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SURVEILLANCE REPORT

Invasive pneumococcal disease in New Zealand

2013

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

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SUMMARY

SUMMARY

Since 17 October 2008, invasive pneumococcal disease (IPD) has been a notifiable disease in New Zealand. 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 this report, the data presented for 2009–2013 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 479 cases of IPD notified in 2013, which equates to a rate of 10.7 cases per 100 000 population. A *S. pneumoniae* isolate from an invasive site was received at ESR for serotyping and antimicrobial susceptibility testing for 454 (95%) of the notified cases.

The rate of IPD in infants aged <2 years has decreased by 81% since the introduction of PCV7: from 104.8 per 100 000 in 2006 to 20.0 per 100 000 in 2013. The reduction in IPD caused by PCV7 serotypes in this age group is even more striking, with a 99% decrease from an average of 83.1 per 100 000 in 2006/2007 to 0.8 per 100 000 in 2013 (note: the 2013 rate was calculated based on one case only). The rate of IPD has also decreased significantly in the 2−4 years age group, with a 54% reduction from 18.3 per 100 000 in 2006 to 8.5 per 100 000 in 2013. Again, the decrease in the subset of IPD caused by PCV7 types in this age group was greater, with a 100% reduction to no cases due to PCV7 types in this age group in 2013.

Due to the indirect or herd immunity effects of routine infant PCV immunisation, there have also been significant 55% and 76% reductions in the rates of IPD due to PCV7 serotypes in the 5−64 years and ≥65 years age groups, respectively, between 2006/2007 and 2013. However, unlike the situation in the <5 year olds, there have been no corresponding significant decreases in the overall rate of IPD (ie, IPD due to any serotype) in either the 5−64 years or ≥65 years age groups since 2006. This is probably due to PCV7 serotypes initially constituting a smaller proportion of the disease in these age groups than those groups directly targeted for vaccination, serotype replacement, and some underestimation of IPD rates prior to 2009 when IPD was not a notifiable disease. 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).

Rates of IPD for the Pacific peoples and Māori ethnic groups were approximately 4-times and 3-times higher, respectively, than the rate for the European or Other ethnic group. Eleven (46%) of the 24 cases in the <2 year age group were of Māori ethnicity.

In 2013, the all-age rate of pneumococcal meningitis was 0.7 per 100 000. The highest rate of meningitis occurred among those <1 year of age (11.7 per 100 000).

The IPD case-fatality rate was 4.0%.

There were no apparent PCV failures in 2013. None of the cases who had received at least two doses of PCV, and for whom the serotype causing disease was known, were due to a serotype covered by the PCV the case had been vaccinated with.

The highest rate of IPD was in Lakes District Health Board (DHB) (25.2 per 100 000, 26 cases), followed by West Coast DHB (18.4 per 100 000, 6 cases). The highest numbers of cases occurred in Counties Manukau (60 cases) and Waitemata (50 cases) DHBs. Between 2009 and 2013, rates of IPD decreased or remained similar across most DHBs.

Since the introduction of PCV7, there have been significant increases in rates of IPD due to non-PCV7 serotypes, particularly 19A, 7F and 22F. In 2013, these three serotypes were the most prevalent types and collectively accounted for 41% of all culture-positive IPD cases. The increases in disease due to serotypes 19A, 7F and 22F have occurred almost wholly in the 5−64 years and ≥65 year age groups. The increases in IPD due to type 7F, a serotype covered by PCV10, have occurred in the last two years and since the immunisation schedule change from PCV7 to PCV10 in July 2011.

Based on the Clinical and Laboratory Standards Institute's meningitis breakpoints, 16% of isolates from IPD cases in 2013 were penicillin resistant and 4% 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 49% in 2013.

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, perhaps most importantly, 19A. Hopefully the direct and indirect effects of PCV13 on serotype 7F and 19A disease will be realised given these two types now constitute a large proportion of IPD in this country.

INTRODUCTION

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 simply 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 [3-6].

Prior to these annual reports, information from ESR's laboratory-based surveillance of IPD was published periodically [7-11]. 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 2013, as well as trend data for recent years.

METHODS

METHODS

Surveillance methods

In this report, data for 2009 to 2013 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 [12]:

- 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 25 July 2014. 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 [13]. 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).

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 [14]. 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 2013 CLSI standards [15].

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 2013 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 2013 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 2013 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 blood, positive pneumococcal antigen test on CSF, culture of *S. pneumoniae* from pleural fluid, culture of *S. pneumoniae* from joint fluid, and culture of *S. pneumoniae* from another normally sterile site.

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. A discontinuous line is used in graphs that present both notification and laboratory-based surveillance data (ie, 2006−2013) to represent the change in the source of IPD data. Compared with notifications, laboratory-based surveillance is likely to underestimate the burden of IPD.

Abbreviations

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

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

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

PPV23: 23-valent pneumococcal polysaccharide vaccine with serotypes 1, 2, 3, 4, 5, 6B, 7F, 8, 9N, 9V, 10A, 11A, 12F, 14, 15B, 17F, 18C, 19A, 19F, 20, 22F, 23F and 33F.

RESULTS

RESULTS

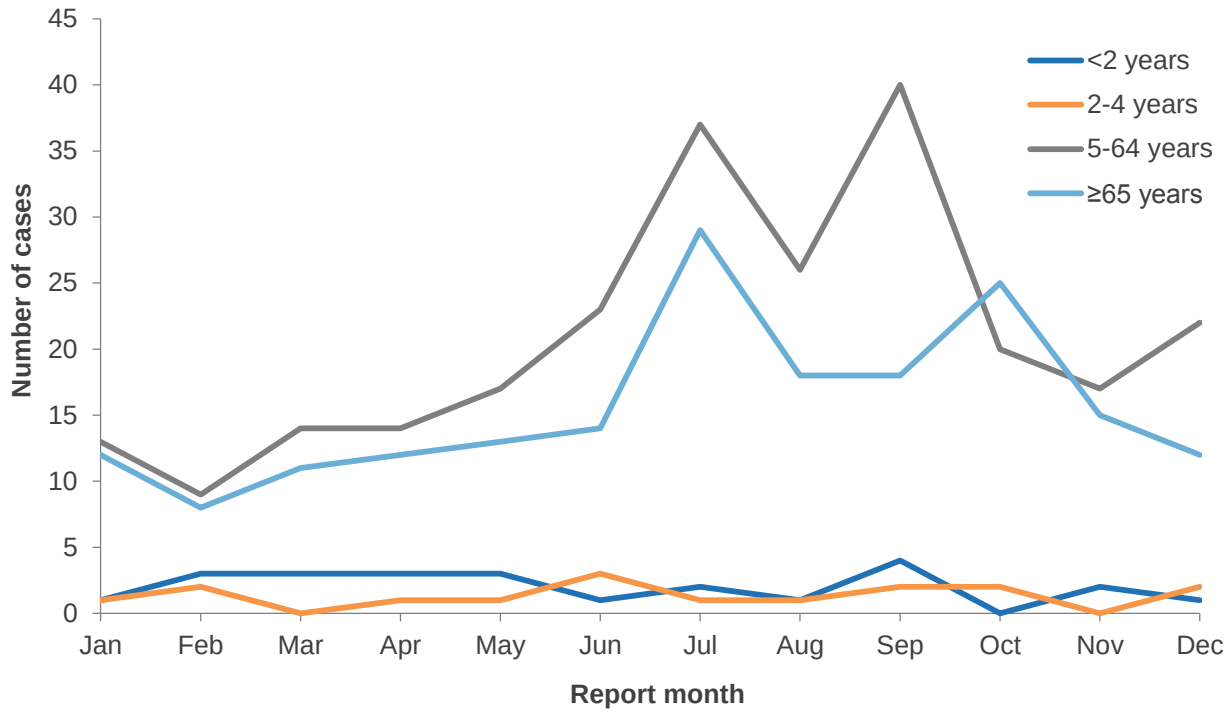
In 2013, 479 cases of IPD were notified. The 2013 notification rate for IPD was 10.7 cases per 100 000 population, similar to the 2012 rate (11.0 per 100 000, 489 cases) but significantly lower than the peak rate observed in 2009 (16.1 per 100 000, 697 cases).

A breakdown of the laboratory criteria upon which the IPD diagnosis was based is available in Table 11 (Appendix). In 2013, 87.5% 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 454 (94.8%) of the 479 cases notified in 2013.

Disease incidence by season

During 2013, there was the usual marked peak of cases in the winter months, particularly among cases aged ≥5 years (Figure 1). However, there were fewer cases notified during August (46 cases) compared with August 2012 (73 cases).

Figure 1. Number of invasive pneumococcal disease cases by age group and month, 2013



Disease incidence by age and sex

Age and sex were recorded for all IPD cases in 2013. The distribution of the 2013 cases by age group and sex is presented in Table 1. In most age groups, the rate of IPD was higher among males than females. The highest rates were in the elderly aged ≥75 years and in infants aged <1 year. Rates of IPD showed an increasing trend with age ≥55 years.

Table 1. Number of cases and rate per 100 000 population of invasive pneumococcal disease by age group and sex, 2013

Age group (years)	Female		Male		Total		
	Cases	Rate	Cases	Rate	Cases	Rate	%[a]
<1	7	23.9	11	36.0	18	30.1	3.8
1	3	10.2	3	9.7	6	9.9	1.3
2–4	7	7.7	9	9.3	16	8.5	3.3
5–14	13	4.6	13	4.4	26	4.5	5.4
15–24	4	1.3	19	5.7	23	3.6	4.8
25–34	7	2.4	11	3.7	18	3.0	3.8
35–44	15	4.9	21	7.5	36	6.2	7.5
45–54	31	9.7	31	10.3	62	10.0	12.9
55–64	41	15.8	46	18.5	87	17.1	18.2
65–74	38	20.5	43	24.6	81	22.5	16.9
75–84	40	37.4	28	31.4	68	34.7	14.2
≥85	23	46.0	15	52.3	38	48.3	7.9
Aggregated age groups (years)							
<2[b]	10	17.0	14	22.7	24	20.0	9.0
<5	17	11.4	23	14.6	40	13.0	11.9
5–64	111	6.2	141	8.1	252	7.1	45.1
≥65	101	29.5	86	29.4	187	29.4	43.0
Total	**229**	**10.1**	**250**	**11.4**	**479**	**10.7**	**100.0**

[a] Percentage of cases in each age group.

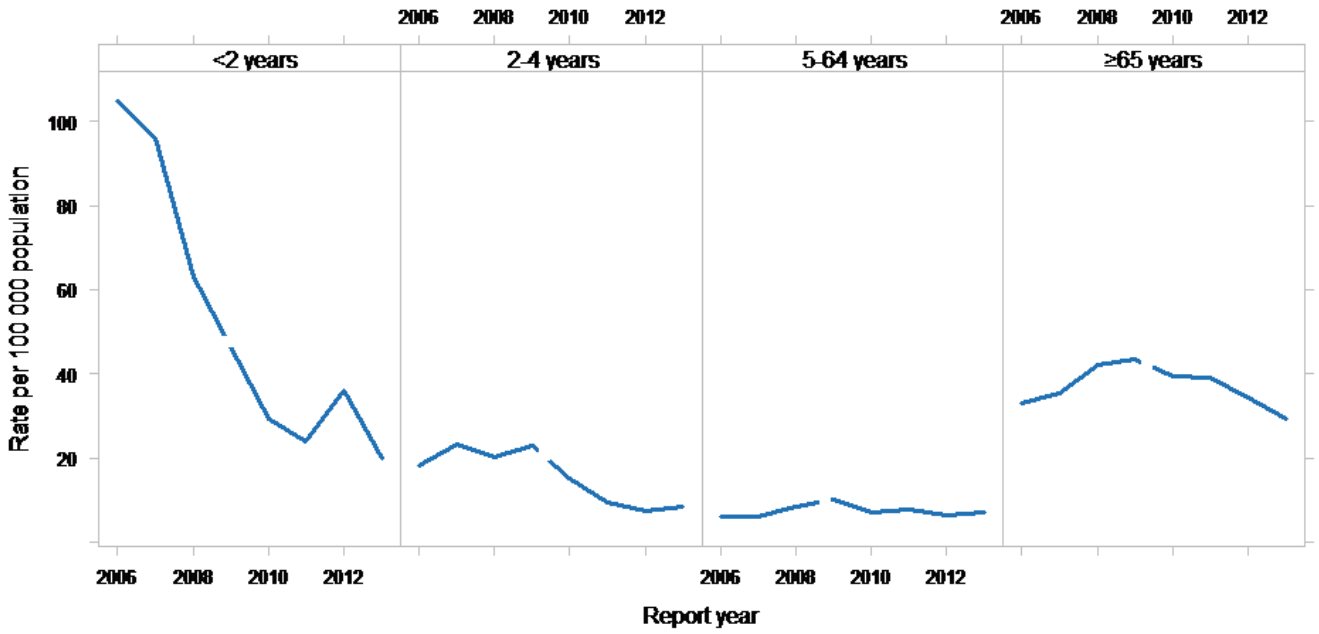
[b] The age in months of the cases <2 years of age is presented in Figure 10 (Appendix).

Between 2006 and 2013, there was a significant 80.9% decrease in the rate of IPD in the <2 years age group (104.8 to 20.0 per 100 000) and a significant 53.6% decrease in the 2–4 years age group (18.3 to 8.5 per 100 000) (Figure 2). The actual reductions in disease rates in these two age groups 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 2013 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 these age groups have decreased significantly over the period of notification-based surveillance of IPD (ie, since 2009).

A further breakdown of cases and rates by age group over the past eight years is available in Table 12 (Appendix).

Figure 2. Rate per 100 000 population of invasive pneumococcal disease by age group and year, 2006–2013



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 464 (96.9%) of the 479 IPD cases in 2013. The age-standardised rates of IPD were highest for the Pacific peoples (31.9 per 100 000, 53 cases) and Māori (27.6 per 100 000, 115 cases) ethnic groups. The rates for these two ethnic groups were, respectively, 3.9 and 3.4 times higher than the rate for the European or Other ethnic group (8.2 per 100 000, 277 cases) (Table 2).

