13	4.0
35–44	14	17.6	4	-	2	-	0	-	16	4.1
45–54	16	21.4	7	23.1	4	-	0	-	21	4.6
55–64	17	34.3	5	25.9	8	18.8	0	-	33	8.0
65–74	18	71.1	17	161.5	2	-	0	-	59	18.5
75–84	7	75.3	8	197.6	2	-	0	-	47	27.0
≥85	2	-	0	-	0	-	0	-	41	55.8
Aggregated age groups (years)										
<2	16	52.0	6	53.1	1	-	0	-	11	18.2
<5	25	31.5	9	30.7	2	-	0	-	19	11.9
5–64	63	11.3	27	11.6	17	3.8	1	-	99	4.4
≥65	27	74.4	25	162.1	4	-	0	-	147	25.9
Crude rate for all ages[b]	**115**	**17.1**	**61**	**21.9**	**23**	**4.5**	**1**	**-**	**265**	**8.9**
Age-standardised rate[c]		**24.6**		**35.0**		**6.1**		**-**		**7.8**

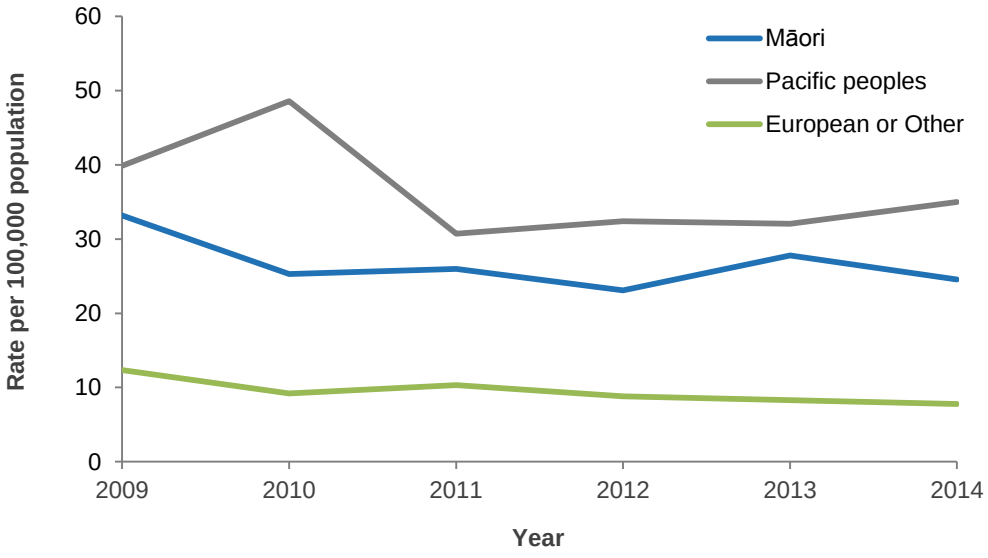
[a] Middle Eastern/Latin American/African.

[b] Ethnicity was recorded for 465 (95.1%) of cases notified in 2014.

[c] The age-standardised rates are direct-standardised to the age distribution of the total New Zealand population.

Note: Denominator data used to determine disease rates for ethnic groups is based on the proportion of people in each ethnic group from the usually resident 2013 census population applied to the 2014 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.

Figure 3. Age-standardised rate per 100,000 population of invasive pneumococcal disease by ethnic group, 2009–2014



Disease incidence by deprivation

In 2014, 471 (96.3%) of the 489 IPD cases had a residential address recorded that could be assigned a 2013 New Zealand Deprivation Index (NZDep13) score. In all age groups, over half the cases resided in NZDep13 quintiles 4 or 5 (Table 3).

The most deprived areas (NZDep13 quintile 5) had the highest rate of IPD (21.6 per 100,000, 180 cases), 4.5 times the rate in the least deprived areas (4.8 per 100,000, 42 cases). Rates of IPD by deprivation index could only be calculated for all ages combined because population data by NZDep13 quintile and age groups was not available.

Between 2009 and 2014, rates of IPD decreased for all NZDep13 quintiles (Table 15, Appendix). The decreases were statistically significant for quintile 1 (-55%), quintile 3 (-58%), quintile 4 (-50%) and quintile 5 (-30%).

Table 3. Number and percentage of invasive pneumococcal disease cases by quintiles of the 2013 New Zealand deprivation index and age group, 2014

NZDep13 quintile[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	12.1	1	4.8	17	8.1	20	9.6	42	8.9	4.8
2	3	9.1	6	28.6	26	12.4	42	20.2	77	16.3	9.0
3	4	12.1	0	0.0	36	17.2	29	13.9	69	14.6	8.2
4	7	21.2	2	9.5	48	23.0	46	22.1	103	21.9	12.4
5	15	45.5	12	57.1	82	39.2	71	34.1	180	38.2	21.6
Total[d]	**33**		**21**		**209**		**208**		**471**		

[a] Quintile of the 2013 New Zealand Deprivation Index (1 = least deprived and 5 = most deprived).

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

[c] Rate per 100,000 population, based on the 2013 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 2014 mid-year population estimates from Statistics New Zealand.

[d] Accurate New Zealand Deprivation Index (NZDep13) data was available for 471 (96.3%) cases notified in 2014.

Disease presentation, hospitalisations and fatalities

In 2014, 465 (95.1%) of the 489 IPD cases had at least one clinical presentation recorded (Table 4). Among infants aged <1 year, meningitis and pneumonia were the most common presentations (33.3% each). Pneumonia was the most common presentation among cases aged ≥5 years (73.9%).

The rate of pneumococcal meningitis was 0.8 per 100,000 across all age groups, but 11.9 per 100,000 (7 cases) among infants aged <1 year (Table 16 in the Appendix).

The seven cases of pneumococcal meningitis aged <1 year were in the European or Other (3 cases), Māori (3 cases) and Pacific peoples (1 case) ethnic groups.

Table 4. Clinical presentation of invasive pneumococcal disease cases by age group, 2014

Age group (years)	Meningitis		Empyema		Pneumonia		Bacteraemia without focus		Other		Total[c]
	Cases[a]	%[b]	Cases[a]	%[b]	Cases[a]	%[b]	Cases[a]	%[b]	Cases[a]	%[b]	
<1	7	33.3	1	4.8	7	33.3	0	-	6	28.6	21
1	2	18.2	0	-	5	45.5	1	9.1	3	27.3	11
2–4	3	15.8	1	5.3	7	36.8	2	10.5	6	31.6	19
5–14	4	22.2	1	5.6	9	50.0	3	16.7	1	5.6	18
15–64	12	6.2	5	2.6	142	73.6	24	12.4	10	5.2	193
≥65	8	3.9	5	2.5	155	76.4	17	8.4	18	8.9	203
Aggregated age groups (years)											
<2	9	28.1	1	3.1	12	37.5	1	3.1	9	28.1	32
<5	12	23.5	2	3.9	19	37.3	3	5.9	15	29.4	51
≥5	24	5.8	11	2.7	306	73.9	44	10.6	29	7.0	414
Total[d]	**36**	**7.7**	**13**	**2.8**	**325**	**69.9**	**47**	**10.1**	**44**	**9.5**	**465**

[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, empyema, pneumonia, bacteraemia without focus and 'Other'. Non-prioritised data, with all presentations recorded for cases who had more than one presentation reported, is available in Table 16 (Appendix). Any cases for which *S. pneumoniae* was 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 465 (95.1%) of cases notified in 2014.

Information on whether the patient survived or died was recorded for 466 (95.3%) of the IPD cases. IPD was recorded as the primary cause of death for 23 cases, giving a case-fatality rate of 4.9% among the cases for whom this information was reported. The case-fatality rates for each age group are presented in Table 17 (Appendix). The European and Other ethnic group had the highest case-fatality rate (6.3%), followed by the Pacific peoples (5.2%) ethnic group. Māori had the lowest case-fatality rate (1.9%). There was one death due to IPD in the <5 years age group in 2014, compared with one death recorded in 2013, four deaths in 2012, no deaths in 2011 and 2010, and one death in 2009.

Among the 474 (96.9%) IPD cases for whom hospitalisation status was recorded, 456 (96.2%) cases were hospitalised. The case-fatality rate among hospitalised cases was 4.6% (21/456). There was one death due to IPD among the 18 cases that were not hospitalised. The hospitalisation status was not known for one case that died.

Immunisation status

Immunisation records were identified in the NIR for 54 of the 56 IPD cases in 2014 who were age-eligible for PCV (ie, cases born after 1 January 2008 and aged ≥6 weeks). Fifty of these 54 cases were recorded as having at least two doses of PCV before the onset of their disease (Table 5). The serotype causing IPD was known for 46 of these 50 cases. Among these 46 cases, there were two cases due to a PCV7 serotype, five cases due to an additional serotype covered by PCV10, 24 cases due to additional serotypes covered by PCV13, and 15 cases due to non-PCV13 serotypes.

The two cases due to PCV7 serotypes appear to be vaccine failures: one case had received one dose of PCV7 and two of PCV10, and one case had received four doses of PCV10. However, this latter case was reported as being immunocompromised and having an underlying chronic illness. Of the five cases due to an additional serotype covered by PCV10, four were cases of serotype 7F disease who had all been vaccinated wholly with PCV7, and the fifth was a case of serotype 1 disease who had received three doses of PCV7 and one dose of PCV10. Of the 24 cases due to additional serotypes covered by PCV13, 17 were cases of serotype 19A disease and 7 were cases of serotype 3 disease. None of these 24 cases had received any doses of PCV13.

There were six asplenic IPD cases reported in 2014 and two of these had not been immunised with pneumococcal vaccine (a female in the 60–69 years age group and a male in the ≥85 age groups).

Table 5. Immunisation status of the 2014 invasive pneumococcal disease cases who were eligible for PCV

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	-	0	-	0	-	0	-
1	0	-	0	-	1	4.0	3	16.7	4	7.4
2	0	-	0	-	2[h]	8.0	2	11.1	5	9.3
3	1[d]	50.0	1[f]	20.0	15[i]	60.0	3	16.7	20	37.0
4	1[e]	50.0	4[g]	80.0	7[j]	28.0	10	55.6	25	46.3
Total	**2**		**5**		**25**		**18**		**54**	

[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 PCV as part of the childhood immunisation schedule (ie, cases born after 1 January 2008 and aged ≥6 weeks) are presented.

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

[d] Case due to serotype 4.

[e] Case due to serotype 19F.

[f] Case due to serotype 7F.

[g] Cases due to serotypes 1 (1) and 7F (3).

[h] Cases due to serotype 3.

[i] Cases due to serotypes 3 (4 cases) and 19A (11 cases).

[j] Cases due to serotypes 3 (1 case) and 19A (6 cases).

A case-by-case analysis was conducted for the 17 cases of serotype 19A in the <5 years age group in 2014 (Table 6).

Ten (58.8%) of the 17 cases had received a primary course of three doses and another six (35.3%) cases had received four doses (ie, a primary series plus booster). The remaining case, a seven month old, had received only one dose of PCV10.

Among the 16 cases who had received three or four doses, one received PCV7 only, 13 had wholly received PCV10 and two had received a mixed schedule of PCV7 and PCV10.

Table 6. Pneumococcal conjugate vaccination history of the serotype 19A invasive pneumococcal disease cases in the less than 5 years age group, 2014

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

Note: None of the cases had received any doses of PCV13.

Risk factors

The risk factors reported among IPD cases in 2014 are presented in Table 7. The most common risk factor among all cases was chronic illness (47.3%). Risk factors for cases in the <2 years, <5 years and ≥5 years age groups are presented in Table 18, Table 19 and Table 20 (Appendix), respectively. Smoking in the household was the most common risk factor recorded for the <2 years age group, although information on this risk factor was only recorded for just over a quarter (9/34) of the cases in this age group. Chronic illness was the most commonly recorded risk factor for the ≥5 years age group.

Table 7. Exposure to risk factors associated with invasive pneumococcal disease for cases, 2014

Risk factor	Cases[a]	Total reported[b]	%[c]
Smoking in the household[d]	6	11	54.5
Chronic illness[e]	208	440	47.3
Premature (<37 weeks gestation)[f]	3	10	30.0
Current smoker[g]	89	330	27.0
Immunocompromised[h]	74	439	16.9
Chronic lung disease or cystic fibrosis	60	443	13.5
Attends childcare[d]	2	15	13.3
Resident in long-term or other chronic-care facility[i]	35	435	8.0
Cochlear implants	1	419	0.2
Anatomical or functional asplenia	6	436	1.4
Congenital or chromosomal abnormality	5	424	1.2

[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 factor for which the information was supplied.

[d] Cases aged <5 years only.

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

[f] Cases aged <1 year only.

[g] Cases aged ≥15 years only.

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

[i] Among cases in the ≥75 years age group, 24.0% (25 cases out of 104 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 Lakes District Health Board (DHB) (25.1 per 100,000, 26 cases), followed by Whanganui (16.1 per 100,000, 10 cases), Northland (15.7 per 100,000, 26 cases) and Tairawhiti (14.9 per 100,000, 7 cases) DHBs (Table 8 and Figure 4). Across the regions, rates ranged from 7.9 in the Southern region to 13.8 per 100,000 in the Midland region (Table 8).

