INVASIVE PNEUMOCOCCAL DISEASE IN NEW ZEALAND, 2015

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Disclaimer

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ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Description
CSLI	Clinical and Laboratory Standards Institute
CSF	Cerebrospinal fluid
DHB	District Health Board
ESR	Institute of Environmental Science and Research Limited
I	Intermediate
IPD	Invasive pneumococcal disease
MELAA	Middle Eastern/Latin American/African
MDR	Multidrug resistant
MIC	Minimum Inhibitory Concentration
NHI	National Health Index
NIR	National Immunisation Register
NT	Not typable
NZDep13	2013 New Zealand Index of Deprivation
PCR	Polymerase chain reaction
PCV	Pneumococcal conjugate vaccine
PCV7	7-valent pneumococcal conjugate vaccine
PCV10	10-valent pneumococcal conjugate vaccine
PCV13	13-valent pneumococcal conjugate vaccine
PHU	Public Health Unit
PPV23	23-valent pneumococcal conjugate vaccine
R	Resistant
S	Susceptible

SUMMARY

In June 2008, pneumococcal conjugate vaccine (PCV) was added to the New Zealand childhood immunisation schedule. The 7-valent conjugate vaccine (PCV7), Prevenar®, was used until a schedule change to the 10-valent conjugate vaccine (PCV10), Synflorix®, in July 2011. In July 2014, Synflorix® was replaced by the 13-valent conjugate vaccine (PCV13), Prevenar13®. In July 2017, Synflorix® will be re-introduced to the childhood immunisation schedule and replace Prevenar13®. Synflorix® has cross-reactivity to serotype 19A, one of the three additional serotypes included in Prevenar13®.

Since 17 October 2008, invasive pneumococcal disease (IPD) has been a notifiable disease in New Zealand. In this report, the data presented for 2009–2015 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 447 cases of IPD notified in 2015, which equates to a rate of 9.7 cases per 100,000 population. An *S. pneumoniae* isolate from an invasive site was received at ESR for serotyping and antimicrobial susceptibility testing for 430 (96.2%) of the notified cases.

In children <5 years of age, the rate of IPD due to PCV10 serotypes has decreased 98.5% (44.2 to 0.7 per 100,000 population between 2006/07 and 2015). The overall rate of IPD (ie, disease due to any serotype) has decreased 85.3% (53.4 to 7.8 per 100,000 between 2006/07 and 2015) in this age group.

Due to the indirect or herd immunity effects of routine infant PCV immunisation, there have also been significant 64.0% and 78.6% reductions in the rates of IPD due to PCV10 serotypes in the 5–64 years and ≥65 years age groups, respectively, between 2006/07 and 2015. However, unlike the situation in the <5 year olds, there have been no decreases in the overall rate of IPD in either the 5–64 years or ≥65 years age groups since 2006. However, it is notable that the overall rates of IPD in the 5−64 years and ≥65 years age groups have decreased significantly over the period of notification-based surveillance of IPD (ie, since 2009).

In 2015, rates of IPD for the Pacific peoples and Māori ethnic groups were 4.3 times and 3.8 times higher, respectively, than the rate for the European or Other ethnic group. Nine (64.3%) of the 14 cases in the <2 years age group were of Māori (6 cases) or Pacific peoples (3 cases) ethnicity.

The all-age rate of pneumococcal meningitis was 0.6 per 100,000.

The IPD case-fatality rate was 6.3%.

There was only one apparent PCV failure in 2015. This case had received four doses of a PCV that included the serotype responsible for their disease.

The highest rate of IPD was in Lakes District Health Board (DHB) (21.0 per 100,000, 22 cases), followed by Northland (16.6 per 100,000, 28 cases) and Tairawhiti (14.8 per 100,000, 7 cases) DHBs. Between 2009 and 2015, rates of IPD have decreased across most DHBs.

The most prevalent serotypes in 2015 were 19A (90 cases), 22F (40 cases), 7F (38 cases) and 3 (33 cases). These four types collectively accounted for 46.7% (201/430) of the culture-positive cases

typed in 2015. The PCV13 serotype 19A has been the most common type among IPD cases since 2011, with significant increases in the 5–64 years and ≥65 years age groups since PCV was introduced.

In addition to these increases in 19A disease in the older age groups, there have been two one-off annual increases in the <2 years age group - between 2011 and 2012 and again between 2013 and 2014. In 2015 there were only two cases of serotype 19A IPD reported in the <2 years age group.

The rates of IPD due to the PCV10 serotype 7F increased in the 5–64 years and ≥65 years age groups between 2011 and 2013. However in 2014 and 2015, there were successive decreases in the rates of IPD due to type 7F in both these age groups. These decreases are probably an indication that the switch from PCV7 to PCV10 for routine infant immunisation in 2011 is now having an indirect effect on type 7F disease in the older age groups.

After an increase in 2014 in the prevalence of IPD due to the PCV13 serotype 3 in the <65 years age groups, cases decreased again in 2015, with no cases in the <2 years age group compared with seven in 2014. This decrease in type 3 disease in 2015 may be a result of the partial coverage of the <2 years age group with PCV13 following the change to this vaccine in 2014.

Based on the Clinical and Laboratory Standards Institute's meningitis breakpoints, 21.9% of isolates from IPD cases in 2015 were penicillin resistant and 2.6% 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 52.1% in 2015.

INTRODUCTION

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

On 1 June 2008, pneumococcal conjugate vaccine (PCV) was added to the New Zealand childhood immunisation schedule, with a catch-up programme for all children born on or after 1 January 2008. Initially the 7-valent conjugate vaccine (PCV7), Prevenar®, was used. In July 2011, Prevenar® was replaced on the schedule with the 10-valent conjugate vaccine (PCV10), Synflorix®. In July 2014, Synflorix® was replaced by the 13-valent conjugate vaccine (PCV13), Prevenar13® [1]. With both the change to PCV10 in 2011 and the change to PCV13 in 2014, there was no catch-up programme for children fully or partially vaccinated with a lower-valency PCV. Any child who was part-way through their 4-dose PCV course completed the course with the higher-valency vaccine. Although both these schedule changes occurred mid-year, the actual use of the new vaccines did not begin until some months later as supplies of the lower-valency vaccines were depleted.

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 [3-8].

Prior to these annual reports, information from ESR's laboratory-based surveillance of IPD was published periodically [9-13]. 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 2015, as well as trend data for recent years.

METHODS

SURVEILLANCE METHODS

In this report, data for 2009 to 2015 is based on IPD case notifications from EpiSurv, 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 [14]:

- isolation of *S. pneumoniae* from blood, cerebrospinal fluid (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 data is collated and analysed on behalf of the Ministry of Health by ESR. A copy of the Case Report Form that is used to collect the notification data is provided in the Appendix.

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 20 June 2016. 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 in EpiSurv. 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 in 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 [15]. The full range of factorised antisera is not held by ESR. Consequently, the serotypes of some isolates could not be determined. In this report, isolates not able to be serotyped are described by their serogroup followed by the designation NT (non-typable) or as 'Non-typable' if unable to be typed by any antisera.

Antimicrobial susceptibility testing

The penicillin and cefotaxime susceptibilities of *S. pneumoniae* isolates are determined by Etest (BioMerieux, France), using Mueller-Hinton agar with 5% sheep blood and incubation for 20–24 hours in 5% CO_2. Chloramphenicol, clindamycin, co-trimoxazole, erythromycin, moxifloxacin, rifampicin, tetracycline and vancomycin susceptibilities are determined by the Clinical and Laboratory Standards Institute's (CLSI's) disc susceptibility testing method [16]. Inducible clindamycin resistance is detected by the D-zone test [16]. All minimum inhibitory concentrations (MICs) and zone of inhibition diameters were interpreted according to the 2015 CLSI standards [17].

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, is derived from the 2015 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 2015 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 2015 mid-year population estimates. The demographic data presented for cases are obtained from the Episurv record. Where ethnicity is reported as unknown in the EpiSurv record (approximately 20% of cases), this information is obtained from the Ministry of Health, through matching to the National Health Index (NHI) database. Any cases that cannot be matched to the NHI database remain of unknown ethnicity. 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 Index of Deprivation (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.

Clinical presentation is determined from the EpiSurv record which is completed through the review of available clinical records. Notifiers are advised to report specific clinical presentations over 'bacteraemia

without focus'. More than one clinical presentation may be recorded for some cases of IPD. The clinical presentations are prioritised in the following order: meningitis, empyema, pneumonia, bacteraemia without focus (positive blood culture without a specific clinical site of infection) and 'Other'. In this report, any cases for which *S. pneumoniae* was identified in CSF (by culture, polymerase chain reaction (PCR) or antigen test) and which were not notified as meningitis cases were considered to be cases of pneumococcal meningitis.

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

IPD notifications from EpiSurv 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 the former National Vaccine Store at ESR 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 from EpiSurv and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD. Compared with notifications, laboratory-based surveillance is likely to underestimate the burden of IPD. In some time-series data presentations in the Appendix of this report, due to page-size limitations, the years 2008-2010 have been omitted. These three years represent the year in which PCV was added to the childhood immunisation schedule and the following two years. However, the earlier years, 2006 and 2007, have been retained to represent the pre-PCV era. Data for 2008-2010 can be obtained from earlier annual reports [2-7].

VACCINE 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

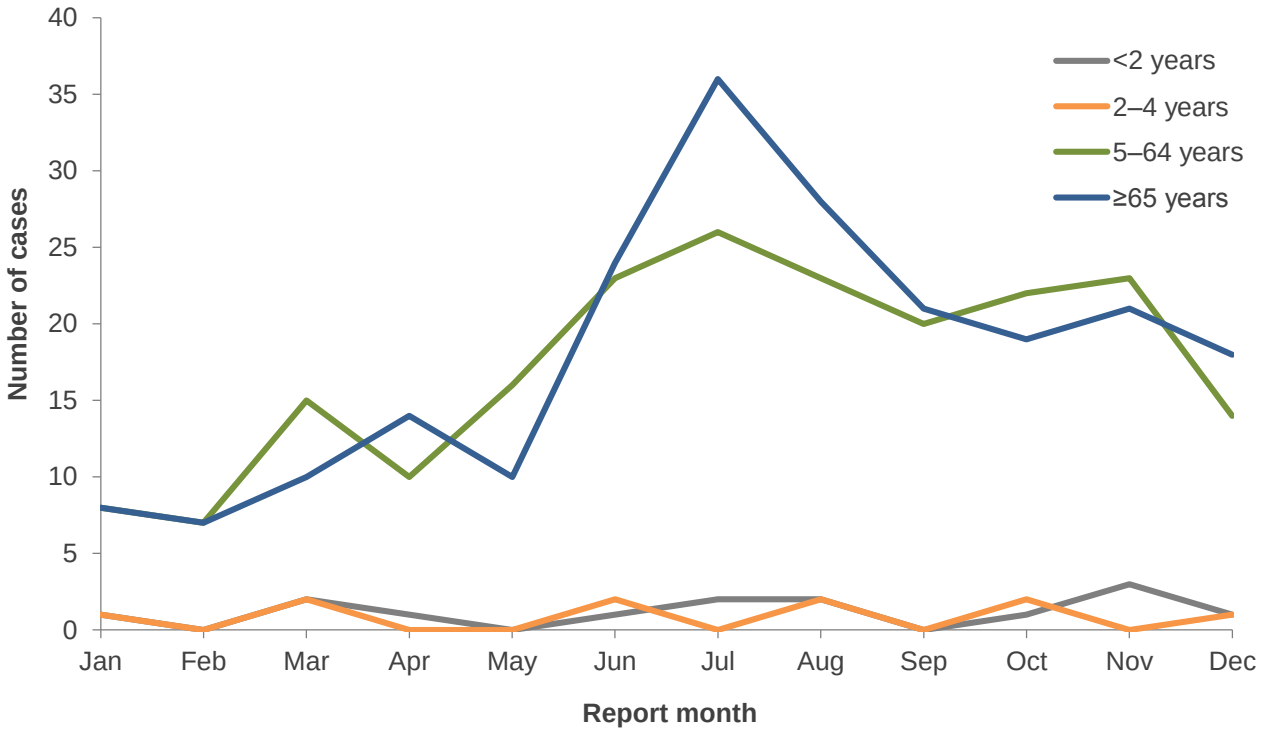
In 2015, 447 cases of IPD were notified. The 2015 notification rate for IPD was 9.7 cases per 100,000 population, a significant decrease from the 2014 rate (10.8 per 100,000, 489 cases).

A breakdown of the laboratory criteria upon which the IPD diagnosis was based is available in Table 12 (Appendix). In 2015, 92.8% 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 430 (96.2%) of the 447 cases notified in 2015.

DISEASE INCIDENCE BY SEASON

During 2015 there was the usual marked peak of cases in the winter months among cases aged ≥5 years (Figure 1).

Figure 1. Number of invasive pneumococcal disease cases by age group and month, 2015



DISEASE INCIDENCE BY AGE AND SEX

Age and sex were recorded for all IPD cases in 2015. The distribution of the 2015 cases by age group and sex is presented in Table 1. The rates of IPD were generally higher among males than females. The highest rates were in adults aged ≥65 years and in infants aged <1 year. Rates of IPD showed an increasing trend with age from 25 years onwards.

Table 1. Number of cases and rate per 100,000 population of invasive pneumococcal disease by age group and sex, 2015

Age group (years)	Female		Male		Total		
	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]	%[b]
<1	4	-	6	19.7	10	16.9	2.2
1	3	-	1	-	4	-	0.9
2–4	5	5.5	5	5.2	10	5.3	2.2
5–14	6	2.0	4	-	10	1.6	2.2
15–24	5	1.6	13	3.8	18	2.7	4.0
25–34	11	3.6	11	3.7	22	3.7	4.9
35–44	12	3.9	14	5.0	26	4.5	5.8
45–54	23	7.0	34	11.2	57	9.0	12.8
55–64	34	12.3	40	15.3	74	13.8	16.6
65–74	44	21.9	57	30.0	101	25.8	22.6
75–84	35	31.8	37	39.7	72	35.4	16.1
≥85	26	51.5	17	57.4	43	53.7	9.6
Aggregated age groups (years)							
<2[c]	7	12.2	7	11.5	14	11.8	3.1
<5	12	8.1	12	7.6	24	7.8	5.4
5–64	91	5.0	116	6.5	207	5.7	46.3
≥65	105	29.0	111	35.5	216	32.0	48.3
Total	**208**	**8.9**	**239**	**10.6**	**447**	**9.7**	**100.0**

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

[b] Percentage of cases in each age group.

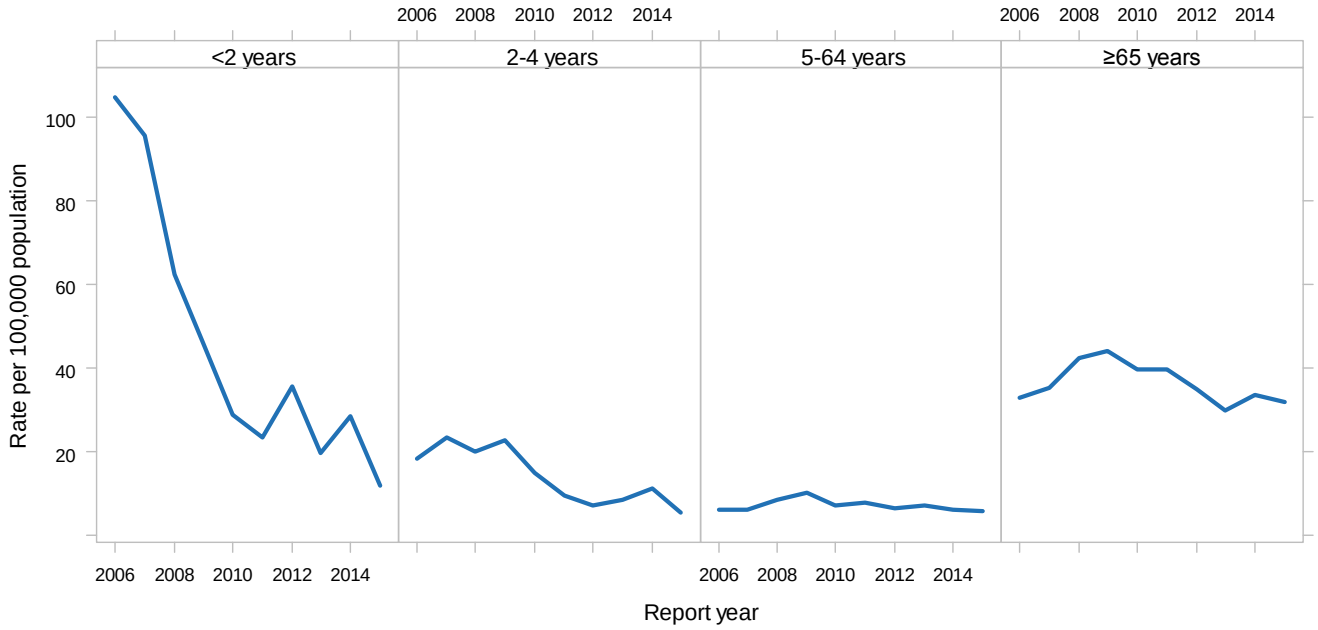
[c] The age in months of the cases <2 years of age is presented in Figure 9 (Appendix).

