Science for Communities

INVASIVE PNEUMOCOCCAL DISEASE IN NEW ZEALAND, 2020

Prepared as part of a Ministry of Health
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DISCLAIMER

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ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Description
CLD	Chronic Lung Disease
CLSI	Clinical and Laboratory Standards Institute
CSF	Cerebrospinal fluid
DHB	District Health Board
ESR	Institute of Environmental Science and Research Ltd
EUCAST	European Committee on Antimicrobial Susceptibility Testing
I	Intermediate resistance
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	Non-typeable
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, a 7-valent pneumococcal conjugate vaccine (PCV7), Prevenar®, was added to the New Zealand childhood immunisation schedule. This was replaced by the 10-valent conjugate vaccine (PCV10), Synflorix® in July 2011. In July 2014, the 13-valent conjugate vaccine, Prevenar13® replaced Synflorix®. In July 2017 Synflorix® was re-introduced to the New Zealand childhood immunisation schedule and replaced Prevenar13®. In July 2020, the 3 month dose of PCV10 was removed from the schedule and the PCV immunisation schedule now includes doses at 6 weeks, 5 months, and 12 months of age.

Invasive pneumococcal disease (IPD) has been a notifiable disease in New Zealand since 17 October 2008. In this report, the data presented for 2009–2020 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 the laboratory-based surveillance, diagnostic microbiology laboratories are requested to refer all invasive isolates of *S. pneumoniae* to ESR for serotyping and antimicrobial susceptibility testing.

In response to the COVID-19 pandemic, nationwide restrictions were put in place in 2020 in order to decrease COVID-19 transmission. Not only did these measures decrease the spread of COVID-19, but they also reduced the transmission of other infectious diseases, including IPD.

Antimicrobial susceptibility testing was performed on 170 (49.7%) of 342 cultures received from notified cases (*n*=350) in 2020. In 2019, a purposeful reduction in antimicrobial susceptibility testing to 50% of *S. pneumoniae* isolates was introduced.

There were 350 cases of IPD notified in 2020, yielding an annual incidence of 6.9 cases per 100,000 population. This was the lowest annual incidence rate since IPD became a notifiable disease in 2008. Prior to 2020, the annual incidence peaked at 16.1 cases per 100,000 in 2009, and the lowest annual incidence rate was recorded in 2015 at 9.7 cases per 100,000.

Incidence

Compared to previous years, in 2020 there was a larger decrease in the number of IPD cases reported in April (*n*=7) with a low number of cases enduring in May (*n*=11). The COVID-19 public health restrictions put in place in March 2020 are likely to have contributed to the lower annual incidence rate and the low number of cases during these months.

The highest annual incidence rate was in the <2 years aggregated age group, at 18.2 cases per 100,000, followed by the ≥65 years age group with a rate of 16.8 cases per 100,000.

In children <5 years, the overall annual incidence rate of IPD (due to any serotype) has shown a decreasing trend since 2009 from 46 cases per 100,000 in 2009 to 12.1 cases per 100,000 in 2020 (almost a 70% decrease), with fluctuations throughout this decade.

In adults ≥65 there has been a 60% decrease in the annual incidence rate of IPD cases between 2009 and 2020 (44 to 16.8 per 100,000 cases).

Ethnicity

Compared to previous years, the crude rates of IPD cases for all ethnic groups decreased in 2020. In 2020, the crude rates of IPD for Pacific peoples and Māori ethnic groups were almost four and three times higher, respectively, than the rate for European and other ethnicity, while the age standardised rates were the highest for Pacific peoples (30.2 per 100,000) followed by Māori (20.3 per 100,000).

In 2020, 10 (45%) of the 22 total cases in the <2 years age group were of Māori ethnicity.

Clinical Outcomes

The all-age annual incidence of pneumococcal meningitis was 0.4 per 100,000 in 2020. Among infants aged <1 year, meningitis was the most common presentation (40%). The IPD case-fatality rate was 3.2%.

Immunisation status

Among the cases of IPD due to serotype 19A in children <5 years of age, three were unvaccinated, eight were either fully vaccinated with only PCV10 or on schedule for age with only PCV10, two were under vaccinated, and five had received a combination of PCV10/PCV13.

District Health Boards

In 2020, the highest all-age annual rate of IPD was in Wairarapa District Health Board (DHB) (14.3 per 100,000, 7 cases), followed by Northland (12.3 per 100,000, 24 cases), Lakes (11.9 per 100,000, 14 cases), Tairawhiti (11.8 per 100,000, 6 cases), and South Canterbury (11.3 per 100,000, 7 cases) DHBs.

Serotypes: Overall incidence

Although the annual incidence of IPD from 2012 has been relatively stable (ranging from 5.7 to 7.2 per 100,000), the annual incidence of IPD in the ≥65 years age group has decreased from a peak of 35.0 per 100,000 in 2012 to 25.0 per 100,000 in 2019 and 16.8 in 2020.

Caution should be taken in interpreting decreases in IPD incidence by age group in 2020 due to the impact of COVID-19 public health measures. Additionally, due to the indirect or herd immunity effects of routine infant PCV immunisation, there have been marked reductions in incidence of IPD due to PCV10 serotypes in the 5–64 years age group since 2012 (PCV10 was first introduced in mid-2011). Specifically, since 2012, the incidence of IPD due to PCV10 serotypes peaked in 2013 at 3.0 per 100,000 and has decreased to 0.3 per 100,000 in 2020. Among ≥65 years age groups, since 2012 the incidence of IPD due to PCV10 serotypes has decreased from a peak of 12.3 cases per 100,000 in 2012 to 1.0 per 100,000 in 2020. Among <5 years age groups, since 2012 the incidence of IPD due to PCV10 serotypes has decreased from a peak of 2.9 cases per 100,000 to 0 cases in 2020.

However, the incidence of IPD due to PCV13 serotypes has been increasing since 2012. In the 5–64 years age group, since 2012 the rate has decreased from a peak of 4.6 cases per 100,000 in 2013 to 1.2 cases per 100,000 in 2020. Among ≥65 years age groups, since 2012 the incidence of IPD due to PCV13 serotypes has decreased from 21.9 cases per 100,000 in 2012 to 5.94 per 100,000 in 2020. Since 2012, the peak incidence was 11.7

cases per 100,000 in 2014 for children under 5 years of age. Since 2018 the rate has steadily increased from 2.3 cases per 100,000 to 6.6 cases per 100,000 in 2020.