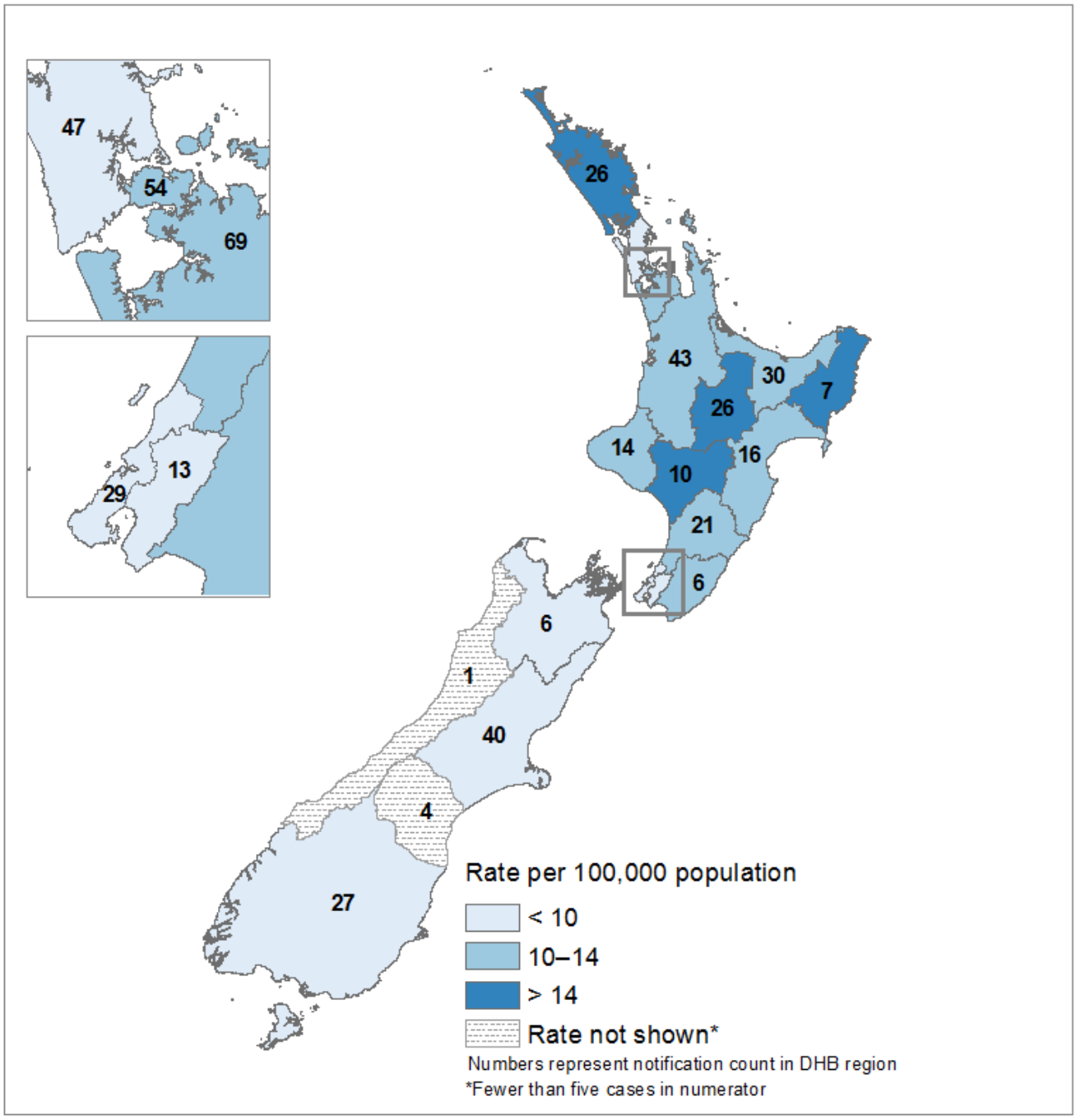
Between 2009 and 2014, rates of IPD remained similar for most DHBs (Table 21 in the Appendix), however, there were significant decreases in Counties Manukau (19.0 to 13.6 per 100,000), Waikato (22.7 to 11.2 per 100,000), Bay of Plenty (24.0 to 13.8 per 100,000), Hawke's Bay (22.6 to 10.0 per 100,000), Hutt Valley (21.2 to 9.1 per 100,000) and Nelson Marlborough (16.1 to 4.2 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, 2014

District Health Board	Cases by age group (years)					Rate[a] (all ages)
	<2	<5	5–64	≥65	All ages	
Northland	4	6	12	8	26	15.7
Waitemata	5	7	24	16	47	8.4
Auckland	3	4	24	26	54	11.4
Counties Manukau	9	13	29	27	69	13.6
Northern region	**21**	**30**	**89**	**77**	**196**	**11.5**
Waikato	4	7	16	20	43	11.2
Lakes	3	4	9	13	26	25.1
Bay of Plenty	0	3	9	18	30	13.8
Tairawhiti	1	2	1	4	7	14.9
Taranaki	1	1	8	5	14	12.2
Midland region	**9**	**17**	**43**	**60**	**120**	**13.8**
Hawke's Bay	0	0	11	5	16	10.0
Whanganui	0	0	3	7	10	16.1
MidCentral	0	0	9	12	21	12.3
Hutt Valley	0	2	5	6	13	9.1
Capital & Coast	0	0	16	13	29	9.8
Wairarapa	0	0	3	3	6	14.0
Nelson Marlborough	0	0	2	4	6	4.2
Central region	**0**	**2**	**49**	**50**	**101**	**9.9**
West Coast	0	0	1	0	1	-
Canterbury	2	3	20	17	40	7.8
South Canterbury	0	0	0	4	4	-
Southern	2	3	14	10	27	8.7
Southern region	**4**	**6**	**35**	**31**	**72**	**7.9**
Total	**34**	**55**	**216**	**218**	**489**	**10.8**

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

Figure 4. Geographic distribution of invasive pneumococcal disease cases, 2014



Serotype distribution

Table 9 shows by age group the number and proportion of the 472 isolates from culture-positive IPD cases referred to ESR in 2014 caused by each of the serotypes included in PCV7, PCV10 and PCV13, and any other serotypes that accounted for more than five cases. Table 22 (Appendix) presents the rates per 100,000 of IPD caused by these same serotypes.

In the <2 years age group, only two cases (6.3%) of IPD were due to a PCV10 serotype (Table 9). One of the cases was <6 weeks old and of Māori ethnicity and the other case was 22 months old and of European or Other ethnicity. The only case in the <5 years age group that died had serotype 3 disease and was 3 years old.

The proportion of IPD due to PCV10 types was higher in the older age groups: 28.9% in the 5–64 years and 22.0% in the ≥65 years age groups (Table 9). Among the ≥65 years age group, 74.6% of cases were due to PPV23 serotypes.

A full list of the serotypes of all isolates from culture-positive IPD cases in 2014 is available in Table 23 (Appendix).

Table 9. Number and percentage of invasive pneumococcal disease cases by serotype, serotypes covered by PCV7, PCV10 and PCV13, and age group, 2014

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]
4	0	-	1	5.0	1	1.9	13	6.2	10	4.8	24	5.1
6B	0	-	0	-	0	-	1	0.5	1	0.5	2	0.4
9V	0	-	0	-	0	-	5	2.4	2	1.0	7	1.5
14	0	-	1	5.0	1	1.9	1	0.5	2	1.0	4	0.8
18C	1	3.1	0	-	1	1.9	3	1.4	5	2.4	9	1.9
19F	1	3.1	0	-	1	1.9	2	0.9	7	3.3	10	2.1
23F	0	-	0	-	0	-	1	0.5	1	0.5	2	0.4
PCV7	**2**	**6.3**	**2**	**10.0**	**4**	**7.7**	**26**	**12.3**	**28**	**13.4**	**58**	**12.3**
1	0	-	1	5.0	1	1.9	0	-	0	-	1	0.2
5	0	-	0	-	0	-	0	-	0	-	0	-
7F	0	-	1	5.0	1	1.9	35	16.6	18	8.6	54	11.4
PCV10	**2**	**6.3**	**4**	**20.0**	**6**	**11.5**	**61**	**28.9**	**46**	**22.0**	**113**	**23.9**
3	7	21.9	2	10.0	9	17.3	18	8.5	15	7.2	42	8.9
6A	0	-	0	-	0	-	0	-	1	0.5	1	0.2
19A	12	37.5	5	25.0	17	32.7	40	19.0	30	14.4	87	18.4
PCV13	**21**	**65.6**	**11**	**55.0**	**32**	**61.5**	**119**	**56.4**	**92**	**44.0**	**243**	**51.5**
6C	3	9.4	1	5.0	4	7.7	10	4.7	12	5.7	26	5.5
8	2	6.3	0	-	2	3.8	12	5.7	7	3.3	21	4.4
9N	2	6.3	0	-	2	3.8	5	2.4	10	4.8	17	3.6
10A	0	-	1	5.0	1	1.9	2	0.9	4	1.9	7	1.5
11A	0	-	0	-	0	-	2	0.9	10	4.8	12	2.5
15B	0	-	1	5.0	1	1.9	2	0.9	4	1.9	7	1.5
16 NT[d]	1	3.1	1	5.0	2	3.8	6	2.8	7	3.3	15	3.2
22F	0	-	1	5.0	1	1.9	17	8.1	21	10.0	39	8.3
23A	1	3.1	0	-	1	1.9	5	2.4	5	2.4	11	2.3
23B	0	-	0	-	0	-	6	2.8	4	1.9	10	2.1
33F	2	6.3	0	-	2	3.8	3	1.4	4	1.9	9	1.9
35 NT[d]	0	-	1	5.0	1	1.9	5	2.4	9	4.3	15	3.2
Other	0	-	3	15.0	3	5.8	17	8.1	20	9.6	40	8.5
Non-PCV[e]	**11**	**34.4**	**9**	**45.0**	**20**	**38.5**	**92**	**43.6**	**117**	**56.0**	**229**	**48.5**
Total[f]	**32**		**20**		**52**		**211**		**209**		**472**	

[a] Aggregated age group.

[b] Among the cases in the ≥65 years age group, 74.6% were due to PPV23 serotypes. Vaccination with PPV23 is recommended for people in this age group.

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

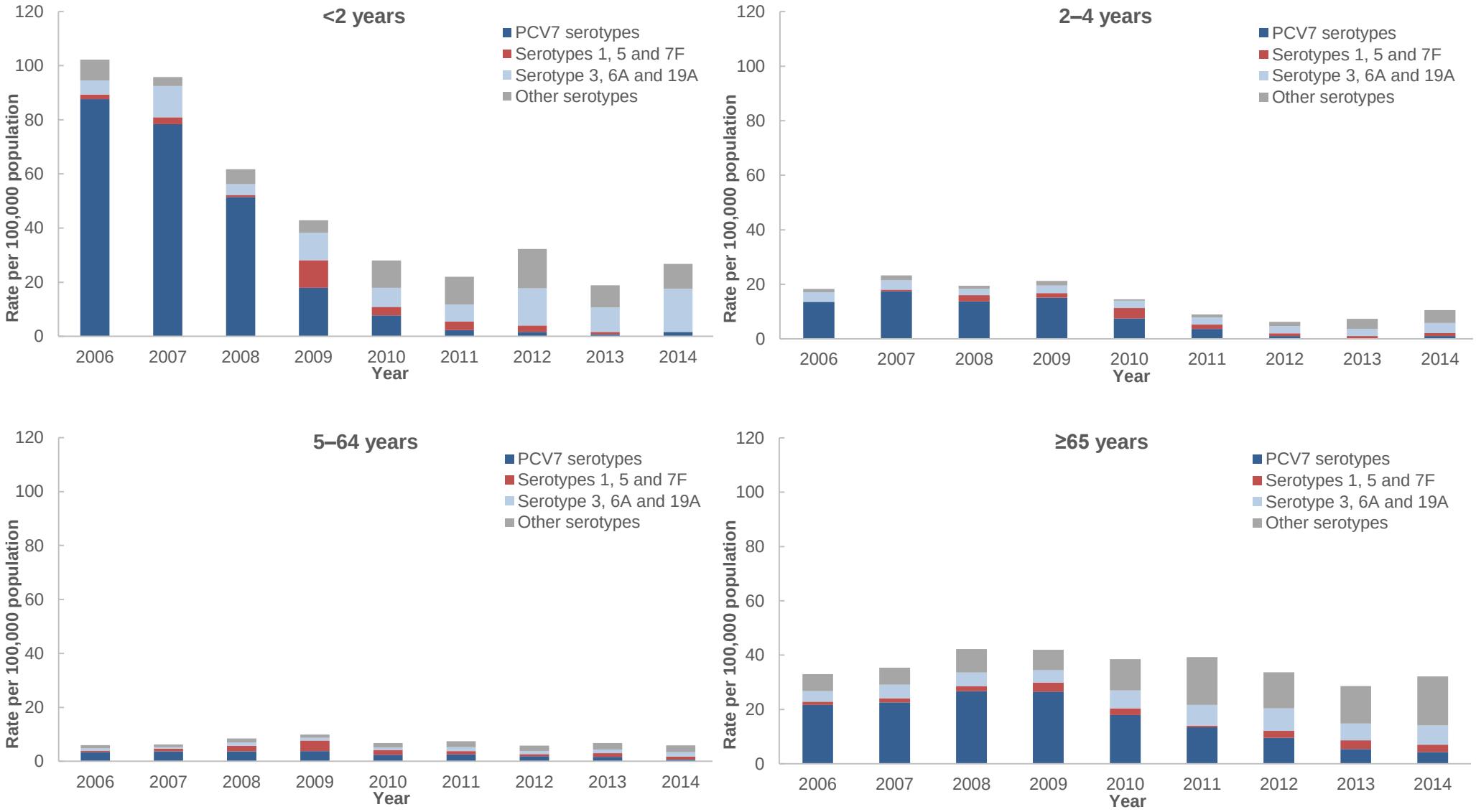
[d] NT: not typable with the range of factorised antisera used at ESR.