Between 2006 and 2015, there was a significant 85.3% decrease in the rate of IPD in the <5 years age group (53.5 to 7.8 per 100,000) (Figure 2). The actual reductions in disease rates in this age group may be greater than these figures indicate due to the change in 2009 from laboratory-based surveillance to the more sensitive notification-based surveillance.

While rates in the older age groups (5–64 years and ≥65 years) in 2015 were similar to the rates in 2006, these results are hard to interpret due to the change during this period from laboratory-based to notification-based surveillance. However, it is notable that the rates in both these older age groups have decreased significantly over the period of notification-based surveillance of IPD (ie, since 2009).

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

Figure 2. Rate per 100,000 population of invasive pneumococcal disease by age group and year, 2006–2015



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 433 (96.9%) of the 447 IPD cases in 2015. The age-standardised rates of IPD were highest for the Pacific peoples (31.3 per 100,000, 51 cases) and Māori (27.7 per 100,000, 107 cases) ethnic groups. The rates for these two ethnic groups were, respectively, 4.3 and 3.8 times higher than the rate for the European or Other ethnic group (7.3 per 100,000, 259 cases) (Table 2).

Among the 14 cases aged <2 years, six cases were Māori ethnic group, five cases were European or Other, and three cases were Pacific peoples.

Between 2009 and 2015, the age-standardised IPD rates decreased significantly in the European or Other (-41.2%), Māori (-16.4%), and Pacific peoples (-21.6%) ethnic groups (Figure 3). Rates of IPD by ethnic group and age group for the years 2009 to 2015 are presented in Table 14 (Appendix).

Table 2. Number of cases, and age-specific and age-standardised rate per 100,000 population of invasive pneumococcal disease by ethnic group and age group, 2015

Age group (years)	Māori		Pacific peoples		Asian		MELAA[a]		European or Other	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
<1	5	32.7	1	-	0	-	0	-	4	-
1	1	-	2	-	0	-	0	-	1	-
2–4	4	-	0	-	0	-	0	-	6	6.1
5–14	2	-	6	10.7	0	-	0	-	2	-
15–24	6	4.7	3	-	0	-	0	-	8	2.2
25–34	7	7.9	3	-	1	-	0	-	11	3.2
35–44	9	11.4	2	-	1	-	0	-	13	3.4
45–54	17	22.6	3	-	1	-	0	-	31	6.8
55–64	11	21.6	15	75.7	4	-	0	-	42	10.0
65–74	28	106.4	8	73.1	5	23.6	1	-	54	16.3
75–84	15	154.5	6	142.1	2	-	0	-	49	27.2
≥85	2	-	2	-	1	-	0	-	38	50.1
Aggregated age groups (years)										
<2	6	19.6	3	-	0	-	0	-	5	8.3
<5	10	12.7	3	-	0	-	0	-	11	7.0
5–64	52	9.2	32	13.5	7	1.5	0	-	107	4.6
≥65	45	119.3	16	99.8	8	25.5	1	-	141	24.0
Total cases and crude rate for all ages[b]	**107**	**15.6**	**51**	**18.0**	**15**	**2.9**	**1**	**-**	**259**	**8.5**
Age-standardised rate[c]		**27.7**		**31.3**		**5.7**		**-**		**7.3**

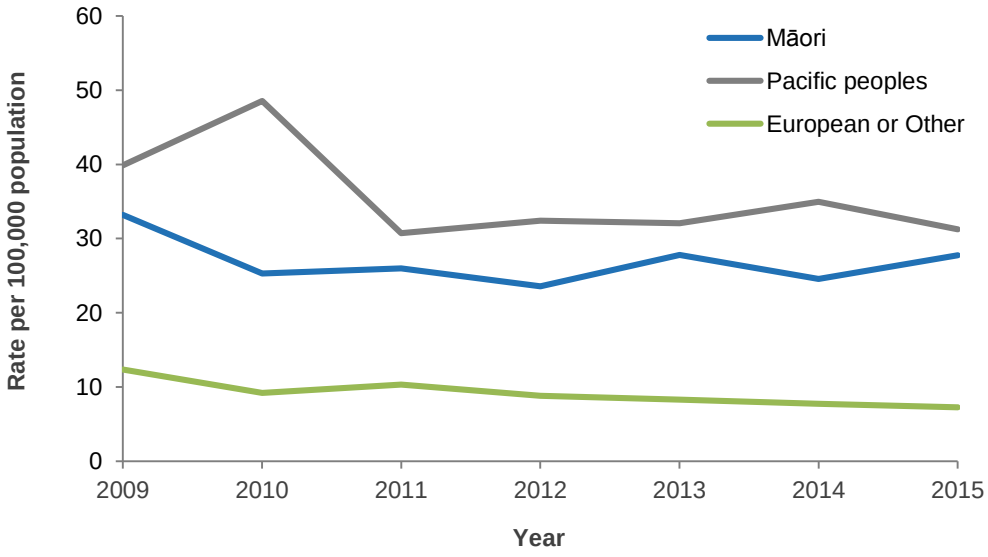
[a] Middle Eastern/Latin American/African.

[b] Ethnicity was recorded for 433 (96.9%) of cases notified in 2015.

[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 2015 mid-year population estimates from Statistics New Zealand. Ethnicity is prioritised in the following order: Māori, Pacific peoples, Asian, MELAA and European or Other ethnicity (including New Zealander). Where there were fewer than five cases in any category, a rate has not been calculated.

Figure 3. Age-standardised rate per 100,000 population of invasive pneumococcal disease by ethnic group, 2009–2015



Note: Rates for the Asian and MELAA ethnic groups are not shown due to small numbers.

DISEASE INCIDENCE BY DEPRIVATION

In 2015, 431 (96.4%) of the 447 IPD cases had a residential address recorded that could be assigned an NZDep13 score. In all age groups, at least 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 (17.5 per 100,000, 146 cases), 2.4 times the rate in the least deprived areas (7.2 per 100,000, 63 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 2015, rates of IPD decreased for all NZDep13 quintiles except quintile 1 (Table 15, Appendix). The decreases were statistically significant for quintile 2 (-25.9%), quintile 3 (-25.7%), quintile 4 (-47.4%) and quintile 5 (-37.6%).

Table 3. Number and percentage of invasive pneumococcal disease cases by quintiles of the 2013 New Zealand deprivation index and age group, 2015

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	2	14.3	0	0.0	35	17.3	26	12.7	63	14.6	7.2
2	1	7.1	1	10.0	28	13.9	30	14.6	60	13.9	7.0
3	1	7.1	3	30.0	38	18.8	39	19.0	81	18.8	9.7
4	1	7.1	3	30.0	28	13.9	49	23.9	81	18.8	9.8
5	9	64.3	3	30.0	73	36.1	61	29.8	146	33.9	17.5
Total[d]	**14**		**10**		**202**		**144**		**431**		

[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 2015 mid-year population estimates from Statistics New Zealand.

[d] Accurate New Zealand Deprivation Index (NZDep13) data was available for 431 (96.4%) cases notified in 2015.

DISEASE PRESENTATION, HOSPITALISATIONS AND FATALITIES

In 2015, 446 (99.8%) of the 447 IPD cases had at least one clinical presentation recorded (Table 4). Among infants aged <1 year, meningitis and bacteraemia without focus were the most common presentations (30.0% each). Pneumonia was the most common presentation among cases aged ≥5 years (73.5%).

The rate of pneumococcal meningitis was 0.6 per 100,000 across all age groups (Table 16 in the Appendix).

The three cases of pneumococcal meningitis aged <1 year were in the Māori (2 cases) and European or Other (1 case) ethnic groups.

Table 4. Clinical presentation of invasive pneumococcal disease cases by age group, 2015

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	3	30.0	0	-	1	10.0	3	30.0	3	30.0	10
1	1	25.0	0	-	2	50.0	0	-	1	25.0	4
2–4	1	10.0	1	10.0	4	40.0	4	40.0	0	-	10
5–14	3	30.0	0	-	3	30.0	4	40.0	0	-	10
15–64	14	7.1	7	3.6	138	70.1	25	12.7	13	6.6	197
≥65	5	2.3	2	0.9	169	78.6	27	12.6	12	5.6	215
Aggregated age groups (years)											
<2	4	28.6	0	-	3	21.4	3	21.4	4	28.6	14
<5	5	20.8	1	4.2	7	29.2	7	29.2	4	16.7	24
≥5	22	5.2	9	2.1	310	73.5	56	13.3	25	5.9	422
Total[d]	**27**	**6.1**	**10**	**2.2**	**317**	**71.1**	**63**	**14.1**	**29**	**6.5**	**446**

[a] Number of cases with 'yes' recorded for the clinical presentation. Only one presentation was counted for each case, with presentations prioritised in the following order: meningitis, empyema, pneumonia, bacteraemia without focus and 'Other'. Non-prioritised data, with all presentations recorded for cases who had more than one presentation reported, is available in Table 16 (Appendix). Any cases for which *S. pneumoniae* was identified in CSF were considered to be cases of pneumococcal meningitis.

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

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

[d] At least one clinical presentation was recorded for 446 (99.8%) of cases notified in 2015.

Information on whether the patient survived or died was recorded for 428 (95.7%) of the IPD cases. IPD was recorded as the primary cause of death for 27 cases, giving a case-fatality rate of 6.3% among the cases for whom this information was reported. There were no deaths due to IPD reported in the <5 years age group in 2015, compared with one death in 2014 and 2013, four deaths in 2012, no deaths in 2011 and 2010, and one death in 2009. The case-fatality rates for each age group are presented in Table 17 (Appendix). The Asian ethnic group had the highest case-fatality rate (3/15 cases, 20.0%), followed by Māori (8/101 cases, 7.9%).

Among the 434 (97.1%) IPD cases for whom hospitalisation status was recorded, 419 (96.5%) cases were hospitalised.

IMMUNISATION STATUS

Immunisation records were identified in the NIR for 20 of the 25 IPD cases in 2015 who were age-eligible for PCV (ie, cases born after 1 January 2008 and aged ≥6 weeks). The five cases who could not be matched to an NIR record were likely to be unimmunised.

Eighteen of the 20 cases with an NIR record were reported as having at least two doses of PCV before the onset of their disease (Table 5). The serotype causing IPD was known for all of these cases. Among these 18 cases, there was one case due to a PCV7 serotype, five cases due to additional serotypes covered by PCV13, and 12 cases due to non-PCV13 serotypes.

The case due to a PCV7 serotype (serotype 4) appears to be a vaccine failure: the case had received four doses of PCV10 and there were no underlying health conditions recorded in EpiSurv for the case. Of the five cases due to an additional serotype covered by PCV13, three were cases of serotype 19A disease and two were cases of serotype 3 disease. None of these five cases had received any doses of PCV13.

There were two asplenic IPD cases reported in 2015. One case (a male in the 65–74 years age group with serotype 17NT disease) had been immunised with pneumococcal vaccine, according to EpiSurv. The immunisation status of the other case (a male in the 45–54 years age group with serotype 31 disease) was not recorded in EpiSurv.

Table 5. Immunisation status of the 2015 invasive pneumococcal disease cases who were eligible for PCV

Number of doses received[a]	Cases due to PCV7 serotypes: 4, 6B, 9V, 14, 18C, 19F or 23F[b]		Cases due to additional PCV10 serotypes: 1, 5 or 7F[b]		Cases due to additional PCV13 serotypes: 3, 6A or 19A[b]		Cases due to non-PCV13 serotypes[b]		Total[b,c]	
	No	%	No	%	No	%	No	%	No	%
0	0	-	0	-	0	-	0	-	0	-
1	0	-	0	-	0	-	2	14.3	2	10.0
2	0	-	0	-	0	-	2	14.3	2	10.0
3	0	-	0	-	2[d]	40.0	5	35.7	7	35.0
4	1[c]	100	0	-	3[e]	60.0	5	35.7	9	45.0
Total	**1**		**0**		**5**		**14**		**20**	

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

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

[c] Case due to serotype 4 and had received 4 doses of PCV10.

[d] Both cases due to serotype 19A and both had received 3 doses of PCV10.

[e] Two of the cases were due to serotype 3 and both had received 4 doses of PCV7. The third case was due to serotype 19A and had received 4 doses of PCV10.

Note: Five cases eligible for PCV were unable to be matched to the NIR. According to EpiSurv records, three of these cases were not immunised and the immunisation status of the other two cases was recorded as unknown.

Further details of the three cases of serotype 19A in the <5 years age group in 2015 are presented in Table 6.

All three cases had received at least a primary course of three doses of PCV10.

Table 6. Pneumococcal conjugate vaccination history of the serotype 19A invasive pneumococcal disease cases in the less than 5 years age group, 2015

Number of doses received	Case number	Age group	Number of PCV7 doses	Number of PCV10 doses	Number of PCV13 doses
3	1	5–14 months	0	3	0
	2	5–14 months	0	3	0
4	3	2–4 years	0	4	0

RISK FACTORS

The risk factors reported among IPD cases in 2015 are presented in Table 7. The most common risk factor among all cases was chronic illness (53.8%). Risk factors for cases in the <2 years, <5 years and ≥5 years age groups are presented in Table 18, Table 19 and Table 20 (Appendix), respectively. Premature gestation (<37 weeks) was the most common risk factor recorded for the <2 years age group, although information on this risk factor was only recorded for just over half (6/10) of the cases (ie, those aged <1 year) for whom this risk factor is monitored. Chronic illness was the most commonly recorded risk factor for the ≥5 years age group.

Table 7. Exposure to risk factors associated with invasive pneumococcal disease for cases, 2015

Risk factor	Cases[a]	Total reported[b]	%[c]
Chronic illness[d]	220	409	53.8
Premature (<37 weeks gestation)[e]	3	6	50.0
Current smoker[f]	88	338	26.0
Immunocompromised[g]	80	406	19.7
Chronic lung disease or cystic fibrosis	67	415	16.1
Smoking in the household[h]	1	7	14.3
Attends childcare[h]	1	7	14.3
Resident in long-term or other chronic-care facility[i]	32	404	7.9
Cochlear implants	7	380	1.8
Congenital or chromosomal abnormality	5	410	1.2
Anatomical or functional asplenia	2	399	0.5

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

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

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

[d] 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 ≥15 years only.

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

[h] Cases aged <5 years only.

[i] Among cases in the ≥75 years age group, 22.5% (23 cases out of 102 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) (21.0 per 100,000, 22 cases), followed by Northland (16.6 per 100,000, 28 cases) and Tairawhiti (14.8 per 100,000, 7 cases) DHBs (Table 8 and Figure 4). Across the regions, rates ranged from 8.5 in the Southern region to 11.8 per 100,000 in the Midland region (Table 8).