Serotypes: Most prevalent serotypes

The most common serotypes in 2020 were 19A (71 cases), 8 (58 cases), 12F (31 cases), and 3 (25 cases). These top four serotypes accounted for 53% (185/350) of IPD cases in 2020. Among children <5 years of age, 54% of cases were due to PCV13 serotypes.

Serotypes: trends in 19A

Despite a decrease in overall incidence of IPD in 2020, in the context of the COVID-19 pandemic and associated restrictions, there was an increase in the number IPD cases that were 19A compared to 2019. The annual incidence rate of 19A IPD cases in the <2 years and 2–4 years age groups have quadrupled between 2018 and 2020 (from 1.6 to 7.5 per 100,000 and from 1.1 to 4.9 per 100,000, respectively).

Serotypes: trends in PCV10 serotypes

Cases of IPD due to the PCV10 serotype 7F increased in the 5–64 years and ≥65 years age groups between 2011 and 2013. However, following the introduction of PCV10 in mid-2011, between 2014–2016, there were successive decreases in IPD due to type 7F in both of these age groups. In fact, the total reported cases of serotype 7F among those 5–64 years of age has continuously decreased since 2013, decreasing from 48 cases to 5 cases in 2020. Among the ≥65 years age group, the total reported cases of serotype 7F have remained low, decreasing to only 1 case reported in 2020, after a slight increase in cases in 2017 and 2018 (n=12 and n=10, respectively).

These decreases are probably an indication that the switch from PCV7 to PCV10 for routine infant immunisation in 2011 is continuing to have an indirect effect on type 7F disease in the older age groups.

Serotypes: trends in other PCV13 serotypes

After an increase in the prevalence of IPD due to the PCV13 serotype 3 in the <2 years age group with seven cases in 2014, cases have decreased to three or fewer cases annually in the <2 years age group since 2016. Literature suggests PCV13 provides minimal protection against carriage or disease against serotype 3. Therefore, it is uncertain whether this decrease in disease due to serotype 3 over 2016-2020 is the result of increasing coverage of the <2 years age group with PCV13 following the change to this vaccine in 2014.

Antimicrobial Resistance

The prevalence of antimicrobial resistance (specifically, penicillin resistance) among invasive pneumococcal isolates has been increasing since 2017. Based on the European Committee on Antimicrobial Susceptibility Testing (EUCAST) breakpoints, 34.1% of isolates in 2020 were resistant to penicillin (meningitis breakpoints-the EUCAST and CLSI (Clinical and Laboratory Standards Institute) penicillin meningitis breakpoints are the same (susceptible, MIC ≤0.06 mg/L; resistant, MIC ≥0.12 mg/L)) and 0.6% were cefotaxime resistant. The proportion of 19A isolates that were resistant to penicillin has increased from under 20% in 2010 to 72.2% in 2020.

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. There was a further schedule change in July 2017, when Synflorix® was re-introduced to the childhood immunisation schedule and replaced Prevenar13®. In July 2020, the 3 month dose of PCV10 was dropped and the PCV immunisation schedule now includes doses at 6 weeks, 5 months, and 12 months of age.

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 [3–11].

Prior to these annual reports, information from ESR's laboratory-based surveillance of IPD was published periodically [12–16]. 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 2020, as well as trend data on antimicrobial susceptibility patterns of circulating serotypes for recent years.

In 2020, the COVID-19 pandemic resulted in the implementation of strict public health measures to decrease disease transmission. The measures implemented not only affected the spread of COVID-19, but other infectious diseases including IPD. The New Zealand government introduced restrictions in March 2020, initially requiring people to self-isolate if returning from overseas. Following this, restrictions on gatherings were put in place and after the introduction of the 4-tiered alert level system, New Zealand entered alert level 4 requiring the entire nation to self-isolate on 25 March [17]. This lasted over one month with the country entering alert level 3 on 27 April, with further reductions in restrictions made on 11 May when the nation entered alert level 2, then alert level 1 on 8 June [17].

METHODS

SURVEILLANCE METHODS

In this report, data for 2009 to 2020 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. In this report, serotype19A is grouped with PCV13 serotypes. In prior reports, 19A was grouped with PCV10 serotypes due to an assumed cross-protection with 19F.

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 [18]:

- isolation of *S. pneumoniae* from blood, cerebrospinal fluid (CSF) or another normally sterile site (e.g., 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 (since 2009) or pleural fluid (since 2016)

The use of a laboratory-based surveillance system for IPD notification has some limitations. The addition of pleural fluid in 2016 may have slightly increased the total number of IPD cases relative to previous years. This is particularly true for cases that were not detected from isolation of *S. pneumoniae* from blood, CSF, or another normally sterile site, nor from detection of *S. pneumoniae* nucleic acid from blood, CSF or another normally sterile site, nor did they have a positive *S. pneumoniae* antigen test on CSF. The total number of additional cases that may have been identified with this method was less than 10.

The use of surveillance data to identify and accurately quantify risk factors for IPD may be limited due to a lack of completeness of data. Moreover, not only are questions about risks often not answered, but when they are answered they often lack context. For example, a child who has been identified as "immunocompromised" may not necessarily be at an increased risk for IPD. A closer examination of the medical records for these cases would be needed to determine true risk. Additionally, some risk factors are especially susceptible to recall bias. That is, a clinician may report all risks, both large and small, after a case is identified, potentially falsely over-representing some risks relative to non-cases in the community. Lastly, the cause of death is unknown in a large proportion of fatalities, and the proportion where the cause of death is unknown has increased over time.

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. The case report form is available 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* (i.e., 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, though from 2019 only 50%

of isolates are tested for susceptibility. 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 1 November 2021. 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 (i.e., 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.