Eleven (45.8%) of the 24 cases in the <2 years age group were of Māori ethnicity.

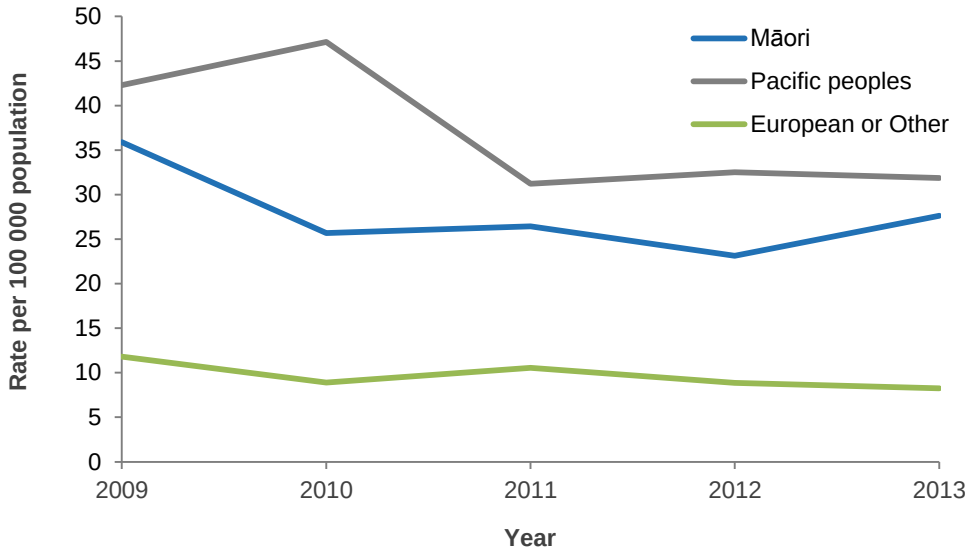
Between 2009 and 2013, the age-standardised IPD rates decreased for the Asian (-58.2%), European or Other (-30.1%), Pacific peoples (-24.6%) and Māori (-23.0%) ethnic groups (Figure 3). Over the same time period, among cases in the <5 years age group, there were significant decreases in the rates for the Māori (-64.6%) and the European or Other (-48.3) ethnic groups. Rates of IPD by ethnic group and age group for the years 2009 to 2013 are presented in Table 13 (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, 2013

Age group (years)	Māori		Pacific peoples		Asian		MELAA[a]		European or Other	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
<1	8	51.7	2	-	1	-	0	-	7	23.8
1	3	-	0	-	0	-	0	-	3	-
2–4	3	-	2	-	2	-	0	-	9	9.2
5–14	5	3.6	8	14.9	2	-	0	-	11	3.4
15–24	14	11.2	1	-	0	-	0	-	7	2.0
25–34	4	-	3	-	1	-	0	-	9	2.7
35–44	7	8.8	7	20.3	3	-	1	-	17	4.4
45–54	23	31.1	7	23.4	0	-	0	-	30	6.7
55–64	16	33.3	9	48.0	6	14.5	1	-	53	13.3
65–74	17	70.1	6	59.5	1	-	0	-	53	17.4
75–84	12	129.1	5	123.6	1	-	0	-	46	26.4
≥85	3	-	3	-	0	-	0	-	32	43.0
Aggregated age groups (years)										
<2	11	35.5	2	-	1	-	0	-	10	16.5
<5	14	17.7	4	-	3	-	0	-	19	12.0
5–64	69	12.5	35	15.1	12	2.7	2	-	127	5.6
≥65	32	90.9	14	93.4	2	-	0	-	131	23.6
Crude rate for all ages[b]	**115**	**17.2**	**53**	**19.2**	**17**	**3.3**	**2**	**-**	**277**	**9.3**
Age-standardised rate[c]		**27.6**		**31.9**		**4.2**		**-**		**8.2**

[a] Middle Eastern/Latin American/African.
[b] Ethnicity was recorded for 464 (96.9%) of cases notified in 2013.
[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 2013 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. Rate per 100 000 population of invasive pneumococcal disease by ethnic group, 2009–2013



Disease incidence by deprivation

In 2013, 450 (94.0%) of the 479 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 (18.8 per 100 000, 157 cases), almost four 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 2013, rates of IPD decreased for all NZDep13 quintiles (Table 14, Appendix). The decreases were statistically significant for quintile 1 (-55%), quintile 3 (-31%), quintile 4 (-37%) and quintile 5 (-49%).

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

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	1	4.5	4	25.0	14	5.9	23	13.1	42	9.3	4.8
2	2	9.1	0	0.0	38	16.0	30	17.1	70	15.6	8.2
3	4	18.2	3	18.8	45	19.0	31	17.7	83	18.4	9.9
4	4	18.2	5	31.3	53	22.4	36	20.6	98	21.8	11.8
5	11	50.0	4	25.0	87	36.7	55	31.4	157	34.9	18.8
Total[d]	**22**		**16**		**237**		**175**		**450**		

[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 2013 mid-year population estimates from Statistics New Zealand.

[d] Accurate New Zealand Deprivation Index (NZDep13) data was available for 450 (94.0%) cases notified in 2013.

Disease presentation, hospitalisations and fatalities

In 2013, 462 (96.5%) of the 479 IPD cases had at least one clinical presentation recorded (Table 4). Among infants aged <1 year, meningitis was the most common presentation (41.2%). Pneumonia was the most common presentation among cases aged ≥5 years (68.6%).

The rate of pneumococcal meningitis was 0.7 per 100 000 across all age groups, but 11.7 per 100 000 (7 cases) among infants aged <1 year (Table 15 in the Appendix).

The seven cases of pneumococcal meningitis aged <1 year were in the European or Other (3 cases), Māori (2 cases), Pacific peoples (1 case) and Asian (1 case) ethnic groups.

Table 4. Clinical presentation of invasive pneumococcal disease cases by age group, 2013

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	41.2	0	-	2	11.8	3	17.6	5	29.4	17
1	0	-	0	-	4	66.7	1	16.7	1	16.7	6
2–4	3	20.0	0	-	6	40.0	3	20.0	3	20.0	15
5–14	5	20.0	2	8.0	9	36.0	5	20.0	4	16.0	25
15–64	13	5.9	9	4.1	165	74.7	22	10.0	12	5.4	221
≥65	5	2.8	1	0.6	145	81.5	17	9.6	10	5.6	178
Aggregated age groups (years)											
<2	7	30.4	0	-	6	26.1	4	17.4	6	26.1	23
<5	10	26.3	0	-	12	31.6	7	18.4	9	23.7	38
≥5	23	5.4	12	2.8	319	75.2	44	10.4	26	6.1	424
Total[d]	**33**	**7.1**	**12**	**2.6**	**331**	**71.6**	**51**	**11.0**	**35**	**7.6**	**462**

[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 15 (Appendix). Any cases for which *S. pneumoniae* was cultured from, or identified in, CSF were considered to be cases of pneumococcal meningitis.

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

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

[d] At least one clinical presentation was recorded for 462 (96.5%) of cases notified in 2013.

Information on whether the patient survived or died was recorded for 445 (92.9%) of the IPD cases. IPD was recorded as the primary cause of death for 18 cases, giving a case-fatality rate of 4.0% among the cases for whom this information was reported. The case-fatality rates for each age group are presented in Table 16 (Appendix). The Asian ethnic group had the highest case-fatality rate (5.9%), followed by the European and Other (4.7%) and Pacific peoples (4.0%) ethnic groups. Māori had the lowest case-fatality rate (2.8%). There was one death due to IPD in the <5 years age group in 2013, compared to four deaths recorded in 2012, no deaths in 2011 and 2010, and one death in 2009.

Among the 466 (97.3%) IPD cases for whom hospitalisation status was recorded, 443 (95.1%) cases were hospitalised. The case-fatality rate among hospitalised cases was 4.1% (18/443). There were no deaths due to IPD among the 23 cases that were not hospitalised.

Immunisation status

Among the 42 cases who were age-eligible for PCV (ie, cases born after 1 January 2008), 33 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 30 of these 33 cases, and none of these 30 cases were due to a serotype covered by the PCV the case had been vaccinated with. Among the 30 cases, there were no cases due to a PCV7 serotype, two cases due to an additional serotype covered by PCV10, 11 cases due to additional serotypes covered by PCV13, and 17 cases due to non-PCV13 serotypes. The two cases due to an additional serotype covered by PCV10, which were both cases of serotype 1 disease, had been vaccinated wholly with PCV7. None of the 11 cases due to serotypes 3, 6A or 19A (additional PCV13 types) had received any doses of PCV13.

Among the 33 cases who had received at least two doses of vaccine, the most commonly identified serotype was 19A (10 cases). Seven of the 10 cases due to serotype 19A had received at least two doses of PCV10.

There were seven asplenic IPD cases reported in 2013 and three of these had not been immunised, including a male in the 30–39 years age group and two females in the 50–59 and 60–69 years age groups. One female in the 50–59 years age group had no vaccination status recorded.

Table 5. Immunisation status of the 2013 invasive pneumococcal disease cases who were born after 1 January 2008

Number of doses received[a]	Cases due to PCV7 serotypes: 4, 6B, 9V, 14, 18C, 19F or 23F[b]		Cases due to additional PCV10 serotypes: 1, 5 or 7F[b]		Cases due to additional PCV13 serotypes: 3, 6A or 19A[b]		Cases due to non-PCV13 serotypes[b]		Total[b,c]	
	No	%	No	%	No	%	No	%	No	%
0	1	100	1	33.3	1	6.3	1	5.3	4	9.5
1	0		0		4	25.0	1	5.3	5	11.9
2	0		0		1[e]	6.3	3	15.8	4	9.5
3	0		0		5[f]	31.3	4	21.1	10	23.8
4	0		2[d]	66.7	5[g]	31.3	10	52.6	19	45.2
Total	**1**		**3**		**16**		**19**		**42**	

[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) are presented.

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

[d] Cases due to serotype 1.

[e] Case due to serotype 19A.

[f] Cases due to serotype 19A.

[g] Cases due to serotypes 19A (4) and 3 (1).

Risk factors

The risk factors reported among IPD cases in 2013 are presented in Table 6. The most common risk factor among all cases was chronic illness (48.0%). Risk factors for cases in the <2 years, <5 years and ≥5 years age groups are presented in Table 17, Table 18 and Table 19 (Appendix), respectively. Smoking in the household was the most common risk factor recorded for the <2 years age group while chronic illness was most commonly recorded for the ≥5 years age group.

Table 6. Exposure to risk factors associated with invasive pneumococcal disease for cases, 2013

Risk factor	Cases[a]	Total reported[b]	%[c]
Chronic illness[d]	208	433	48.0
Premature (<37 weeks gestation)[e]	6	15	40.0
Smoking in the household[f]	6	17	35.3
Current smoker[g]	92	346	26.6
Attends childcare[f]	4	17	23.5
Immunocompromised[h]	71	425	16.7
Chronic lung disease or cystic fibrosis	71	442	16.1
Resident in long-term or other chronic-care facility[i]	28	434	6.5
Anatomical or functional asplenia	7	429	1.6
Congenital or chromosomal abnormality	5	415	1.2
Cochlear implants	5	414	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 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 <1 year only.

[f] Cases aged <5 years 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, 19.6% (18 cases out of 92 for whom the information was supplied) were residents in a long-term or other chronic-care facility.

Disease incidence by District Health Board

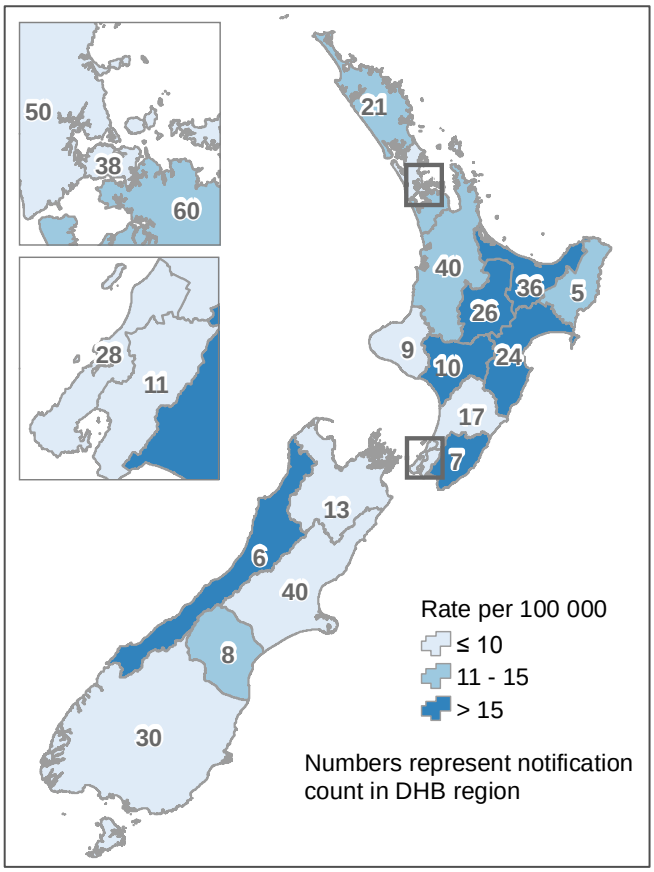
The highest rate of IPD was in Lakes District Health Board (DHB) (25.2 per 100 000, 26 cases), followed by West Coast DHB (18.4 per 100 000, 6 cases). Across the regions, rates ranged from 9.3 in the Southern region to 13.7 per 100 000 in the Midland region (Figure 4). Table 7 shows the number of cases by age group and rates for each DHB and region in 2013.

Between 2009 and 2013, rates of IPD remained similar for most DHBs (Table 20 in the Appendix), however, there was a significant decrease for Counties Manukau (18.7 to 11.6 per 100 000), Waikato (22.8 to 10.7 per 100 000), Taranaki (18.5 to 8.1 per 100 000) and Hutt Valley (21.0 to 7.6 per 100 000) DHBs.