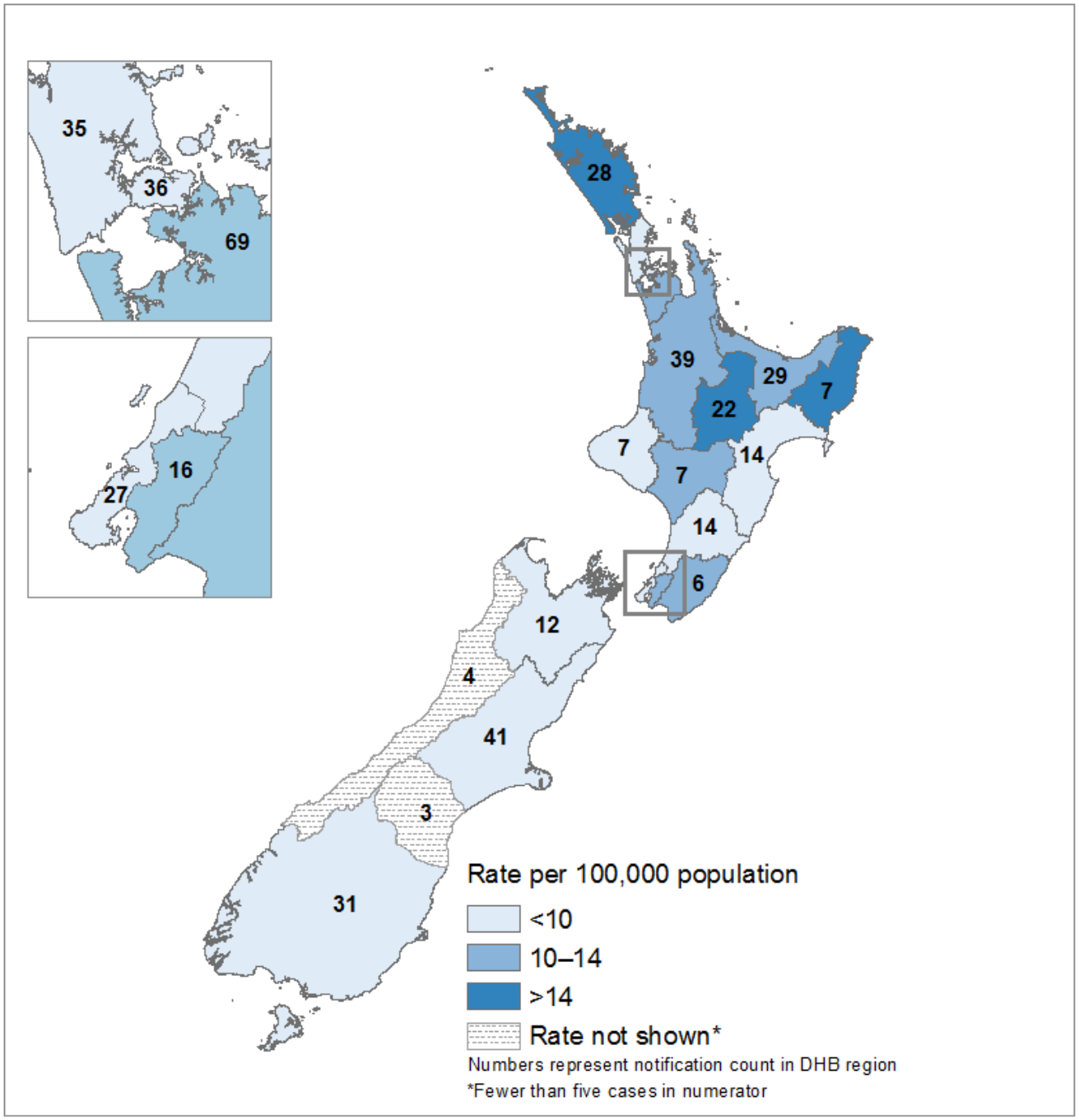
Between 2009 and 2015, rates of IPD have decreased for most DHBs (Table 21 in the Appendix). These decreases were statistically significant in Waitemata, Auckland, Counties Manukau, Waikato, Bay of Plenty, Taranaki, Hawke's Bay and Hutt Valley DHBs.

Table 8. Number of cases of invasive pneumococcal disease by age group and rate per 100,000 population for each District Health Board, 2015

District Health Board	Cases by age group (years)					Rate[a] (all ages)
	<2	<5	5–64	≥65	All ages	
Northland	1	1	15	12	28	16.6
Waitemata	1	1	14	20	35	6.1
Auckland	1	2	21	13	36	7.3
Counties Manukau	5	7	39	23	69	13.2
Northern region	**8**	**11**	**89**	**68**	**168**	**9.6**
Waikato	2	3	17	19	39	10.0
Lakes	0	1	9	12	22	21.0
Bay of Plenty	0	2	12	15	29	13.1
Tairawhiti	0	0	3	4	7	14.8
Taranaki	0	0	3	4	7	6.0
Midland region	**2**	**6**	**44**	**54**	**104**	**11.8**
Hawke's Bay	0	0	2	12	14	8.7
Whanganui	0	0	3	4	7	11.2
MidCentral	0	0	7	7	14	8.1
Hutt Valley	0	1	5	10	16	11.1
Capital & Coast	0	0	12	15	27	9.0
Wairarapa	0	1	3	2	6	13.9
Nelson Marlborough	0	0	7	5	12	8.3
Central region	**0**	**2**	**39**	**55**	**96**	**9.3**
West Coast	0	0	1	3	4	-
Canterbury	2	3	21	17	41	7.8
South Canterbury	0	0	2	1	3	-
Southern	2	2	11	18	31	9.9
Southern region	**4**	**5**	**35**	**39**	**79**	**8.5**
Total	**14**	**24**	**207**	**216**	**447**	**9.7**

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

Figure 4. Geographic distribution of invasive pneumococcal disease cases, 2015



SEROTYPE DISTRIBUTION

Table 9 shows by age group the number and proportion of the 430 isolates from culture-positive IPD cases referred to ESR in 2015 caused by each of the serotypes included in PCV7, PCV10 and PCV13, and any other serotypes that accounted for five or more cases. Table 22 (Appendix) presents the rates per 100,000 of IPD caused by these same serotypes.

In the <2 years age group, only three cases (21.4%) of IPD were due to a PCV13 serotype (Table 9). One of the cases was serotype 6B, 5 months old, of Pacific peoples ethnicity and immunisation status was unknown (ie, the case could not be matched to a NIR record and was most likely unimmunised). The other two cases were both serotype 19A, 10 months old, of European or Other ethnicity and fully vaccinated for their age with three doses of PCV10 (see Table 6).

The proportion of IPD due to PCV13 types was higher in the older age groups: 56.6% in the 5–64 years and 46.6% in the ≥65 years age groups (Table 9). Among the ≥65 years age group, 74.0% of cases were due to PPV23 serotypes.

A full list of the serotypes of all isolates from culture-positive IPD cases in 2015 is available in Table 23 (Appendix).

Table 9. Number and percentage of invasive pneumococcal disease cases by serotype, serotypes covered by PCV7, PCV10 and PCV13, and age group, 2015

Serotype	<2 years		2–4 years		<5 years[a]		5–64 years		≥65 years[b]		Total	
	Cases	%[c]	Cases	%[c]	Cases	%[c]	Cases	%[c]	Cases	%[c]	Cases	%[c]
4	0	-	1	10.0	1	4.2	9	4.5	7	3.4	17	4.0
6B	1	7.1	0	-	1	4.2	0	-	1	0.5	2	0.5
9V	0	-	0	-	0	-	3	1.5	1	0.5	4	0.9
14	0	-	0	-	0	-	0	-	3	1.4	3	0.7
18C	0	-	0	-	0	-	1	0.5	1	0.5	2	0.5
19F	0	-	0	-	0	-	14	7.1	5	2.4	19	4.4
23F	0	-	0	-	0	-	1	0.5	5	2.4	6	1.4
PCV7	**1**	**7.1**	**1**	**10.0**	**2**	**8.3**	**28**	**14.1**	**23**	**11.1**	**53**	**12.3**
1	0	-	0	-	0	-	0	-	1	0.5	1	0.2
5	0	-	0	-	0	-	0	-	0	-	0	-
7F	0	-	0	-	0	-	28	14.1	10	4.8	38	8.8
PCV10	**1**	**7.1**	**1**	**10.0**	**2**	**8.3**	**56**	**28.3**	**34**	**16.3**	**92**	**21.4**
3	0	-	2	20.0	2	8.3	15	7.6	16	7.7	33	7.7
6A	0	-	0	-	0	-	1	0.5	0	-	1	0.2
19A	2	14.3	1	10.0	3	12.5	40	20.0	47	22.6	90	20.9
PCV13	**3**	**21.4**	**4**	**40.0**	**7**	**29.2**	**112**	**56.6**	**97**	**46.6**	**216**	**50.2**
6C	1	7.1	1	10.0	2	8.3	13	6.6	11	5.3	26	6.0
8	1	7.1	0	-	1	4.2	12	6.1	5	2.4	18	4.2
9N	0	-	0	-	0	-	5	2.5	4	1.9	9	2.1
11A	0	-	0	-	0	-	1	0.5	4	1.9	5	1.2
15A	0	-	0	-	0	-	2	1.0	4	1.9	6	1.4
15B	1	7.1	2	20.0	3	12.5	4	2.0	6	2.9	13	3.0
16F	0	-	0	-	0	-	2	1.0	3	1.4	5	1.2
22F	1	7.1	1	10.0	2	8.3	15	7.6	23	11.1	40	9.3
23A	2	14.3	0	-	2	8.3	4	2.0	10	4.8	16	3.7
23B	0	-	1	10.0	1	4.2	3	1.5	8	3.8	12	2.8
31	0	-	0	-	0	-	2	1.0	3	1.4	5	1.2
33F	2	14.3	0	-	2	8.3	4	2.0	8	3.8	14	3.3
35F	1	-	0	-	1	4.2	3	1.5	1	0.5	5	1.2
Other	2	14.3	1	10.0	3	12.5	16	8.1	21	10.1	40	9.3
Non-PCV[d]	**11**	**78.6**	**6**	**60.0**	**17**	**70.8**	**86**	**43.4**	**111**	**53.4**	**214**	**49.8**
Total[e]	**14**		**10**		**24**		**198**		**208**		**430**	

[a] Aggregated age group.

[b] Among the cases in the ≥65 years age group, 74.0% were due to PPV23 serotypes. Vaccination with PPV23 is recommended for people in this age group.

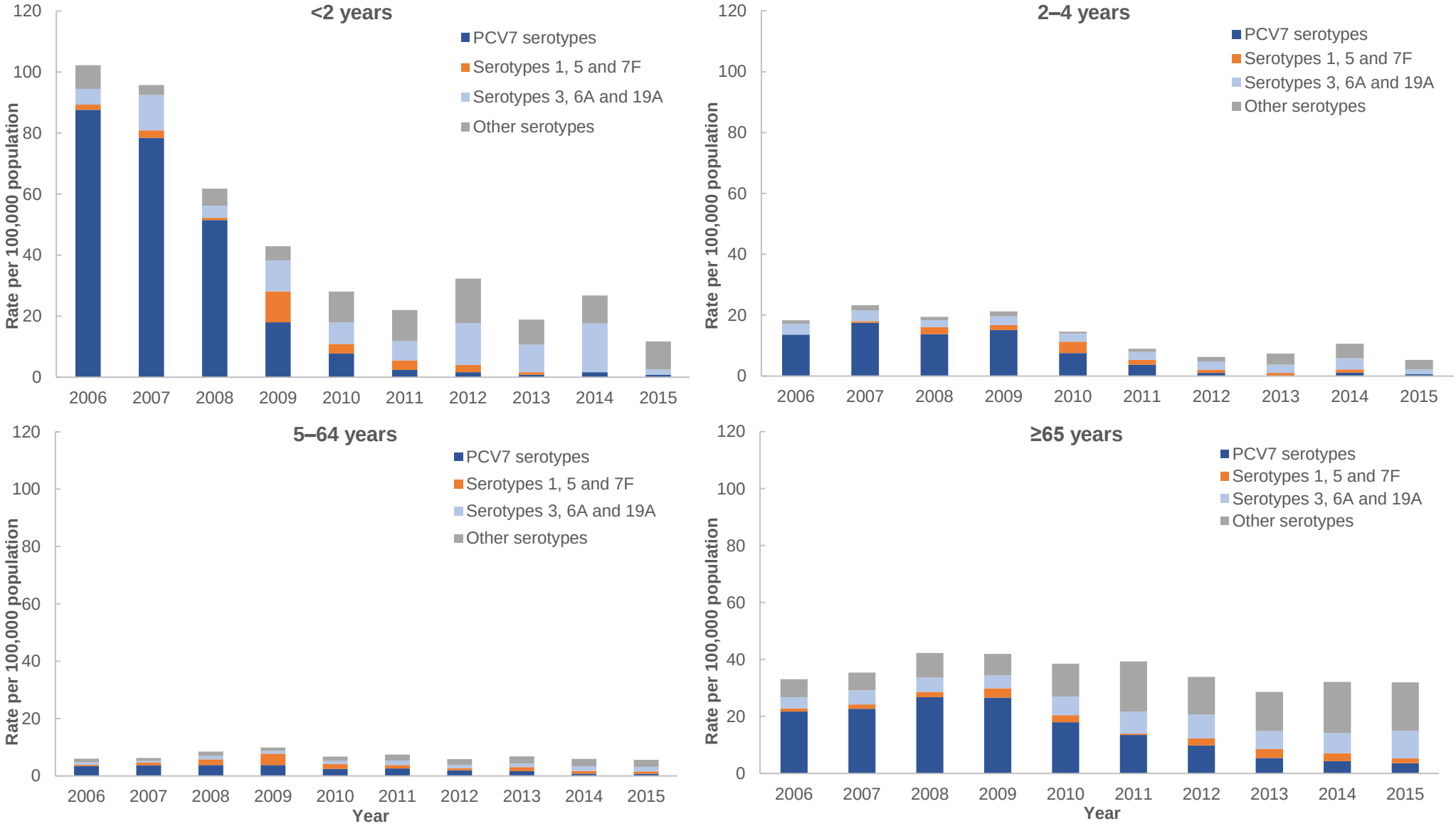
[c] Percentage of cases within the age group with the serotype.

[d] The specific non-PCV serotypes listed are those that accounted for five or more cases of IPD in 2015.

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

The trends in the rates of disease due to PCV7 serotypes, the additional serotypes covered by PCV10 (1, 5 and 7F) and PCV13 (3, 6A and 19A), and all other serotypes for the different age groups are presented in Figure 5. Since the introduction of PCV7 to the national immunisation schedule in 2008 and the change to PCV10 in 2011, there have been significant decreases in IPD rates due to PCV10 serotypes in all age groups, with a greater decrease for PCV7 serotypes. The largest decreases have been in the <2 years and 2–4 years age groups, with 99.0% and 96.6% reductions in the rates between 2006/2007 and 2015, respectively, in these two age groups, resulting in a 98.5% reduction in the combined <5 years age group. The reductions over the same time period in the older age groups have also been significant, at 64.0% in the 5–64 years age group and 78.6% in the ≥65 years group. Data is presented for each of the age groups in Table 24, Table 25, Table 26 and Table 27 (Appendix) and for all cases in Table 28 (Appendix).