[e] The specific non-PCV serotypes listed are those that accounted for more than five cases of IPD in 2014.

[f] Total number of isolates from culture-positive cases referred to ESR for serotyping for each age group.

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 PCV7 to the national immunisation schedule in 2008 and the change to PCV10 in 2011, there have been significant decreases in IPD rates due to PCV10 serotypes in all age groups. The largest decreases have been in the <2 years and 2–4 years age groups, with 98.0% and 73.3% reductions in the rates between 2006/2007 and 2014, respectively, in these two age groups, resulting in a 95.6% reduction in the combined <5 years age group. The reductions over the same time period in the older age groups have also been significant, at 60.0% in the 5–64 years age group and 69.9% in the ≥65 years group. Data is presented for each of the age groups in Table 24, Table 25, Table 26 and Table 27 (Appendix) and for all cases in Table 28 (Appendix).

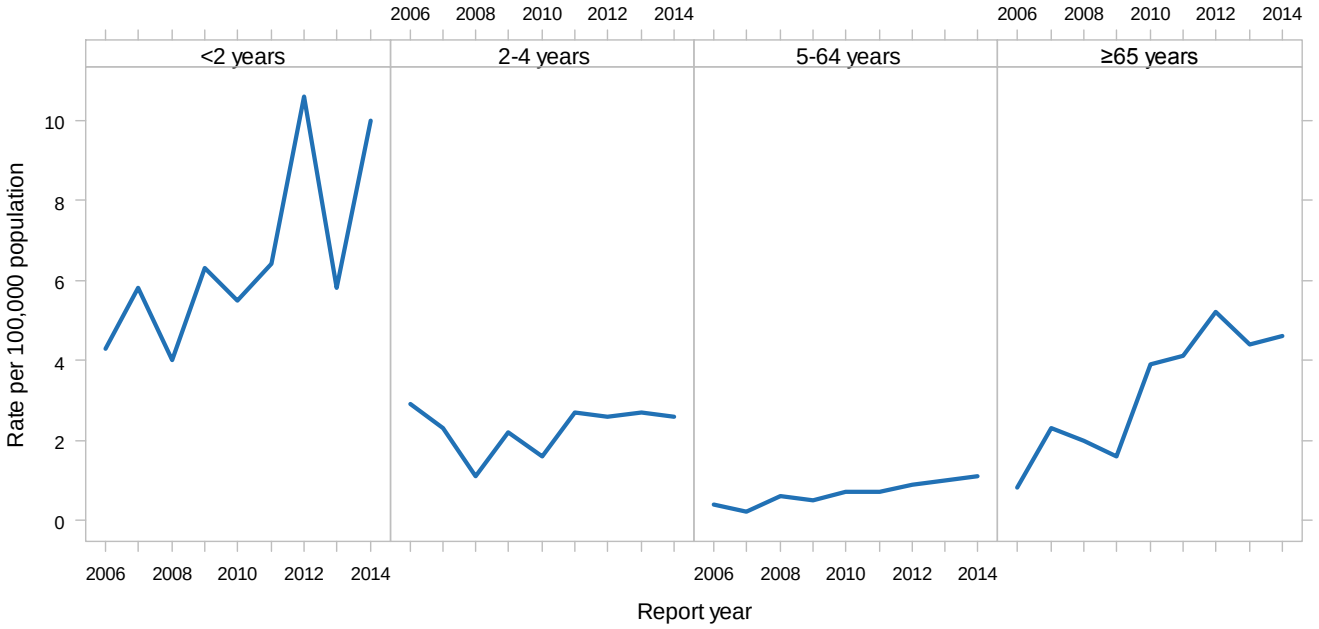
Figure 5. Rate per 100,000 population of invasive pneumococcal disease due to PCV7 serotypes, additional PCV10 types, additional PCV13 types and non-PCV13 types, by age group and year, 2006–2014



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 2014, there were a total of 87 IPD cases due to the PCV13 serotype 19A, and type 19A was the most prevalent serotype in all age groups (Table 9). Since 2006/2007, there have been significant increases in the rate of 19A disease in the 5–64 years (0.3 to 1.1 per 100,000) and ≥65 years (1.5 to 4.6 per 100,000) age groups (Figure 6 and Table 29 in the Appendix). Between 2011 and 2012, a significant increase in serotype 19A IPD was observed in the <2 years age group (from 6.3 to 10.5 per 100,000), followed by a decrease in 2013 to 5.8 per 100,000 and another increase in 2014 to 10.0 per 100,000.

Figure 6. Rate per 100,000 population of invasive pneumococcal disease due to serotype 19A by age group and year, 2006–2014

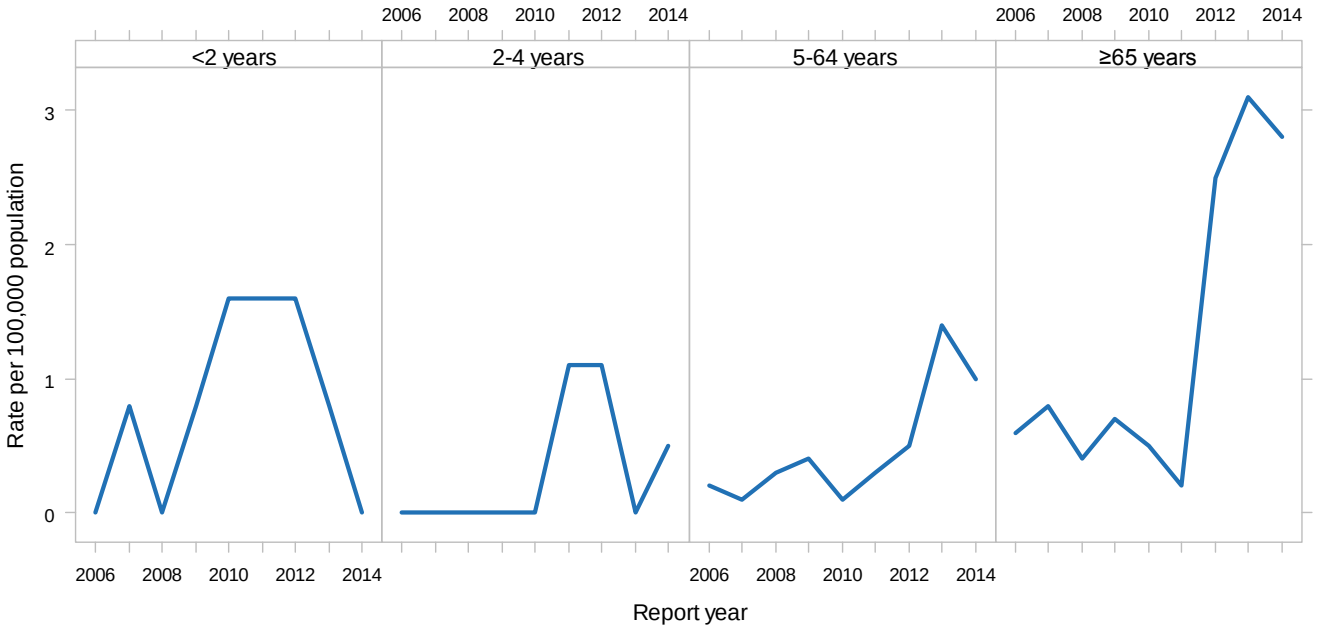


Note: Data presented from 2009 onwards is based on IPD notifications and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD.

The other common serotypes in 2014 were 7F (54 cases), 3 (42 cases) and 22F (39 cases) (Table 9). Of particular note, rates of IPD due to the PCV10 serotype 7F increased in the 5–64 years and ≥65 years age groups between 2011 and 2013 after the change from PCV7 to PCV10. However in 2014, the rates of IPD due to type 7F decreased in both age groups (Figure 7 and Table 30 in the Appendix).

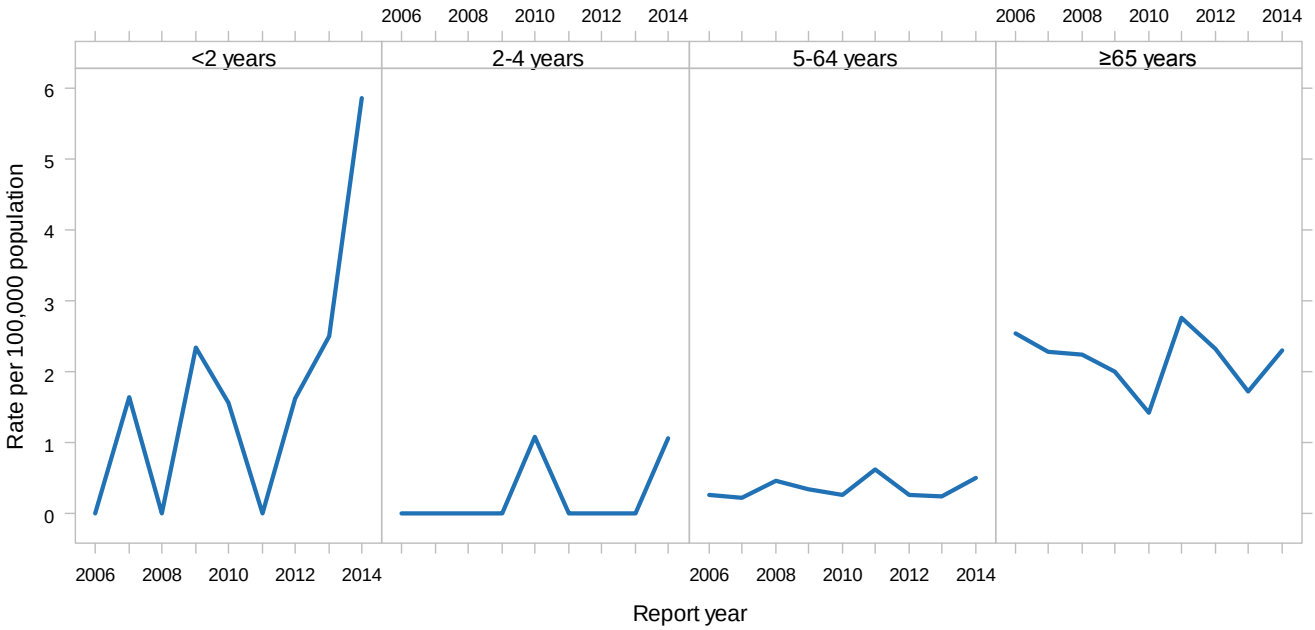
The most notable change in serotype prevalence in 2014 was the increase in cases of IPD due to the PCV13 serotype 3, with total case numbers of this type increasing from 23 in 2013 to 42, with most of the increase in the <65 years age groups (Figure 8, and Table 25 and Table 26 in the Appendix).

Figure 7. Rate per 100,000 population of invasive pneumococcal disease due to serotype 7F by age group and year, 2006–2014



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 population of invasive pneumococcal disease due to serotype 3 by age group and year, 2006–2014



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 472 culture-positive IPD cases referred to ESR in 2014. The penicillin and cefotaxime MIC distributions are presented in Table 31 (Appendix).

Based on the CLSI meningitis interpretations, 17.6% of isolates were resistant to penicillin and 3.8% were cefotaxime resistant. 6.8% of isolates had combined penicillin (meningitis interpretation) and erythromycin resistance, and 0.2% had combined penicillin (non-meningitis interpretation) and erythromycin resistance. Among the penicillin-resistant isolates (meningitis interpretation), 24.1% (20/83) were multiresistant to at least three additional antibiotics, most commonly co-trimoxazole, erythromycin and tetracycline with or without cefotaxime resistance.

Rates of penicillin resistance, cefotaxime resistance and multidrug resistance over the last 10 years (2005–2014) are presented in Table 32 (Appendix). There has been no overall trend in the prevalence of penicillin resistance (meningitis interpretation) between 2005 and 2014. Penicillin resistance rates have varied year-to-year from a high of 22.3% in 2007 to a low of 14.1% in 2011, with the rate of 17.6% in 2014 being in the middle of the range. Likewise there has been no significant trend in the last 10 years in the rate of cefotaxime resistance (meningitis interpretation). The rate (3.8%) of cefotaxime resistance in 2014 was within the range (1.9-5.1%) recorded for other years during the last decade.