Table 7. Number of cases of invasive pneumococcal disease by age group and rate per 100 000 population for each District Health Board, 2013

District Health Board	Cases by age group (years)					Rate (all ages)
	<2	<5	5–64	≥65	All ages	
Northland	2	5	9	7	21	13.2
Waitemata	4	6	22	22	50	8.9
Auckland	2	3	26	9	38	8.1
Counties Manukau	1	6	33	21	60	11.6
Northern region	**9**	**20**	**90**	**59**	**169**	**9.9**
Waikato	1	3	21	16	40	10.7
Lakes	2	2	12	12	26	25.2
Bay of Plenty	4	5	20	11	36	16.9
Tairawhiti	0	0	0	5	5	10.7
Taranaki	0	0	6	3	9	8.1
Midland region	**7**	**10**	**59**	**47**	**116**	**13.7**
Hawke's Bay	0	0	12	12	24	15.4
Whanganui	1	1	5	4	10	16.0
MidCentral	0	0	8	9	17	10.0
Hutt Valley	0	0	6	5	11	7.6
Capital & Coast	1	1	18	9	28	9.3
Wairarapa	0	0	6	1	7	17.2
Nelson Marlborough	1	2	7	4	13	9.2
Central region	**3**	**4**	**62**	**44**	**110**	**10.9**
West Coast	0	0	6	0	6	18.4
Canterbury	3	3	17	20	40	7.9
South Canterbury	0	0	3	5	8	14.0
Southern	2	3	15	12	30	9.7
Southern region	**5**	**6**	**41**	**37**	**84**	**9.3**
Total	**24**	**40**	**252**	**187**	**479**	**10.7**

Figure 4. Geographic distribution of invasive pneumococcal disease cases, 2013



Serotype distribution

In 2013 in the <2 years age group, only one case (4.3%) of IPD was due to a PCV7 serotype and one case was due to serotype 7F, one of the three additional types covered by PCV10 (Table 8). These two cases were both <6 weeks old, and were of Māori (1 case) and Asian (1 case) ethnicity. The only case in the <5 years age group that died had serotype 3 disease and was also <6 weeks old.

The proportion of IPD due to PCV7 types was higher in the older age groups: 23.9% in the 5−64 years and 19.0% in the ≥65 years age groups (Table 8). Among the ≥65 years age group, 75.4% of cases were due to PPV23 serotypes.

Table 8 shows by age group the number and proportion of the 454 isolates from culture-positive IPD cases referred to ESR in 2013 caused by each of the serotypes included in PCV7, PCV10 and PCV13, and any other serotypes that accounted for more than five cases. Table 21 (Appendix) presents the rates per 100 000 of IPD caused by these same serotypes. A full list of the serotypes of all isolates from culture-positive IPD cases in 2013 is available in Table 22 (Appendix).

Table 8. Number and percentage of invasive pneumococcal disease cases by serotype, serotypes covered by PCV7, PCV10 and PCV13, and age group, 2013

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	-	0	-	0	-	23	9.7	9	5.0	32	7.0
6B	0	-	0	-	0	-	3	1.3	4	2.2	7	1.5
9V	0	-	0	-	0	-	8	3.4	3	1.7	11	2.4
14	0	-	0	-	0	-	3	1.3	4	2.2	7	1.5
18C	0	-	0	-	0	-	10	4.2	6	3.4	16	3.5
19F	1	4.3	0	-	1	2.7	7	2.9	5	2.8	13	2.9
23F	0	-	0	-	0	-	3	1.3	3	1.7	6	1.3
PCV7	**1**	**4.3**	**0**	**-**	**1**	**2.7**	**57**	**23.9**	**34**	**19.0**	**92**	**20.3**
1	0	-	2	14.3	2	5.4	1	0.4	0	-	3	0.7
5	0	-	0	-	0	-	0	-	0	-	0	-
7F	1	4.3	0	-	1	2.7	48	20.2	20	11.2	69	15.2
PCV10	**2**	**8.7**	**2**	**14.3**	**4**	**10.8**	**106**	**44.5**	**54**	**30.2**	**164**	**36.1**
3	3	13.0	0	-	3	8.1	9	3.8	11	6.1	23	5.1
6A	1	4.3	0	-	1	2.7	2	0.8	0	-	3	0.4
19A	7	30.4	5	35.7	12	32.4	36	15.1	28	15.6	76	16.7
PCV13	**13**	**56.5**	**7**	**50.0**	**20**	**54.1**	**153**	**64.3**	**93**	**52.0**	**266**	**58.6**
6C	0	-	0	-	0	-	9	3.8	12	6.7	21	4.6
7A	0	-	1	7.1	1	2.7	5	2.1	0	-	6	1.3
8	2	8.7	0	-	2	5.4	10	4.2	5	2.8	17	3.7
9N	0	-	0	-	0	-	2	0.8	10	5.6	12	2.6
10A	1	4.3	0	-	1	2.7	3	1.3	2	1.1	6	1.3
11A	2	8.7	1	7.1	3	8.1	7	2.9	1	0.6	11	2.4
15B	0	-	1	7.1	1	2.7	2	0.8	5	2.8	8	1.8
15 NT[d]	0	-	0	-	0	-	2	0.8	4	2.2	6	1.3
16 NT[d]	0	-	0	-	0	-	3	1.3	4	2.2	7	1.5
17F	0	-	1	7.1	1	2.7	2	0.8	3	1.7	6	1.3
22F	1	4.3	0	-	1	2.7	24	10.0	16	8.9	41	9.0
23A	0	-	0	-	0	-	0	-	6	3.4	6	1.3
23B	1	4.3	1	7.1	2	5.4	1	0.4	3	1.7	6	1.3
33F	1	4.3	0	-	1	2.7	5	2.1	5	2.8	11	2.4
35 NT[d]	0	-	1	7.1	1	2.7	2	0.8	4	2.2	7	1.5
Other	2	8.7	1	7.1	3	8.1	8	3.4	6	3.4	17	3.7
Non-PCV[e]	**10**	**43.5**	**7**	**50.0**	**17**	**45.9**	**85**	**35.7**	**86**	**48.0**	**188**	**41.4**
Total[f]	**23**		**14**		**37**		**238**		**179**		**454**	

[a] Aggregated age group.

[b] Among the cases in the ≥65 year age group, 75.4% 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.

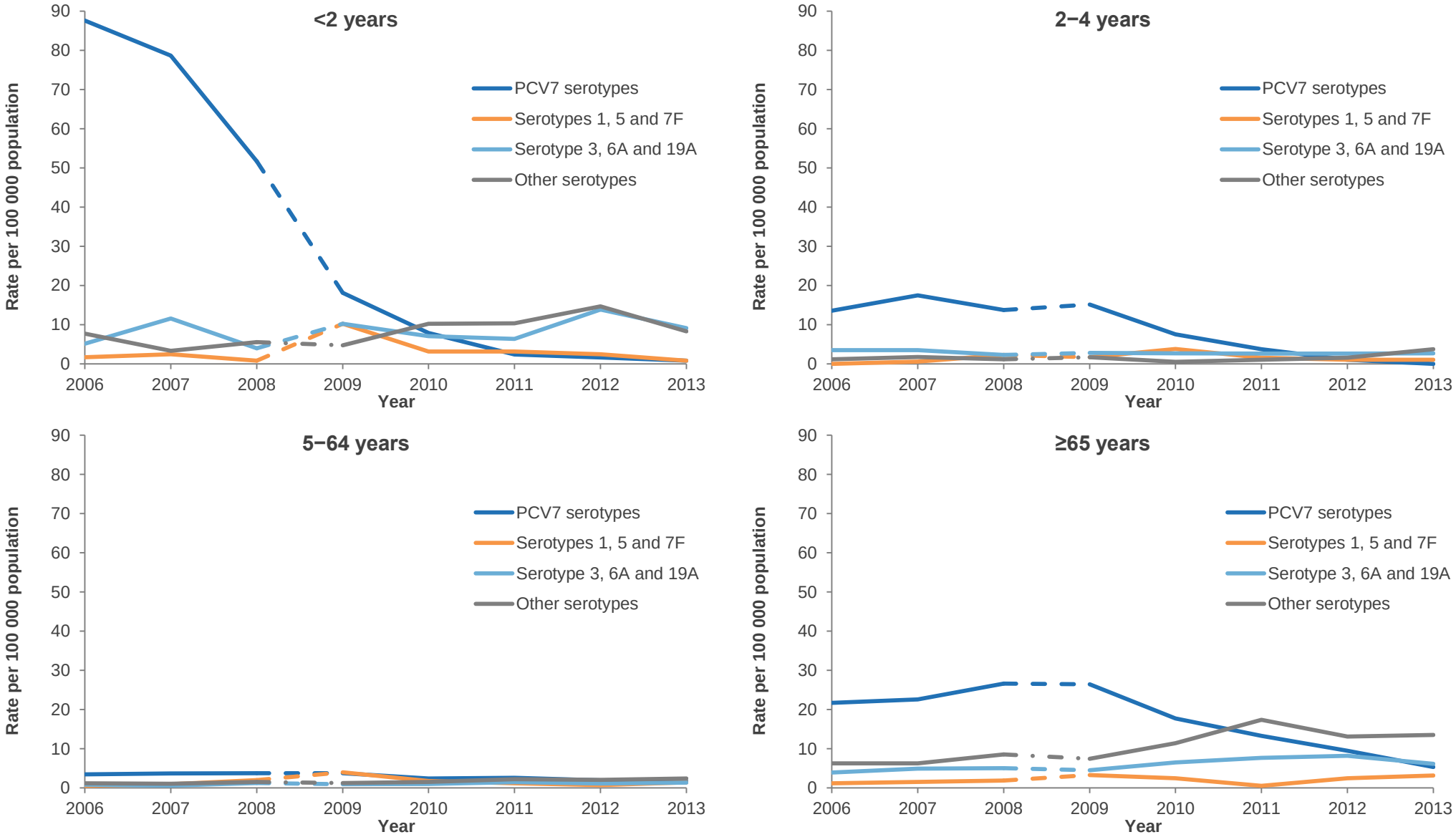
[d] NT: not typable with the range of factorised antisera used at ESR.

[e] The specific serotypes listed are those that accounted for more than five cases of IPD in 2013.

[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 PCV to the national immunisation schedule, there have been significant decreases in IPD rates due to PCV7 serotypes in all age groups. The largest decreases have been in the <2 years and 2−4 years age groups, with 99.0% and 100% reductions in the rates between 2006/2007 and 2013, respectively, in these two age groups. The reductions over the same time period in the older age groups have also been significant, at 54.6% in the 5−64 years age group and 75.8% in the ≥65 years group. Data is presented for each of the age groups in Table 23, Table 24, Table 25 and Table 26 (Appendix) and for all cases in Table 27 (Appendix).

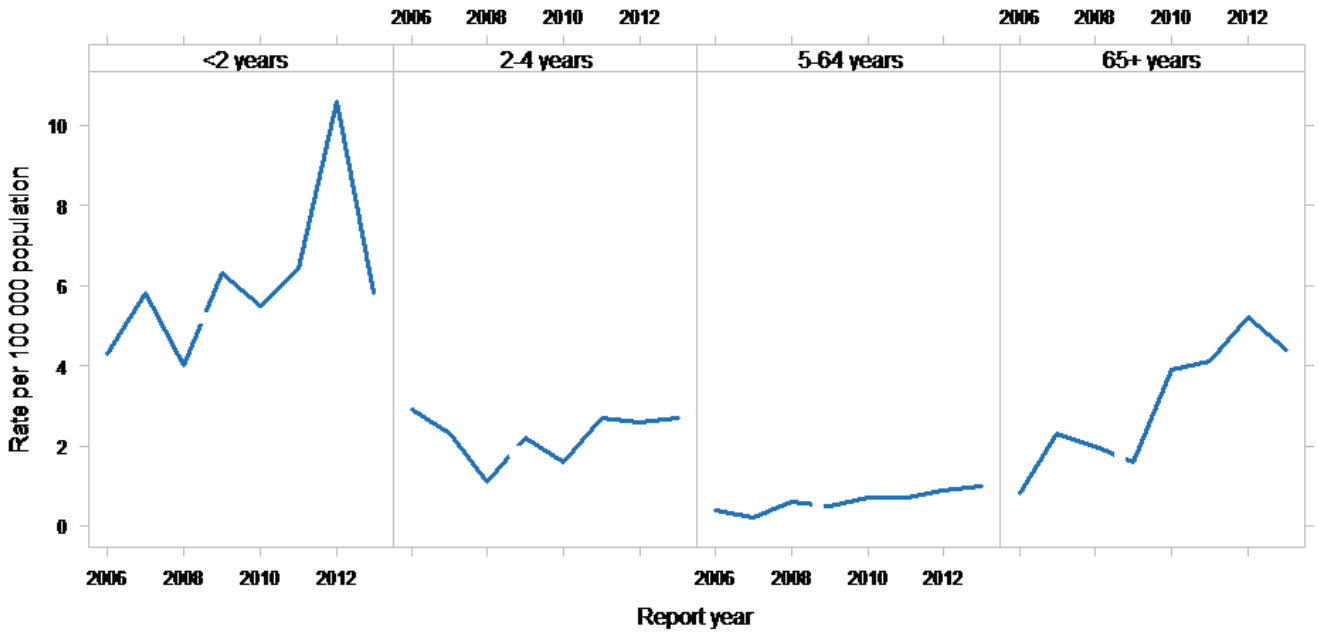
Figure 5. Rate per 100 000 population of invasive pneumococcal disease due to PCV7 serotypes, additional PCV10 types, additional PCV13 types and non-PCV13 types, by age group and year, 2006–2013



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 2013, the non-PCV7 serotype 19A was the most prevalent serotype overall (76 cases) and also in the <5 years and ≥65 years age groups (Table 8). Since 2006/2007, there have been significant increases in the rate of 19A disease in the 5−64 years (0.3 to 1.0 per 100 000) and ≥65 years (1.5 to 4.4 per 100 000) age groups (Figure 6 and Table 28 in the Appendix). Between 2011 and 2012, a significant increase in serotype 19A IPD was also observed in the <2 years age group (from 6.4 to 10.6 per 100 000), but this rate decreased in 2013 to 5.8 per 100 000.