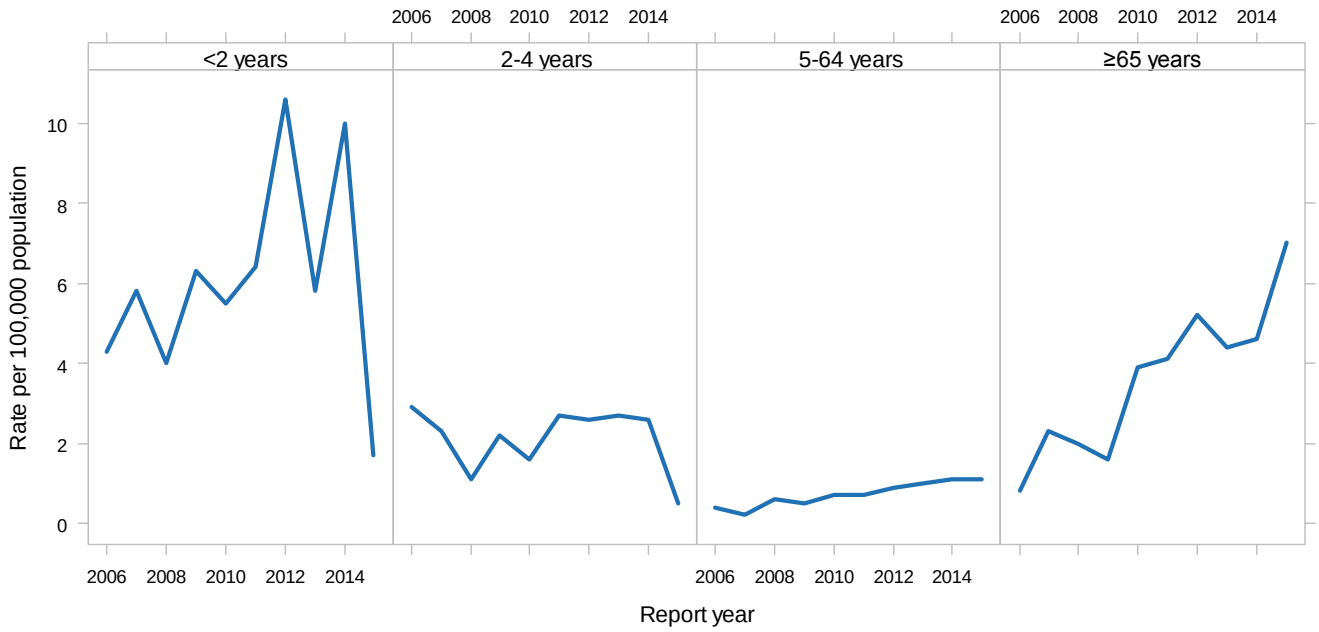
Figure 5. Rate per 100,000 population of invasive pneumococcal disease due to PCV7 serotypes, additional PCV10 types, additional PCV13 types and non-PCV13 types, by age group and year, 2006–2015



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

In 2015, there were a total of 90 IPD cases due to the PCV13 serotype 19A – more than twice the number of any other serotype and type 19A was the most prevalent serotype in the 5–64 and ≥65 years age groups (Table 9). Since 2006, there have been significant increases in the rate of 19A disease in the 5–64 years (0.4 to 1.1 per 100,000) and ≥65 years [0.8 (rate based on 4 cases) to 7.0 per 100,000] age groups (Figure 6 and Table 29 in the Appendix). Between 2011 and 2012, a significant increase in serotype 19A IPD was observed in the <2 years age group (from 6.3 to 10.5 per 100,000), followed by a decrease in 2013 to 5.8 per 100,000 and another increase in 2014 to 10.0 per 100,000. In 2015 there were only two cases of serotype 19A IPD reported in the <2 years age group.

Figure 6. Rate per 100,000 population of invasive pneumococcal disease due to serotype 19A by age group and year, 2006–2015

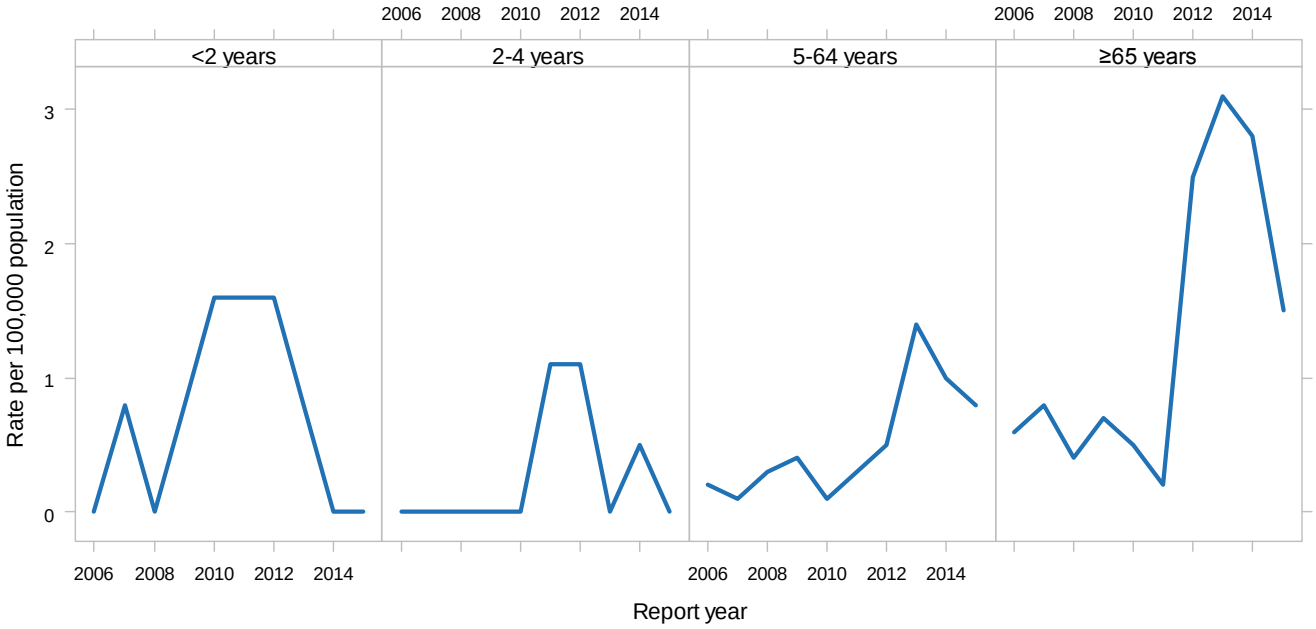


Note: Data presented from 2009 onwards is based on IPD notifications and data prior to 2009 is from ESR's national laboratory-based surveillance of IPD.

The other common serotypes in 2015 were 22F (40 cases), 7F (38 cases) and 3 (33 cases) (Table 9). Of particular note, rates of IPD due to the PCV10 serotype 7F increased in the 5–64 years and ≥65 years age groups between 2011 and 2013. However in 2014 and 2015, there were successive decreases in the rates of IPD due to type 7F in both age groups (Figure 7 and Table 30 in the Appendix).

There was a notable increase in the prevalence of the PCV13 serotype 3 in 2014, with total case numbers of this type increasing from 23 in 2013 to 42, with most of the increase in the <65 years age groups. However, in 2015 cases of type 3 IPD decreased again (to 33 cases), with no cases in the <2 years age group compared with seven in 2014 (Table 24, Table 25, Table 26 and Table 27 in the Appendix).

Figure 7. Rate per 100,000 population of invasive pneumococcal disease due to serotype 7F by age group and year, 2006–2015



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

ANTIMICROBIAL SUSCEPTIBILITY

Table 10 shows the antimicrobial susceptibility of the isolates from the 430 culture-positive IPD cases referred to ESR in 2015. The penicillin and cefotaxime MIC distributions are presented in Table 31 (Appendix).

Based on the CLSI meningitis interpretations, 21.9% of isolates were resistant to penicillin and 2.6% were cefotaxime resistant. Among the penicillin-resistant isolates (meningitis interpretation), 21.3% (20/94) were multiresistant to at least three additional antibiotics, most commonly co-trimoxazole, erythromycin and tetracycline with or without cefotaxime resistance.

Rates of penicillin resistance, cefotaxime resistance and multidrug resistance over the last 10 years (2006–2015) are presented in Table 32 (Appendix). There has been no overall trend in the prevalence of penicillin resistance between 2006 and 2015. Penicillin resistance rates (meningitis interpretation) have varied year-to-year from a high of 22.3% in 2007 to a low of 14.1% in 2011, with the rate of 21.9% in 2015 near the top of the range. Likewise, there has been no significant trend in the last 10 years in the rate of cefotaxime resistance. The rate of 2.6% cefotaxime resistance (meningitis interpretation) in 2015 was within the range (1.9-5.1%) recorded for other years during the last decade.

Trends in resistance to the non-β-lactam antibiotics over the last 10 years are presented in Table 33 (Appendix). All isolates remain susceptible to vancomycin. Moxifloxacin susceptibility has been tested since 2005, with no resistance identified and a maximum of one isolate per year with intermediate resistance. Rifampicin susceptibility has been tested since 2010, with no resistance identified.

Table 10. Antimicrobial susceptibility among isolates from invasive pneumococcal disease cases, 2015

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	78.1	-	21.9
non-meningitis	≤2	4	≥8	97.9	1.6	0.5
oral treatment	≤0.06	0.12-1	≥2	78.1	17.4	4.4
Cefotaxime						
meningitis	≤0.5	1	≥2	93.5	4.0	2.6
non-meningitis	≤1	2	≥4	97.4	1.6	0.9
	Zone diameter (mm)					
Chloramphenicol	≥21	-	≤20	98.1	-	1.9
Clindamycin[c]	≥19	16-18	≤15	93.0	0.2	6.7
Co-trimoxazole	≥19	16-18	≤15	75.1	4.7	20.2
Erythromycin	≥21	16-20	≤15	89.3	0.2	10.5
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	90.0	0.0	10.0
Vancomycin	≥17	-	-	100.0	-	-

[a] Clinical and Laboratory Standards Institute [17].

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

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

Penicillin and cefotaxime resistance in each region and DHB is presented in Table 34 (Appendix). Regional rates of penicillin resistance (meningitis interpretation) ranged from a low of 7.8% in the Central region to a high of 32.3% in the Northern region, and the difference between these two regions was significant (p <0.05). There was a similar spread in the regional rates of cefotaxime resistance (meningitis interpretation) from 0.0% in the Central region to 3.7% in the Northern region, but none of the regional differences in cefotaxime resistance reached statistical significance.

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

Table 11. Penicillin and cefotaxime resistance among isolates from invasive pneumococcal disease cases, 2015

Age group (years)	Penicillin		Cefotaxime			
	Resistant[a] MIC ≥0.12 mg/L		Intermediate[a] MIC 1 mg/L		Resistant[a] MIC ≥2 mg/L	
	Number	%[b]	Number	%[b]	Number	%[b]
<2 (n=14)	5	35.1	0	-	0	-
2−4 (n=10)	2	20.0	1	10.0	0	-
5−64 (n=198)	46	23.2	7	3.5	6	3.0
≥65 (n=208)	41	19.7	9	4.3	5	2.4
All ages (n=430)	**94**	**21.9**	**17**	**4.0**	**11**	**2.6**

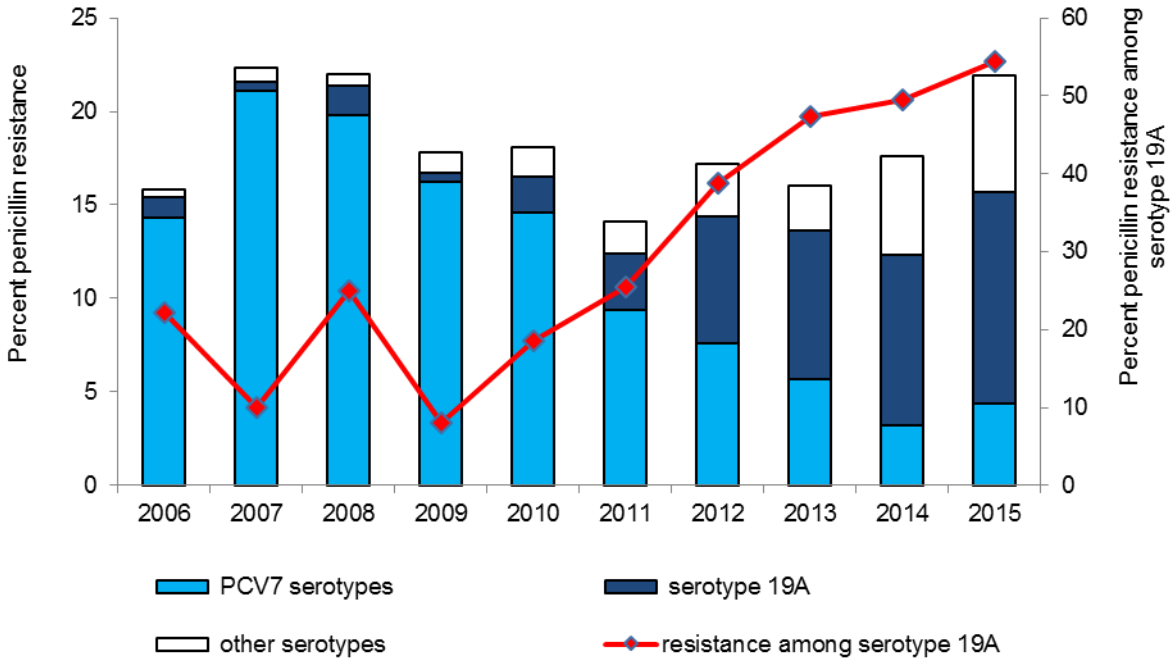
[a] CLSI meningitis interpretations; no intermediate category for penicillin [17].

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

Since the introduction of PCV into the childhood immunisation schedule, the serotype distribution among penicillin-resistant invasive pneumococci has changed markedly, with a steady decline in the proportion of penicillin resistance due to PCV7 types (Figure 8). In 2006–2007, PCV7 types accounted for 92.8% of the penicillin resistance compared with just 20.2% in 2015 (Table 35 in the Appendix). Conversely other serotypes, especially type 19A, now account for the majority of penicillin-resistant invasive pneumococci. In 2015 serotype 19A accounted for 52.1% of the penicillin-resistant invasive pneumococci (Figure 8 and Table 35 in the Appendix). In addition, the prevalence of penicillin resistance among serotype 19A isolates has increased significantly in recent years from an average of 15.8% in 2006–2007 to 54.4% in 2015 (Figure 8 and Table 36 in the Appendix).

In contrast to serotype 19A being the most prevalent type among penicillin-resistant invasive pneumococci in 2015, serotype 19F accounted for the majority of cefotaxime resistance and multiresistance: 72.7% and 55.0%, respectively. Serotype 19A was the next most prevalent type among cefotaxime-resistant and multiresistant isolates, accounting for 18.2% and 30.0%, respectively (Table 35 in the Appendix).

Figure 8. Penicillin-resistance among pneumococci from invasive disease cases, 2006–2015



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

DISCUSSION

2015 marks the seventh full year since the addition of PCV to the immunisation schedule and the impact of routine infant immunisation is now evident across all age groups. The overall notification rate of IPD has decreased by 40.1% between 2009 and 2015.

The direct impact of vaccination can be seen in the youngest ages. In children <5 years of age the overall rate of IPD (ie, disease due to any serotype) has decreased 85.3% (53.5 to 7.8 per 100,000 population between 2006/07 and 2015) while the rate of IPD due to PCV10 serotypes decreased 98.5% between 2006/07 and 2015 [44.2 to 0.7 (based on 2 cases) per 100,000].

The indirect impact of childhood vaccination can be seen in the change in the notification rates for the older age groups. While the overall rates of IPD in the 5–64 and ≥65 years age groups are still similar to the rates recorded prior to the introduction of PCV infant immunisation in 2008, the rates in these older age groups have decreased significantly since 2009, that is, over the period that surveillance has been consistently based on notifications following IPD becoming a notifiable disease in late 2008. Since 2009 among cases aged 5–64 years, the overall rate of IPD has decreased from 10.3 to 5.7 per 100,000 population (44.6% decrease). Among cases aged ≥65 years, the overall rate of IPD has decreased from 44.0 per 100,000 in 2009 to 32.0 per 100,000 (27.1% decrease). The use of 2009 as a baseline year is likely to be a more valid measure of the impact of infant immunisation on IPD in the older age groups, as laboratory-based surveillance used prior to 2009 likely underestimated IPD rates.

Rates of IPD due to vaccine serotypes in the 5–64 and ≥65 years age groups have decreased even when compared with the pre-vaccine period. Between this period (ie, 2006/7) and 2015, the rates of IPD due to PCV10 types decreased 64.0% in the 5–64 years age group (4.3 to 1.5 per 100,000) and 78.6% in the ≥65 years age group (23.5 to 5.0 per 100,000). In the ≥65 years age group it is clear that the serotypes responsible for disease have changed with a decrease in the proportion of vaccine types and increase in the non-vaccine serotypes.