Trends in resistance to the non-β-lactam antibiotics over the last 10 years are presented in Table 33 (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, 2014

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	82.4	-	17.6
non-meningitis	≤2	4	≥8	98.1	1.7	0.2
oral treatment	≤0.06	0.12-1	≥2	82.4	13.1	4.4
Cefotaxime						
meningitis	≤0.5	1	≥2	93.4	2.8	3.8
non-meningitis	≤1	2	≥4	96.2	2.8	1.1
	Zone diameter (mm)					
Chloramphenicol	≥21	-	≤20	99.4	-	0.6
Clindamycin[c]	≥19	16-18	≤15	94.3	0.2	5.5
Co-trimoxazole	≥19	16-18	≤15	79.0	1.9	19.1
Erythromycin	≥21	16-20	≤15	92.2	0.0	7.8
Moxifloxacin	≥18	15-17	≤14	100.0	0.0	0.0
Rifampicin	≥19	17-18	≤16	100.0	0.0	0.0
Tetracycline	≥28	25-27	≤24	92.6	0.0	7.4
Vancomycin	≥17	-	-	100.0	-	-

[a] Clinical and Laboratory Standards Institute [16].

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

[c] The percentage resistant given is for constitutive clindamycin resistance. A further two (0.4%) isolates had inducible clindamycin resistance.

Penicillin and cefotaxime resistance in each region and DHB is presented in Table 34 (Appendix). Regional rates of penicillin resistance (meningitis interpretation) ranged from a low of 8.5% in the Central region to a high of 22.6% in the Northern region, and the difference between these two regions was significant (*p* <0.05*)*. There was a similar spread in the regional rates of cefotaxime resistance (meningitis interpretation) from 1.1% in the Central region to 5.3% in the Northern region, but none of the regional differences in cefotaxime resistance reached statistical significance.

Penicillin and cefotaxime resistance among isolates from cases in the different age groups is shown in Table 11. Penicillin and cefotaxime resistance was highest among isolates from cases <2 years old, but there were no significant differences in resistance rates between the four age groups analysed.

Table 11. Penicillin and cefotaxime resistance among isolates from invasive pneumococcal disease cases, 2014

Age group (years)	Penicillin		Cefotaxime			
	Resistant[a] MIC ≥0.12 mg/L		Intermediate[a] MIC 1 mg/L		Resistant[a] MIC ≥2 mg/L	
	Number	%[b]	Number	%[b]	Number	%[b]
<2 (n=32)	10	31.3	0	0.0	4	12.5
2–4 (n=20)	4	20.0	0	0.0	1	5.0
5–64 (n=211)	34	16.1	7	3.3	5	2.4
≥65 (n=209)	35	16.7	6	2.9	8	3.8
All ages (n=472)	**83**	**17.6**	**13**	**2.8**	**18**	**3.8**

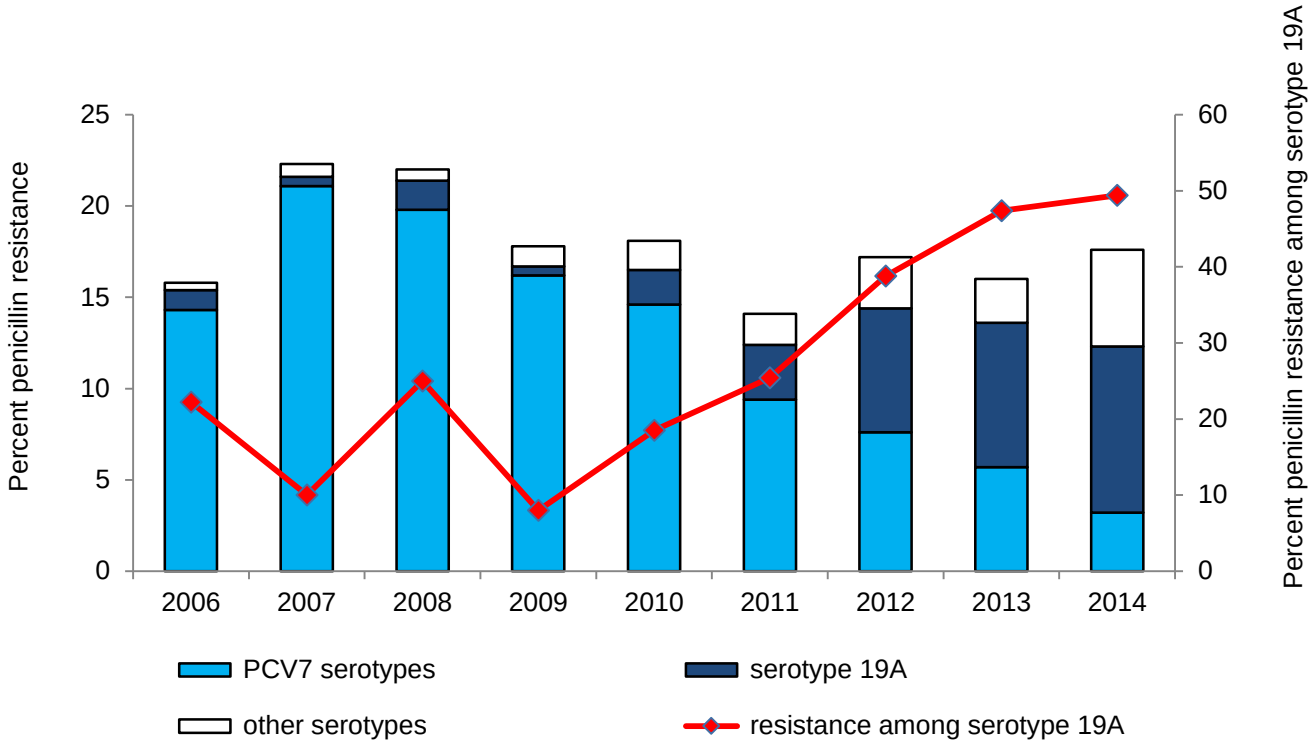
[a] CLSI meningitis interpretations; no intermediate category for penicillin [16].

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

Since the introduction of PCV into the childhood immunisation schedule, the serotype distribution among penicillin-resistant invasive pneumococci has changed markedly, with a steady decline in the proportion of penicillin resistance due to PCV7 types (Figure 9). In 2006–2007, PCV7 types accounted for 92.8% of the penicillin resistance compared with just 18.1% in 2014 (Table 35 in the Appendix). Conversely other serotypes, especially type 19A, now account for the majority of penicillin-resistant invasive pneumococci. In 2014 serotype 19A accounted for 51.8% of the penicillin-resistant invasive pneumococci (Table 35 in the Appendix). In addition, the prevalence of penicillin resistance among serotype 19A isolates has increased significantly in recent years from an average of 15.8% in 2006–2007 to 49.4% in 2014 (Figure 9 and Table 36 in the Appendix).

The prevalence of cefotaxime resistance and multidrug resistance has also increased among serotype 19A invasive isolates. In 2006–2007, no cefotaxime resistance was detected among type 19A isolates whereas 10.3% were resistant in 2014. Over the same time period, multidrug resistance increased from 1.8% to 11.5% (Table 35 in the Appendix). By 2014, serotype 19A accounted for 50.0% of the cefotaxime-resistant and 50.0% of the multidrug-resistant invasive pneumococci (Table 35 in the Appendix). Serotype 19A multidrug-resistant isolates were most commonly resistant to penicillin, cefotaxime, co-trimoxazole, erythromycin and tetracycline.

Figure 9. Penicillin-resistance among pneumococci from invasive disease cases, 2006–2014



Note: The bar chart and scale on the left-hand vertical axis show the percentage of pneumococcal isolates from invasive disease that were penicillin resistant (CLSI meningitis interpretation). Each bar is split to indicate the proportion of the penicillin-resistant isolates that were PCV-7 serotypes, the proportion that were serotype 19A and the proportion that were other serotypes. The line graph and scale on the right-hand vertical axis show the percentage of serotype 19A isolates that were penicillin resistant.

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 July 2011 there was a schedule change with PCV10 replacing PCV7, and again in July 2014 there was another schedule change with PCV13 replacing PCV10. Although both these schedule changes occurred mid-year, the actual use of the new vaccines did not begin until some months later as supplies of the lower-valency vaccines were depleted.

2014 marks the sixth full year since the addition of PCV to the immunisation schedule and the impact of routine infant immunisation is now evident across all age groups. In children <5 years of age, the rate of IPD due to PCV10 serotypes has decreased 96% (44.2 to 1.9 per 100,000 population between 2006/7 and 2014). The overall rate of IPD (ie, disease due to any serotype) has decreased 67% (53.5 to 17.8 per 100,000 between 2006 and 2014) in these children.

While the overall rates of IPD in the 5–64 and ≥65 years age groups are still similar to the rates recorded prior to the introduction of PCV infant immunisation in 2008, the rates in these older age groups have decreased significantly since 2009, that is, over the period that surveillance has been consistently based on notifications following IPD becoming a notifiable disease in late 2008. The use of 2009 as a baseline year is likely to be a more valid measure of the impact of infant immunisation on IPD in the older age groups, as laboratory-based surveillance used prior to 2009 likely underestimated IPD rates. Therefore, comparison of current rates of IPD with data from before 2009 is likely to underestimate any reductions in the incidence of IPD in these older age groups.

Despite the difficulties in measuring changes in the overall rates of IPD in the 5–64 and ≥65 years age groups, rates of IPD due to vaccine serotypes have unequivocally decreased in these age groups even when compared with the pre-vaccine period. Between this period (ie, 2006/7) and 2014, the rates of IPD due to PCV10 types decreased 58% in the 5–64 years age group and 70% in the ≥65 years age group. These decreases occurred despite marked increases in IPD due to serotype 7F (a PCV10 serotype) in these age groups since 2012 (see further discussion below).

When comparing New Zealand's IPD rates with those in other countries, factors such as differences in surveillance systems, ethnic composition, the dates PCV was added to immunisation schedules and the vaccines used need to be acknowledged. However, the overall rate of IPD recorded in New Zealand in 2014, 10.8 per 100,000, is similar to the rate of 10.1 per 100,000 recorded in England and Wales for the 2008–2010 period, 2–4 years after the addition of PCV7 to their national immunisation programme. Another 3–4 years on after the switch to PCV13 in 2010, the England and Wales rate has dropped to 6.9 per 100,000 [17]. The overall IPD rate in Australia in 2010, 5 years after universal PCV7 immunisation commenced in 2005 and the last year before PCV13 was introduced, was 7.4 per 100,000 [18]. However, it is noteworthy that there were pneumococcal vaccination programmes targeting high-risk populations in Australia for several years before universal PCV7 introduction in 2005 and higher valency vaccines (PCV10 and PCV13) were also used in certain parts of these populations. In contrast, the New Zealand rate in 2014 was somewhat lower than that of 14.3 per 100,000 reported in 2009 by the Active Bacterial Core surveillance in the United States, 9 years after the introduction of PCV7 and the year before the switch to PCV13 in that country [19].

Although the incidence of IPD has decreased in all ethnic groups since 2009, there are still marked ethnic disparities, with the age-standardised rates in the Māori and Pacific peoples ethnic groups consistently at least three times those in the European or Other ethnic group. Almost two-thirds (22/34) of the cases in infants <2 years old in 2014 belonged to the Māori or Pacific peoples ethnic groups. The unequal burden of IPD in Māori and Pacific peoples is consistent with ethnic group disparities identified generally for infectious diseases in New Zealand [20]. It is also consistent with reports from other countries of the

persistence of ethnic disparities in the incidence of IPD despite overall reductions in disease following the introduction of PCV [18, 21].

The most prevalent serotypes in 2014 were 19A, 7F, 3 and 22F, and these four types collectively accounted for 47% (222/472) of the culture-positive cases. Serotype 7F is a PCV10 type, types 19A and 3 are PCV13 types, and type 22F is not currently included in any PCV although it is included in PPV23. All four serotypes have increased significantly since the introduction of PCV7 infant immunisation and essentially replaced PCV7 types.

Serotype 19A has been the most prevalent type in New Zealand each year since 2011. In many other countries, serotype 19A is the type most frequently reported to have increased and replaced vaccine types after the introduction of PCV7 [22]. While most of the increases in type 19A disease have occurred in older children and adults, in 2012 and again in 2014 there were noticeable increases in cases of 19A disease in the <5 years age group, although the case numbers are still relatively small: 18 in 2012 and 17 in 2014 versus an average of 11.8 in other years since 2009. The reasons, if any, for these increases in 2012 and 2014 are not evident. A detailed analysis of the vaccination history of the 2012 cases provided no evidence that the change to PCV10 in 2011 may have accounted for the increase [6]. An analysis of the vaccination history of the 2014 cases showed that 14 cases had received at least 3 doses of PCV10. Notably the increasing prevalence of IPD due to type 19A does not appear to have been affected by the change from PCV7 to PCV10, in contrast to some studies on the effectiveness of PCV10 which have suggested that the type 19F antigen in PCV10 provides some cross-protection against serotype 19A disease [23, 24]. This evidence of cross-protection had lead to the recent approval of a label change for Synflorix® (PCV10) in Europe to include protection against serotype 19A [25].