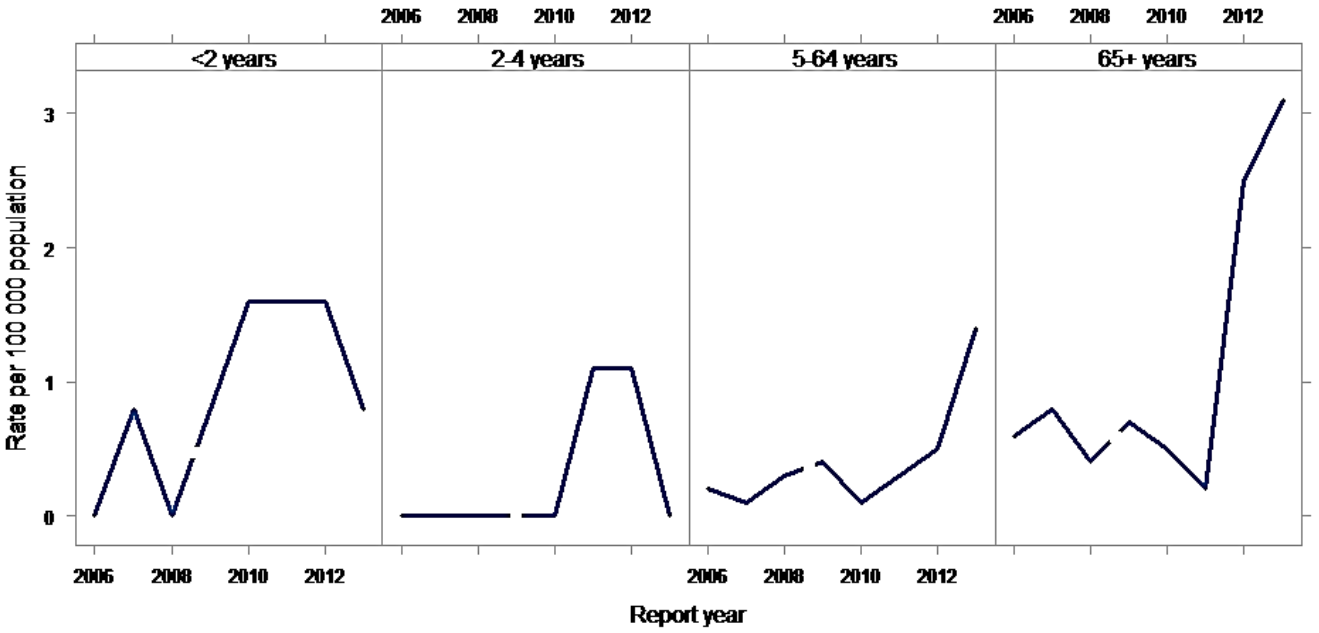
Figure 6. Rate per 100 000 population of invasive pneumococcal disease due to serotype 19A by age group and year, 2006–2013



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

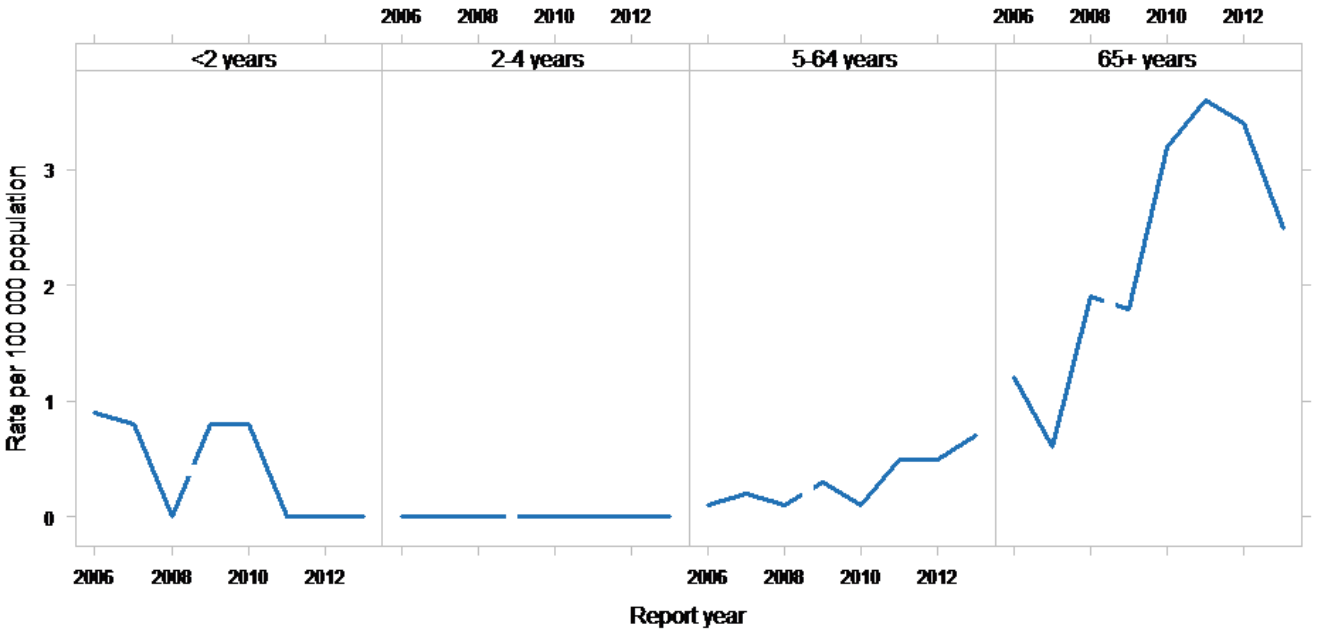
The other common non-PCV7 serotypes in 2013 were 7F (69 cases) and 22F (41 cases) (Table 8). These two serotypes are most commonly isolated from IPD cases ≥5 years of age. Of particular note, rates of IPD due to the PCV10 serotype 7F have increased in the last two years in the ≥65 years age group and in the last year in the 5−64 years age group (Figure 7 and Table 29 in the Appendix). Increases in rates of IPD due to serotype 22F have been apparent since 2010 in the ≥65 years age group (Figure 8 and Table 26) and since 2011 in the 5–64 years age group (Figure 8 and Table 25).

Figure 7. Rate per 100 000 population of invasive pneumococcal disease due to serotype 7F by age group and year, 2006–2013



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 22F by age group and year, 2006–2013



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 9 shows the antimicrobial susceptibility of the isolates from the 454 culture-positive IPD cases referred to ESR in 2013. The penicillin and cefotaxime MIC distributions are shown in Table 30 in the Appendix.

Based on the CLSI meningitis interpretations, 16.1% of isolates were resistant to penicillin and 3.7% were cefotaxime resistant. Nearly five percent (4.6%) 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), 24.7% (18/73) were multiresistant to at least three additional antibiotics, commonly co-trimoxazole, erythromycin and tetracycline with or without cefotaxime resistance.

Trends in penicillin resistance, cefotaxime resistance and multidrug resistance over the last 10 years (2004−2013) are shown in Table 31 (Appendix). The rate of penicillin resistance, based on the meningitis interpretive standards, has varied year-to-year over these 10 years from a high of 22.3% in 2007 to a low of 14.1% in 2011, with the rate of 16.1% in 2013 being at the lower end of the range. Similarly, the rate (3.7%) of cefotaxime resistance in 2013, based on the meningitis interpretive standards, was within the range of rates (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 shown in Table 32 (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 9. Antimicrobial susceptibility among isolates from invasive pneumococcal disease cases, 2013

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	83.9	-	16.1
non-meningitis	≤2	4	≥8	98.5	1.3	0.2
oral treatment	≤0.06	0.12-1	≥2	83.9	10.1	6.0
Cefotaxime						
meningitis	≤0.5	1	≥2	91.9	4.4	3.7
non-meningitis	≤1	2	≥4	96.3	3.3	0.4
	Zone diameter (mm)					
Chloramphenicol	≥21	-	≤20	99.1	-	0.9
Clindamycin[c]	≥19	16-18	≤15	96.3	0.0	3.5
Co-trimoxazole	≥19	16-18	≤15	75.6	2.9	21.6
Erythromycin	≥21	16-20	≤15	94.3	0.0	5.7
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	92.5	0.0	7.5
Vancomycin	≥17	-	-	100.0	-	-

[a] Clinical and Laboratory Standards Institute [15].

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

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

Penicillin and cefotaxime resistance in each region and DHB is shown in Table 33 (Appendix). Both penicillin and cefotaxime resistance (meningitis interpretations) were significantly higher in the Northern region than the other three regions: 22.6% penicillin resistance in the Northern region versus 10.8−13.6% in other regions, and 7.1% cefotaxime resistance in the Northern region versus 0.0−3.6% in the other regions.

Penicillin and cefotaxime resistance among isolates from cases in the different age groups is shown in Table 10. Penicillin and cefotaxime resistance was significantly more common among cases in the 2−4 years age group, however, there were only a small number of cases in this age group.

Table 10. Penicillin and cefotaxime resistance among isolates from invasive pneumococcal disease cases, 2013

Age group (years)	Penicillin		Cefotaxime			
	Resistant[a] MIC ≥0.12 mg/L		Intermediate[a] MIC 1 mg/L		Resistant[a] MIC ≥2 mg/L	
	No[b]	%[c]	No[b]	%[c]	No[b]	%[c]
<2 (n=23)	4	17.4	0	-	1	4.3
2−4 (n=14)	6	42.9	0	-	3	21.4
5−64 (n=238)	35	14.7	10	4.2	7	2.9
≥65 (n=179)	28	15.6	10	5.6	6	3.4
All ages (n=454)	**73**	**16.1**	**20**	**4.4**	**17**	**3.7**

[a] CLSI meningitis interpretations; no intermediate category for penicillin [15].

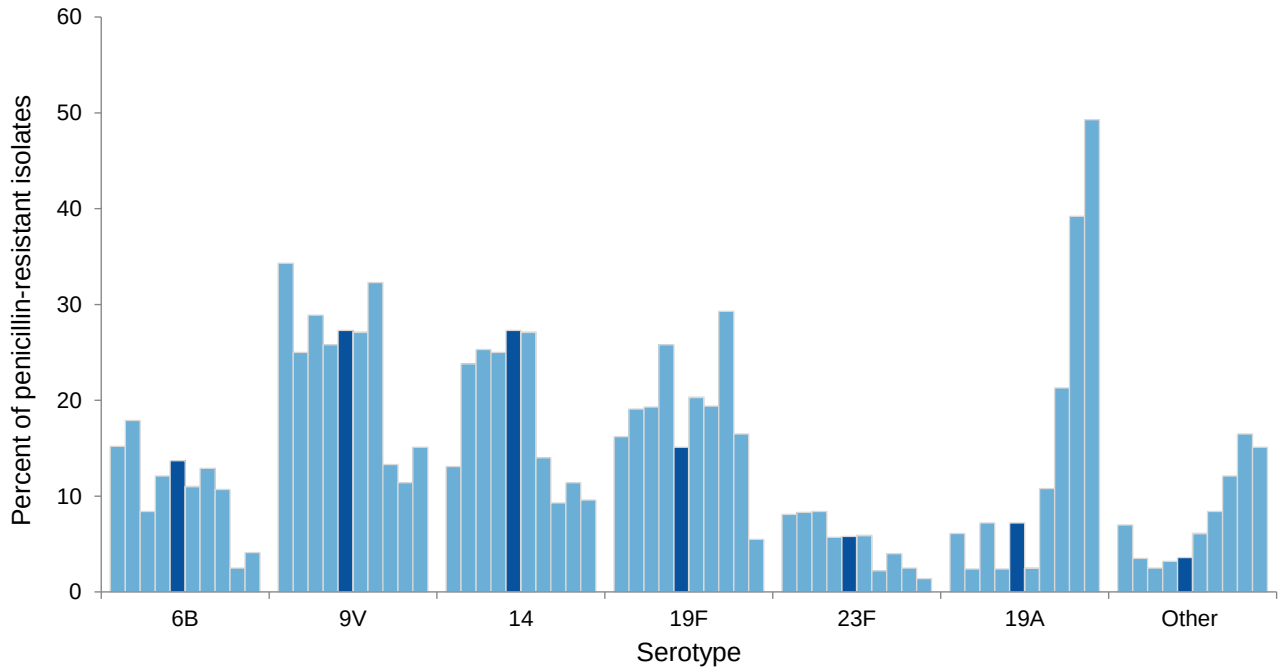
[b] Number of isolates.

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

In 2013, 35.6% of penicillin-resistant isolates and 52.9% of cefotaxime-resistant isolates were serotypes included in PCV10 (Table 34 in the Appendix). The serotypes most commonly associated with penicillin-resistant invasive pneumococci over the last 10 years are shown in Figure 9. Until 2010, serotypes 9V, 14 and 19F were the most prevalent serotypes among penicillin-resistant isolates. However each year since 2010, serotype 19A has constituted an increasing proportion of the penicillin-resistant isolates. In the last two years, type 19A was the most prevalent penicillin-resistant serotype and, in 2013, accounted for nearly half (49.3%) of the penicillin-resistant isolates. In 2013, serotype 19A was also the most prevalent type among cefotaxime-resistant and multidrug-resistant isolates, accounting for 41.2% and 61.1% of these isolates, respectively (Table 34 in the Appendix). This is a change from historic patterns where serotype 19F has been the type most commonly associated with cefotaxime resistance and multidrug resistance. However, type 19F was the second most common type associated with cefotaxime and multidrug resistance in 2013. Both types 19A and 19F multiresistant isolates were commonly resistant to cefotaxime, co-trimoxazole, erythromycin and tetracycline.

In 2010 and 2011, when serotype 19A isolates first started to represent an increasing proportion of penicillin-resistant isolates from IPD cases, this increase was mainly due to type 19A being responsible for an increasing proportion of IPD cases, rather than resistance becoming more prevalent among the type. However, since 2012 there have also been increases in the rates of penicillin resistance, cefotaxime resistance and multiresistance among 19A isolates (Table 35 in the Appendix).

Figure 9. Serotype distribution among penicillin-resistant pneumococci from invasive disease cases, 2004–2013



Note: The series of bars for each serotype represent the individual years 2004 to 2012 from left to right, with the darker coloured bar indicating 2008, the year PCV was added to the childhood immunisation schedule. Penicillin resistance is according to the CLSI meningitis interpretation [15].