Although the incidence of IPD has decreased in all ethnic groups since 2009, there are still marked ethnic disparities, with the age-standardised rates in the Māori and Pacific peoples ethnic groups 3.8 and 4.3 times those in the European or Other ethnic group. The rates for Māori and Pacific peoples have decreased significantly between 2009 and 2015 though the overall rates appear to have plateaued from 2010 to 2015 for Māori and between 2011 and 2015 for Pacific peoples. 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].

The most prevalent serotypes in 2015 were 19A, 22F, 7F and 3, and these four types collectively accounted for 47% (201/430) of the culture-positive cases. Serotype 7F is a PCV10 type, types 19A and 3 are PCV13 types, and type 22F is not currently included in any PCV although it is included in PPV23. All four serotypes have increased significantly since the introduction of PCV7 infant immunisation and essentially replaced PCV7 types.

Serotype 19A has been the most prevalent type in New Zealand each year since 2011. The overall rate is 2.0 per 100,000 similar to 2014. For 2015 the incidence rate increased in the ≥65 years age group to

7.0 per 100,000 from 4.6 per 100,000 in 2014. In many other countries, serotype 19A is the type most frequently reported to have increased and replaced vaccine types after the introduction of PCV7 [21]. While most of the increases in type 19A disease have occurred in older children and adults, in 2012 and again in 2014 there were noticeable increases in cases of 19A disease in the <5 years age group, although the case numbers are still relatively small: 18 in 2012 and 17 in 2014 versus an average of 10.0 in other years since 2009. In 2015 the number of cases was 3 in the <5 years age group. In July 2014, PCV13 (Prevenar13®) replaced PCV10 on the immunisation schedule. While allowing for the delay in practical changeover to the new vaccine, a proportion of <2 year olds will have commenced or completed their vaccination course with PCV13 in 2015. The delay in changeover to the new vaccine has been estimated to be approximately five months, with PCV13 being used for about 93% of first doses given in December 2014 and about 98% of first doses in January 2015.

Increases in serotype 7F IPD were first noted in 2012, with rates essentially doubling in 2012 and again in 2013.The total number of cases fell in 2014 and 2015. The incidence rate for 2015 was 0.8 per 100,000, the same rate as 2012. These increases in IPD due to type 7F occurred after the immunisation schedule change from PCV7 to PCV10 in July 2011, and serotype 7F is one of the three additional types in PCV10. However, the increases have occurred almost wholly in the older age groups rather than the vaccine-eligible age groups. International and local experience has shown that indirect immunity lags behind direct immunity by at least a couple of years [22, 23] and the reduction in cases in the last two years may reflect that experience.

Type 3 IPD cases almost doubled between 2013 and 2014 from 23 to 42 cases while in 2015 the number of cases decreased to 33. Unlike the situation with the other prevalent replacement types, in particular 19A, 7F and 22F, the increase in type 3 IPD cases in 2014 occurred in mainly in the <65 years age groups. Type 3 is a PCV13 type and the reduction in cases for 2015 may be a result of the partial coverage with PCV13 for the <2 year old age group with the change in the immunisation schedule. However, the prevalence of type 3 IPD will need close monitoring as some studies have suggested that PCV13 does not provide good protection against this serotype [24, 25].

In July 2014, PCV13 (Prevenar13®) replaced PCV10 on the childhood immunisation schedule in New Zealand. PCV13 gives additional coverage for serotypes 3, 6A and 19A. International and New Zealand's experience with PCV7 has 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, 26]. The direct impact becomes apparent sooner than the indirect one [26].The direct and indirect effects of PCV13 on serotype 3, 6A and 19A disease in New Zealand may become clear in future years as PCV13 coverage increases. In the <2 years age group there were two cases of IPD caused by serotype 3, 6A or 19A in 2015 compared to an average of nearly 16 for the preceding three years. In 2017, the immunisation schedule will change with the re-introduction of PCV10 in place of PCV13. Surveillance will demonstrate if the recent reduction in PCV13 serotypes is maintained and allow analysis of future potential impacts of the planned change in vaccine type.

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APPENDIX

CASE REPORT FORM Invasive Pneumococcal Disease

Invasive pneumococcal disease EpiSurv No.

Reporting Authority

Name of Public Health Officer responsible for case

Notifier Identification

Reporting source* ○ General Practitioner ○ Hospital-based Practitioner ○ Laboratory ○ Self-notification ○ Outbreak Investigation ○ Other

Name of reporting source **Organisation**

Date reported* **Contact phone**

Usual GP **Practice** **GP phone**

GP/Practice address Number Street Suburb

Town/City Post Code ☐ GeoCode

Case Identification

Name of case* Surname Given Name(s)

NHI number* **Email**

Current address* Number Street Suburb

Town/City Post Code ☐ GeoCode

Phone (home) **Phone (work)** **Phone (other)**

Case Demography

Location **TA*** **DHB***

Date of birth* **OR** **Age** ○ Days ○ Months ○ Years

Sex* ○ Male ○ Female ○ Indeterminate ○ Unknown

Occupation*

Occupation location ○ Place of Work ○ School ○ Pre-school

Name

Address Number Street Suburb

Town/City Post Code ☐ GeoCode

Alternative location ○ Place of Work ○ School ○ Pre-school

Name

Address Number Street Suburb

Town/City Post Code ☐ GeoCode

Ethnic group case belongs to* (tick all that apply)

☐ NZ European ☐ Maori ☐ Samoan ☐ Cook Island Maori

☐ Niuean ☐ Chinese ☐ Indian ☐ Tongan

☐ Other (such as Dutch, Japanese, Tokelauan) *(specify)

Invasive pneumococcal disease EpiSurv No.

Basis of Diagnosis

CLINICAL PRESENTATION*

Pneumonia	○ Yes	○ No	○ Unknown
Bacteraemia without focus	○ Yes	○ No	○ Unknown
Meningitis	○ Yes	○ No	○ Unknown
Empyema	○ Yes	○ No	○ Unknown
Septic arthritis	○ Yes	○ No	○ Unknown
Other	○ Yes	○ No	○ Unknown

If other, specify

LABORATORY CRITERIA

Specimen* (tick all with positive results)

Blood	☐ culture		☐ NAAT[2]	[1] refer to the case report form instructions
CSF	☐ culture	☐ antigen detection[1]	☐ NAAT	[2] nucleic acid amplification test
Pleural fluid	☐ culture	☐ antigen detection[1]	☐ NAAT	
Joint fluid	☐ culture		☐ NAAT	
Other sterile site specimen	☐ culture		☐ NAAT	

(specify)

STATUS* ○ Under investigation ○ Confirmed ○ Not a case

ADDITIONAL LABORATORY DETAILS

Capsular type*

ESR Updated ☐ Laboratory

Date result updated Sample Number

Clinical Course and Outcome

Date of onset* ☐ Approximate ☐ Unknown

Hospitalised* ○ Yes ○ No ○ Unknown

Date hospitalised* ☐ Unknown

Hospital*

Died* ○ Yes ○ No ○ Unknown

Date died* ☐ Unknown

Was this disease the primary cause of death?* ○ Yes ○ No ○ Unknown

If no, specify the primary cause of death*

Outbreak Details

Is this case part of an outbreak (i.e. known to be linked to one or more other cases of the same disease)?*

☐ Yes **If yes, specify Outbreak No.***

Invasive pneumococcal disease EpiSurv No.

Risk Factors

Premature <37 weeks gestation (if case is <1 year of age)* ○ Yes ○ No ○ Unknown

Congenital or chromosomal abnormality (*includes Down's syndrome*)* ○ Yes ○ No ○ Unknown

Chronic lung disease or Cystic Fibrosis* ○ Yes ○ No ○ Unknown

Anatomical or functional asplenia* ○ Yes ○ No ○ Unknown

Immunocompromised* ○ Yes ○ No ○ Unknown

Includes HIV/AIDS, lymphoma, organ transplant, multiple myeloma, nephrotic syndrome, chronic drug therapy (e.g. chemotherapy or >20 mg/d prednisolone in last year), dysgammaglobulinaemia and sickle cell anaemia.

Chronic illness* ○ Yes ○ No ○ Unknown

Includes CSF leak, intracranial shunts, diabetes, cardiac disease (angina, MI, heart failure, coronary bypass), pulmonary disease (asthma, bronchitis, emphysema), chronic liver disease, renal impairment and alcohol related.

Cochlear implants* ○ Yes ○ No ○ Unknown

Current smoker* ○ Yes ○ No ○ Unknown

Smoking in the household (if case is <5 years of age)* ○ Yes ○ No ○ Unknown

Attends childcare (if case is <5 years of age)* ○ Yes ○ No ○ Unknown

Attends childcare (regular attendance >4 hours per week) in a grouped childcare setting outside the home.

Resident in long term or other chronic care facility* ○ Yes ○ No ○ Unknown

Other risk factors including illness that requires regular medical review (specify)*

Protective Factors

At any time prior to onset, had the case been immunised with the pneumococcal polysaccharide or pneumococcal conjugate vaccine?* ○ Yes ○ No ○ Unknown

If yes, specify vaccination details*

Source of information* ○ Patient/caregiver recall ○ Documented

Dose 1:* ○ Polysaccharide ○ Conjugate ○ Unknown

Date given* Or age when first dose was given ○ Weeks ○ Months ○ Years

Dose 2:* ○ Polysaccharide ○ Conjugate ○ Not given ○ Unknown

Date given* Or age when second dose was given ○ Weeks ○ Months ○ Years

Dose 3:* ○ Polysaccharide ○ Conjugate ○ Not given ○ Unknown

Date given* Or age when third dose was given ○ Weeks ○ Months ○ Years

Dose 4:* ○ Polysaccharide ○ Conjugate ○ Not given ○ Unknown

Date given* Or age when fourth dose was given ○ Weeks ○ Months ○ Years

Dose 5:* ○ Polysaccharide ○ Conjugate ○ Not given ○ Unknown

Date given* Or age when fifth dose was given ○ Weeks ○ Months ○ Years

Dose 6:* ○ Polysaccharide ○ Conjugate ○ Not given ○ Unknown

Date given* Or age when sixth dose was given ○ Weeks ○ Months ○ Years

NIR Vaccination Status (to be completed by ESR)

○ Fully vaccinated for age ○ Partially vaccinated for age ○ Not vaccinated ○ Not applicable

Date status updated NIR Reference

Comments*

Table 12. Laboratory criteria upon which invasive pneumococcal disease diagnosis based, as recorded in the case notification, 2015

Basis of diagnosis	Prioritised[a]		Total response	
	Cases	%[b]	Cases	%[b]
Culture of *S. pneumoniae* from:	**445**	**99.6**	**445[c]**	**99.6**
Blood	407	91.1	415	92.8
CSF	17	3.8	17	3.8
Pleural fluid	5	1.1	5	1.1
Joint fluid	7	1.6	12	2.7
Other normally sterile site[d]	9	2.0	12	2.7
Positive pneumococcal antigen test on CSF	**1**	**0.2**	**4**	**0.9**
Detection of pneumococcal DNA	**1**	**0.2**	**1**	**0.2**

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

[b] Percent of total 447 cases.

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

[d] Includes nine different sterile sites.

Figure 9. Number of invasive pneumococcal disease cases in the less than 2 years age group by age (in months), 2015

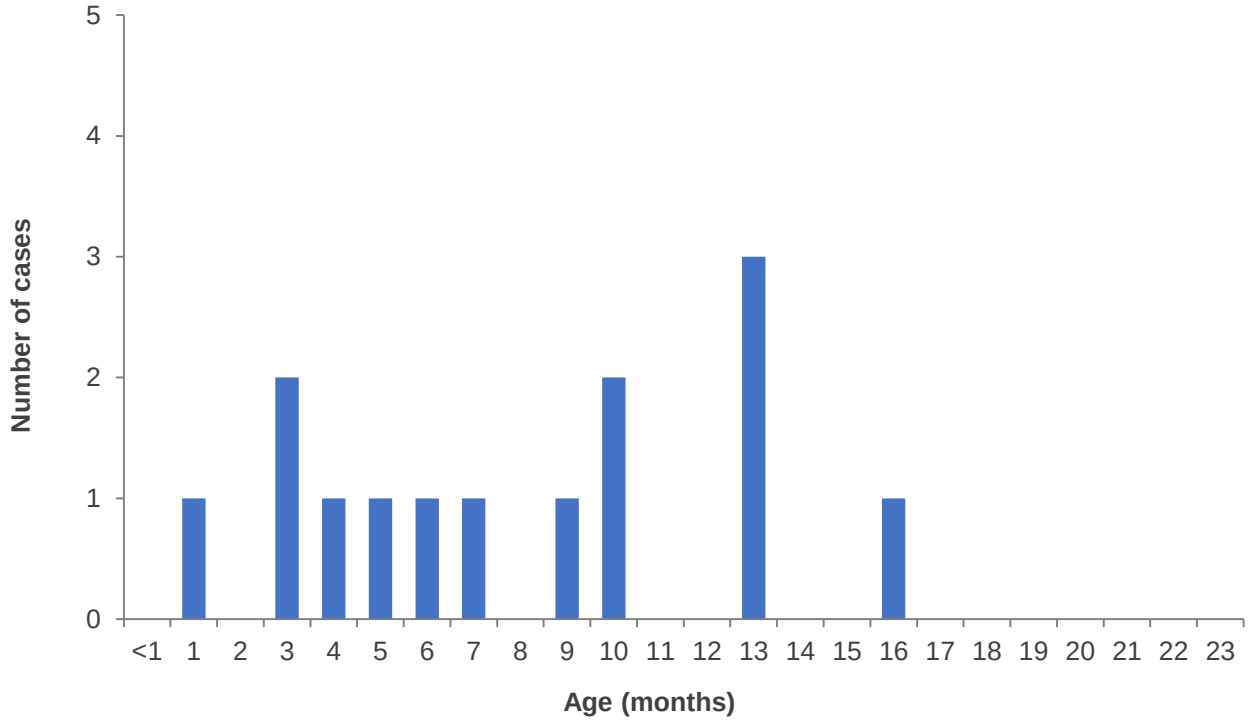

Table 13. Number of cases and rate per 100,000 population of invasive pneumococcal disease by age group and year, 2006/07–2015

Age group (years)	2006/2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
<1	59.5	98.2	37	57.4	34	53.2	22	34.1	23	36.6	31	50.7	18	29.9	22	37.4	10	16.9
1	59.5	102.2	42	67.9	25	38.9	15	23.5	7	10.8	13	20.7	6	9.8	12	19.8	4	-
2–4	35.5	20.8	35	20.0	41	22.9	28	15.1	18	9.5	14	7.3	16	8.4	21	11.1	10	5.3
5–14	24.5	4.1	35	5.9	58	9.8	23	3.9	29	4.9	20	3.4	26	4.4	18	3.0	10	1.6
15–24	17.0	2.8	29	4.8	53	8.7	25	4.1	27	4.3	21	3.4	23	3.7	19	3.0	18	2.7
25–34	20.0	3.7	32	5.9	53	9.8	25	4.6	40	7.4	24	4.4	18	3.3	24	4.2	22	3.7
35–44	47.5	7.5	53	8.4	68	10.9	39	6.3	36	5.9	37	6.1	36	6.1	36	6.1	26	4.5
45–54	39.5	6.9	55	9.2	55	9.0	59	9.6	55	8.9	44	7.1	62	9.9	50	8.0	57	9.0
55–64	59.5	13.7	87	19.1	69	14.7	75	15.5	87	17.5	74	14.7	87	17.0	69	13.1	74	13.8
65–74	77.0	27.5	87	29.9	94	31.3	80	25.7	84	25.9	84	24.5	81	22.5	105	27.9	101	25.8
75–84	70.5	39.5	88	48.6	94	51.6	87	47.4	88	47.5	82	43.6	68	35.5	67	34.1	72	35.4
≥85	30.0	50.5	51	80.7	53	80.8	57	83.2	58	82.0	45	61.8	38	50.9	46	59.2	43	53.7
Aggregated age groups (years)																		
<2	119.0	100.2	79	62.5	59	46.0	37	28.8	30	23.6	44	35.5	24	19.7	34	28.5	14	11.8
<5	154.5	53.4	114	37.9	100	32.6	65	20.7	48	15.1	58	18.4	40	12.8	55	17.8	24	7.8
5–64	208.0	6.1	291	8.5	356	10.3	246	7.1	274	7.9	220	6.3	252	7.2	216	6.1	207	5.7
≥65	177.5	34.2	226	42.2	241	44.0	224	39.8	230	39.7	211	35.0	187	29.9	218	33.5	216	32.0
Total	**540.0**	**12.8**	**631**	**14.8**	**697**	**16.2**	**535**	**12.3**	**552**	**12.6**	**489**	**11.1**	**479**	**10.8**	**489**	**10.8**	**447**	**9.7**

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. Where there are fewer than five cases in any category, a rate has not been calculated.