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 [19]. Some serotypes form serogroups and factor antisera are required to identify the serotype within that serogroup. The full complement of factorised antisera is not held by ESR. Consequently, some isolates are described by their serogroup followed by the designation NT (non-typeable). Isolates where the serotype is undetermined are designated 'Non-typeable' in this report.

Antimicrobial susceptibility testing

Penicillin and cefotaxime susceptibilities were determined by Etest (bioMerieux, France), using EUCAST Mueller-Hinton Fastidious agar and incubation for 20–24 hours in 5% CO_2. Chloramphenicol, clindamycin, co-trimoxazole, erythromycin, moxifloxacin, rifampicin, tetracycline and vancomycin susceptibilities were determined by EUCAST disc susceptibility testing methods [20]. Inducible clindamycin resistance was detected by the D-zone test [20]. All minimum inhibitory concentrations (MICs) and zone of inhibition diameters were interpreted according to the current EUCAST clinical breakpoints [21].

The antimicrobial susceptibility data presented in this report for the years prior to 2016 is based on CLSI methods [22] and breakpoints. EUCAST breakpoints, where they differ from CLSI breakpoints, have not been retrospectively applied to MICs and zone diameters determined by CLSI methods due to differences between the two methods. In this report, when associations between penicillin resistance and patient demographics, geographical distribution or serotypes are made, penicillin resistance as defined by the meningitis breakpoints have been used. The EUCAST and CLSI penicillin meningitis breakpoints are the same (susceptible, MIC ≤0.06 mg/L; resistant, MIC ≥0.12 mg/L). These penicillin breakpoints are also those commonly used for surveillance purposes. The EUCAST clinical breakpoints for co-trimoxazole changed in 2019 and are noted in the results.

In this report, multidrug resistance (MDR) is defined as resistance to three antibiotics in addition to penicillin. For the purposes of this definition, the meningitis breakpoints for penicillin were used.

ANALYTICAL METHODS

The denominator data used to determine all disease rates, except the rates for ethnic groups and deprivation index, is derived from the 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 2017 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 resident 2018 census population applied to the 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 unknown. 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, detection of *S. pneumoniae* DNA in CSF, positive pneumococcal antigen test on CSF, detection of *S. pneumoniae* DNA in blood, culture of *S. pneumoniae* from pleural fluid, culture of *S. pneumoniae* from joint fluid, culture of *S. pneumoniae* from another normally sterile site, detection of *S. pneumoniae* DNA in pleural fluid, positive pneumococcal antigen test of pleural fluid, detection of *S. pneumoniae* DNA in joint fluid and detection of *S. pneumoniae* DNA in other normally sterile site.

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 or after disease onset were not counted in the analysis.

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. Data for 2008–2019 can be obtained from earlier annual reports [2–11].

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

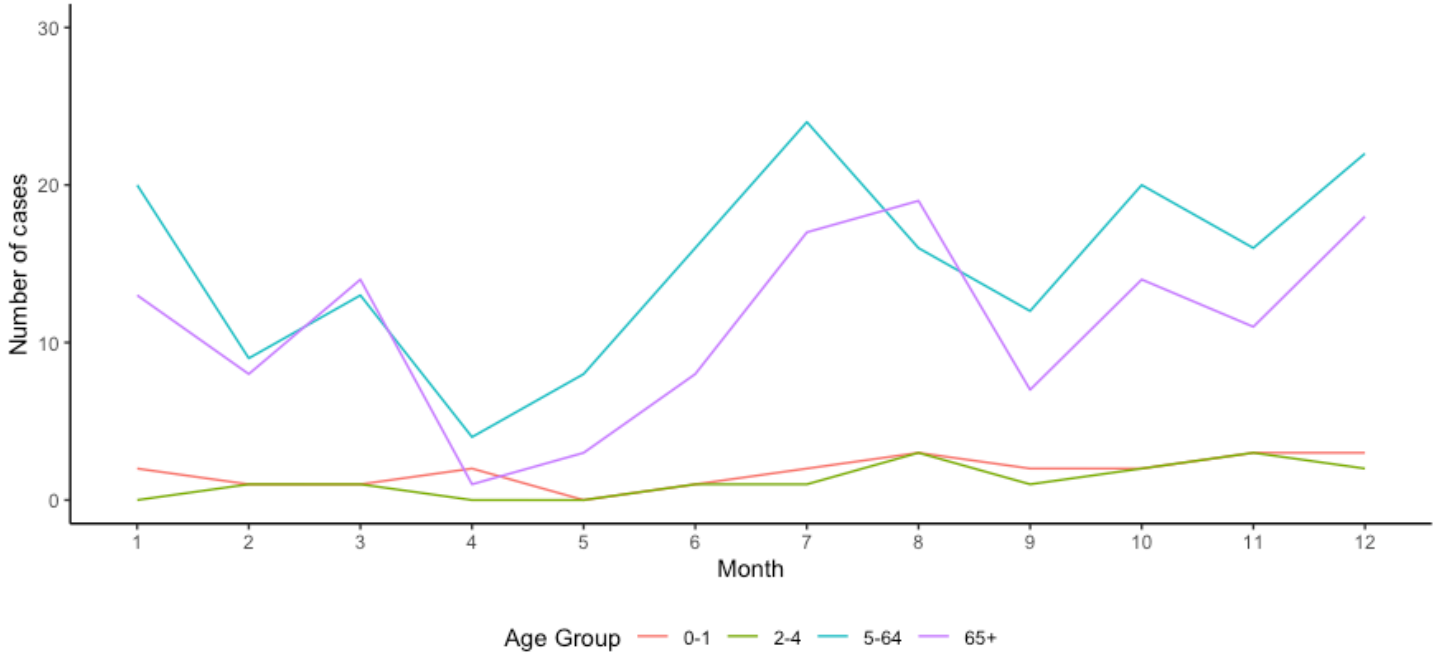
In 2020, 350 cases of IPD were notified. The 2020 annual incidence rate for IPD was 6.9 cases per 100,000 population, which was the lowest annual incidence rate of IPD recorded since 2008 when IPD became a notifiable disease. It is important to note that the low incidence rates of IPD in 2020, coincided with national restrictions put in place in response to the COVID-19 pandemic. These restrictions led to a decline of transmission rates for IPD as well as other infectious diseases.