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 although, in effect, the use of PCV10 did not begin until late 2011 as supplies of PCV7 were depleted.

2013 marks the fifth full year since the addition of PCV to the immunisation schedule and the impact of routine infant immunisation is evident across all age groups, but particularly among children age-eligible for vaccination. Since 2006, the rate of IPD has decreased 76% in the <5 years age group. Of particular note, IPD due to serotypes covered by PCV10 has been almost eliminated in this age group, with just four cases due to a PCV10 type in 2013.

This striking reduction in the incidence of IPD in the <5 years age group mirrors the international experience following the introduction of infant PCV immunisation. International experience has also shown that, within a year or two of the introduction of infant PCV immunisation, the incidence of pneumococcal disease in non-vaccinated children and adults also begins to fall due to indirect or herd immunity [16, 17]. In New Zealand such an indirect effect, as measured by significant decreases in the rate of IPD due to PCV7 serotypes, was first evident in the ≥65 years age group in 2010 and a year later was also observed in the 5−64 years age group [4, 5]. By 2013, the rate of IPD due to PCV7 types in these two older age groups had decreased 76% and 55%, respectively, since 2006/2007.

However, unlike the situation in the <5 year olds, there have been no corresponding significant decreases in the overall rate of IPD (ie, IPD due to any serotype) in either the 5−64 years or ≥65 years age groups since 2006. There are likely to be several reasons for this apparent lack of a significant reduction in IPD in these older age groups. The reasons include (1) the fact that PCV7 serotypes initially (ie, in the pre-vaccine era) accounted for a smaller proportion of IPD in the 5−64 years and ≥65 years age groups [11]; (2) an increase in the incidence of IPD caused by non-vaccine types (ie, serotype replacement– see further discussion below); and (3) the likely underestimation of IPD rates prior to 2009 when IPD was not a notifiable disease. It is notable that the incidence of IPD in these older age groups has decreased significantly over the period of notification-based surveillance of IPD (ie, since 2009).

The incidence of IPD has decreased in all ethnic groups since 2009, however, 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. Nearly half (11/24) the cases in infants <2 years old in 2013 were of Māori ethnicity, but only two cases belonged to the Pacific peoples ethnic group. The unequal burden of IPD in Māori and Pacific peoples is consistent with ethnic group disparities identified generally for infectious diseases in New Zealand [18]. 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 [19, 20].

As with all vaccines that target only specific types, there is concern that pneumococcal serotypes not covered by the scheduled PCV will increase and essentially ‘replace’ vaccine types as the principal cause of IPD. This has happened to some extent in several countries, although increases in disease due to non-vaccine types have usually been somewhat smaller than the reductions in disease due to vaccine types [16, 17, 21]. Serotype 19A is the type most frequently reported to have increased after the introduction of PCV7 [16, 21], but increases in other non-PCV7 serotypes, for example 7F and 22F in England and Wales, have also been reported [17]. Increases in type 19A disease have been of particular concern as this serotype is often associated with antibiotic resistance [22, 23].

In New Zealand since the introduction of PCV7 in 2008 there have been significant increases in rates of IPD due to three non-PCV7 serotypes: 19A, 7F and 22F. In 2013, these were the most prevalent serotypes and collectively accounted for 41% of all culture-positive IPD cases. Notably the increases in disease due to serotypes 19A, 7F and 22F have occurred almost wholly in the 5−64 years and ≥65 year age groups. The one exception to the association of these three serotypes with the older age groups was an increase in the rate of 19A disease in the <2 years age group in 2012. However, in 2013 the rate of 19A disease in the <2 years age group returned to a rate very similar to the rates observed prior to 2012.

While increases in 19A disease have been apparent since 2010, the increase in 7F disease was first noted in 2012, with rates essentially doubling in 2012 and again in 2013. These recent increases in IPD due to type 7F are particularly noteworthy given they have occurred after the immunisation schedule change from PCV7 to PCV10 in July 2011, and serotype 7F is one of the three additional types covered by PCV10. However, as noted above, 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.

In the pre-PCV era, most antimicrobial-resistant invasive pneumococci belonged to one of the serotypes included in PCV7. For example, during the 1998-2005 period in New Zealand, 99.2% of penicillin-resistant invasive pneumococci were PCV7 serotypes [11]. Therefore it could be expected that a decrease in IPD caused by PCV7 types following the introduction of the vaccine would have the concomitant effect of reducing the incidence of IPD caused by resistant pneumococci. Such an effect on resistance had been observed in other countries, but has been offset to some extent by high or increasing levels of resistance among some serotypes, especially 19A, that have replaced vaccine types [23, 24].

There is little change in the prevalence of resistance among isolates from IPD cases in New Zealand. While PCV7 serotypes are now accounting for a smaller proportion of the penicillin-resistant isolates than in previous years, conversely serotype 19A is accounting for a much greater proportion: 49.3% in 2013 versus 3% in 2009 [3, 4]. When serotype 19A isolates were first noted to represent an increasing proportion of penicillin-resistant isolates from IPD cases, this increase was mainly due to type 19A being responsible for an increasing proportion of IPD cases, rather than resistance becoming more prevalent among the type. However, since 2012 there have also been increases in the rates of penicillin resistance, cefotaxime resistance and multiresistance among 19A isolates.

There were no apparent PCV failures in 2013. None of the cases who had received at least two doses of PCV, and for whom the serotype causing disease was known, were due to a serotype covered by the PCV the case had been vaccinated with. 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, perhaps most importantly, 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 [25-29]. It is to be hoped that the direct and indirect effects of PCV13 on serotype 7F and 19A disease will be realised in New Zealand, given these two types now constitute a large proportion of IPD in this country.

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APPENDIX

APPENDIX

Table 11. Laboratory criteria upon which invasive pneumococcal disease diagnosis based, as recorded in the case notification, 2013

Basis of diagnosis	Prioritised[a]		Total response	
	Cases	%	Cases	%
Culture of *S. pneumoniae* from:	**479**	**100.0**	**479**	**100.0**
Blood	419	87.5	427	89.1
CSF	24	5.0	24	5.0
Pleural fluid	9	1.9	9	1.9
Joint fluid	8	1.7	9	1.9
Other	19	4.0	26	5.4
Positive pneumococcal antigen test on CSF	**0**	**-**	**4**	**0.8**
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 blood, positive pneumococcal antigen test on CSF, culture of *S. pneumoniae* from pleural fluid, culture of *S. pneumoniae* from joint fluid, and culture of *S. pneumoniae* from another normally sterile site. No cases were laboratory confirmed by the detection of *S. pneumoniae* DNA in CSF, pleural fluid, joint fluid or other sites.

Figure 10. Number of invasive pneumococcal disease cases in the less than 2 years age group by age (in months), 2013

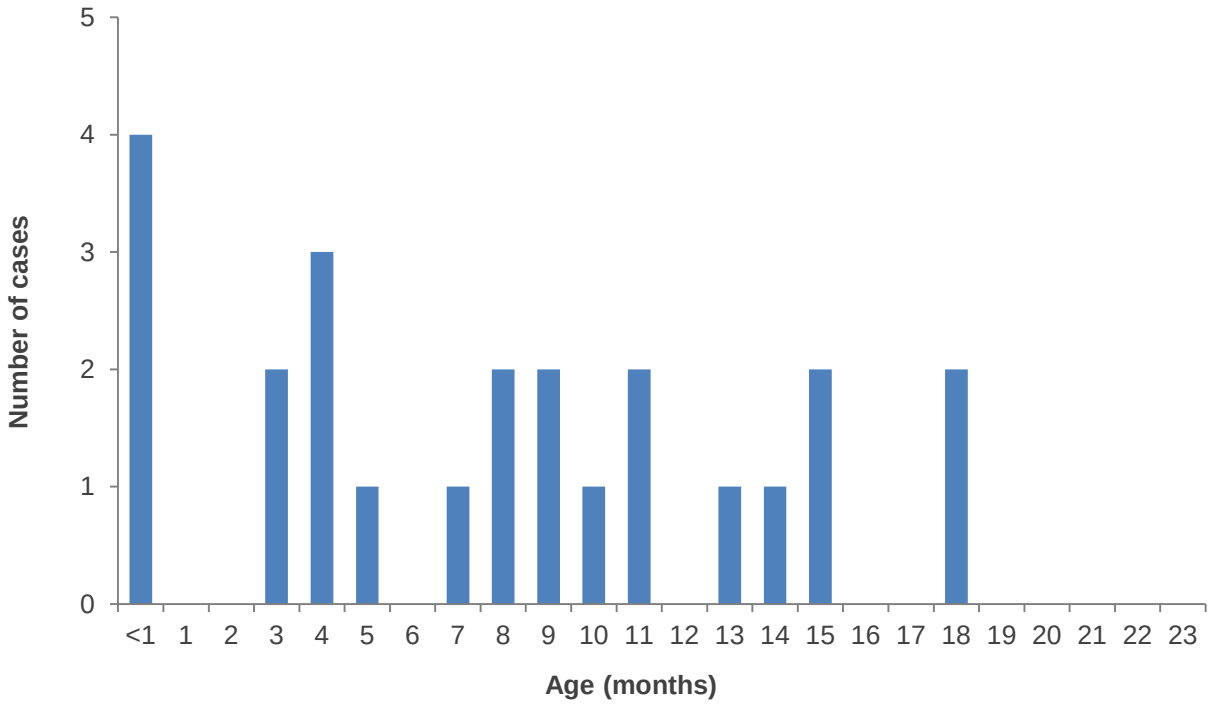

Table 12. Number of cases and rate per 100 000 population of invasive pneumococcal disease by age group and year, 2006–2013

Age group (years)	2006		2007		2008		2009		2010		2011		2012		2013	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
<1	71	120.2	48	77.7	37	57.7	34	53.9	22	34.5	23	36.9	31	51.2	18	30.1
1	51	88.9	68	115.3	42	68.2	25	39.1	15	23.8	7	11.0	13	21.0	6	9.9
2–4	31	18.3	40	23.3	35	20.1	41	23.0	28	15.1	18	9.6	14	7.4	16	8.5
5–14	20	3.3	29	4.9	35	5.9	58	9.9	23	3.9	29	5.0	20	3.4	26	4.5
15–24	15	2.5	19	3.1	29	4.7	53	8.4	25	3.9	27	4.2	21	3.3	23	3.6
25–34	16	2.9	24	4.4	32	5.9	53	9.6	25	4.5	40	7.1	24	4.2	18	3.0
35–44	54	8.5	41	6.5	53	8.5	68	11.0	39	6.4	36	6.0	37	6.2	36	6.2
45–54	42	7.4	37	6.3	55	9.2	55	9.1	59	9.6	55	8.9	44	7.1	62	10.0
55–64	56	13.0	63	14.3	87	19.1	69	14.7	75	15.6	87	17.6	74	14.8	87	17.1
65–74	67	24.3	87	30.5	87	29.8	94	31.1	80	25.5	84	25.8	84	24.4	81	22.5
75–84	68	38.2	73	40.5	88	48.3	94	51.1	87	46.8	88	46.7	81	42.2	68	34.7
≥85	34	58.5	26	42.6	51	80.0	53	79.6	57	81.3	58	79.3	45	59.3	38	48.3
Aggregated age groups (years)																
<2	122	104.8	116	96.1	79	62.9	59	46.4	37	29.2	30	23.8	44	35.9	24	20.0
<5	153	53.5	156	53.4	114	38.0	100	32.7	65	20.8	48	15.3	58	18.6	40	13.0
5–64	203	6.0	213	6.2	291	8.5	356	10.3	246	7.1	274	7.8	220	6.3	252	7.1
≥65	169	33.0	186	35.3	226	42.0	241	43.6	224	39.4	230	39.2	210	34.3	187	29.4
Total	**525**	**12.5**	**555**	**13.1**	**631**	**14.8**	**697**	**16.1**	**535**	**12.2**	**552**	**12.5**	**488**	**11.0**	**479**	**10.7**

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

Table 13. Rate per 100 000 population of invasive pneumococcal disease by ethnic group, age group and year, 2009–2013

Age group (years)	Ethnic group[a,b]																			
	Māori					Pacific peoples					Asian					European or Other				
	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013	2009	2010	2011	2012	2013
<2	86.6	64.3	46.3	44.3	35.5	64.0	50.0	58.8	86.2	-	-	-	-	-	-	27.7	14.1	7.9	25.9	16.5
<5	50.0	38.7	24.8	22.5	17.7	49.6	37.1	26.8	43.9	-	19.5	19.0	16.2	-	-	23.2	9.9	7.4	13.0	12.0
5−64	21.1	13.7	11.8	11.1	12.5	28.0	24.8	18.2	13.9	15.1	3.7	1.8	1.6	1.1	2.7	7.0	4.5	6.8	4.9	5.6
≥65	97.2	73.3	89.6	68.0	90.9	106.2	142.3	87.1	97.3	93.4	30.0	-	-	24.8	-	37.4	35.6	35.7	30.6	23.6
All ages[c]	**35.9**	**25.7**	**26.4**	**23.1**	**27.6**	**42.3**	**47.1**	**31.2**	**32.5**	**31.9**	**10.1**	**5.3**	**4.3**	**5.8**	**4.2**	**11.8**	**8.9**	**10.5**	**8.9**	**8.2**

[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).

[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, and 464 (96.9%) cases in 2013.

[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 2010–2013. 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 14. Rate per 100 000 population of invasive pneumococcal disease by quintiles of the 2013 NZ Deprivation Index and year, 2009–2013

NZDep13 quintile[a]	2009		2010		2011		2012		2013	
	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
2	81	9.5	65	7.6	66	7.7	69	8.1	70	8.2
3	109	13.0	83	9.9	95	11.3	77	9.2	83	9.9
4	154	18.6	103	12.4	121	14.6	96	11.6	98	11.8
5	234	28.1	199	23.9	178	21.4	158	19.0	157	18.8
Total[c]	**643**		**501**		**517**		**464**		**450**	

[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 2013 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 and 450 (93.9%) cases in 2013.