Increases in serotype 7F IPD were first noted in 2012, with rates essentially doubling in 2012 and again in 2013. These increases in IPD due to type 7F were particularly noteworthy given they occurred after the immunisation schedule change from PCV7 to PCV10 in July 2011, and serotype 7F is one of the three additional types in PCV10. However, the increases have occurred almost wholly in the older age groups rather than the vaccine-eligible age groups, and international and local experience has shown that indirect immunity lags behind direct immunity by at least a couple of years [26, 27]. And indeed in 2014 there was no further increase in IPD due to type 7F and the number of cases decreased 22% (from 69 in 2013 to 54 in 2014).

One of the most notable changes in serotype prevalence in 2014 was the increase in type 3 IPD, with cases almost doubling between 2013 and 2014. Unlike the situation with the other prevalent replacement types, in particular 19A, 7F and 22F, the increase in type 3 IPD cases in 2014 occurred in mainly in the <65 years age groups. Given type 3 is a PCV13 type, it might be expected that cases should be controlled in the future with the change in 2014 to the routine use of PCV13 in our immunisation schedule. However, the prevalence of type 3 IPD will need close monitoring as some studies have suggested that PCV13 does not provide good protection against this serotype [28, 29].

There were two apparent PCV failures in 2014. Although these two cases had received at least three doses of a PCV that included the serotype responsible for their disease, one of the cases was reported as being immunocompromised.

In July 2014, PCV13 (Prevenar13®) replaced PCV10 on the childhood immunisation schedule in New Zealand. PCV13 will give additional coverage for serotypes 3, 6A and 19A. New Zealand's own experience with PCV7 and multiple studies in many other countries have demonstrated the effectiveness of PCV7 in reducing the incidence of IPD due to PCV7 types in both the age groups targeted for vaccination and older children and adults. Early data from those countries which have introduced PCV13 indicate similar direct and indirect effects from this vaccine [17, 29]. It is to be hoped that the direct and indirect effects of PCV13 on serotype 3, 7F and 19A disease will be realised in New Zealand, given these three types now constitute a large proportion of IPD in this country.

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APPENDIX

E/S/R

THE SCIENCE BEHIND THE TRUTH

APPENDIX

Table 12. Laboratory criteria upon which invasive pneumococcal disease diagnosis based, as recorded in the case notification, 2014

Basis of diagnosis	Prioritised[a]		Total response	
	Cases	%	Cases	%[b]
Culture of *S. pneumoniae* from:	**484**	**99.0**	**484[c]**	**99.0**
Blood	433	88.5	441	90.2
CSF	20	4.1	20	4.1
Pleural fluid	7	1.4	7	1.4
Joint fluid	12	2.5	15	3.1
Other	12	2.5	27	5.5
Positive pneumococcal antigen test on CSF	**5**	**1.0**	**7**	**1.4**
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, detection of *S. pneumoniae* DNA in CSF, positive pneumococcal antigen test on CSF, culture of *S. pneumoniae* from pleural fluid, culture of *S. pneumoniae* from joint fluid, and culture of *S. pneumoniae* from another normally sterile site. No cases were laboratory confirmed by the detection of *S. pneumoniae* DNA in blood, pleural fluid, joint fluid or other sites.

[b] Percent of total 489 cases.

[c] Number of cases that had *S. pneumoniae* cultured from any normally sterile site.

Figure 10. Number of invasive pneumococcal disease cases in the less than 2 years age group by age (in months), 2014

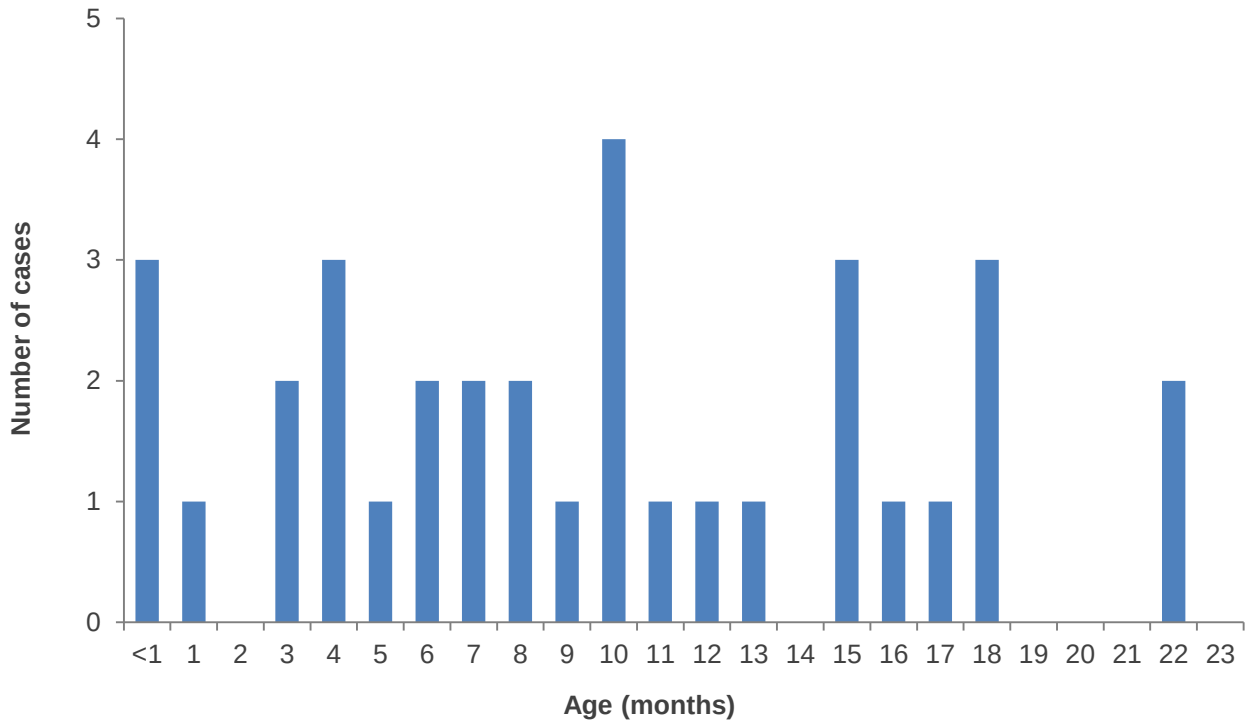

Table 13. Number of cases and rate per 100,000 population of invasive pneumococcal disease by age group and year, 2006–2014

Age group (years)	2006		2007		2008		2009		2010		2011		2012		2013		2014	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
<1	71	120.2	48	77.3	37	57.4	34	53.2	22	34.1	23	36.6	31	50.7	18	29.9	22	37.4
1	51	88.9	68	115.2	42	67.9	25	38.9	15	23.5	7	10.8	13	20.7	6	9.8	12	19.8
2–4	31	18.3	40	23.3	35	20.0	41	22.9	28	15.1	18	9.5	14	7.3	16	8.4	21	11.1
5–14	20	3.3	29	4.8	35	5.9	58	9.8	23	3.9	29	4.9	20	3.4	26	4.4	18	3.0
15–24	15	2.5	19	3.1	29	4.8	53	8.7	25	4.1	27	4.3	21	3.4	23	3.7	19	3.0
25–34	16	2.9	24	4.4	32	5.9	53	9.8	25	4.6	40	7.4	24	4.4	18	3.3	24	4.2
35–44	54	8.5	41	6.5	53	8.4	68	10.9	39	6.3	36	5.9	37	6.1	36	6.1	36	6.1
45–54	42	7.4	37	6.3	55	9.2	55	9.0	59	9.6	55	8.9	44	7.1	62	9.9	50	8.0
55–64	56	13.0	63	14.3	87	19.1	69	14.7	75	15.5	87	17.5	74	14.7	87	17.0	69	13.1
65–74	67	24.3	87	30.5	87	29.9	94	31.3	80	25.7	84	25.9	84	24.5	81	22.5	105	27.9
75–84	68	38.2	73	40.7	88	48.6	94	51.6	87	47.4	88	47.5	81	43.1	68	35.5	67	34.1
≥85	34	58.5	26	42.8	51	80.7	53	80.8	57	83.2	58	82.0	45	61.8	38	50.9	46	59.2
Aggregated age groups (years)																		
<2	122	104.8	116	95.7	79	62.5	59	46.0	37	28.8	30	23.6	44	35.5	24	19.7	34	28.5
<5	153	53.5	156	53.2	114	37.9	100	32.6	65	20.7	48	15.1	58	18.4	40	12.8	55	17.8
5–64	203	6.0	213	6.3	291	8.5	356	10.3	246	7.1	274	7.9	220	6.3	252	7.2	216	6.1
≥65	169	33.0	186	35.4	226	42.2	241	44.0	224	39.8	230	39.7	210	34.8	187	29.9	218	33.5
Total	**525**	**12.5**	**555**	**13.1**	**631**	**14.8**	**697**	**16.2**	**535**	**12.3**	**552**	**12.6**	**488**	**11.1**	**479**	**10.8**	**489**	**10.8**

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. Age-standardised rate per 100,000 population of invasive pneumococcal disease by ethnic group, age group and year, 2009–2014

Age group (years)	Ethnic group[a,b]											
	Māori						Pacific peoples					
	2009	2010	2011	2012	2013	2014	2009	2010	2011	2012	2013	2014
<2	87.8	63.4	45.7	43.9	35.1	52.0	66.0	49.4	58.1	85.3	-	53.1
<5	49.4	38.4	24.5	22.2	17.5	31.5	51.4	36.8	26.5	43.3	-	30.7
5–64	20.8	13.7	11.9	11.1	12.5	11.3	27.3	24.9	18.3	14.0	15.2	11.6
≥65	89.3	74.0	90.1	68.7	91.8	74.4	101.0	143.5	87.5	98.3	94.4	162.1
All ages[c]	**33.2**	**25.3**	**26.0**	**23.1**	**27.8**	**24.6**	**39.9**	**48.6**	**30.7**	**32.4**	**32.1**	**35.0**

Age group (years)	Ethnic group[a,b]											
	Asian						European or Other					
	2009	2010	2011	2012	2013	2014	2009	2010	2011	2012	2013	2014
<2	-	-	-	-	-	-	29.4	13.9	7.8	25.6	16.3	18.2
<5	13.8	18.9	16.0	-	-	-	24.6	9.9	7.3	12.9	11.8	11.9
5–64	3.0	1.8	1.6	1.1	2.7	3.8	7.4	4.6	6.8	4.9	5.7	4.4
≥65	23.8	-	-	25.1	-	-	38.4	36.0	35.8	31.0	24.0	25.9
All ages[c]	**7.4**	**5.5**	**4.2**	**5.8**	**4.3**	**6.1**	**12.4**	**9.2**	**10.3**	**8.8**	**8.3**	**7.8**

[a] Rates were not calculated for the Middle Eastern/Latin American/African (MELAA) ethnic group as there were less than five cases reported each year for this ethnic group (2009, 1 case; 2010, 3 cases; 2011, 3 cases; 2012, 4 cases; 2013, 2 cases; 2014, 1 case).

[b] Ethnicity was recorded for 680 (97.6%) cases notified in 2009, 532 (99.4%) cases in 2010, 540 (97.8%) cases in 2011, 475 (97.3%) cases in 2012, 464 (96.9%) cases in 2013, and 465 (95.1%) in 2014.

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

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 usually resident 2013 census population applied to the corresponding mid-year population estimates from Statistics New Zealand for 2010–2014. For 2009, the 2006 census population was used. 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. Rate per 100,000 population of invasive pneumococcal disease by quintiles of the 2013 NZ Deprivation Index and year, 2009–2014

NZDep13 quintile[a]	2009		2010		2011		2012		2013		2014	
	Cases	Rate[b]	Cases	Rate[b]	Cases	Rate[b]	Cases	Rate[b]	Cases	Rate[b]	Cases	Rate[b]
1	65	7.4	51	5.8	57	6.5	64	7.3	42	4.8	42	4.8
2	81	9.5	65	7.6	66	7.7	69	8.1	70	8.2	77	9.0
3	109	13.0	83	9.9	95	11.3	77	9.2	83	9.9	69	8.2
4	154	18.6	103	12.4	121	14.6	96	11.6	98	11.8	103	12.4
5	234	28.1	199	23.9	178	21.4	158	19.0	157	18.8	180	21.6
Total[c]	**643**		**501**		**517**		**464**		**450**		**471**	

[a] Quintile of the 2013 New Zealand Deprivation Index (1 = least deprived and 5 = most deprived).

[b] Rate per 100,000 population, based on the 2013 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 2014 mid-year population estimates from Statistics New Zealand.

[c] Accurate New Zealand Deprivation Index (NZDep13) data was available for 643 (92.3%) cases notified in 2009, 501 (93.6%) cases in 2010, 517 (93.7%) cases in 2011, 464 (95.1%) cases in 2012, 450 (93.9%) cases in 2013, and 471 (96.3%) cases in 2014.