Table 14. Age-standardised rate per 100,000 population of invasive pneumococcal disease by ethnic group, age group and year, 2009–2015

Age group (years)	Ethnic group[a,b]													
	Māori							Pacific peoples						
	2009	2010	2011	2012	2013	2014	2015	2009	2010	2011	2012	2013	2014	2015
<2	87.8	63.4	45.7	43.9	35.1	52.0	19.6	66.0	49.4	58.1	85.3	-	53.1	-
<5	49.4	38.4	24.5	22.2	17.5	31.5	12.7	51.4	36.8	26.5	43.3	-	30.7	-
5–64	20.8	13.7	11.9	11.1	12.5	11.3	9.2	27.3	24.9	18.3	14.0	15.2	11.6	13.5
≥65	89.3	74.0	90.1	71.7	91.8	74.4	119.3	101.0	143.5	87.5	98.3	94.4	162.1	99.8
All ages[c]	**33.2**	**25.3**	**26.0**	**23.6**	**27.8**	**24.6**	**27.7**	**39.9**	**48.6**	**30.7**	**32.4**	**32.1**	**35.0**	**31.3**

Age group (years)	Ethnic group[a,b]													
	Asian							European or Other						
	2009	2010	2011	2012	2013	2014	2015	2009	2010	2011	2012	2013	2014	2015
<2	-	-	-	-	-	-	-	29.4	13.9	7.8	25.6	16.3	18.2	8.3
<5	13.8	18.9	16.0	-	-	-	-	24.6	9.9	7.3	12.9	11.8	11.9	7.0
5–64	3.0	1.8	1.6	1.1	2.7	3.8	1.5	7.4	4.6	6.8	4.9	5.7	4.4	4.6
≥65	23.8	-	-	25.1	-	-	25.5	38.4	36.0	35.8	31.0	24.0	25.9	24.0
All ages[c]	**7.4**	**5.5**	**4.2**	**5.8**	**4.3**	**6.1**	**5.7**	**12.4**	**9.2**	**10.3**	**8.8**	**8.3**	**7.8**	**7.3**

[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 (2010, 3 cases; 2011, 3 cases; 2012, 4 cases; 2013, 2 cases; 2014, 1 case; 2015, 1 case).

[b] Ethnicity was recorded for 532 (99.4%) cases in 2010, 540 (97.8%) cases in 2011, 476 (97.3%) cases in 2012, 464 (96.9%) cases in 2013, 465 (95.1%) in 2014 and 433 (96.9%) in 2015.

[c] Rates presented for all ages 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 corresponding mid-year population estimates from Statistics New Zealand for 2010–2015. Ethnicity is prioritised in the following order: Māori, Pacific peoples, Asian, MELAA and European or Other ethnicity (including New Zealander). Where there are fewer than five cases in any category, a rate has not been calculated.

Table 15. Rate per 100,000 population of invasive pneumococcal disease by quintiles of the 2013 NZ Deprivation Index and year, 2009–2015

NZDep13 quintile[a]	2009		2010		2011		2012		2013		2014		2015	
	Cases	Rate[b]	Cases	Rate[b]	Cases	Rate[b]	Cases	Rate[b]	Cases	Rate[b]	Cases	Rate[b]	Cases	Rate[b]
1	65	7.4	51	5.8	57	6.5	64	7.3	42	4.8	42	4.8	63	7.2
2	81	9.5	65	7.6	66	7.7	70	8.1	70	8.2	77	9.0	60	7.0
3	109	13.0	83	9.9	95	11.3	77	9.2	83	9.9	69	8.2	81	9.7
4	154	18.6	103	12.4	121	14.6	96	11.6	98	11.8	103	12.4	81	9.8
5	234	28.1	199	23.9	178	21.4	158	19.0	157	18.8	180	21.6	146	17.5
Total[c]	**643**		**501**		**517**		**465**		**450**		**471**		**431**	

[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 2015 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, 465 (95.1%) cases in 2012, 450 (93.9%) cases in 2013, 471 (96.3%) cases in 2014 and 431 (96.4%) cases in 2015.

Table 16. Number of cases and rate per 100,000 population of invasive pneumococcal disease by clinical presentation and age group, 2015

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	3	-	1	-	3	-	3	-	3	-
1	1	-	0	-	2	-	1	-	1	-
2–4	1	-	1	-	6	3.2	4	-	0	-
5–14	3	-	0	-	4	-	5	0.8	0	-
15–64	14	0.5	7	0.2	141	4.7	29	1.0	21	0.7
≥65	5	0.7	2		170	25.2	37	5.5	23	3.4
Total[c]	**27**	**0.6**	**11**	**0.2**	**326**	**7.1**	**79**	**1.7**	**48**	**1.0**

[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 446 (99.8%) cases notified in 2015.

Table 17. Case-fatality rates for invasive pneumococcal disease cases by age group, 2015

Age group (years)	Cases died[a]	Total reported[b]	Case-fatality rate[c] (%)
<1	0	10	0.0
1	0	4	0.0
2–4	0	10	0.0
5–14	0	9	0.0
15–64	8	189	4.2
≥65	19	206	9.2
Total	**27**	**428**	**6.3**

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

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

[c] Calculated on the basis of the number of cases for whom the information on outcomes was recorded. Information on whether the case survived or died was recorded for 428 (95.7%) of cases notified in 2015.

Table 18. Exposure to risk factors associated with invasive pneumococcal disease for cases aged less than 2 years, 2015

Risk factor	Cases[a]	Total reported[b]	%[c]
Premature (<37 weeks gestation)[d]	3	6	50.0
Smoking in the household	1	4	25.0
Chronic illness	1	13	7.7
Immunocompromised	1	14	7.1

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

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

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

[d] Cases aged <1 year only.

Note: No cases aged <2 years were reported as having anatomical or functional asplenia, chronic lung disease or cystic fibrosis, congenital or chromosomal abnormality, 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 less than 5 years, 2015

Risk factor	Cases[a]	Total reported[b]	%[c]
Premature (<37 weeks gestation)[d]	3	6	50.0
Smoking in the household	1	7	14.3
Attends childcare	1	7	14.3
Immunocompromised[e]	3	24	12.5
Chronic illness[f]	2	22	9.1
Chronic lung disease or cystic fibrosis	1	23	4.3
Congenital and chromosomal abnormality	1	24	4.2

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

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

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

[d] Cases aged <1 year only.

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

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

Note: No cases aged <5 years were reported as having anatomical or functional asplenia or cochlear implants; or being a resident in a long-term or other chronic-care facility.

Table 20. Exposure to risk factors associated with invasive pneumococcal disease for cases aged 5 years and over, 2015

Risk factor	Cases[a]	Total reported[b]	%[c]
Chronic illness[d]	218	387	56.3
Current smoker[e]	88	338	26.0
Immunocompromised[f]	77	382	20.2
Chronic lung disease or cystic fibrosis	66	392	16.8
Resident in long-term or other chronic-care facility[g]	32	383	8.4
Cochlear implants	7	359	1.9
Congenital or chromosomal abnormality	4	386	1.0
Anatomical or functional asplenia	2	375	0.5
Other risk factors	113	-	-

[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, 22.5% (23 cases out of 102 for whom the information was supplied) were residents in a long-term or other chronic-care facility.

Table 21. Rate per 100,000 population of invasive pneumococcal disease by District Health Board, 2009–2015

District Health Board	Rate[a]						
	2009	2010	2011	2012	2013	2014	2015
Northland	20.2	10.6	12.9	14.1	12.8	15.7	16.6
Waitemata	12.0	11.7	11.1	7.0	9.0	8.4	6.1
Auckland	11.6	10.1	11.5	11.4	8.3	11.4	7.3
Counties Manukau	19.0	21.9	15.4	15.3	12.1	13.6	13.2
Northern region	**14.8**	**14.2**	**12.7**	**11.3**	**10.1**	**11.5**	**9.6**
Waikato	22.7	12.8	12.4	11.2	10.6	11.2	10.0
Lakes	28.5	17.5	28.1	13.6	25.2	25.1	21.0
Bay of Plenty	24.0	15.6	13.6	16.8	16.7	13.8	13.1
Tairawhiti	19.4	-	10.7	-	10.6	14.9	14.8
Taranaki	18.3	9.0	9.8	12.4	7.9	12.2	6.0
Midland region	**22.9**	**13.2**	**14.2**	**12.8**	**13.5**	**13.8**	**11.8**
Hawke's Bay	22.6	15.3	16.5	13.3	15.1	10.0	8.7
Whanganui	19.0	14.3	9.5	9.6	16.1	16.1	11.2
MidCentral	10.3	10.8	11.3	6.5	10.1	12.3	8.1
Hutt Valley	21.2	14.7	11.9	8.4	7.7	9.1	11.1
Capital & Coast	10.5	8.0	6.5	9.9	9.5	9.8	9.0
Wairarapa	29.6	12.1	16.7	23.8	16.5	14.0	13.9
Nelson Marlborough	16.1	-	12.8	14.2	9.1	4.2	8.3
Central region	**16.0**	**10.4**	**11.2**	**10.8**	**10.9**	**9.9**	**9.3**
West Coast	-	-	-	-	18.2	-	-
Canterbury	10.9	8.2	13.4	8.2	7.9	7.8	7.8
South Canterbury	10.8	-	14.1	10.5	13.9	-	-
Southern	17.4	15.6	12.2	11.5	9.8	8.7	9.9
Southern region	**12.7**	**10.3**	**12.5**	**9.2**	**9.3**	**7.9**	**8.5**
Total	**16.2**	**12.3**	**12.6**	**11.1**	**10.8**	**10.8**	**9.7**

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

Table 22. Number of cases and rate per 100,000 population of invasive pneumococcal disease by serotype, serotypes covered by PCV7, PCV10 and PCV13, and age group, 2015

Serotype	<2 years		2–4 years		<5 years[a]		5–64 years		≥65 years[b]		Total	
	Cases	Rate[c]	Cases	Rate[c]	Cases	Rate[c]	Cases	Rate[c]	Cases	Rate[c]	Cases	Rate[c]
4	0	-	1	-	1	-	9	0.2	7	1.0	17	0.4
6B	1	-	0	-	1	-	0	-	1	-	2	-
9V	0	-	0	-	0	-	3	-	1	-	4	-
14	0	-	0	-	0	-	0	-	3	-	3	-
18C	0	-	0	-	0	-	1	-	1	-	2	-
19F	0	-	0	-	0	-	14	0.4	5	0.7	19	0.4
23F	0	-	0	-	0	-	1	-	5	0.7	6	0.1
PCV7	**1**	**-**	**1**	**-**	**2**	**-**	**28**	**0.8**	**23**	**3.4**	**53**	**1.2**
1	0	-	0	-	0	-	0	-	1	-	1	-
5	0	-	0	-	0	-	0	-	0	-	0	-
7F	0	-	0	-	0	-	28	0.8	10	1.5	38	0.8
PCV10	**1**	**-**	**1**	**-**	**2**	**-**	**56**	**1.5**	**34**	**5.0**	**92**	**2.0**
3	0	-	2	-	2	-	15	0.4	16	2.4	33	0.7
6A	0	-	0	-	0	-	1	-	0	-	1	-
19A	2	-	1	-	3	-	40	1.1	47	7.0	90	2.0
PCV13	**3**	**-**	**4**	**-**	**7**	**2.3**	**112**	**3.1**	**97**	**14.4**	**216**	**4.7**
6C	1	-	1	-	2	-	13	0.4	11	1.6	26	0.6
8	1	-	0	-	1	-	12	0.3	5	0.7	18	0.4
9N	0	-	0	-	0	-	5	0.1	4	-	9	0.2
11A	0	-	0	-	0	-	1	-	4	-	5	0.1
15A	0	-	0	-	0	-	2	-	4	-	6	0.1
15B	1	-	2	-	3	-	4	-	6	0.9	13	0.3
16F	0	-	0	-	0	-	2	-	3	-	5	0.1
22F	1	-	1	-	2	-	15	0.4	23	3.4	40	0.9
23A	2	-	0	-	2	-	4	-	10	1.5	16	0.3
23B	0	-	1	-	1	-	3	-	8	1.2	12	0.3
31	0	-	0	-	0	-	2	-	3	-	5	0.1
33F	2	-	0	-	2	-	4	-	8	1.2	14	0.3
35F	1	-	0	-	1	-	3	-	1	-	5	0.1
Other	2	-	1	-	3	-	16	0.4	21	3.1	40	0.9
Non-PCV[e]	**11**	**9.3**	**6**	**3.2**	**17**	**5.6**	**86**	**2.4**	**111**	**16.5**	**214**	**4.7**
Total[f]	**14**	**11.8**	**10**	**5.3**	**24**	**7.8**	**198**	**5.5**	**208**	**30.8**	**430**	**9.4**

[a] Aggregated age group.

[b] Among the cases in the ≥65 year age group, 74.0% were due to one of the serotypes included in PPV23. Vaccination with PPV23 is recommended for people in this age group.

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

[e] The specific non-PCV serotypes listed are those that accounted for five or more cases of IPD in 2015.

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

Table 23. Number and percentage of invasive pneumococcal disease cases by serotype for each age group, 2015

Serotype	<2 years		<5 years		5–64 years		≥65 years		All ages	
	Cases	%[a]	Cases	%[a]	Cases	%[a]	Cases	%[a]	Cases	%[a]
1	0	-	0	-	0	-	1	0.5	1	0.2
3	0	-	2	8.3	15	7.6	16	7.7	33	7.7
4	0	-	1	4.2	9	4.5	7	3.4	17	4.0
6A	0	-	0	-	1	0.5	0	-	1	0.2
6B	1	7.1	1	4.2	0	-	1	0.5	2	0.5
6C	1	7.1	2	8.3	13	6.6	11	5.3	26	6.0
7C	0	-	0	-	1	0.5	2	1.0	3	0.7
7F	0	-	0	-	28	14.1	10	4.8	38	8.8
8	1	7.1	1	4.2	12	6.1	5	2.4	18	4.2
9N	0	-	0	-	5	2.5	4	1.9	9	2.1
9V	0	-	0	-	3	1.5	1	0.5	4	0.9
10A	0	-	0	-	3	1.5	1	0.5	4	0.9
11A	0	-	0	-	1	0.5	4	1.9	5	1.2
12F	0	-	0	-	1	0.5	3	1.4	4	0.9
13	0	-	0	-	1	0.5	0	-	1	0.2
14	0	-	0	-	0	-	3	1.4	3	0.7
15A	0	-	0	-	2	1.0	4	1.9	6	1.4
15B	1	7.1	3	12.5	4	2.0	6	2.9	13	3.0
15C	0	-	0	-	1	0.5	0	-	1	0.2
16F	0	-	0	-	2	1.0	3	1.4	5	1.2
17F	0	-	0	-	1	0.5	2	1.0	3	0.7
17 NT[b]	0	-	0	-	0	-	1	0.5	1	0.2
18A	0	-	0	-	1	0.5	0	-	1	0.2
18C	0	-	0	-	1	0.5	1	0.5	2	0.5
19A	2	14.3	3	12.5	40	20.2	47	22.6	90	20.9
19F	0	-	0	-	14	7.1	5	2.4	19	4.4
20	0	-	0	-	1	0.5	1	0.5	2	0.5
22F	1	7.1	2	8.3	15	7.6	23	11.1	40	9.3
23A	2	14.3	2	8.3	4	2.0	10	4.8	16	3.7
23B	0	-	1	4.2	3	1.5	8	3.8	12	2.8
23F	0	-	0	-	1	0.5	5	2.4	6	1.4
29	1	7.1	1	4.2	0	-	2	1.0	3	0.7
31	0	-	0	-	2	1.0	3	1.4	5	1.2
33F	2	14.3	2	8.3	4	2.0	8	3.8	14	3.2
33 NT[b]	1	7.1	1	4.2	0	-	2	1.0	3	0.7
34	0	-	0	-	0	-	2	1.0	2	0.5
35B	0	-	1	4.2	2	1.0	1	0.5	4	0.9
35F	1	7.1	1	4.2	3	1.5	1	0.5	5	1.2
38	0	-	0	-	2	1.0	1	0.5	3	0.7
Non-typable	0	-	0	-	2	1.0	3	1.4	5	1.2
Total[c]	**14**		**24**		**198**		**208**		**430**	