Table 15. Number of cases and rate per 100 000 population of invasive pneumococcal disease by clinical presentation and age group, 2013

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	11.7	0	-	4	-	5	8.4	9	15.0
1	0	-	0	-	4	-	2	-	2	-
2–4	3	-	0	-	6	3.2	5	2.7	7	3.7
5–14	5	0.9	2	-	9	1.5	7	1.2	6	1.0
15–64	13	0.4	9	0.3	171	5.8	38	1.3	38	1.3
≥65	5	0.8	1	-	146	23.0	29	4.6	24	3.8
Total[c]	**33**	**0.7**	**12**	**0.3**	**340**	**7.6**	**86**	**1.9**	**86**	**1.9**

[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 462 (96.5%) cases notified in 2013.

Table 16. Case-fatality rates for invasive pneumococcal disease cases by age group, 2013

Age group (years)	Cases died[a]	Total reported[b]	Case-fatality rate[c] (%)
<1	1	18	5.6
1	0	6	0.0
2–4	0	15	0.0
5–14	0	23	0.0
15–64	6	210	2.9
≥65	11	173	6.4
Total	**18**	**445**	**4.0**

[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 445 (92.9%) of cases notified in 2013.

Table 17. Exposure to risk factors associated with invasive pneumococcal disease for cases aged less than 2 years, 2013

Risk factor	Cases[a]	Total reported[b]	%[c]
Smoking in the household	6	13	46.2
Premature (<37 weeks gestation)[d]	6	15	40.0
Attends childcare	2	12	16.7
Congenital or chromosomal abnormality	1	23	4.3

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

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

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

[d] Cases aged <1 year only.

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

Table 18. Exposure to risk factors associated with invasive pneumococcal disease for cases aged less than 5 years, 2013

Risk factor	Cases[a]	Total reported[b]	%[c]
Premature (<37 weeks gestation)[d]	6	15	40.0
Smoking in the household	6	17	35.3
Attends childcare	4	17	23.5
Chronic illness[e]	3	36	8.3
Immunocompromised[f]	2	34	5.9
Congenital or chromosomal abnormality	1	35	2.9

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

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

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

[d] Cases aged <1 year only.

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

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

Note: No cases aged <5 years were reported as having anatomical or functional asplenia, chronic lung disease or cystic fibrosis, or cochlear implants; or being 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 5 years and over, 2013

Risk factor	Cases[a]	Total reported[b]	%[c]
Chronic illness[d]	205	397	51.6
Current smoker[e]	92	346	26.6
Immunocompromised[f]	69	391	17.6
Chronic lung disease or cystic fibrosis	71	406	17.5
Resident in long-term or other chronic-care facility[g]	28	398	7.0
Anatomical or functional asplenia	7	394	1.8
Cochlear implants	5	382	1.3
Congenital or chromosomal abnormality	4	380	1.1
Other risk factors	84	-	-

[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, 19.6% (18 cases out of 92 for whom the information was supplied) were residents in a long-term or other chronic-care facility.

Table 20 Rate per 100 000 population of invasive pneumococcal disease by District Health Board, 2009–2013

District Health Board	Rate[a]				
	2009	2010	2011	2012	2013
Northland	20.5	10.8	13.3	14.5	13.2
Waitemata	11.9	11.5	11.0	6.9	8.9
Auckland	11.5	10.0	11.4	11.3	8.1
Counties Manukau	18.7	21.4	15.0	14.8	11.6
Northern region	**14.7**	**14.0**	**12.5**	**11.2**	**9.9**
Waikato	22.8	12.9	12.5	11.3	10.7
Lakes	28.5	17.5	28.2	13.6	25.2
Bay of Plenty	24.1	15.7	13.7	17.0	16.9
Tairawhiti	19.5	-	10.7	-	10.7
Taranaki	18.5	9.2	10.0	12.7	8.1
Midland region	**23.1**	**13.2**	**14.3**	**12.9**	**13.7**
Hawke's Bay	22.7	15.5	16.7	13.5	15.4
Whanganui	19.0	14.2	9.5	9.6	16.0
MidCentral	10.2	10.8	11.3	6.5	10.0
Hutt Valley	21.0	14.6	11.8	8.3	7.6
Capital & Coast	10.4	7.9	6.4	9.8	9.3
Wairarapa	30.0	12.4	17.2	24.6	17.2
Nelson Marlborough	16.1	-	12.9	14.2	9.2
Central region	**16.0**	**10.4**	**11.1**	**10.8**	**10.9**
West Coast	-	-	-	-	18.4
Canterbury	11.0	8.3	13.3	8.0	7.9
South Canterbury	10.8	-	14.2	10.6	14.0
Southern	17.3	15.5	12.1	11.4	9.7
Southern region	**12.7**	**10.3**	**12.5**	**9.1**	**9.3**
Total	**16.1**	**12.2**	**12.5**	**11.0**	**10.7**

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

Table 21. 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, 2013

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	-	0	-	0	-	23	0.7	9	1.4	32	0.7
6B	0	-	0	-	0	-	3	-	4	-	7	0.2
9V	0	-	0	-	0	-	8	0.2	3	-	11	0.2
14	0	-	0	-	0	-	3	-	4	-	7	0.2
18C	0	-	0	-	0	-	10	0.3	6	0.9	16	0.4
19F	1	-	0	-	1	-	7	0.2	5	0.8	13	0.3
23F	0	-	0	-	0	-	3	-	3	-	6	0.1
PCV7	**1**	**-**	**0**	**-**	**1**	**-**	**57**	**1.6**	**34**	**5.4**	**92**	**2.1**
1	0	-	2	-	2	-	1	-	0	-	3	-
5	0	-	0	-	0	-	0	-	0	-	0	-
7F	1	-	0	-	1	-	48	1.4	20	3.1	69	1.5
PCV10	**2**	**-**	**2**	**-**	**4**	**-**	**106**	**3.0**	**54**	**8.5**	**164**	**3.7**
3	3	-	0	-	3	-	9	0.3	11	1.7	23	0.5
6A	1	-	0	-	1	-	2	-	0	-	3	-
19A	7	5.8	5	2.7	12	3.9	36	1.0	28	4.4	76	1.7
PCV13	**13**	**10.8**	**7**	**3.7**	**20**	**6.5**	**153**	**4.3**	**93**	**14.6**	**266**	**5.9**
6C	0	-	0	-	0	-	9	0.3	12	1.9	21	0.5
7A	0	-	1	-	1	-	5	0.1	0	-	6	0.1
8	2	-	0	-	2	-	10	0.3	5	0.8	17	0.4
9N	0	-	0	-	0	-	2	-	10	1.6	12	0.3
10A	1	-	0	-	1	-	3	-	2	-	6	0.1
11A	2	-	1	-	3	-	7	0.2	1	-	11	0.2
15B	0	-	1	-	1	-	2	-	5	0.8	8	0.2
15 NT[d]	0	-	0	-	0	-	2	-	4	-	6	0.1
16 NT[d]	0	-	0	-	0	-	3	-	4	-	7	0.2
17F	0	-	1	-	1	-	2	-	3	-	6	0.1
22F	1	-	0	-	1	-	24	0.7	16	2.5	41	0.9
23A	0	-	0	-	0	-	0	-	6	0.9	6	0.1
23B	1	-	1	-	2	-	1	-	3	-	6	0.1
33F	1	-	0	-	1	-	5	0.1	5	0.8	11	0.2
35 NT[d]	0	-	1	-	1	-	2	-	4	-	7	0.2
Other	2	-	1	-	3	-	8	0.2	6	0.9	17	0.4
Non-PCV[e]	**10**	**8.3**	**7**	**3.7**	**17**	**5.5**	**85**	**2.4**	**86**	**13.5**	**188**	**4.2**
Total[f]	**23**	**20.0**	**14**	**7.5**	**37**	**12.0**	**238**	**6.7**	**179**	**28.2**	**454**	**10.2**

[a] Aggregated age group.

[b] Among the cases in the ≥65 year age group, 75.4% 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 serotypes listed are those that accounted for more than five cases of IPD in 2013.

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

Table 22. Number and percentage of invasive pneumococcal disease cases by serotype for each age group, 2013

Serotype	<2 years		<5 years		5–64 years		≥65 years		All ages	
	Cases	%[a]	Cases	%[a]	Cases	%[a]	Cases	%[a]	Cases	%[a]
1	0	-	2	5.4	1	0.4	0	-	3	0.7
3	3	13.0	3	8.1	9	3.8	11	6.1	23	5.1
4	0	-	0	-	23	9.7	9	5.0	32	7.0
6A	1	4.3	1	2.7	2	0.8	0	-	3	0.7
6B	0	-	0	-	3	1.3	4	2.2	7	1.5
6C	0	-	0	-	9	3.8	12	6.7	21	4.6
7A	0	-	1	2.7	5	2.1	0	-	6	1.3
7F	1	4.3	1	2.7	48	20.2	20	11.2	69	15.2
7 NT[b]	1	4.3	1	2.7	0	-	0	-	1	0.2
8	2	8.7	2	5.4	10	4.2	5	2.8	17	3.7
9N	0	-	0	-	2	0.8	10	5.6	12	2.6
9V	0	-	0	-	8	3.4	3	1.7	11	2.4
9 NT[b]	0	-	0	-	0	-	1	0.6	1	0.2
10A	1	4.3	1	2.7	3	1.3	2	1.1	6	1.3
11A	2	8.7	3	8.1	7	2.9	1	0.6	11	2.4
12F	0	-	0	-	3	1.3	0	-	3	0.7
14	0	-	0	-	3	1.3	4	2.2	7	1.5
15B	0	-	1	2.7	2	0.8	5	2.8	8	1.8
15 NT[b]	0	-	0	-	2	0.8	4	2.2	6	1.3
16 NT[b]	0	-	0	-	3	1.3	4	2.2	7	1.5
17F	0	-	1	2.7	2	0.8	3	1.7	6	1.3
18C	0	-	0	-	10	4.2	6	3.4	16	3.5
19A	7	30.4	12	32.4	36	15.1	28	15.6	76	16.7
19F	1	4.3	1	2.7	7	2.9	5	2.8	13	2.9
20	0	-	0	-	1	0.4	1	0.6	2	0.4
21	0	-	1	2.7	0	-	0	-	1	0.2
22F	1	4.3	1	2.7	24	10.1	16	8.9	41	9.0
23A	0	-	0	-	0	-	6	3.4	6	1.3
23B	1	4.3	2	5.4	1	0.4	3	1.7	6	1.3
23F	0	-	0	-	3	1.3	3	1.7	6	1.3
31	0	-	0	-	1	0.4	1	0.6	2	0.4
33F	1	4.3	1	2.7	5	2.1	5	2.8	11	2.4
33 NT[b]	0	-	0	-	1	0.4	1	0.6	2	0.4
34	0	-	0	-	2	0.8	0	-	2	0.4
35 NT[b]	0	-	1	2.7	2	0.8	4	2.2	7	1.5
38	1	4.3	1	2.7	0	-	2	1.1	3	0.7
Total[c]	**23**		**37**		**238**		**179**		**454**	

[a] Percentage of cases due to each serotype out of the total number of culture-positive cases within the age group.
[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 23. 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, 2006/2007–2013

Serotype	2006/2007		2008		2009		2010		2011		2012		2013	
	No[a]	Rate[b]	No[c]	Rate[d]	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	5	4.0	1	-	0	-	0	-	0	-	0	-
6B	18.0	15.2	21	16.7	4	-	1	-	1	-	0	-	0	-
9V	4.5	3.8	3	-	0	-	0	-	1	-	0	-	0	-
14	39.0	32.9	21	16.7	7	5.5	3	-	0	-	1	-	0	-
18C	6.0	5.1	6	4.8	1	-	0	-	1	-	0	-	0	-
19F	15.5	13.1	6	4.8	8	6.3	6	4.7	0	-	1	-	1	-
23F	9.0	7.6	3	-	2	-	0	-	0	-	0	-	0	-
PCV7	**98.5**	**83.1**	**65**	**51.7**	**23**	**18.1**	**10**	**7.9**	**3**	**-**	**2**	**-**	**1**	**-**
1	2.0	-	1	-	12	9.4	2	-	2	-	1	-	0	-
5	0.0	-	0	-	0	-	0	-	0	-	0	-	0	-
7F	0.5	-	0	-	1	-	2	-	2	-	2	-	1	-
PCV10	**101.0**	**85.2**	**66**	**52.5**	**36**	**28.3**	**14**	**11.0**	**7**	**5.6**	**5**	**4.1**	**2**	**-**
3	1.0	-	0	-	3	-	2	-	0	-	2	-	3	-
6A/6C[e]	3.0	-	0	-	2	-	2	-	1	-	4	-	1	-
19A	6.0	5.1	5	4.0	8	6.3	7	5.5	8	6.4	13	10.6	7	5.8
PCV13	**111.0**	**93.6**	**71**	**56.5**	**49**	**38.6**	**25**	**19.7**	**16**	**12.7**	**24**	**19.6**	**13**	**10.8**
7A	0.5	-	0	-	0	-	0	-	1	-	0	-	0	-
8	0.0	-	2	-	0	-	0	-	2	-	2	-	2	-
9N	0.0	-	0	-	0	-	0	-	1	-	0	-	0	-
10A	0.5	-	1	-	0	-	1	-	1	-	3	-	1	-
11A	0.5	-	0	-	1	-	0	-	1	-	2	-	2	-
15B	0.5	-	0	-	0	-	0	-	0	-	4	-	0	-
15 NT[f]	0.0	-	0	-	1	-	0	-	0	-	0	-	0	-
16 NT[f]	0.0	-	0	-	0	-	0	-	0	-	0	-	0	-
17F	0.0	-	0	-	0	-	0	-	0	-	1	-	0	-
22F	1.0	-	0	-	1	-	1	-	0	-	0	-	1	-
23A	0.0	-	0	-	1	-	0	-	0	-	0	-	0	-
23B	0.5	-	0	-	0	-	0	-	0	-	0	-	1	-
33F	0.5	-	1	-	0	-	4	-	1	-	0	-	1	-
35 NT[f]	0.0	-	1	-	0	-	1	-	3	-	2	-	0	-
Other	2.5	-	2	-	1	-	4	3.9	2	4.0	2	-	2	-
Non-PCV[g]	**6.5**	**5.5**	**7**	**5.6**	**6**	**4.7**	**11**	**8.7**	**12**	**9.5**	**16**	**13.1**	**10**	**8.3**

[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] Specific serotypes listed are those that accounted for more than five cases in 2013.