Of the 350 cases of IPD, *S. pneumoniae* isolates from 342 cases were received by ESR. Antimicrobial susceptibility testing was performed on 49.7% (170/342) of the available isolates in 2020. (Note: Since 2019, a purposeful reduction in antimicrobial susceptibility testing to 50% of *S pneumoniae* isolates was introduced to reduce workload on laboratories.)

DISEASE INCIDENCE BY SEASON

As in previous years, in 2020 there was a peak of cases of IPD in the winter months among cases aged 5 years and over. However, this peak was less marked than in previous years and a similar number of cases were observed towards the end of 2020 (Figure 1). There was a greater decrease in number of cases of IPD in April and May, compared to previous years. It is important to note that national COVID-19 restrictions were put in place in March 2020 and again in August/September 2020, resulting in lower transmission rates of infectious diseases, including IPD.

Figure 1. Number of invasive pneumococcal disease cases by age group and month, 2020



DISEASE INCIDENCE BY AGE AND SEX

The rates of IPD were greater for males compared to females in all aggregated age groups, except for the <2 years age group (Table 1). The aggregated age group with the highest incidence rate for females was the <2 years age group (20.3 cases per 100,000), followed by the ≥65 years age group (16.2 cases per 100,000). The age group with the highest incidence rate for males was the ≥65 years age group (17.6 cases per 100,000), followed by the <2 years age group (16.2 cases per 100,000). The 5–64 years age group had the lowest incidence rates for both females and males (4.4 and 4.7 cases per 100,000, respectively).

There were 350 cases of IPD notified in 2020, yielding an annual incidence rate of 6.9 cases per 100,000 population (Table 1). The aggregated age group with the highest annual incidence rate in 2020 was the <2 years age group (18.2 cases per 100,000), followed by the ≥65 years age group (16.8 cases per 100,000).

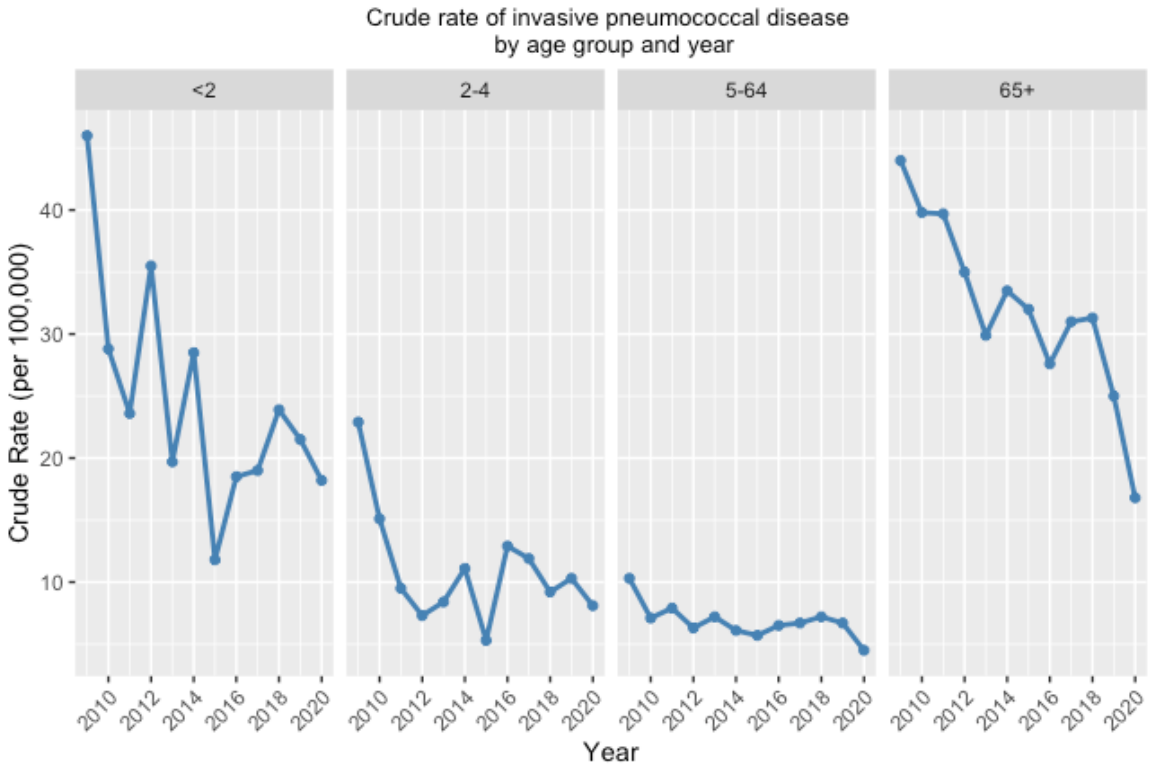
Table 1. Number of cases and rate per 100,000 population of invasive pneumococcal disease by age group and sex, 2020

Age group (years)	Female		Male		Total		
	Cases	Rate[a]	Cases	Rate[a]	Cases	Rate[a]	Percentage[b]
<1	5	17.1	5	16.3	10	16.7	2.9
1	7	23.4	5	16.1	12	19.7	3.4
2–4	5	5.6	10	10.5	15	8.1	4.3
5–14	4	--	5	1.5	9	--	2.6
15–24	4	--	5	1.5	9	--	2.6
25–34	14	3.8	16	4.2	30	--	8.6
35–44	10	3.1	12	3.8	22	--	6.3
45–54	15	4.5	22	6.8	37	5.6	10.6
55–64	40	12.6	33	11.0	73	11.9	20.9
65–74	28	11.9	35	15.7	63	13.7	18.0
75–84	25	19.2	23	20.4	48	19.7	13.7
≥85	15	27.7	7	20.4	22	24.9	6.3
Aggregated age groups (years)							
<2	12	20.3	10	16.2	22	18.2	6.3
<5	17	11.4	20	12.8	37	12.1	10.6
5–64	87	--	93	4.7	180	--	51.4
≥65	68	16.2	65	17.6	133	16.8	38.0
Total	172	6.7	178	7.1	350	6.9	100