Table 16. Number of cases and rate per 100,000 population of invasive pneumococcal disease by clinical presentation and age group, 2014

Age group (years)	Meningitis		Empyema		Pneumonia		Bacteraemia without focus		Other	
	Cases[a]	Rate[b]	Cases[a]	Rate[b]	Cases[a]	Rate[b]	Cases[a]	Rate[b]	Cases[a]	Rate[b]
<1	7	11.9	2	-	9	15.3	1	-	8	13.6
1	2	-	0	-	5	8.3	4	-	4	-
2–4	3	-	1	-	8	4.2	2	-	9	4.8
5–14	4	-	1	-	10	1.7	4	-	1	-
15–64	12	0.4	5	0.2	144	4.9	37	1.3	19	0.6
≥65	8	1.2	5	0.8	158	24.3	27	4.2	26	4.0
Total[c]	**36**	**0.8**	**14**	**0.3**	**334**	**7.4**	**75**	**1.7**	**67**	**1.5**

[a] Number of cases with 'yes' recorded for each clinical presentation. Some cases reported having more than one clinical presentation. Any cases 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 465 (95.1%) cases notified in 2014.

Table 17. Case-fatality rates for invasive pneumococcal disease cases by age group, 2014

Age group (years)	Cases died[a]	Total reported[b]	Case-fatality rate[c] (%)
<1	0	21	0.0
1	0	11	0.0
2–4	1	19	5.3
5–14	1	18	5.6
15–64	5	193	2.6
≥65	16	204	7.8
Total	**23**	**466**	**4.9**

[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 466 (95.3%) of cases notified in 2014.

Table 18. Exposure to risk factors associated with invasive pneumococcal disease for cases aged less than 2 years, 2014

Risk factor	Cases[a]	Total reported[b]	%[c]
Smoking in the household	6	9	66.7
Premature (<37 weeks gestation)[d]	3	10	30.0
Attends childcare	2	13	15.4
Cochlear implants	1	29	3.4
Chronic illness	1	29	3.4

[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.

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

Table 19. Exposure to risk factors associated with invasive pneumococcal disease for cases aged less than 5 years, 2014

Risk factor	Cases[a]	Total reported[b]	%[c]
Smoking in the household	6	11	54.5
Premature (<37 weeks gestation)[d]	3	10	30.0
Attends childcare	2	15	13.3
Chronic illness[e]	6	46	13.0
Immunocompromised[f]	4	42	9.5
Anatomical or functional asplenia	2	45	4.4
Chronic lung disease or cystic fibrosis	1	46	2.2
Cochlear impants	1	46	2.2

[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] 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 congenital or chromosomal abnormality; or being a resident in a long-term or other chronic-care facility.

Table 20. Exposure to risk factors associated with invasive pneumococcal disease for cases aged 5 years and over, 2014

Risk factor	Cases[a]	Total reported[b]	%[c]
Chronic illness[d]	202	394	51.3
Current smoker[e]	89	330	27.0
Immunocompromised[f]	70	397	17.6
Chronic lung disease or cystic fibrosis	59	397	14.9
Resident in long-term or other chronic-care facility[g]	35	385	9.1
Congenital or chromosomal abnormality	5	379	1.3
Anatomical or functional asplenia	4	391	1.0
Other risk factors	100	-	-

[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 ≥15 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, 24.0% (25 cases out of 104 for whom the information was supplied) were residents in a long-term or other chronic-care facility.

Note: No cases aged ≥5 years were reported as having cochlear implants.

Table 21. Rate per 100,000 population of invasive pneumococcal disease by District Health Board, 2009–2014

District Health Board	Rate[a]					
	2009	2010	2011	2012	2013	2014
Northland	20.2	10.6	12.9	14.1	12.8	15.7
Waitemata	12.0	11.7	11.1	7.0	9.0	8.4
Auckland	11.6	10.1	11.5	11.4	8.3	11.4
Counties Manukau	19.0	21.9	15.4	15.3	12.1	13.6
Northern region	**14.8**	**14.2**	**12.7**	**11.3**	**10.1**	**11.5**
Waikato	22.7	12.8	12.4	11.2	10.6	11.2
Lakes	28.5	17.5	28.1	13.6	25.2	25.1
Bay of Plenty	24.0	15.6	13.6	16.8	16.7	13.8
Tairawhiti	19.4	-	10.7	-	10.6	14.9
Taranaki	18.3	9.0	9.8	12.4	7.9	12.2
Midland region	**22.9**	**13.2**	**14.2**	**12.8**	**13.5**	**13.8**
Hawke's Bay	22.6	15.3	16.5	13.3	15.1	10.0
Whanganui	19.0	14.3	9.5	9.6	16.1	16.1
MidCentral	10.3	10.8	11.3	6.5	10.1	12.3
Hutt Valley	21.2	14.7	11.9	8.4	7.7	9.1
Capital & Coast	10.5	8.0	6.5	9.9	9.5	9.8
Wairarapa	29.6	12.1	16.7	23.8	16.5	14.0
Nelson Marlborough	16.1	-	12.8	14.2	9.1	4.2
Central region	**16.0**	**10.4**	**11.2**	**10.8**	**10.9**	**9.9**
West Coast	-	-	-	-	18.2	-
Canterbury	10.9	8.2	13.4	8.0	7.9	7.8
South Canterbury	10.8	-	14.1	10.5	13.9	-
Southern	17.4	15.6	12.2	11.5	9.8	8.7
Southern region	**12.7**	**10.3**	**12.5**	**9.2**	**9.3**	**7.9**
Total	**16.2**	**12.3**	**12.6**	**11.1**	**10.8**	**10.8**

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

Table 22. Number of cases and rate per 100,000 population of invasive pneumococcal disease by serotype, serotypes covered by PCV7, PCV10 and PCV13, and age group, 2014

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]
4	0	-	1	-	1	-	13	0.4	10	1.5	24	0.5
6B	0	-	0	-	0	-	1	-	1	-	2	-
9V	0	-	0	-	0	-	5	0.1	2	-	7	0.2
14	0	-	1	-	1	-	1	-	2	-	4	-
18C	1	-	0	-	1	-	3	-	5	0.8	9	0.2
19F	1	-	0	-	1	-	2	-	7	1.1	10	0.2
23F	0	-	0	-	0	-	1	-	1	-	2	-
PCV7	**2**	**-**	**2**	**-**	**4**	**-**	**26**	**0.7**	**28**	**4.3**	**58**	**1.3**
1	0	-	1	-	1	-	0	-	0	-	1	-
5	0	-	0	-	0	-	0	-	0	-	0	-
7F	0	-	1	-	1	-	35	1.0	18	2.8	54	1.2
PCV10	**2**	**-**	**4**	**-**	**6**	**1.9**	**61**	**1.7**	**46**	**7.1**	**113**	**2.5**
3	7	5.9	2	-	9	2.9	18	0.5	15	2.3	42	0.9
6A	0	-	0	-	0	-	0	-	1	-	1	-
19A	12	10.0	5	2.6	17	5.5	40	1.1	30	4.6	87	1.9
PCV13	**21**	**17.6**	**11**	**5.8**	**32**	**10.4**	**119**	**3.4**	**92**	**14.1**	**243**	**5.4**
6C	3	-	1	-	4	-	10	0.3	12	1.8	26	0.6
8	2	-	0	-	2	-	12	0.3	7	1.1	21	0.5
9N	2	-	0	-	2	-	5	0.1	10	1.5	17	0.4
10A	0	-	1	-	1	-	2	-	4	-	7	0.2
11A	0	-	0	-	0	-	2	-	10	1.5	12	0.3
15B	0	-	1	-	1	-	2	-	4	-	7	0.2
16 NT[d]	1	-	1	-	2	-	6	0.2	7	1.1	15	0.3
22F	0	-	1	-	1	-	17	0.5	21	3.2	39	0.9
23A	1	-	0	-	1	-	5	0.1	5	0.8	11	0.2
23B	0	-	0	-	0	-	6	0.2	4	-	10	0.2
33F	2	-	0	-	2	-	3	-	4	-	9	0.2
35 NT[d]	0	-	1	-	1	-	5	0.1	9	1.4	15	0.3
Other	0	-	3	-	3	-	17	0.5	20	3.1	40	0.9
Non-PCV[e]	**11**	**9.2**	**9**	**4.8**	**20**	**6.5**	**92**	**2.6**	**117**	**18.0**	**229**	**5.1**
Total[f]	**32**	**26.8**	**20**	**10.6**	**52**	**16.8**	**211**	**5.9**	**209**	**32.1**	**472**	**10.5**

[a] Aggregated age group.

[b] Among the cases in the ≥65 year age group, 74.6% 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] NT: not typable with the range of factorised antisera used at ESR.

[e] The specific non-PCV serotypes listed are those that accounted for more than five cases of IPD in 2014.

[f] Total number of isolates from culture-positive cases referred to ESR for serotyping for each age group.

Table 23. Number and percentage of invasive pneumococcal disease cases by serotype for each age group, 2014

Serotype	<2 years		<5 years		5–64 years		≥65 years		All ages	
	Cases	%[a]	Cases	%[a]	Cases	%[a]	Cases	%[a]	Cases	%[a]
1	0	-	1	1.9	0	-	0	-	1	0.2
3	7	21.9	9	17.3	18	8.5	15	7.2	42	8.9
4	0	-	1	1.9	13	6.2	10	4.8	24	5.1
6A	0	-	0	-	0	-	1	0.5	1	0.2
6B	0	-	0	-	1	0.5	1	0.5	2	0.4
6C	3	9.4	4	7.7	10	4.7	12	5.7	26	5.5
7C	0	-	0	-	0	-	1	0.5	1	0.2
7F	0	-	1	1.9	35	16.6	18	8.6	54	11.4
8	2	6.3	2	3.8	12	5.7	7	3.3	21	4.4
9N	2	6.3	2	3.8	5	2.4	10	4.8	17	3.6
9V	0	-	0	-	5	2.4	2	1.0	7	1.5
10A	0	-	1	1.9	2	0.9	4	1.9	7	1.5
10 NT[b]	0	-	0	-	1	0.5	0	-	1	0.2
11A	0	-	0	-	2	0.9	10	4.8	12	2.5
11 NT[b]	0	-	0	-	1	0.5	0	-	1	0.2
12F	0	-	0	-	1	0.5	1	0.5	2	0.4
13	0	-	0	-	1	0.5	1	0.5	2	0.4
14	0	-	1	1.9	1	0.5	2	1.0	4	0.8
15A	0	-	0	-	1	0.5	0	-	1	0.2
15B	0	-	1	1.9	2	0.9	4	1.9	7	1.5
15C	0	-	1	1.9	0	-	0	-	1	0.2
15 NT[b]	0	-	0	-	0	-	2	1.0	2	0.4
16 NT[b]	1	3.1	2	3.8	6	2.8	7	3.3	15	3.2
17F	0	-	0	-	3	1.4	1	0.5	4	0.8
17 NT[b]	0	-	0	-	1	0.5	1	0.5	2	0.4
18C	1	3.1	1	1.9	3	1.4	5	2.4	9	1.9
19A	12	37.5	17	32.7	40	19.0	30	14.4	87	18.4
19F	1	3.1	1	1.9	2	0.9	7	3.3	10	2.1
20	0	-	0	-	1	0.5	3	1.4	4	0.8
21	0	-	1	1.9	0	-	0	-	1	0.2
22A	0	-	0	-	0	-	1	0.5	1	0.2
22F	0	-	1	1.9	17	8.1	21	10.0	39	8.3
23A	1	3.1	1	1.9	5	2.4	5	2.4	11	2.3
23B	0	-	0	-	6	2.8	4	1.9	10	2.1
23F	0	-	0	-	1	0.5	1	0.5	2	0.4
24 NT[b]	0	-	0	-	1	0.5	0	-	1	0.2
31	0	-	0	-	2	0.9	3	1.4	5	1.1
33F	2	6.3	2	3.8	3	1.4	4	1.9	9	1.9
33 NT[b]	0	-	0	-	1	0.5	0	-	1	0.2
34	0	-	0	-	1	0.5	1	0.5	2	0.4
35F	0	-	0	-	0	-	1	0.5	1	0.2
35 NT[b]	0	-	1	1.9	5	2.4	9	4.3	15	3.2
37	0	-	0	-	0	-	1	0.5	1	0.2
38	0	-	0	-	1	0.5	2	1.0	3	0.6
Non-typable	0	-	1	1.9	1	0.5	1	0.5	3	0.6
Total[c]	**32**		**52**		**211**		**209**		**472**	

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

[b] NT: not typable with the range of factorised antisera used at ESR.

[c] Total number of isolates from culture-positive cases referred to ESR for serotyping for each age group.