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

Table 24. Number of cases and rate per 100 000 population of invasive pneumococcal disease in the less than 5 years age group by serotype, by serotype, and serotypes covered by PCV7, PCV10 and PCV13, 2006/2007–2013

Serotype	2006/2007		2008		2009		2010		2011		2012		2013	
	No[a]	Rate[b]	No[c]	Rate[d]	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	7	2.3	2	-	2	-	1	-	0	-	0	-
6B	23.5	8.1	25	8.3	8	2.6	2	-	1	-	0	-	0	-
9V	7.0	2.4	4	-	1	-	2	-	1	-	1	-	0	-
14	47.5	16.4	31	10.3	17	5.6	7	2.2	1	-	2	-	0	-
18C	10.5	3.6	6	2.0	4	-	0	-	2	-	0	-	0	-
19F	19.0	6.6	11	3.7	13	4.3	9	2.9	3	-	1	-	1	-
23F	9.5	3.3	5	1.7	5	1.6	2	-	1	-	0	-	0	-
PCV7	**125.0**	**43.2**	**89**	**29.7**	**50**	**16.4**	**24**	**7.7**	**10**	**3.2**	**4**	**-**	**1**	**-**
1	2.5	-	5	1.7	15	4.9	9	2.9	3	-	1	-	2	-
5	0.0	-	0	-	0	-	0	-	0	-	0	-	0	-
7F	0.5	-	0	-	1	-	2	-	4	-	4	-	1	-
PCV10	**128.0**	**44.3**	**94**	**31.3**	**66**	**21.6**	**35**	**11.2**	**17**	**5.4**	**9**	**2.9**	**4**	**-**
3	1.0	-	0	-	3	-	4	-	0	-	2	-	3	-
6A/6C[e]	4.5	1.6	2	-	3	-	2	-	1	-	4	-	1	-
19A	10.5	3.6	7	2.3	12	3.9	10	3.2	13	4.1	18	5.8	12	3.9
PCV13	**144.0**	**49.8**	**103**	**34.3**	**84**	**27.5**	**51**	**16.4**	**31**	**9.9**	**33**	**10.6**	**20**	**6.5**
7A	0.5	-	0	-	0	-	0	-	1	-	0	-	1	-
8	0.0	-	2	-	0	-	0	-	2	-	2	-	2	-
9N	0.0	-	0	-	2	-	0	-	1	-	0	-	0	-
10A	1.0	-	2	-	0	-	1	-	1	-	4	-	1	-
11A	0.5	-	0	-	1	-	0	-	1	-	2	-	3	-
15B	1.0	-	0	-	0	-	0	-	2	-	6	1.9	1	-
15 NT[f]	0.0	-	0	-	1	-	0	-	0	-	0	-	0	-
16 NT[f]	0.0	-	0	-	0	-	0	-	0	-	0	-	0	-
17F	0.5		0	-	0	-	0	-	0	-	1	-	1	-
22F	1.0	-	0	-	1	-	1	-	0	-	0	-	1	-
23A	0.5		0	-	1	-	0	-	0	-	0	-	0	-
23B	0.5	-	0	-	0	-	0	-	0	-	0	-	2	-
33F	1.0	-	1	-	0	-	4	-	1	-	0	-	1	-
35 NT[f]	0.0	-	1	-	0	-	1	-	3	-	2	-	1	-
Other	2.5	-	3	-	3	-	5	1.6	2		2	-	3	-
Non-PCV[g]	**9.0**	**3.1**	**9**	**3.0**	**9**	**2.9**	**12**	**3.8**	**14**	**4.5**	**19**	**6.1**	**17**	**5.5**

[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] Specific serotypes listed are those that accounted for more than five cases in 2013.

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

Table 25. Number of cases and rate per 100 000 population of invasive pneumococcal disease in the 5–64 years age group by serotype, by serotype, and serotypes covered by PCV7, PCV10 and PCV13, 2006/2007–2013

Serotype	2006/2007		2008		2009		2010		2011		2012		2013	
	No[a]	Rate[b]	No[c]	Rate[d]	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	33	1.0	32	0.9	26	0.7	30	0.9	26	0.7	23	0.7
6B	11.5	0.3	9	0.3	8	0.2	4	-	7	0.2	3	-	3	-
9V	11.0	0.3	19	0.6	15	0.4	13	0.4	10	0.3	5	0.1	8	0.2
14	31.0	0.9	29	0.8	23	0.7	15	0.4	18	0.5	11	0.3	3	-
18C	5.5	0.2	8	0.2	10	0.3	4	-	7	0.2	5	0.1	10	0.3
19F	12.0	0.4	15	0.4	26	0.8	12	0.3	14	0.4	13	0.4	7	0.2
23F	12.0	0.4	15	0.4	16	0.5	9	0.3	5	0.1	5	0.1	3	-
PCV7	**121.0**	**3.6**	**128**	**3.7**	**130**	**3.8**	**83**	**2.4**	**91**	**2.6**	**68**	**1.9**	**57**	**1.6**
1	19.0	0.6	56	1.6	124	3.6	58	1.7	30	0.9	7	0.2	1	-
5	0.0	-	0	-	0	-	0	-	0	-	0	-	0	-
7F	6.0	0.2	12	0.3	13	0.4	4	-	11	0.3	18	0.5	48	1.4
PCV10	**146.0**	**4.3**	**196**	**5.7**	**267**	**7.7**	**145**	**4.2**	**132**	**3.8**	**93**	**2.6**	**106**	**3.0**
3	8.5	0.3	16	0.5	12	0.3	9	0.3	22	0.6	9	0.3	9	0.3
6A/6C[e]	5.0	0.1	5	0.1	5	0.1	6	0.2	9	0.3	6	0.2	11	0.3
19A	10.0	0.3	22	0.6	16	0.5	23	0.7	26	0.7	30	0.9	36	1.0
PCV13	**169.5**	**5.0**	**239**	**7.0**	**300**	**8.7**	**183**	**5.2**	**189**	**5.4**	**138**	**3.9**	**162**	**4.6**
7A	2.5	-	1	-	1	-	1	-	4	-	1	-	5	0.1
8	12.0	0.4	11	0.3	8	0.2	7	0.2	9	0.3	11	0.3	10	0.3
9N	4.0	-	6	0.2	4	-	7	0.2	3	-	5	0.1	2	-
10A	3.0	-	0	-	2	-	2	-	5	0.1	2	-	3	-
11A	3.5	-	5	0.1	2	-	8	0.2	5	0.1	5	0.1	7	0.2
15B	0.5	-	0	-	0	-	0	-	2	-	2	-	2	-
15 NT[f]	0.0	-	0	-	0	-	0	-	0	-	1	-	2	-
16 NT[f]	0.0	-	0	-	0	-	0	-	0	-	0	-	3	-
17F	0.5	-	3	-	0	-	3	-	3	-	2	-	2	-
22F	5.0	0.1	5	0.1	11	0.3	4	-	17	0.5	19	0.5	24	0.7
23A	0.5	-	2	-	1	-	4	-	2	-	4	-	0	-
23B	0.5	-	0	-	0	-	1	-	1	-	5	0.1	1	-
33F	0.0	-	2	-	1	-	5	0.1	2	-	1	-	5	0.1
35 NT[f]	1.0	-	1	-	1	-	0	-	3	-	0	-	2	-
Other	5.0	0.1	16	0.5	11	0.3	9	0.3	15	0.4	8	0.2	8	0.2
Non-PCV[g]	**38.0**	**1.1**	**52**	**1.5**	**42**	**1.2**	**51**	**1.5**	**71**	**2.0**	**66**	**1.9**	**76**	**2.2**

[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] Specific serotypes listed are those that accounted for more than five cases in 2013.

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

Table 26. Number of cases and rate per 100 000 population of invasive pneumococcal disease in the 65 years and over age group by serotype, by serotype, and serotypes covered by PCV7, PCV10 and PCV13, 2006/2007–2013

Serotype	2006/2007		2008		2009		2010		2011		2012		2013	
	No[a]	Rate[b]	No[c]	Rate[d]	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	21	3.9	23	4.2	18	3.2	15	2.6	22	3.6	9	1.4
6B	11.0	2.1	16	3.0	17	3.1	15	2.6	10	1.7	5	0.8	4	-
9V	14.5	2.8	18	3.3	19	3.4	16	2.8	4	-	7	1.1	3	-
14	35.5	6.8	48	8.9	35	6.3	18	3.2	9	1.5	5	0.8	4	-
18C	3.0	-	8	1.5	6	1.1	5	0.9	7	1.2	4	-	6	0.9
19F	16.5	3.2	16	3.0	19	3.4	15	2.6	22	3.7	11	1.8	5	0.8
23F	15.0	2.9	16	3.0	27	4.9	14	2.5	11	1.9	4	-	3	-
PCV7	**115.0**	**22.2**	**143**	**26.6**	**146**	**26.4**	**101**	**17.7**	**78**	**13.3**	**58**	**9.5**	**34**	**5.4**
1	3.5	-	8	1.5	14	2.5	10	1.8	2	-	0	-	0	-
5	0.0	-	0	-	0	-	1	-	0	-	0	-	0	-
7F	3.5	-	2	-	4	-	3	-	1	-	15	2.5	20	3.1
PCV10	**122.0**	**23.5**	**153**	**28.4**	**164**	**29.7**	**115**	**20.2**	**81**	**13.8**	**73**	**11.9**	**54**	**8.5**
3	12.5	2.4	12	2.2	11	2.0	8	1.4	16	2.7	14	2.3	11	1.7
6A/6C[e]	2.5	-	4	-	5	0.9	13	2.3	14	2.4	12	2.0	12	1.9
19A	8.0	1.5	11	2.0	9	1.6	22	3.9	24	4.1	32	5.2	28	4.4
PCV13	**145.0**	**27.9**	**180**	**33.5**	**189**	**34.2**	**158**	**27.8**	**135**	**23.0**	**131**	**21.4**	**105**	**16.5**
7A	1.0	-	0	-	1	-	1	-	3	-	0	-	0	-
8	3.5	-	4	-	4	-	0	-	2	-	5	0.8	5	0.8
9N	4.0	-	5	0.9	2	-	8	1.4	11	1.9	3	-	10	1.6
10A	2.0	-	0	-	2	-	3	-	5	0.9	4	-	2	-
11A	3.5	-	2	-	3	-	5	0.9	8	1.4	7	1.1	1	-
15B	1.0	-	0	-	2	-	0	-	1	-	2	-	5	0.8
15 NT[f]	0.0	-	0	-	0	-	0	-	2	-	1	-	4	-
16 NT[f]	0.5	-	0	-	0	-	1	-	2	-	0	-	4	-
17F	1.0	-	2	-	2	-	1	-	4	-	0	-	3	-
22F	4.5	0.9	10	1.9	10	1.8	18	3.2	21	3.6	21	3.4	16	2.5
23A	1.0	-	4	-	2	-	4	-	1	-	1	-	6	0.9
23B	0.5	-	0	-	0	-	1	-	1	-	2	-	3	-
33F	1.5	-	7	1.3	3	-	4	-	8	1.4	8	1.3	5	0.8
35 NT[f]	1.0	-	1	-	1	-	1	-	5	0.9	3	-	4	-
Other	7.5	1.4	11	2.0	9	1.6	12	2.1	19	3.2	15	2.5	6	0.9
Non-PCV[g]	**32.5**	**6.3**	**46**	**8.6**	**41**	**7.4**	**59**	**10.4**	**93**	**15.8**	**72**	**11.8**	**74**	**11.6**

[a] Average number of cases during 2006/2007.

[b] Average rate per 100 000 population during 2006/2007.

[c] Number of cases reported.

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

[e] Serotypes 6A and 6C were only distinguished from 2010 onwards; therefore they have been combined for this analysis.

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

[g] Specific serotypes listed are those that accounted for more than five cases in 2013.