[a] Where there were fewer than five cases, a rate has not been calculated.
[b] Percentage of cases in each age group

Between 2009 and 2020, there has been a greater than 50% decrease in annual incidence of IPD in all age groups (Figure 2). The annual incidence rate for 5–64 years age group and the ≥65 years age group has decreased to the lowest annual incidence rate recorded since 2009 (decreasing from 10.3 to 4.5 per 100,000 and from 44.0 to 16.8 per 100,000 respectively). In the <2 years age group the annual incidence rate has decreased from 21.5 cases per 100,000 in 2019 to 18.2 cases per 100,000 in 2020, which is similar to the rate recorded in 2016 and 2017 (18.5 and 19.0 cases per 100,000). The annual incidence rate in the 2–4 years age group has decreased from 12.9 to 8.1 per 100,000 since 2016. Prior to which the lowest recorded annual incidence rates in these age groups were recorded in 2015 (11.8 per 100,000 for the <2 years age group and 5.3 per 100,000 for the 2–4 years age group).

Figure 2. Rate per 100,000 population of invasive pneumococcal disease by age group and year, 2009–2020



DISEASE INCIDENCE BY ETHNIC GROUP

Ethnicity was recorded for all 350 (100%) of IPD cases in 2020. The age-standardised rates of IPD were highest for the Pacific peoples (30.2 per 100,000, 61 cases) and Māori (20.3 per 100,000, 114 cases). (Table 2).

Among the 22 cases <2 years of age, ten cases (45.5%) were of Māori ethnicity, six (27.3%) were European or Other ethnicity, four (18.2%) were of Pacific peoples ethnicity and one case (4.5%) was of Asian ethnicity and another (4.5%) was of MELAA ethnicity.

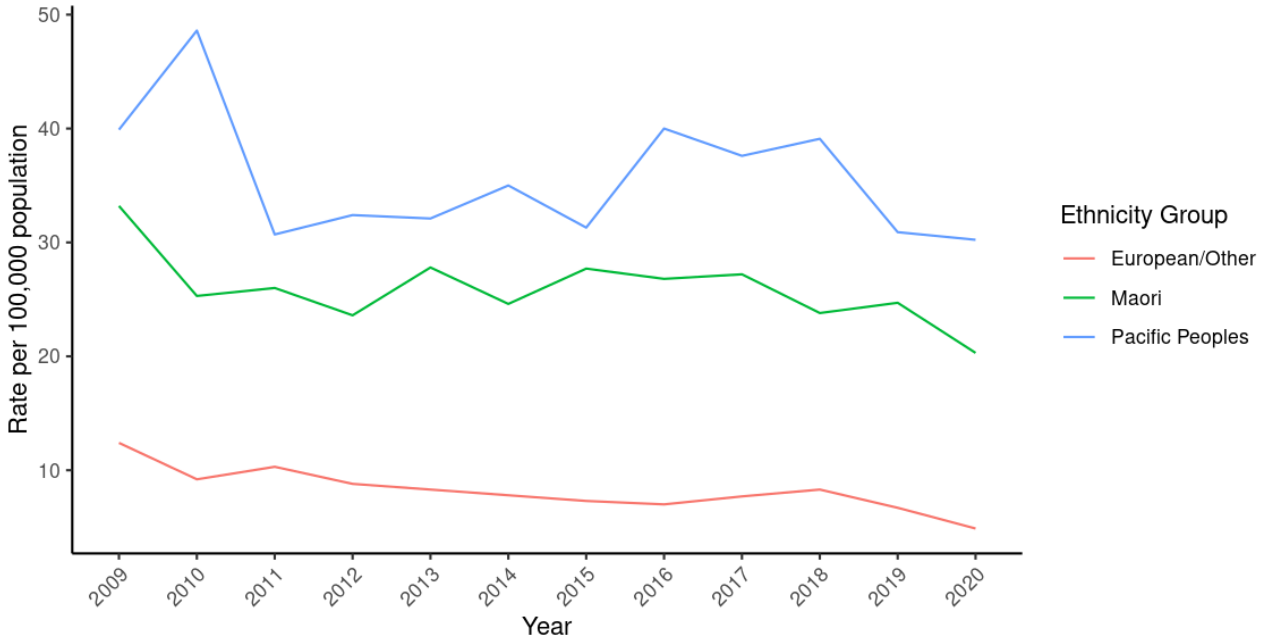
Table 2. Number of cases, and age-specific and age-standardised rate per 100,000 population of invasive pneumococcal disease by ethnic group and age group, 2020

Age group (years)	Māori		Pacific peoples		Asian		MELAA[a]		European or Other	
	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
<1	7	43.4	2	--	0	0	0	0	1	--
1	3	--	2	--	1	--	1	--	5	15.9
2–4	4	--	2	--	3	--	0	0	6	8.5
5–14	5	2.8	1	--	1	--	0	0	2	--
15–24	0	0	3	--	2	--	0	0	4	--
25–34	15	12.2	8	14.9	0	0	0	0	7	1.9
35–44	10	10.6	3	--	2	--	0	0	7	1.9
45–54	22	24.0	5	12.8	4	--	0	0	6	1.4
55–64	21	29.1	13	48.6	5	7.6	1	--	33	7.4
65–74	13	35.2	11	72.8	1	--	0	0	38	10.3
75–84	11	78.1	6	97.1	5	34.0	0	0	26	12.5
≥85	3	--	5	359.0	1	--	0	0	13	16.1
Aggregated age groups (years)										
<2	10	29.0	4	--	1	--	1	--	6	10.4
<5	14	16.6	6	20.3	4	--	1	--	12	9.1
5–64	73	10.4	33	11.4	14	2.1	1	--	59	2.6
≥65	27	50.1	22	97.0	7	13.0	0	0	77	11.7
Total cases and crude rate for all ages[b]	114	13.5	61	17.9	25	3.2	2	--	148	4.8
Age-standardised rate[c]		**20.3**		**30.2**		**5.0**		**4.0**		**4.2**

[a] Middle Eastern/Latin American/African.
[b] Ethnicity was recorded for 350 (100.0%) of cases notified in 2020.
[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 2018 census population applied to the 2020 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.