Table 24. Number of cases and rate per 100,000 population of invasive pneumococcal disease in the less than 2 years age group by serotype, and serotypes covered by PCV7, PCV10 and PCV13, 2006/2007, 2010–2014

Serotype	2006/2007		2010		2011		2012		2013		2014	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
4	6.5	5.5	0	-	0	-	0	-	0	-	0	-
6B	18.0	15.2	1	-	1	-	0	-	0	-	0	-
9V	4.5	3.8	0	-	1	-	0	-	0	-	0	-
14	39.0	32.8	3	-	0	-	1	-	0	-	0	-
18C	6.0	5.1	0	-	1	-	0	-	0	-	1	-
19F	15.5	13.0	6	4.7	0	-	1	-	1	-	1	-
23F	9.0	7.6	0	-	0	-	0	-	0	-	0	-
PCV7	**98.5**	**82.9**	**10**	**7.8**	**3**	**-**	**2**	**-**	**1**	**-**	**2**	**-**
1	2.0	-	2	-	2	-	1	-	0	-	0	-
5	0.0	-	0	-	0	-	0	-	0	-	0	-
7F	0.5	-	2	-	2	-	2	-	1	-	0	-
PCV10	**101.0**	**85.0**	**14**	**10.9**	**7**	**5.5**	**5**	**4.0**	**2**	**-**	**2**	**-**
3	1.0	-	2	-	0	-	2	-	3	-	7	5.9
6A/6C[e]	3.0	-	2	-	1	-	4	-	1	-	3	-
19A	6.0	5.1	7	5.4	8	6.3	13	10.5	7	5.8	12	10.0
PCV13	**111.0**	**93.4**	**25**	**19.5**	**16**	**12.6**	**24**	**19.4**	**13**	**10.7**	**24**	**20.1**
8	0.0	-	0	-	2	-	2	-	2	-	2	-
9N	0.0	-	0	-	1	-	0	-	0	-	2	-
10A	0.5	-	1	-	1	-	3	-	1	-	0	-
11A	0.5	-	0	-	1	-	2	-	2	-	0	-
15B	0.5	-	0	-	0	-	4	-	0	-	0	-
16 NT[f]	0.0	-	0	-	0	-	0	-	0	-	1	-
22F	1.0	-	1	-	0	-	0	-	1	-	0	-
23A	0.0	-	0	-	0	-	0	-	0	-	1	-
23B	0.5	-	0	-	0	-	0	-	1	-	0	-
33F	0.5	-	4	-	1	-	0	-	1	-	2	-
35 NT[f]	0.0	-	1	-	3	-	2	-	0	-	0	-
Other	3.0	-	4	-	3	-	2	-	2	-	0	-
Non-PCV[g]	**6.5**	**5.5**	**11**	**8.6**	**12**	**9.4**	**15**	**12.1**	**10**	**8.2**	**8**	**6.7**

[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] NT: not typable with the range of factorised antisera used at ESR.

[g] The specific non-PCV serotypes listed are those that accounted for more than five cases in 2014.

Note: Data presented from 2010 onwards is based on IPD notifications and data for 2006/07 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 less than 5 years age group by serotype, by serotype, and serotypes covered by PCV7, PCV10 and PCV13, 2006/2007, 2010–2014

Serotype	2006/2007		2010		2011		2012		2013		2014	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
4	8.0	2.8	2	-	1	-	0	-	0	-	1	-
6B	23.5	8.1	2	-	1	-	0	-	0	-	0	-
9V	7.0	2.4	2	-	1	-	1	-	0	-	0	-
14	47.5	16.4	7	2.2	1	-	2	-	0	-	1	-
18C	10.5	3.6	0	-	2	-	0	-	0	-	1	-
19F	19.0	6.6	9	2.9	3	-	1	-	1	-	1	-
23F	9.5	3.3	2	-	1	-	0	-	0	-	0	-
PCV7	**125.0**	**43.2**	**24**	**7.6**	**10**	**3.2**	**4**	**-**	**1**	**-**	**4**	**-**
1	2.5	-	9	2.9	3	-	1	-	2	-	1	-
5	0.0	-	0	-	0	-	0	-	0	-	0	-
7F	0.5	-	2	-	4	-	4	-	1	-	1	-
PCV10	**128.0**	**44.2**	**35**	**11.1**	**17**	**5.4**	**9**	**2.9**	**4**	**-**	**6**	**1.9**
3	1.0	-	4	-	0	-	2	-	3	-	9	2.9
6A/6C[e]	4.5	1.6	2	-	1	-	4	-	1	-	4	-
19A	10.5	3.6	10	3.2	13	4.1	18	5.7	12	3.8	17	5.5
PCV13	**144.0**	**49.7**	**51**	**16.2**	**31**	**9.8**	**33**	**10.5**	**20**	**6.4**	**36**	**11.7**
8	0.0	-	0	-	2	-	2	-	2	-	2	-
9N	0.0	-	0	-	1	-	0	-	0	-	2	-
10A	1.0	-	1	-	1	-	4	-	1	-	1	-
11A	0.5	-	0	-	1	-	2	-	3	-	0	-
15B	1.0	-	0	-	2	-	6	1.9	1	-	1	-
16 NT[f]	0.0	-	0	-	0	-	0	-	0	-	2	-
22F	1.0	-	1	-	0	-	0	-	1	-	1	-
23A	0.5	-	0	-	0	-	0	-	0	-	1	-
23B	0.5	-	0	-	0	-	0	-	2	-	0	-
33F	1.0	-	4	-	1	-	0	-	1	-	2	-
35 NT[f]	0.0	-	1	-	3	-	2	-	1	-	1	-
Other	3.5	-	5	1.6	3	-	3	-	5	1.6	3	-
Non-PCV[g]	**9.0**	**3.1**	**12**	**3.8**	**14**	**4.4**	**19**	**6.0**	**17**	**5.4**	**16**	**5.2**

[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] NT: not typable with the range of factorised antisera used at ESR.

[g] The specific non-PCV serotypes listed are those that accounted for more than five cases in 2014.

Note: Data presented from 2010 onwards is based on IPD notifications and data for 2006/07 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 in the 5–64 years age group by serotype, by serotype, and serotypes covered by PCV7, PCV10 and PCV13, 2006/2007, 2010–2014

Serotype	2006/2007		2010		2011		2012		2013		2014	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
4	38.0	1.1	26	0.7	30	0.9	26	0.7	23	0.7	13	0.4
6B	11.5	0.3	4	-	7	0.2	3	-	3	-	1	-
9V	11.0	0.3	13	0.4	10	0.3	5	0.1	8	0.2	5	0.1
14	31.0	0.9	15	0.4	18	0.5	11	0.3	3	-	1	-
18C	5.5	0.2	4	-	7	0.2	5	0.1	10	0.3	3	-
19F	12.0	0.4	12	0.3	14	0.4	13	0.4	7	0.2	2	-
23F	12.0	0.4	9	0.3	5	0.1	5	0.1	3	-	1	-
PCV7	**121.0**	**3.6**	**83**	**2.4**	**91**	**2.6**	**68**	**1.9**	**57**	**1.6**	**26**	**0.7**
1	19.0	0.6	58	1.7	30	0.9	7	0.2	1	-	0	-
5	0.0	-	0	-	0	-	0	-	0	-	0	-
7F	6.0	0.2	4	-	11	0.3	18	0.5	48	1.4	35	1.0
PCV10	**146.0**	**4.3**	**145**	**4.2**	**132**	**3.8**	**93**	**2.7**	**106**	**3.0**	**61**	**1.7**
3	8.5	0.3	9	0.3	22	0.6	9	0.3	9	0.3	18	0.5
6A/6C[e]	5.0	0.1	6	0.2	9	0.3	6	0.2	11	0.3	10	0.3
19A	10.0	0.3	23	0.7	26	0.7	30	0.9	36	1.0	40	1.1
PCV13	**169.5**	**5.0**	**183**	**5.3**	**189**	**5.4**	**138**	**4.0**	**162**	**4.6**	**129**	**3.8**
8	12.0	0.4	7	0.2	9	0.3	11	0.3	10	0.3	12	0.3
9N	4.0	-	7	0.2	3	-	5	0.1	2	-	5	0.1
10A	3.0	-	2	-	5	0.1	2	-	3	-	2	-
11A	3.5	-	8	0.2	5	0.1	5	0.1	7	0.2	2	-
15B	0.5	-	0	-	2	-	2	-	2	-	2	-
16 NT[f]	0.0	-	0	-	0	-	0	-	3	-	6	0.2
22F	5.0	0.1	4	-	17	0.5	19	0.5	24	0.7	17	0.5
23A	0.5	-	4	-	2	-	4	-	0	-	5	0.1
23B	0.5	-	1	-	1	-	5	0.1	1	-	6	0.2
33F	0.0	-	5	0.1	2	-	1	-	5	0.1	3	-
35 NT[f]	1.0	-	0	-	3	-	0	-	2	-	5	0.1
Other	8.0	0.2	13	0.4	22	0.6	12	0.3	17	0.5	17	0.5
Non-PCV[g]	**38.0**	**1.1**	**51**	**1.5**	**71**	**2.0**	**66**	**1.9**	**76**	**2.2**	**82**	**2.3**

[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] NT: not typable with the range of factorised antisera used at ESR.

[g] The specific non-PCV serotypes listed are those that accounted for more than five cases in 2014.

Note: Data presented from 2010 onwards is based on IPD notifications and data for 2006/07 is from ESR's national laboratory-based surveillance of IPD.

Table 27. Number of cases and rate per 100,000 population of invasive pneumococcal disease in the 65 years and over age group by serotype, by serotype, and serotypes covered by PCV7, PCV10 and PCV13, 2006/2007, 2010–2014

Serotype	2006/2007		2010		2011		2012		2013		2014	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
4	19.5	3.8	18	3.2	15	2.6	22	3.6	9	1.4	10	1.5
6B	11.0	2.1	15	2.7	10	1.7	5	0.8	4	-	1	-
9V	14.5	2.8	16	2.8	4	-	7	1.2	3	-	2	-
14	35.5	6.8	18	3.2	9	1.6	5	0.8	4	-	2	-
18C	3.0	-	5	0.9	7	1.2	4	-	6	1.0	5	0.8
19F	16.5	3.2	15	2.7	22	3.8	11	1.8	5	0.8	7	1.1
23F	15.0	2.9	14	2.5	11	1.9	4	-	3	-	1	-
PCV7	**115.0**	**22.2**	**101**	**17.9**	**78**	**13.4**	**58**	**9.6**	**34**	**5.4**	**28**	**4.3**
1	3.5	-	10	1.8	2	-	0	-	0	-	0	-
5	0.0	-	1	-	0	-	0	-	0	-	0	-
7F	3.5	-	3	-	1	-	15	2.5	20	3.2	18	2.8
PCV10	**122.0**	**23.5**	**115**	**20.4**	**81**	**14.0**	**73**	**12.1**	**54**	**8.6**	**46**	**7.1**
3	12.5	2.4	8	1.4	16	2.8	14	2.3	11	1.8	15	2.3
6A/6C[e]	2.5	-	13	2.3	14	2.4	12	2.0	12	1.9	13	2.0
19A	8.0	1.5	22	3.9	24	4.1	32	5.3	28	4.5	30	4.6
PCV13	**145.0**	**28.0**	**158**	**28.0**	**135**	**23.3**	**131**	**21.7**	**105**	**16.8**	**104**	**16.0**
8	3.5	-	0	-	2	-	5	0.8	5	0.8	7	1.1
9N	4.0	-	8	1.4	11	1.9	3	-	10	1.6	10	1.5
10A	2.0	-	3	-	5	0.9	4	-	2	-	4	-
11A	3.5	-	5	0.9	8	1.4	7	1.2	1	-	10	1.5
15B	1.0	-	0	-	1	-	2	-	5	0.8	4	-
16 NT[f]	0.5	-	1	-	2	-	0	-	4	-	7	1.1
22F	4.5	0.9	18	3.2	21	3.6	21	3.5	16	2.6	21	3.2
23A	1.0	-	4	-	1	-	1	-	6	1.0	5	0.8
23B	0.5	-	1	-	1	-	2	-	3	-	4	-
33F	1.5	-	4	-	8	1.4	8	1.3	5	0.8	4	-
35 NT[f]	1.0	-	1	-	5	0.9	3	-	4	-	9	1.4
Other	9.5	1.8	14	2.5	28	4.8	16	2.7	13	2.1	20	3.1
Non-PCV[g]	**32.5**	**6.3**	**59**	**10.5**	**93**	**16.0**	**72**	**11.9**	**74**	**11.8**	**105**	**16.1**

[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] NT: not typable with the range of factorised antisera used at ESR.

[g] The specific non-PCV serotypes listed are those that accounted for more than five cases in 2014.

Note: Data presented from 2010 onwards is based on IPD notifications and data for 2006/07 is from ESR's national laboratory-based surveillance of IPD.