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

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

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

Table 24. Number of cases and rate per 100,000 population of invasive pneumococcal disease in the less than 2 years age group by serotype, and serotypes covered by PCV7, PCV10 and PCV13, 2006/2007, 2011–2015

Serotype	2006/2007		2011		2012		2013		2014		2015	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
4	6.5	5.5	0	-	0	-	0	-	0	-	0	-
6B	18.0	15.2	1	-	0	-	0	-	0	-	1	-
9V	4.5	3.8	1	-	0	-	0	-	0	-	0	-
14	39.0	32.8	0	-	1	-	0	-	0	-	0	-
18C	6.0	5.1	1	-	0	-	0	-	1	-	0	-
19F	15.5	13.0	0	-	1	-	1	-	1	-	0	-
23F	9.0	7.6	0	-	0	-	0	-	0	-	0	-
PCV7	**98.5**	**82.9**	**3**	**-**	**2**	**-**	**1**	**-**	**2**	**-**	**1**	**-**
1	2.0	-	2	-	1	-	0	-	0	-	0	-
5	0.0	-	0	-	0	-	0	-	0	-	0	-
7F	0.5	-	2	-	2	-	1	-	0	-	0	-
PCV10	**101.0**	**85.0**	**7**	**5.5**	**5**	**4.0**	**2**	**-**	**2**	**-**	**1**	**-**
3	1.0	-	0	-	2	-	3	-	7	5.9	0	-
6A/6C[e]	3.0	-	1	-	4	-	1	-	3	-	1	-
19A	6.0	5.1	8	6.3	13	10.5	7	5.8	12	10.0	2	-
PCV13	**111.0**	**93.4**	**16**	**12.6**	**24**	**19.4**	**13**	**10.7**	**24**	**20.1**	**4**	**-**
8	0.0	-	2	-	2	-	2	-	2	-	1	-
9N	0.0	-	1	-	0	-	0	-	2	-	0	-
11A	0.5	-	1	-	2	-	2	-	0	-	0	-
15A	0.0	-	0	-	0	-	0	-	0	-	0	-
15B	0.5	-	0	-	4	-	0	-	0	-	1	-
16F	0.0	-	0	-	0	-	0	-	0	-	0	-
22F	1.0	-	0	-	0	-	1	-	0	-	1	-
23A	0.0	-	0	-	0	-	0	-	1	-	2	-
23B	0.5	-	0	-	0	-	1	-	0	-	0	-
31	0.0	-	0	-	0	-	0	-	0	-	0	-
33F	0.5	-	1	-	0	-	1	-	2	-	2	-
35F	0.0	-	0	-	0	-	0	-	0	-	1	-
Other	3.5	-	7	5.5	8	6.5	3	-	1	-	2	-
Non-PCV[f]	**6.5**	**5.5**	**12**	**9.4**	**16**	**12.9**	**10**	**8.2**	**8**	**6.7**	**10**	**8.4**

[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] The specific non-PCV serotypes listed are those that accounted for five or more cases in 2015.

Note: Data presented from 2011 onwards is based on IPD notifications and data for 2006/07 is from ESR's national laboratory-based surveillance of IPD.

Table 25. Number of cases and rate per 100,000 population of invasive pneumococcal disease in the less than 5 years age group by serotype, and serotypes covered by PCV7, PCV10 and PCV13, 2006/2007, 2011–2015

Serotype	2006/2007		2011		2012		2013		2014		2015	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
4	8.0	2.8	1	-	0	-	0	-	1	-	1	-
6B	23.5	8.1	1	-	0	-	0	-	0	-	1	-
9V	7.0	2.4	1	-	1	-	0	-	0	-	0	-
14	47.5	16.4	1	-	2	-	0	-	1	-	0	-
18C	10.5	3.6	2	-	0	-	0	-	1	-	0	-
19F	19.0	6.6	3	-	1	-	1	-	1	-	0	-
23F	9.5	3.3	1	-	0	-	0	-	0	-	0	-
PCV7	**125.0**	**43.2**	**10**	**3.2**	**4**	**-**	**1**	**-**	**4**	**-**	**2**	**-**
1	2.5	-	3	-	1	-	2	-	1	-	0	-
5	0.0	-	0	-	0	-	0	-	0	-	0	-
7F	0.5	-	4	-	4	-	1	-	1	-	0	-
PCV10	**128.0**	**44.2**	**17**	**5.4**	**9**	**2.9**	**4**	**-**	**6**	**1.9**	**2**	**-**
3	1.0	-	0	-	2	-	3	-	9	2.9	2	-
6A/6C[e]	4.5	1.6	1	-	4	-	1	-	4	-	2	-
19A	10.5	3.6	13	4.1	18	5.7	12	3.8	17	5.5	3	-
PCV13	**144.0**	**49.7**	**31**	**9.8**	**33**	**10.5**	**20**	**6.4**	**36**	**11.7**	**9**	**2.9**
8	0.0	-	2	-	2	-	2	-	2	-	1	-
9N	0.0	-	1	-	0	-	0	-	2	-	0	-
11A	0.5	-	1	-	2	-	3	-	0	-	0	-
15A	0.0	-	0	-	0	-	0	-	0	-	0	-
15B	1.0	-	2	-	6	1.9	1	-	1	-	3	-
16F	0.0	-	0	-	0	-	0	-	0	-	0	-
22F	1.0	-	0	-	0	-	1	-	1	-	2	-
23A	0.5	-	0	-	0	-	0	-	1	-	2	-
23B	0.5	-	0	-	0	-	2	-	0	-	1	-
31	0.0	-	0	-	0	-	0	-	0	-	0	-
33F	1.0	-	1	-	0	-	1	-	2	-	2	-
35F	0.0	-	0	-	0	-	0	-	0	-	1	-
Other	4.5	1.6	7	2.3	9	2.9	7	2.2	7	2.3	3	-
Non-PCV[f]	**9.0**	**3.1**	**14**	**4.4**	**19**	**6.0**	**17**	**5.4**	**16**	**5.2**	**15**	**4.9**

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

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

[c] Number of cases reported.

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

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

[f] The specific non-PCV serotypes listed are those that accounted for five or more cases in 2015.

Note: Data presented from 2011 onwards is based on IPD notifications and data for 2006/07 is from ESR's national laboratory-based surveillance of IPD.

Table 26. Number of cases and rate per 100,000 population of invasive pneumococcal disease in the 5–64 years age group by serotype, and serotypes covered by PCV7, PCV10 and PCV13, 2006/2007, 2011–2015

Serotype	2006/2007		2011		2012		2013		2014		2015	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
4	38.0	1.1	30	0.9	26	0.7	23	0.7	13	0.4	9	0.2
6B	11.5	0.3	7	0.2	3	-	3	-	1	-	0	-
9V	11.0	0.3	10	0.3	5	0.1	8	0.2	5	0.1	3	-
14	31.0	0.9	18	0.5	11	0.3	3	-	1	-	0	-
18C	5.5	0.2	7	0.2	5	0.1	10	0.3	3	-	1	-
19F	12.0	0.4	14	0.4	13	0.4	7	0.2	2	-	14	0.4
23F	12.0	0.4	5	0.1	5	0.1	3	-	1	-	1	-
PCV7	**121.0**	**3.6**	**91**	**2.6**	**68**	**1.9**	**57**	**1.6**	**26**	**0.7**	**28**	**0.8**
1	19.0	0.6	30	0.9	7	0.2	1	-	0	-	0	-
5	0.0	-	0	-	0	-	0	-	0	-	0	-
7F	6.0	0.2	11	0.3	18	0.5	48	1.4	35	1.0	28	0.8
PCV10	**146.0**	**4.3**	**132**	**3.8**	**93**	**2.7**	**106**	**3.0**	**61**	**1.7**	**56**	**1.5**
3	8.5	0.3	22	0.6	9	0.3	9	0.3	18	0.5	15	0.4
6A/6C[e]	5.0	0.1	9	0.3	6	0.2	11	0.3	10	0.3	14	0.4
19A	10.0	0.3	26	0.7	30	0.9	36	1.0	40	1.1	40	1.1
PCV13	**169.5**	**5.0**	**189**	**5.4**	**138**	**4.0**	**162**	**4.6**	**129**	**3.8**	**125**	**3.5**
8	12.0	0.4	9	0.3	11	0.3	10	0.3	12	0.3	12	0.3
9N	4.0	-	3	-	5	0.1	2	-	5	0.1	5	0.1
11A	3.5	-	5	0.1	5	0.1	7	0.2	2	-	1	-
15A	0.0	-	0	-	0	-	0	-	1	-	2	-
15B	0.5	-	2	-	2	-	2	-	2	-	4	-
16F	0.0	-	0	-	0	-	0	-	0	-	2	-
22F	5.0	0.1	17	0.5	19	0.5	24	0.7	17	0.5	15	0.4
23A	0.5	-	2	-	4	-	0	-	5	0.1	4	-
23B	0.5	-	1	-	5	0.1	1	-	6	0.2	3	-
31	0.0	-	0	-	0	-	1	-	2	-	2	-
33F	0.0	-	2	-	1	-	5	0.1	3	-	4	-
35F	0.0	-	0	-	0	-	0	-	0	-	3	-
Other	12.0	0.4	30	0.9	14	0.4	24	0.7	27	0.8	16	0.4
Non-PCV[f]	**38.0**	**1.1**	**71**	**2.0**	**66**	**1.9**	**76**	**2.2**	**82**	**2.3**	**73**	**2.0**

[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] The specific non-PCV serotypes listed are those that accounted for five or more cases in 2015.

Note: Data presented from 2011 onwards is based on IPD notifications and data for 2006/07 is from ESR's national laboratory-based surveillance of IPD.

Table 27. Number of cases and rate per 100,000 population of invasive pneumococcal disease in the 65 years and over age group by serotype, and serotypes covered by PCV7, PCV10 and PCV13, 2006/2007, 2011–2015

Serotype	2006/2007		2011		2012		2013		2014		2015	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
4	19.5	3.8	15	2.6	22	3.6	9	1.4	10	1.5	7	1.0
6B	11.0	2.1	10	1.7	5	0.8	4	-	1	-	1	-
9V	14.5	2.8	4	-	8	1.3	3	-	2	-	1	-
14	35.5	6.8	9	1.6	5	0.8	4	-	2	-	3	-
18C	3.0	-	7	1.2	4	-	6	1.0	5	0.8	1	-
19F	16.5	3.2	22	3.8	11	1.8	5	0.8	7	1.1	5	0.7
23F	15.0	2.9	11	1.9	4	-	3	-	1	-	5	0.7
PCV7	**115.0**	**22.2**	**78**	**13.4**	**59**	**9.8**	**34**	**5.4**	**28**	**4.3**	**23**	**3.4**
1	3.5	-	2	-	0	-	0	-	0	-	1	-
5	0.0	-	0	-	0	-	0	-	0	-	0	-
7F	3.5	-	1	-	15	2.5	20	3.2	18	2.8	10	1.5
PCV10	**122.0**	**23.5**	**81**	**14.0**	**74**	**12.3**	**54**	**8.6**	**46**	**7.1**	**34**	**5.0**
3	12.5	2.4	16	2.8	14	2.3	11	1.8	15	2.3	16	2.4
6A/6C[e]	2.5	-	14	2.4	12	2.0	12	1.9	13	2.0	11	1.6
19A	8.0	1.5	24	4.1	32	5.3	28	4.5	30	4.6	47	7.0
PCV13	**145.0**	**28.0**	**135**	**23.3**	**132**	**21.9**	**105**	**16.8**	**104**	**16.0**	**108**	**16.0**
8	3.5	-	2	-	5	0.8	5	0.8	7	1.1	5	0.7
9N	4.0	-	11	1.9	3	-	10	1.6	10	1.5	4	-
11A	3.5	-	8	1.4	7	1.2	1	-	10	1.5	4	-
15A	0.0	-	0	-	0	-	0	-	0	-	4	-
15B	1.0	-	1	-	2	-	5	0.8	4	-	6	0.9
16F	0.0	-	0	-	0	-	0	-	0	-	3	-
22F	4.5	0.9	21	3.6	21	3.5	16	2.6	21	3.2	23	3.4
23A	1.0	-	1	-	1	-	6	1.0	5	0.8	10	1.5
23B	0.5	-	1	-	2	-	3	-	4	-	8	1.2
31	0.0	-	3	-	1	-	1	-	3	-	3	-
33F	1.5	-	8	1.4	8	1.3	5	0.8	4	-	8	1.2
35F	0.0	-	0	-	0	-	0	-	1	-	1	-
Other	13.0	2.5	37	6.4	22	3.6	22	3.5	36	5.5	21	3.1
Non-PCV[f]	**32.5**	**6.3**	**93**	**16.0**	**72**	**11.9**	**74**	**11.8**	**105**	**16.1**	**100**	**14.8**

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

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

[c] Number of cases reported.

[d] Rate per 100,000 population. 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] The specific non-PCV serotypes listed are those that accounted for five or more cases in 2015.

Note: Data presented from 2011 onwards is based on IPD notifications and data for 2006/07 is from ESR's national laboratory-based surveillance of IPD.

Table 28. Number of cases and rate per 100,000 population of invasive pneumococcal disease by serotype, and serotypes covered by PCV7, PCV10 and PCV13, all ages, 2006/2007, 2011–2015

Serotype	2006/2007		2011		2012		2013		2014		2015	
	No[a]	Rate[b]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]	No[c]	Rate[d]
4	65.5	1.6	46	1.0	48	1.1	32	0.7	24	0.5	17	0.4
6B	46.0	1.1	18	0.4	8	0.2	7	0.2	2	-	2	-
9V	32.5	0.8	15	0.3	14	0.3	11	0.2	7	0.2	4	-
14	114.0	2.7	28	0.6	18	0.4	7	0.2	4	-	3	-
18C	19.0	0.5	16	0.4	9	0.2	16	0.4	9	0.2	2	-
19F	47.5	1.1	39	0.9	25	0.6	13	0.3	10	0.2	19	0.4
23F	36.5	0.9	17	0.4	9	0.2	6	0.1	2	-	6	0.1
PCV7	**361.0**	**8.6**	**179**	**4.1**	**131**	**3.0**	**92**	**2.1**	**58**	**1.3**	**53**	**1.2**
1	25.0	0.6	35	0.8	8	0.2	3	-	1	-	1	-
5	0.0	-	0	-	0	-	0	-	0	-	0	-
7F	10.0	0.2	16	0.4	37	0.8	69	1.6	54	1.2	38	0.8
PCV10	**396.0**	**9.4**	**230**	**5.2**	**176**	**4.0**	**164**	**3.7**	**113**	**2.5**	**92**	**2.0**
3	22.0	0.5	38	0.9	25	0.6	23	0.5	42	0.9	33	0.7
6A/6C[e]	12.0	0.3	24	0.5	22	0.5	24	0.5	27	0.6	27	0.6
19A	28.5	0.7	63	1.4	80	1.8	76	1.7	87	1.9	90	2.0
PCV13	**458.5**	**10.9**	**355**	**8.1**	**303**	**6.9**	**287**	**6.5**	**269**	**6.0**	**242**	**5.3**
8	15.5	0.4	13	0.3	18	0.4	17	0.4	21	0.5	18	0.4
9N	8.0	0.2	15	0.3	8	0.2	12	0.3	17	0.4	9	0.2
11A	7.5	0.2	14	0.3	14	0.3	11	0.2	12	0.3	5	0.1
15A	0.0	-	0	-	0	-	0	-	0	-	6	0.1
15B	2.5	-	5	0.1	10	0.2	8	0.2	7	0.2	13	0.3
16F	0.0	-	0	-	0	-	0	-	0	0.3	5	0.1
22F	10.5	0.2	38	0.9	40	0.9	41	0.9	39	0.9	40	0.9
23A	2.0	-	3	-	5	0.1	6	0.1	11	0.2	16	0.3
23B	1.5	-	2	-	7	0.2	6	0.1	10	0.2	12	0.3
31	0.0	-	3	-	1	-	2	-	5	0.1	5	0.1
33F	2.5	-	11	0.3	9	0.2	11	0.2	9	0.2	14	0.3
35F	0.5	-	0	-	0	-	0	-	1	-	5	0.1
Other	29.0	0.7	74	1.7	45	1.0	53	1.2	71	1.6	40	0.9
Non-PCV[f]	**79.5**	**1.9**	**178**	**4.1**	**157**	**3.6**	**167**	**3.8**	**203**	**4.5**	**189**	**4.1**

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

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

[c] Number of cases reported.