Between 2009 and 2020, the age-standardised IPD rates decreased in the European or Other (-60%), Māori (-39%) and Pacific peoples (-25%) ethnic groups (Figure 3).

Figure 3. Age-standardised rate per 100,000 population of invasive pneumococcal disease by ethnic group, 2009–2020



Note: Rates for the Asian and MELAA ethnic groups are not shown due to small numbers. The age-standardised rates are direct-standardised to the age distribution of the total New Zealand population.

DISEASE INCIDENCE BY DEPRIVATION

In 2020, 300 (85.7%) of the 350 IPD cases had a residential address recorded that could be assigned an NZDep13 score. Greater than 50% of IPD cases resided in NZDep13 quintiles 4 or 5 (Table 3). There was an increasing trend with a greater proportion of cases in the more deprived quintiles. The difference between quintiles became greater with a higher NZDep13 quintile. For example, there were 25% more cases who resided in NZDep13 quintile 2 compared to quintile 1, but there were 81% more cases residing in NZDep13 quintile 5 compared to quintile 4. In age groups <65 years more than half of cases resided in NZDep13 quintiles 4 or 5.

Table 3. Number and percentage of invasive pneumococcal disease cases by quintiles of the 2013 New Zealand deprivation index and age group, 2020

NZDep13 quintile[a]	<2 years		2–4 years		5–64 years		≥65 years		Total	
	Cases	%[b]	Cases	%[b]	Cases	%[b]	Cases	%[b]	Cases	%[b]
1	2	9.1	0	0	12	6.7	14	10.5	28	8.0
2	1	4.5	3	20.0	19	10.6	12	9.0	35	10.0
3	4	18.2	1	6.7	21	11.7	23	17.3	49	14.0
4	5	22.7	4	26.7	35	19.4	23	17.3	67	19.1
5	8	36.4	4	26.7	71	39.4	38	28.6	121	34.6
Unknown[c]	2	9.1	3	20.0	22	12.2	23	17.3	50	14.3
Total[d]	**22**	**100**	**15**	**100**	**180**	**100**	**133**	**100**	**350**	**100**

[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] Cases which for which accurate New Zealand Deprivation Index (NZDep13) was unknown.
[d] Accurate New Zealand Deprivation Index (NZDep13) data was available for 300 (85.7%) cases notified in 2020.

DISEASE PRESENTATION, HOSPITALISATIONS AND FATALITIES

In 2020, 332 (94.9%) of the 350 IPD cases had at least one clinical presentation recorded (Table 4). Among infants aged <1 year, meningitis was the most common presentation (40.0%), followed by pneumonia and bacteraemia without focus (30.0% and 20.0% respectively). All four cases of pneumococcal meningitis age <1 year were of Māori ethnicity.

Bacteraemia without focus was the most common presentation in children aged 1 year (50.0%) and children aged 5–14 years (37.5%). Pneumonia was the most common presentation in children aged 2–4 years (69.2%), adults 15–64 years (62.7%) and adults ≥65 years (72.4%). Overall, for IPD cases ≥5 years of age pneumonia was the most common presentation (65.7%).

Table 4. Clinical presentation of invasive pneumococcal disease cases by age group, 2020

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	4	40.0	0	-	3	30.0	2	20.0	1	10.0	10
1	1	8.3	1	8.3	4	33.3	6	50.0	0	-	12
2–4	0	-	1	7.7	9	69.2	2	15.4	1	7.7	13
5–14	1	12.5	1	12.5	2	25.0	3	37.5	1	12.5	8
15–64	13	7.8	1	0.6	104	62.7	25	15.1	23	13.9	166
≥65	3	2.4	2	1.6	89	72.4	20	16.3	9	7.3	123
Aggregated age groups (years)											
<2	5	22.7	1	4.5	7	31.8	8	36.4	1	4.5	22
<5	5	14.3	2	5.7	16	45.7	10	28.6	2	5.7	35
≥5	17	5.7	4	1.3	195	65.7	48	16.2	33	11.1	297
Total[d]	22	6.6	6	1.8	211	63.6	58	17.5	35	10.5	332

[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'. 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 332 (94.9%) of cases notified in 2020.

Hospitalisations and Fatalities

As a result of the case definition, all IPD cases would likely be hospitalised, however, hospitalisation information was recorded for 343 (98.0%) IPD cases in 2020, with 332 (96.8) IPD cases noted as hospitalised. The proportion of IPD cases that were hospitalised has remained high between 2017 to 2020 (ranging from 96.1% in 2017 to 97.8% in 2018).

Information on whether the patient survived or died was recorded for 341 (97.7%) IPD cases in 2020. IPD was recorded as the primary cause of death for 11 cases (a further 10 had an unknown cause of death and two were not attributable), giving a case-fatality rate of 3.2% among the cases for whom this information was reported. There was one death due to IPD reported in the <5 years age group in 2020 (as well as another death in the <5 years age group of which the cause was unknown), compared to two in 2019 and one in 2017 and 2018.

IMMUNISATION STATUS

Immunisation records were identified for IPD cases who were age-eligible for PCV (ie, cases born after 1 January 2008). The number of doses received more than 14 days before onset of IPD (determined using the earliest episode date available from onset of illness date, hospitalised date, or date reported to the public health unit) are shown. PCV vaccine was defined as PCV7, PCV10, PCV13—the number of doses of covering PCV is specific to the serotype detected and the PCV type received. It should be noted that the PCV immunisation schedule changed in July 2020, dropping the 3 month dose, retaining PCV10 doses at 6 weeks, 5 months, and 12 months.

In 2020, immunisation records were identified in the NIR for 40 IPD cases (Table 5). An additional 3 IPD cases were age-eligible for PCV but had no data within NIR nor in EpiSurv and are assumed to be unvaccinated. Of the 43 PCV-eligible IPD cases in 2020, 23 cases were either non-PCV serotypes, the serotype data was missing or was non-typable, and 20 cases were diagnosed with a serotype that was contained within PCV7, PCV10 or PCV13. Of these 20, 18 were serotype 19A, 15 of whom had received at least one dose of PCV10. Two cases had received one dose, four cases received two doses, two cases received three doses and two cases had received four doses of PCV10. Another five cases had received one PCV10 dose and three PCV13 doses. Two cases of serotype 3 were identified, one of which had received three doses of PCV10 and another who had received four doses.