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

Table 27. 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, 2006/2007–2013

Serotype	2006/2007		2008		2009		2010		2011		2012		2013	
	No[a]	Rate[b]	No[c]	Rate[d]	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	61	1.4	57	1.3	46	1.1	46	1.0	48	1.1	32	0.7
6B	46.0	1.1	50	1.2	33	0.8	21	0.5	18	0.4	8	0.2	7	0.2
9V	32.5	0.8	41	1.0	35	0.8	31	0.7	15	0.3	13	0.3	11	0.2
14	114.0	2.7	108	2.5	75	1.7	40	0.9	28	0.6	18	0.4	7	0.2
18C	19.0	0.5	22	0.5	20	0.5	9	0.2	16	0.4	9	0.2	16	0.4
19F	47.5	1.1	42	1.0	58	1.3	36	0.8	39	0.9	25	0.6	13	0.3
23F	36.5	0.9	36	0.8	48	1.1	25	0.6	17	0.4	9	0.2	6	0.1
PCV7	**361.0**	**8.6**	**360**	**8.4**	**326**	**7.6**	**208**	**4.8**	**179**	**4.1**	**130**	**2.9**	**92**	**2.1**
1	25.0	0.6	69	1.6	153	3.5	77	1.8	35	0.8	8	0.2	3	-
5	0.0	-	0	-	0	-	1	-	0	-	0	-	0	-
7F	10.0	0.2	14	0.3	18	0.4	9	0.2	16	0.4	37	0.8	69	1.5
PCV10	**396.0**	**9.4**	**443**	**10.4**	**497**	**11.5**	**295**	**6.8**	**230**	**5.2**	**175**	**3.9**	**164**	**3.7**
3	22.0	0.5	28	0.7	26	0.6	21	0.5	38	0.9	25	0.6	23	0.5
6A/6C[e]	12.0	0.3	11	0.3	13	0.3	21	0.5	24	0.5	22	0.5	24	0.5
19A	28.5	0.7	40	0.9	37	0.9	55	1.3	63	1.4	80	1.8	76	1.7
PCV13	**458.5**	**10.9**	**522**	**12.2**	**573**	**13.3**	**392**	**9.0**	**355**	**8.1**	**302**	**6.8**	**287**	**6.4**
7A	3.5	-	1	-	2	-	2	-	8	0.2	1	-	6	0.1
8	15.5	0.4	17	0.4	12	0.3	7	0.2	13	0.3	18	0.4	17	0.4
9N	8.0	0.2	11	0.3	8	0.2	15	0.3	15	0.3	8	0.2	12	0.3
10A	6.0	0.1	2	-	4	-	6	0.1	11	0.2	10	0.2	6	0.1
11A	7.5	0.2	7	0.2	6	0.1	13	0.3	14	0.3	14	0.3	11	0.2
15B	2.5	-	0	-	2	-	0	-	5	0.1	10	0.2	8	0.2
15 NT[f]	0.0	-	0	-	1	-	0	-	2	-	2	-	6	0.1
16 NT[f]	0.0	-	0	-	0	-	0	-	0	-	0	-	7	0.2
17F	2.5	-	5	0.1	2	-	4	-	7	0.2	3	-	6	0.1
22F	10.5	0.2	15	0.4	22	0.5	23	0.5	38	0.9	40	0.9	41	0.9
23A	2.0	-	6	0.1	4	-	8	0.2	3	-	5	0.1	6	0.1
23B	1.5	-	0	-	0	-	2	-	2	-	7	0.2	6	0.1
33F	2.5	-	10	0.2	4	-	13	0.3	11	0.2	9	0.2	11	0.2
35 NT[f]	0.5	-	0	-	0	-	0	-	0	-	0	-	7	0.2
Other	17.0	0.4	33	0.8	25	0.6	29	0.7	49	1.1	30	0.7	17	0.4
Non-PCV[g]	**79.5**	**1.9**	**107**	**2.5**	**92**	**2.1**	**122**	**2.8**	**178**	**4.0**	**157**	**3.5**	**167**	**3.7**

[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] Specific serotypes listed are those that accounted for more than five cases in 2013.

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

Table 28. Serotype 19A invasive pneumococcal disease case numbers, proportions and rates per 100 000 population, by age group, 2004–2013

Year	<2 years			<5 years			5–64 years			≥65 years			All ages		
	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]
2004	8	6.3	7.0	10	6.2	3.5	5	2.6	0.2	8	4.2	1.7	23	4.2	0.6
2005	6	5.3	5.2	8	5.3	2.8	10	5.6	0.3	9	5.5	1.8	27	5.5	0.7
2006	5	4.2	4.3	10	6.6	3.5	13	6.4	0.4	4	2.4	-	27	5.2	0.6
2007	7	6.0	5.8	11	7.1	3.8	7	3.3	0.2	12	6.5	2.3	30	5.4	0.7
2008	5	6.4	4.0	7	6.3	2.3	22	7.6	0.6	11	4.8	2.0	40	6.3	0.9
2009	8	14.5	6.3	12	12.9	3.9	16	4.7	0.5	9	3.9	1.6	37	5.6	0.9
2010	7	19.4	5.5	10	15.9	3.2	23	9.8	0.7	22	10.1	3.9	55	10.7	1.3
2011	8	28.6	6.4	13	28.9	4.1	26	10.0	0.7	24	10.5	4.1	63	11.8	1.4
2012	13	32.5	10.6	18	34.6	5.8	30	14.7	0.9	32	15.8	5.2	80	17.4	1.8
2013	7	30.4	5.8	12	32.4	3.9	36	15.1	1.0	28	15.6	4.4	76	16.7	1.7

[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 29. Serotype 7F invasive pneumococcal disease case numbers, proportions and rates per 100 000 population, by age group, 2006–2013

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	0.3	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	5.0	-	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

[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 30. Penicillin and cefotaxime MIC distribution among isolates from invasive pneumococcal disease cases, 2013

Antibiotic	Percent of isolates with an MIC (mg/L) of:[a]										
	0.008	0.016	0.03	0.06	0.12	0.25	0.5	1	2	4	8
Penicillin	0.0	15.0	67.4	1.5	1.8	4.4	1.1	2.9	4.4	1.3	0.2
Cefotaxime	0.2	48.9	32.6	2.9	2.6	3.1	1.5	4.4	3.3	0.4	0.0

[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 [15].

Table 31. Trends in penicillin resistance, cefotaxime resistance and multidrug resistance among isolates from invasive pneumococcal disease cases, 2004−2013

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	
2004	545	81.8	18.2	98.5	1.5	0.0	81.8	8.1	10.1	87.2	9.7	3.1	96.9	2.4	0.7	5.3
2005	492	82.9	17.1	98.6	1.4	0.0	82.9	10.0	7.1	90.5	6.5	3.1	97.0	1.7	1.4	6.7
2006	522	84.1	15.9	98.9	1.0	0.2	84.1	8.1	7.9	90.0	7.3	2.7	97.3	1.7	1.0	4.4
2007	555	77.7	22.3	99.1	0.7	0.2	77.7	16.0	6.3	86.0	11.4	2.7	97.3	1.1	1.6	6.1
2008	630	77.9	22.1	99.5	0.5	0.0	77.9	14.6	7.5	84.9	10.0	5.1	94.9	3.0	2.1	5.9
2009	665	82.3	17.7	99.7	0.3	0.0	82.3	12.3	5.4	91.1	6.9	2.0	98.1	1.4	0.6	5.3
2010	514	81.9	18.1	99.0	1.0	0.0	81.9	12.1	6.0	91.8	6.2	1.9	98.1	0.4	1.6	5.4
2011	533	85.9	14.1	99.1	0.8	0.2	85.9	9.4	4.7	93.4	3.6	3.0	97.0	1.1	1.9	5.8
2012	459	82.8	17.2	98.0	1.3	0.7	82.8	9.4	7.8	92.4	3.5	4.1	95.9	2.8	1.3	6.3
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

[a] CLSI penicillin meningitis interpretations: susceptible (S), MIC ≤0.06 mg/L; resistant (R), MIC ≥0.12 mg/L; no intermediate category [15].
[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 [15].
[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 [15].
[d] CLSI cefotaxime meningitis interpretations: susceptible (S), MIC ≤0.5 mg/L; intermediate (I), MIC 1 mg/L; resistant (R), MIC ≥2 mg/L [15].
[e] CLSI cefotaxime non-meningitis interpretations: susceptible (S), MIC ≤1 mg/L; intermediate (I), MIC 2 mg/L; resistant (R), MIC ≥4 mg/L [15].
[f] Multidrug resistant − resistant to penicillin (CLSI meningitis interpretation) and three additional antibiotics [15].

Table 32. Trends in resistance to non-β-lactam antibiotics among isolates from invasive pneumococcal disease cases, 2004−2013

Year	Number of isolates	Chloramphenicol		Clindamycin[a]			Co-trimoxazole			Erythromycin			Tetracycline		
		%S	%R	%S	%I	%R[b]	%S	%I	%R	%S	%I	%R	%S	%I	%R
2004	545	97.3	2.8	-	-	-	61.1	0.2	38.7	91.4	0.2	8.4	91.9	0.2	7.9
2005	492	96.8	3.3	-	-	-	67.3	0.6	32.1	87.8	0.0	12.2	90.9	0.6	8.5
2006	522	98.5	1.5	-	-	-	65.7	1.5	32.8	88.7	0.2	11.1	92.5	0.4	7.1
2007	555	97.7	2.3	93.7	0.0	6.3	63.2	1.8	35.0	86.0	0.4	13.7	90.8	0.7	8.5
2008	630	97.6	2.4	94.6	0.0	5.4	67.6	2.2	30.2	87.8	0.3	11.9	91.9	0.5	7.6
2009	665	98.8	1.2	95.3	0.2	4.5	72.6	2.1	25.3	90.2	0.2	9.6	92.5	0.3	7.2
2010	514	98.1	2.0	94.7	0.0	5.3	73.5	2.1	24.3	91.1	0.0	9.0	91.6	0.8	7.6
2011	533	99.1	0.9	93.4	0.0	6.6	78.4	0.8	20.8	88.7	0.0	11.3	90.6	0.6	8.8
2012	459	99.6	0.4	94.1	0.0	5.9	77.3	1.3	21.4	91.3	0.0	8.7	91.9	0.0	8.1
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

[a] Clindamycin susceptibility tested since 2007.

[b] Includes isolates with inducible clindamycin resistance.

Note:

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

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

Table 33. Penicillin and cefotaxime resistance among isolates from invasive pneumococcal disease cases by region and District Health Board, 2013

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	21	19.1	4.8	0.0
Waitemata	46	28.3	6.5	15.2
Auckland	37	18.9	8.1	0.0
Counties Manukau	51	21.6	3.9	7.8
Northland region	**155**	**22.6**	**5.8**	**7.1**
Waikato	38	10.5	7.9	0.0
Lakes	26	11.5	0.0	0.0
Bay of Plenty	35	20.0	2.9	0.0
Tairawhiti	5	0.0	0.0	0.0
Taranaki	9	11.1	0.0	0.0
Midland region	**113**	**13.3**	**3.5**	**0.0**
Hawke's Bay	23	17.4	8.7	0.0
Whanganui	9	11.1	0.0	0.0
MidCentral	13	23.1	7.7	7.7
Hutt Valley	11	9.1	9.1	0.0
Capital and Coast	27	7.4	3.7	3.7
Wairarapa	7	14.3	0	14.3
Nelson Marlborough	13	15.4	0.0	0.0
Central region	**103**	**13.6**	**4.9**	**2.9**
West Coast	6	16.7	0.0	0.0
Canterbury	39	12.8	5.1	2.6
South Canterbury	8	0.0	0.0	0.0
Southern	30	10.0	0.0	6.7
Southern region	**83**	**10.8**	**2.4**	**3.6**
Total	**454**	**16.1**	**4.4**	**3.7**

[a] CLSI meningitis interpretations; no intermediate category for penicillin [15].

Table 34. Serotypes among penicillin-resistant, cefotaxime-resistant and -intermediate, and multiresistant isolates from invasive pneumococcal disease cases, 2013

Serotype	Penicillin		Cefotaxime				% MDR[b]	
	Resistant[a] MIC ≥0.12 mg/L		Intermediate[a] MIC 1 mg/L		Resistant[a] MIC ≥2 mg/L			
	No	%[c]	No	%[c]	No	%[c]	No	%[c]
4	0	-	0	-	0	-	0	-
6B	3	4.1	2	10.0	0	-	0	-
9V	11	15.1	7	35.0	1	5.9	0	-
14	7	9.6	4	20.0	3	17.7	1	5.6
18C	0	-	0	-	0	-	0	-
19F	4	5.5	0	-	4	23.5	4	22.2
23F	1	1.4	0	-	1	5.9	1	5.6
PCV7 serotypes	**26**	**35.6**	**13**	**65.0**	**9**	**52.9**	**6**	**33.3**
1	0	-	0	-	0	-	0	-
5	0	-	0	-	0	-	0	-
7F	0	-	0	-	0	-	0	
PCV10 serotypes	**26**	**35.6**	**13**	**65.0**	**9**	**52.9**	**6**	**33.3**
3	0	-	0	-	0	-	0	-
6A	0	-	0	-	0	-	0	-
19A	36	49.3	2	10.0	7	41.2	11	61.1
PCV13 serotypes	**62**	**84.9**	**15**	**75.0**	**16**	**94.1**	**17**	**94.4**
6C	1	1.4	0	-	0	-	0	-
15 NT[d]	2	2.7	1	5.0	0	-	1	5.6
23A	1	1.4	0	-	0	-	0	-
23B	1	1.4	0	-	0	-	0	-
34	1	1.4	1	5.0	0	-	0	-
35 NT[d]	5	6.9	3	15.0	1	5.9	0	-
Non-PCV serotypes	**11**	**15.1**	**5**	**25.0**	**1**	**5.9**	**1**	**5.6**
Total	**73**		**20**		**17**		**18**	

[a] CLSI meningitis interpretations; no intermediate category for penicillin [15].

[b] Resistant to penicillin (CLSI meningitis interpretation) and three additional antibiotics [15].

[c] Percentage of the intermediate or resistant isolates.

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

Table 35. Trends in penicillin resistance, cefotaxime resistance and multidrug resistance among serotype 19A isolates from invasive pneumococcal disease cases, 2004−2013

Year	Number of isolates	Penicillin resistant[a] MIC ≥0.12 mg/L		Cefotaxime resistant[b] MIC ≥2 mg/L		% MDR	
		No	Percent (95% CI)	No	Percent (95% CI)	No	Percent (95% CI)
2004	23	6	26.1 (10.2-48.4)	1	4.4 (0.1-21.9)	1	4.4 (0.1-21.9)
2005	27	2	7.4 (0.9-24.3)	0	0.0 (0.0-12.7)	0	0.0 (0.0-12.7)
2006	27	6	22.2 (8.6-42.3)	0	0.0 (0.0-12.7)	0	0.0 (0.0-12.7)
2007	30	3	10.0 (2.1-26.5)	0	0.0 (0.0-11.6)	1	3.3 (0.1-17.2)
2008	40	10	25.0 (12.7-41.2)	1	2.5 (0.1-13.2)	3	7.5 (1.6-20.4)
2009	37	3	8.1 (1.7-21.9)	0	0.0 (0.0-9.5)	0	0.0 (0.0-9.5)
2010	54	10	18.5 (9.3-31.4)	0	0.0 (0.0-6.6)	4	7.4 (2.1-17.9)
2011	63	16	25.4 (15.3-37.9)	1	1.6 (0.04-8.5)	2	3.2 (0.4-11.0)
2012	80	31	38.8 (28.1-50.3)	5	6.3 (2.1-14.0)	12	15.0 (8.0-24.8)
2013	76	36	47.4 (35.8-59.2)	7	9.2 (3.8-18.1)	11	14.5 (7.5-24.4)

[a] Penicillin resistant using CLSI meningitis interpretation [15].
[b] Cefotaxime resistant using CLSI meningitis interpretation [15].
[c] Resistant to penicillin (CLSI meningitis interpretation) and three additional antibiotics [15].