Table 28. Number of cases and rate per 100,000 population of invasive pneumococcal disease by serotype, by serotype, and serotypes covered by PCV7, PCV10 and PCV13, all ages, 2006/2007, 2010–2014

Serotype	2006/2007		2010		2011		2012		2013		2014	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
4	65.5	1.6	46	1.1	46	1.0	48	1.1	32	0.7	24	0.5
6B	46.0	1.1	21	0.5	18	0.4	8	0.2	7	0.2	2	-
9V	32.5	0.8	31	0.7	15	0.3	13	0.3	11	0.2	7	0.2
14	114.0	2.7	40	0.9	28	0.6	18	0.4	7	0.2	4	-
18C	19.0	0.5	9	0.2	16	0.4	9	0.2	16	0.4	9	0.2
19F	47.5	1.1	36	0.8	39	0.9	25	0.6	13	0.3	10	0.2
23F	36.5	0.9	25	0.6	17	0.4	9	0.2	6	0.1	2	-
PCV7	**361.0**	**8.6**	**208**	**4.8**	**179**	**4.1**	**130**	**2.9**	**92**	**2.1**	**58**	**1.3**
1	25.0	0.6	77	1.8	35	0.8	8	0.2	3	-	1	-
5	0.0	-	1	-	0	-	0	-	0	-	0	-
7F	10.0	0.2	9	0.2	16	0.4	37	0.8	69	1.6	54	1.2
PCV10	**396.0**	**9.4**	**295**	**6.8**	**230**	**5.2**	**175**	**4.0**	**164**	**3.7**	**113**	**2.5**
3	22.0	0.5	21	0.5	38	0.9	25	0.6	23	0.5	42	0.9
6A/6C[e]	12.0	0.3	21	0.5	24	0.5	22	0.5	24	0.5	27	0.6
19A	28.5	0.7	55	1.3	63	1.4	80	1.8	76	1.7	87	1.9
PCV13	**458.5**	**10.9**	**392**	**9.0**	**355**	**8.1**	**302**	**6.9**	**287**	**6.5**	**269**	**6.0**
8	15.5	0.4	7	0.2	13	0.3	18	0.4	17	0.4	21	0.5
9N	8.0	0.2	15	0.3	15	0.3	8	0.2	12	0.3	17	0.4
10A	6.0	0.1	6	0.1	11	0.3	10	0.2	6	0.1	7	0.2
11A	7.5	0.2	13	0.3	14	0.3	14	0.3	11	0.2	12	0.3
15B	2.5	-	0	-	5	0.1	10	0.2	8	0.2	7	0.2
16 NT[f]	0.0	-	0	-	0	-	0	-	7	0.2	15	0.3
22F	10.5	0.2	23	0.5	38	0.9	40	0.9	41	0.9	39	0.9
23A	2.0	-	8	0.2	3	-	5	0.1	6	0.1	11	0.2
23B	1.5	-	2	-	2	-	7	0.2	6	0.1	10	0.2
33F	2.5	-	13	0.3	11	0.3	9	0.2	11	0.2	9	0.2
35 NT[f]	0.5	-	0	-	0	-	0	-	7	0.2	15	0.3
Other	23.0	0.5	35	0.8	66	1.5	36	0.8	35	0.8	40	0.9
Non-PCV[g]	**79.5**	**1.9**	**122**	**2.8**	**178**	**4.1**	**157**	**3.6**	**167**	**3.8**	**203**	**4.5**

[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] NT: not typable with the range of factorised antisera used at ESR.

[g] The specific non-PCV serotypes listed are those that accounted for more than five cases in 2014.

Note: Data presented from 2010 onwards is based on IPD notifications and data prio for 2006/07 is from ESR's national laboratory-based surveillance of IPD.

Table 29. Serotype 19A invasive pneumococcal disease case numbers, proportions and rates per 100,000 population, by age group, 2004–2014

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	2.1	40	6.3	0.9
2009	8	14.5	6.2	12	12.9	3.9	16	4.7	0.5	9	3.9	1.6	37	5.6	0.9
2010	7	19.4	5.4	10	15.9	3.2	23	9.8	0.7	22	10.1	3.9	55	10.7	1.3
2011	8	28.6	6.3	13	28.9	4.1	26	10.0	0.7	24	10.5	4.1	63	11.8	1.4
2012	13	33.3	10.5	18	34.6	5.7	30	14.7	0.9	32	15.8	5.3	80	17.4	1.8
2013	7	30.4	5.8	12	32.4	3.8	36	15.1	1.0	28	15.6	4.5	76	16.7	1.7
2014	12	37.5	10.0	17	32.7	5.5	40	19.0	1.1	30	14.4	4.6	87	18.4	1.9

[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 30. Serotype 7F invasive pneumococcal disease case numbers, proportions and rates per 100,000 population, by age group, 2004–2014

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	2	1.6	-	3	1.9	-	12	6.2	0.4	1	0.5	-	18	3.3	0.4
2005	2	1.8	-	3	2.0	-	4	2.3	-	2	1.2	-	11	2.2	0.3
2006	0	0.0	-	0	0.0	-	8	4.0	0.2	3	1.8	-	11	2.1	0.3
2007	1	0.9	-	1	0.6	-	4	1.9	-	4	2.2	-	9	1.6	0.2
2008	0	0.0	-	0	0.0	-	12	4.1	0.4	2	0.9	-	14	2.2	0.3
2009	1	1.8	-	1	1.1	-	13	3.8	0.4	4	1.7	-	18	2.7	0.4
2010	2	5.6	-	2	3.2	-	4	1.7	-	3	1.4	-	9	1.8	0.2
2011	2	7.1	-	4	8.9	-	11	4.2	0.3	1	0.4	-	16	3.0	0.4
2012	2	5.1	-	4	7.7	-	18	8.8	0.5	15	7.4	2.5	37	8.1	0.8
2013	1	4.3	-	1	2.7	-	48	20.2	1.4	20	11.2	3.1	69	15.2	1.5
2014	0	0.0	-	1	1.9	-	35	16.6	1.0	18	8.6	2.8	54	11.4	1.2

[a] Number of cases due to serotype 7F.

[b] Percentage of cases within the age group due to serotype 7F.

[c] Rate per 100,000 population for IPD due to serotype 7F. 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 31. Penicillin and cefotaxime MIC distribution among isolates from invasive pneumococcal disease cases, 2014

Antibiotic	Percent of isolates with an MIC (mg/L) of:[a]												
	0.004	0.008	0.016	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16
Penicillin	0.0	0.6	17.2	58.7	5.9	2.1	6.1	2.3	2.5	2.5	1.7	0.2	0.0
Cefotaxime	0.2	0.4	14.8	55.5	10.6	3.8	6.6	1.5	2.8	2.8	0.2	0.4	0.4

[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 [16].

Table 32. Trends in penicillin susceptibility, cefotaxime susceptibility and multidrug resistance among isolates from invasive pneumococcal disease cases, 2005–2014

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	
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
2013	454	83.9	16.1	98.5	1.3	0.2	83.9	10.1	6.0	91.9	4.4	3.7	96.3	3.3	0.4	4.0
2014	472	82.4	17.6	98.1	1.7	0.2	82.4	13.1	4.4	93.4	2.8	3.8	96.2	2.8	1.1	4.2

[a] CLSI penicillin meningitis interpretations: susceptible (S), MIC ≤0.06 mg/L; resistant (R), MIC ≥0.12 mg/L; no intermediate category [16].

[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 [16].

[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 [16].

[d] CLSI cefotaxime meningitis interpretations: susceptible (S), MIC ≤0.5 mg/L; intermediate (I), MIC 1 mg/L; resistant (R), MIC ≥2 mg/L [16].

[e] CLSI cefotaxime non-meningitis interpretations: susceptible (S), MIC ≤1 mg/L; intermediate (I), MIC 2 mg/L; resistant (R), MIC ≥4 mg/L [16].

[f] Multidrug resistant − resistant to penicillin (CLSI meningitis interpretation) and ≥3 additional antibiotics [16].

Table 33. Trends in resistance to non-β-lactam antibiotics among isolates from invasive pneumococcal disease cases, 2005–2014

Year	Number of isolates	Chloramphenicol		Clindamycin[a]			Co-trimoxazole			Erythromycin			Tetracycline		
		%S[b]	%R[b]	%S[b]	%I[b]	%R[b,c]	%S[b]	%I[b]	%R[b]	%S[b]	%I[b]	%R[b]	%S[b]	%I[b]	%R[b]
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
2013	454	99.1	0.9	96.3	0.0	3.7	75.6	2.9	21.6	94.3	0.0	5.7	92.5	0.0	7.5
2014	472	99.4	0.6	94.3	0.0	5.9	79.0	1.9	19.1	92.2	0.0	7.8	92.6	0.0	7.4

[a] Clindamycin susceptibility tested since 2007.

[b] S: susceptible; I: intermediate; R: resistant.

[c] Includes isolates with inducible clindamycin resistance.

Note: 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 34. Penicillin and cefotaxime resistance among isolates from invasive pneumococcal disease cases by region and District Health Board, 2014

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	24	25.0	4.2	0.0
Waitemata	44	29.6	2.3	6.8
Auckland	53	24.5	3.8	9.4
Counties Manukau	69	15.9	4.3	2.9
Northland region	**190**	**22.6**	**3.7**	**5.3**
Waikato	43	23.3	0.0	4.7
Lakes	26	15.4	3.9	0.0
Bay of Plenty	28	25.0	10.7	10.7
Tairawhiti	5	0.0	0.0	0.0
Taranaki	14	0.0	0.0	0.0
Midland region	**116**	**18.1**	**3.4**	**4.3**
Hawke's Bay	14	7.1	0.0	0.0
Whanganui	8	0.0	0.0	0.0
MidCentral	19	0.0	0.0	0.0
Hutt Valley	13	15.4	7.7	0.0
Capital & Coast	29	10.3	0.0	3.5
Wairarapa	6	33.3	0.0	0.0
Nelson Marlborough	5	0.0	0.0	0.0
Central region	**94**	**8.5**	**1.1**	**1.1**
West Coast	1	0.0	0.0	0.0
Canterbury	40	20.0	2.5	5.0
South Canterbury	4	0.0	0.0	0.0
Southern	27	11.1	0.0	0.0
Southern region	**72**	**15.3**	**1.4**	**2.8**
Total	**472**	**17.6**	**2.8**	**3.8**

[a] CLSI meningitis interpretations; no intermediate category for penicillin [16].

Table 35. Serotypes among penicillin-resistant, cefotaxime-resistant and multidrug-resistant isolates from invasive pneumococcal disease cases, 2014

Serotype	Penicillin		Cefotaxime				% MDR[b]	
	Resistant[a] MIC ≥0.12 mg/L		Intermediate[a] MIC 1 mg/L		Resistant[a] MIC ≥2 mg/L			
	Number	%[c]	Number	%[c]	Number	%[c]	Number	%[c]
4	0	-	0	-	0	-	0	-
6B	0	-	0	-	0	-	0	-
9V	5	6.0	3	23.1	1	5.6	0	-
14	2	2.4	0	-	1	5.6	0	-
18C	0	-	0	-	0	-	0	-
19F	7	8.4	2	15.4	5	27.8	7	35.0
23F	1	1.2	1	7.7	0	-	1	5.0
PCV7 serotypes	**15**	**18.1**	**6**	**46.2**	**7**	**38.9**	**8**	**40.0**
1	0	-	0	-	0	-	0	-
5[d]	0	-	0	-	0	-	0	-
7F	1	1.2	1	7.7	0	-	0	-
PCV10 serotypes	**16**	**19.3**	**7**	**53.8**	**7**	**38.9**	**8**	**40.0**
3	0	-	0	-	0	-	0	-
6A	1	1.2	0	-	0	-	1	5.0
19A	43	51.8	0	-	9	50.0	10	50.0
PCV13 serotypes	**60**	**72.3**	**7**	**53.8**	**16**	**88.9**	**19**	**95.0**
6C	4	4.8	1	7.7	0	-	0	-
15A	1	1.2	1	7.7	0	-	0	-
15 NT[e]	2	2.4	0	-	0	-	1	5.0
17F	1	1.2	0	-	0	-	0	-
23A	2	2.4	0	-	0	-	0	-
23B	4	4.8	0	-	0	-	0	-
35 NT[e]	8	9.6	4	30.8	2	11.1	0	-
Non-typable[e]	1	1.2	0	-	0	-	0	-
Non-PCV serotypes	**23**	**27.7**	**6**	**46.2**	**2**	**11.1**	**1**	**5.0**
Total	**83**		**13**		**18**		**20**	

[a] CLSI meningitis interpretations; no intermediate category for penicillin [16].

[b] Multidrug resistant − resistant to penicillin (CLSI meningitis interpretation) and ≥3 additional antibiotics [16].

[c] Percentage of the intermediate or resistant isolates.

[d] There were no serotype 5 isolates from cases of invasive disease in 2014.

[e] NT: not typable with the range of factorised antisera used at ESR.

Table 36. Trends in penicillin resistance, cefotaxime resistance and multidrug resistance among serotype 19A isolates from invasive pneumococcal disease cases, 2005–2014

Year	Number of serotype 19A isolates	Penicillin resistant[a] MIC ≥0.12 mg/L		Cefotaxime resistant[a] MIC ≥2 mg/L		% MDR[b]	
		No[c]	% (95% CI)[d]	No[c]	% (95% CI)[d]	No[c]	% (95% CI)[d]
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)
2013	76	36	47.4 (35.8-59.2)	7	9.2 (3.8-18.1)	11	14.5 (7.5-24.4)
2014	87	43	49.4 (38.5-60.4)	9	10.3 (4.8-18.7)	10	11.5 (5.7-20.1)

[a] CLSI meningitis interpretations [16].

[b] Multidrug resistant − resistant to penicillin (CLSI meningitis interpretation) and ≥3 additional antibiotics [16].

[c] Number of resistant isolates.

[d] 95% CI: 95% confidence interval.

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