Table 5. Immunisation status of the 2020 IPD cases (n=43) who were age-eligible for PCV and have an NIR record

Vaccine Type (doses)	PCV7 Serotypes							PCV10 Serotypes			PCV13 Serotypes			Non-PCV Serotypes or UNK	Number of People
	4 n=0	6B n=0	9V n=0	14 n=0	18C n=0	19F n=0	23F n=0	1 n=0	5 n=0	7F n=0	19A n=18	3 n=2	6A n=0	n=23	
PCV7															
1														0	0
2														0	0
3														0	0
4														1	1
PCV10															
1											2			1	3
2											4			1	5
3											2	1		5	8
4											2	1		7	10
PCV13															
1														0	0
2														0	0
3														0	0
4														2	2
Multiple PCVs															
PCV7/PCV10														1[a]	1
PCV7/PCV13														1[b]	1
PCV10/PCV13											5[c]			4[d]	9
PCV7/PCV10/PCV13														0	0
Unvaccinated											3			0	3
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**18**	**2**	**0**	**23**	**43**

Note: blank cells represent zero observations.
[a]Three PCV7 doses/one PCV10 dose.
[b]One PCV7 doses/four PCV13 doses
[c]Five cases received one PCV10 doses/three PCV13 doses
[d]One case received three PCV10 doses/one PCV13 dose; one case received two PCV10 doses/two PCV13 doses; one case received one PCV10 dose/three PCV13 doses; one case received two PCV10 doses/twoPCV13 doses

19A in children under 5 and Immunisation status

In 2020, there were 18 children <5 years of age diagnosed with 19A, 15 of whom had received at least one dose of PCV at least 14 days before disease onset (Table 6). Six were <1 years of age, one of whom was unvaccinated, while the other five were on schedule for their vaccinations for their age. One of the infants <1 years of age had received one PCV10 dose, three had received two PCV10 doses and one had received three PCV10 doses. Ten children aged 1 to 4 years with serotype 19A IPD had received at least one dose of PCV at least 14 days before disease onset. Two cases were unvaccinated and two were under vaccinated for their age, one of whom had received one dose and one had received two doses of PCV10. One case was on schedule with three PCV10 doses. The other seven cases in this age group were fully vaccinated, of whom two had received four doses of PCV10, and five had received one dose of PCV10 plus three doses of PCV13.

Table 6. Pneumococcal conjugate vaccination history of the serotype 19A invasive pneumococcal disease cases in <5 years age group, 2020

Case number	Age group	Number of PCV7 doses	Number of PCV10 doses	Number of PCV13 doses	Last dose received	Vaccination Status	Risk factors*
1	<1				N/A	Unvaccinated	None
2	<1		1		PCV10	On Schedule	None
3	<1		2		PCV10	On Schedule	Congenital/chromosomal abnormality
4	<1		2		PCV10	On Schedule	None
5	<1		2		PCV10	On Schedule	None
6	<1		3		PCV10	On Schedule	None
7	1 to 4				N/A	Unvaccinated	None
8	1 to 4				N/A	Unvaccinated	None
9	1 to 4		1		PCV10	Under Vaccinated	None
10	1 to 4		2		PCV10	Under Vaccinated	None
11	1 to 4		3		PCV10	On Schedule	None
12	1 to 4		1	3	PCV10	Fully Vaccinated	Congenital/chromosomal abnormalities, chronic lung disease
13	1 to 4		1	3	PCV10	Fully Vaccinated	None
14	1 to 4		1	3	PCV10	Fully Vaccinated	congenital/chromosomal abnormality, high risk chronic conditions
15	1 to 4		1	3	PCV10	Fully Vaccinated	None
16	1 to 4		1	3	PCV10	Fully Vaccinated	chronic illness, immunocompromised
17	1 to 4		4		PCV10	Fully Vaccinated	None
18	1 to 4		4		PCV10	Fully Vaccinated	Not recorded

* congenital/chromosomal abnormality, chronic condition, immunocompromise, cochlear implant, pre/post splenectomy

RISK FACTORS

The risk factors reported among IPD cases in 2020 which would have made the case eligible for additional funded vaccines are presented in Table 7. The risk factors reported for children <5 years of age were being immunocompromised and chronic lung disease, reported in 2.9% of cases with responses for each of these risk factors. More than 20% of cases ≥5 years of age were reported to be immunocompromised and over 25% had chronic lung disease. No children <5 years of age had asplenia, and only one adult was asplenic. No cases of IPD were reported to have cochlear implants.

Table 7. Conditions reported and associated with highest risk of IPD (2020)**

	<2 Years (n=22)				<5 Years (n=37)				≥5 Years (n=313)			
Risk factor	**Cases[a]**	**Total[b]**	**%[c]**	**Unknown**	**Cases[a]**	**Total[b]**	**%[c]**	**Unknown**	**Cases[a]**	**Total[b]**	**%[c]**	**Unknown**
Anatomical or functional asplenia	0	21	0.0	1	0	33	0.0	4	1	266	<1.0	47
Immuno-compromised	0	22	0.0	0	1	35	2.9	2	59	264	22.3	49
Cochlear implants	0	22	0.0	0	0	33	0.0	4	0	252	0.0	61
Chronic lung disease, including CLD of prematurity	0	22	0.0	0	1	35	2.9	2	71	280	25.4	33

[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.
**Entitled to High Risk vaccine schedule as per immunisation handbook 2020

In addition to risk factors that would make an individual eligible for a high-risk vaccine schedule, there are other chronic conditions that are known to be associated with increased risk of IPD. Chronic illness such as cardiac disease, alcohol-related disease, diabetes, and chronic liver disease was reported in 9.4% of cases with responses in children <5 years of age and 70.0% of cases with responses ≥5 years of age.

Other conditions associated with increased risk of IPD include Down Syndrome and pre-term birth. Of these, only data on premature birth is regularly collected in EpiSurv. In 2020, among cases for which information was recorded, 8.3% (*n=2)* of children under 5 years of age and 11.8% (*n=2*) of children under 2 years of age were premature.