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

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

[f] The specific non-PCV serotypes listed are those that accounted five or more cases in 2015.

Note: Data presented from 2011 onwards is based on IPD notifications and data prior for 2006/07 is from ESR's national laboratory-based surveillance of IPD.

Table 29. Serotype 19A invasive pneumococcal disease case numbers, proportions and rates per 100,000 population, by age group, 2004–2015

Year	<2 years			<5 years			5–64 years			≥65 years			All ages		
	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]
2004	8	6.3	7.0	10	6.2	3.5	5	2.6	0.2	8	4.2	1.7	23	4.2	0.6
2005	6	5.3	5.2	8	5.3	2.8	10	5.6	0.3	9	5.5	1.8	27	5.5	0.7
2006	5	4.2	4.3	10	6.6	3.5	13	6.4	0.4	4	2.4	-	27	5.2	0.6
2007	7	6.0	5.8	11	7.1	3.8	7	3.3	0.2	12	6.5	2.3	30	5.4	0.7
2008	5	6.4	4.0	7	6.3	2.3	22	7.6	0.6	11	4.8	2.1	40	6.3	0.9
2009	8	14.5	6.2	12	12.9	3.9	16	4.7	0.5	9	3.9	1.6	37	5.6	0.9
2010	7	19.4	5.4	10	15.9	3.2	23	9.8	0.7	22	10.1	3.9	55	10.7	1.3
2011	8	28.6	6.3	13	28.9	4.1	26	10.0	0.7	24	10.5	4.1	63	11.8	1.4
2012	13	32.5	10.5	18	34.6	5.7	30	14.7	0.9	32	15.7	5.3	80	17.4	1.8
2013	7	30.4	5.8	12	32.4	3.8	36	15.1	1.0	28	15.6	4.5	76	16.7	1.7
2014	12	37.5	10.0	17	32.7	5.5	40	19.0	1.1	30	14.4	4.6	87	18.4	1.9
2015	2	14.3	-	3	12.5	-	40	20.2	1.1	47	22.6	7.0	90	20.9	2.0

[a] Number of cases due to serotype 19A.

[b] Percentage of cases within the age group due to serotype 19A.

[c] Rate per 100,000 population for IPD due to serotype 19A. Rates were not calculated where there were fewer than five cases.

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

Table 30. Serotype 7F invasive pneumococcal disease case numbers, proportions and rates per 100,000 population, by age group, 2004–2015

Year	<2 years			<5 years			5–64 years			≥65 years			All ages		
	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]	Cases[a]	%[b]	Rate[c]
2004	2	1.6	-	3	1.9	-	12	6.2	0.4	1	0.5	-	18	3.3	0.4
2005	2	1.8	-	3	2.0	-	4	2.3	-	2	1.2	-	11	2.2	0.3
2006	0	0.0	-	0	0.0	-	8	4.0	0.2	3	1.8	-	11	2.1	0.3
2007	1	0.9	-	1	0.6	-	4	1.9	-	4	2.2	-	9	1.6	0.2
2008	0	0.0	-	0	0.0	-	12	4.1	0.4	2	0.9	-	14	2.2	0.3
2009	1	1.8	-	1	1.1	-	13	3.8	0.4	4	1.7	-	18	2.7	0.4
2010	2	5.6	-	2	3.2	-	4	1.7	-	3	1.4	-	9	1.8	0.2
2011	2	7.1	-	4	8.9	-	11	4.2	0.3	1	0.4	-	16	3.0	0.4
2012	2	5.0	-	4	7.7	-	18	8.8	0.5	15	7.4	2.5	37	8.0	0.8
2013	1	4.3	-	1	2.7	-	48	20.2	1.4	20	11.2	3.1	69	15.2	1.5
2014	0	0.0	-	1	1.9	-	35	16.6	1.0	18	8.6	2.8	54	11.4	1.2
2015	0	0.0	-	0	0.0	-	28	14.1	0.8	10	4.8	1.5	38	8.8	0.8

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

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

[c] Rate per 100,000 population for IPD due to serotype 7F. Rates were not calculated where there were fewer than five cases.

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

Table 31. Penicillin and cefotaxime MIC distribution among isolates from invasive pneumococcal disease cases, 2015

Antibiotic	Percent of isolates with an MIC (mg/L) of:[a]												
	0.004	0.008	0.016	0.03	0.06	0.12	0.25	0.5	1	2	4	8	16
Penicillin	0.0	1.4	37.7	36.7	2.3	4.4	6.3	4.0	2.8	2.3	1.6	0.5	0.0
Cefotaxime	0.2	3.0	51.6	21.6	3.3	6.5	3.5	3.7	4.0	1.6	0.5	0.5	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 [17].

Table 32. Trends in penicillin susceptibility, cefotaxime susceptibility and multidrug resistance among isolates from invasive pneumococcal disease cases, 2006–2015

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	
2006	522	84.1	15.9	98.9	1.0	0.2	84.1	8.1	7.9	90.0	7.3	2.7	97.3	1.7	1.0	4.4
2007	555	77.7	22.3	99.1	0.7	0.2	77.7	16.0	6.3	86.0	11.4	2.7	97.3	1.1	1.6	6.1
2008	630	77.9	22.1	99.5	0.5	0.0	77.9	14.6	7.5	84.9	10.0	5.1	94.9	3.0	2.1	5.9
2009	665	82.3	17.7	99.7	0.3	0.0	82.3	12.3	5.4	91.1	6.9	2.0	98.1	1.4	0.6	5.3
2010	514	81.9	18.1	99.0	1.0	0.0	81.9	12.1	6.0	91.8	6.2	1.9	98.1	0.4	1.6	5.4
2011	533	85.9	14.1	99.1	0.8	0.2	85.9	9.4	4.7	93.4	3.6	3.0	97.0	1.1	1.9	5.8
2012	459	82.8	17.2	98.0	1.3	0.7	82.8	9.4	7.8	92.4	3.5	4.1	95.9	2.8	1.3	6.3
2013	454	83.9	16.1	98.5	1.3	0.2	83.9	10.1	6.0	91.9	4.4	3.7	96.3	3.3	0.4	4.0
2014	472	82.4	17.6	98.1	1.7	0.2	82.4	13.1	4.4	93.4	2.8	3.8	96.2	2.8	1.1	4.2
2015	430	78.1	21.9	97.9	1.6	0.5	78.1	17.4	4.4	93.5	4.0	2.6	97.4	1.6	0.9	4.7

[a] CLSI penicillin meningitis interpretations: susceptible (S), MIC ≤0.06 mg/L; resistant (R), MIC ≥0.12 mg/L; no intermediate category [17].

[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 [17].

[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 [17].

[d] CLSI cefotaxime meningitis interpretations: susceptible (S), MIC ≤0.5 mg/L; intermediate (I), MIC 1 mg/L; resistant (R), MIC ≥2 mg/L [17].

[e] CLSI cefotaxime non-meningitis interpretations: susceptible (S), MIC ≤1 mg/L; intermediate (I), MIC 2 mg/L; resistant (R), MIC ≥4 mg/L [17].

[f] Multidrug resistant − resistant to penicillin (CLSI meningitis interpretation) and ≥3 additional antibiotics [17].

Table 33. Trends in resistance to non-β-lactam antibiotics among isolates from invasive pneumococcal disease cases, 2006–2015

Year	Number of isolates	Chloramphenicol		Clindamycin[a]			Co-trimoxazole			Erythromycin			Tetracycline		
		%S[b]	%R[b]	%S[b]	%I[b]	%R[b,c]	%S[b]	%I[b]	%R[b]	%S[b]	%I[b]	%R[b]	%S[b]	%I[b]	%R[b]
2006	522	98.5	1.5	-	-	-	65.7	1.5	32.8	88.7	0.2	11.1	92.5	0.4	7.1
2007	555	97.7	2.3	93.7	0.0	6.3	63.2	1.8	35.0	86.0	0.4	13.7	90.8	0.7	8.5
2008	630	97.6	2.4	94.6	0.0	5.4	67.6	2.2	30.2	87.8	0.3	11.9	91.9	0.5	7.6
2009	665	98.8	1.2	95.3	0.2	4.5	72.6	2.1	25.3	90.2	0.2	9.6	92.5	0.3	7.2
2010	514	98.1	2.0	94.7	0.0	5.3	73.5	2.1	24.3	91.1	0.0	9.0	91.6	0.8	7.6
2011	533	99.1	0.9	93.4	0.0	6.6	78.4	0.8	20.8	88.7	0.0	11.3	90.6	0.6	8.8
2012	459	99.6	0.4	94.1	0.0	5.9	77.3	1.3	21.4	91.3	0.0	8.7	91.9	0.0	8.1
2013	454	99.1	0.9	96.3	0.0	3.7	75.6	2.9	21.6	94.3	0.0	5.7	92.5	0.0	7.5
2014	472	99.4	0.6	94.3	0.0	5.9	79.0	1.9	19.1	92.2	0.0	7.8	92.6	0.0	7.4
2015	430	98.1	1.9	93.0	0.0	7.0	75.1	4.7	20.2	89.3	0.2	10.5	90.0	0.0	10.0

[a] Clindamycin susceptibility tested since 2007.

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

[c] Includes isolates with inducible clindamycin resistance.

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

Table 34. Penicillin and cefotaxime resistance among isolates from invasive pneumococcal disease cases by region and District Health Board, 2015

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	27	25.9	7.4	3.7
Waitemata	33	21.2	6.1	3.0
Auckland	35	37.1	8.6	2.9
Counties Manukau	66	37.9	3.0	4.6
Northland region	**161**	**32.3**	**5.6**	**3.7**
Waikato	38	18.4	2.6	5.3
Lakes	22	13.6	0.0	0.0
Bay of Plenty	27	25.9	14.8	0.0
Tairawhiti	7	28.6	14.3	14.3
Taranaki	7	0.0	0.0	0.0
Midland region	**101**	**18.8**	**5.9**	**3.0**
Hawke's Bay	14	14.3	0.0	0.0
Whanganui	7	0.0	0.0	0.0
MidCentral	14	7.1	0.0	0.0
Hutt Valley	15	0.0	0.0	0.0
Capital & Coast	26	7.7	3.9	0.0
Wairarapa	6	0.0	0.0	0.0
Nelson Marlborough	8	25.0	0.0	0.0
Central region	**90**	**7.8**	**1.1**	**0.0**
West Coast	4	0.0	0.0	0.0
Canterbury	41	22.0	2.4	2.4
South Canterbury	3	0.0	0.0	0.0
Southern	30	23.3	0.0	3.3
Southern region	**78**	**20.5**	**1.3**	**2.6**
Total	**430**	**21.9**	**4.0**	**2.6**

[a] CLSI meningitis interpretations; no intermediate category for penicillin [17].

Table 35. Serotypes among penicillin-resistant, cefotaxime-resistant and multidrug-resistant isolates from invasive pneumococcal disease cases, 2015

Serotype	Penicillin		Cefotaxime				% MDR[b]	
	Resistant[a] MIC ≥0.12 mg/L		Intermediate[a] MIC 1 mg/L		Resistant[a] MIC ≥2 mg/L			
	Number	%[c]	Number	%[c]	Number	%[c]	Number	%[c]
4	0	-	0	-	0	-	0	-
6B	1	1.1	0	-	0	-	0	-
9V	4	4.3	2	11.8	0	-	0	-
14	1	1.1	1	5.9	0	-	0	-
18C	0	-	0	-	0	-	0	-
19F	11	11.7	2	11.8	8	72.7	11	55.0
23F	2	2.1	1	5.9	1	9.1	1	5.0
PCV7 serotypes	**19**	**20.2**	**6**	**35.3**	**9**	**81.8**	**12**	**60.0**
1	0	-	0	-	0	-	0	-
5[d]	0	-	0	-	0	-	0	-
7F	1	1.1	0	-	0	-	0	-
PCV10 serotypes	**20**	**21.3**	**6**	**35.3**	**9**	**81.8**	**12**	**60.0**
3	1	1.1	0	-	0	-	0	-
6A	1	1.1	0	-	0	-	0	-
19A	49	52.1	5	29.4	2	18.2	6	30.0
PCV13 serotypes	**71**	**75.5**	**11**	**64.7**	**11**	**100.0**	**18**	**90.0**
6C	4	4.3	1	5.9	0	-	1	5.0
15A	4	4.3	1	5.9	0	-	1	5.0
15 NT[e]	3	3.2	0	-	0	-	0	-
17F	3	3.2	0	-	0	-	0	-
23A	2	2.1	0	-	0	-	0	-
23B	1	1.1	0	-	0	-	0	-
35 NT[e]	4	4.3	3	17.6	0	-	0	-
Non-typable[e]	2	2.1	1	5.9	0	-	0	-
Non-PCV serotypes	**23**	**24.5**	**6**	**35.3**	**0**	**-**	**2**	**10.0**
Total	**94**		**17**		**11**		**20**	

[a] CLSI meningitis interpretations; no intermediate category for penicillin [17].

[b] Multidrug resistant − resistant to penicillin (CLSI meningitis interpretation) and ≥3 additional antibiotics [17].

[c] Percentage of the intermediate or resistant isolates.

[d] There were no serotype 5 isolates from cases of invasive disease in 2015.

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

Table 36. Trends in penicillin resistance, cefotaxime resistance and multidrug resistance among serotype 19A isolates from invasive pneumococcal disease cases, 2006–2015

Year	Number of serotype 19A isolates	Penicillin resistant[a] MIC ≥0.12 mg/L		Cefotaxime resistant[a] MIC ≥2 mg/L		% MDR[b]	
		No[c]	% (95% CI)[d]	No[c]	% (95% CI)[d]	No[c]	% (95% CI)[d]
2006	27	6	22.2 (8.6-42.3)	0	0.0 (0.0-12.7)	0	0.0 (0.0-12.7)
2007	30	3	10.0 (2.1-26.5)	0	0.0 (0.0-11.6)	1	3.3 (0.1-17.2)
2008	40	10	25.0 (12.7-41.2)	1	2.5 (0.1-13.2)	3	7.5 (1.6-20.4)
2009	37	3	8.1 (1.7-21.9)	0	0.0 (0.0-9.5)	0	0.0 (0.0-9.5)
2010	54	10	18.5 (9.3-31.4)	0	0.0 (0.0-6.6)	4	7.4 (2.1-17.9)
2011	63	16	25.4 (15.3-37.9)	1	1.6 (0.04-8.5)	2	3.2 (0.4-11.0)
2012	80	31	38.8 (28.1-50.3)	5	6.3 (2.1-14.0)	12	15.0 (8.0-24.8)
2013	76	36	47.4 (35.8-59.2)	7	9.2 (3.8-18.1)	11	14.5 (7.5-24.4)
2014	87	43	49.4 (38.5-60.4)	9	10.3 (4.8-18.7)	10	11.5 (5.7-20.1)
2015	90	49	54.4 (43.6-65.0)	2	2.2 (0.3-7.8)	6	6.7 (2.5-13.9)

[a] CLSI meningitis interpretations [17]

[b] Multidrug resistant − resistant to penicillin (CLSI meningitis interpretation) and ≥3 additional antibiotics [17].

[c] Number of resistant isolates.

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

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