DISEASE INCIDENCE BY DISTRICT HEALTH BOARD

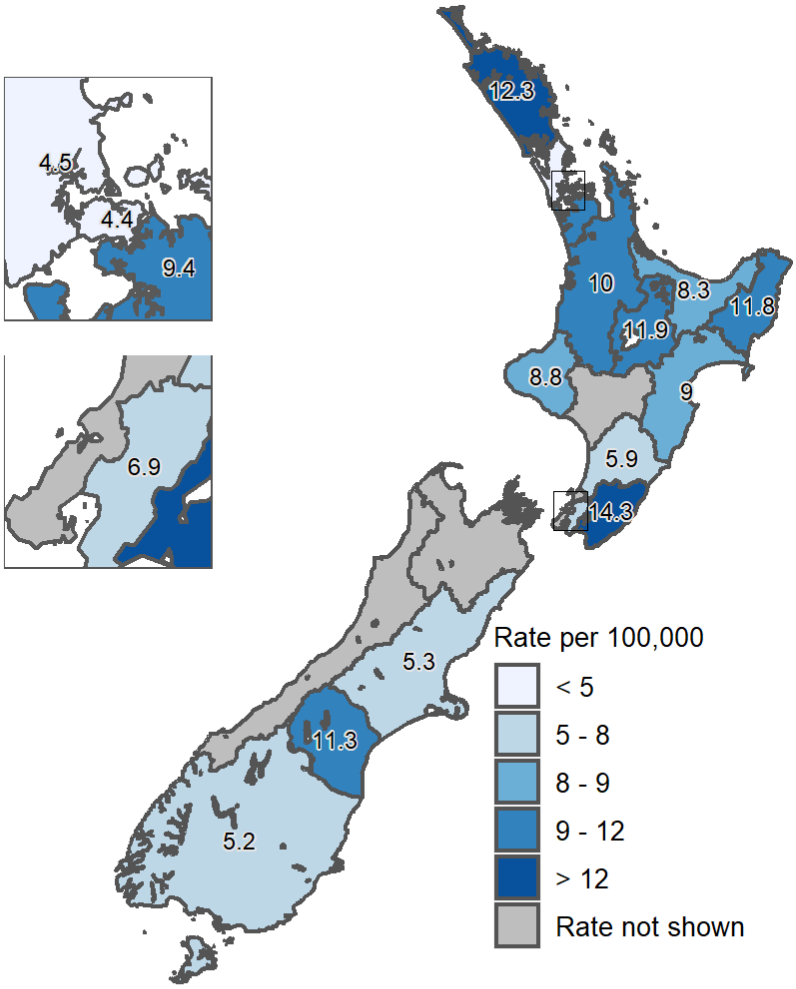
In 2020 the highest rate of IPD was in Wairarapa District Health Board (DHB) (14.3 per 100,000, 7 cases), followed by Northland (12.3 per 100,000, 24 cases), Lakes (11.9 per 100,000, 14 cases), Tairawhiti (11.8 per 100,000, 6 cases) and South Canterbury (11.3 per 100,000, 7 cases) DHBs (Table 8 and Figure 4). Across the regions, rates ranged from 5.6 in the Southern region to 9.7 in the Midland region (Table 8).

Table 8. Number of cases of invasive pneumococcal disease by age group and rate per 100,000 population for each District Health Board, 2020

District Health Board	Cases by age group (years)					Rate[a] (all ages)
	<2	<5	5–64	≥65	All ages	
Northland	0	0	12	12	24	12.3
Waitemata	1	3	15	11	29	4.5
Auckland	2	4	11	7	22	4.4
Counties Manukau	2	3	38	15	56	9.4
Northern region	**5**	**10**	**76**	**45**	**131**	**6.8**
Waikato	4	6	16	22	44	10.0
Lakes	1	3	7	4	14	11.9
Bay of Plenty	2	4	7	11	22	8.3
Tairawhiti	0	0	3	3	6	11.8
Taranaki	1	1	8	2	11	8.8
Midland region	**8**	**14**	**41**	**42**	**97**	**9.7**
Hawke's Bay	2	2	10	4	16	9.0
Whanganui	0	0	3	0	3	--
MidCentral	0	0	10	1	11	5.9
Hutt Valley	1	2	6	3	11	6.9
Capital & Coast	0	0	8	7	15	4.6
Wairarapa	0	0	2	5	7	14.3
Nelson Marlborough	0	0	1	1	2	--
Central region	**3**	**4**	**40**	**21**	**65**	**5.8**
West Coast	0	1	0	0	1	--
Canterbury	6	7	13	11	31	5.3
South Canterbury	0	0	4	3	7	11.3
Southern	0	1	6	11	18	5.1
Southern region	**6**	**9**	**23**	**25**	**57**	**5.6**
Total	**22**	**37**	**180**	**133**	**350**	**6.9**

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

Figure 4. Geographic distribution of invasive pneumococcal disease cases, 2020



Between 2019 and 2020 the rates of IPD cases decreased in all regions (Northern region decreased from 9.8 per 100,000 to 6.8 per 100,000; Midland region from 17.4 to 9.7; Central region from 10.6 to 5.8; Southern region from 7.2 to 5.6). Rates of IPD in Taranaki DHB decreased by over 50% from 17.1 per 100,000 to 8.8 per 100,000. Rates remained relatively similar in Waikato DHB (10.0 per 100,000 in 2020, compared to 10.3 per 100,000 in 2019) and Wairarapa DHB (decreasing from 14.7 in 2019 to 14.3 per 100,000 in 2020).

There were less than five cases in the Whanganui, Nelson Marlborough and West Coast. Compared to 2019, the number of cases in these DHBs decreased by at least three quarters, with an 80% decrease in the number of cases in Nelson Marlborough (from 10 to 2 cases) 79% in Whanganui (14 to 3 cases) and 75% in the West Coast (4 to 1 case).

The number of cases of IPD remained the same or decreased in all District Health Board's between 2019 and 2020 except in Tairawhiti with numbers increasing from four to six and South Canterbury with IPD case numbers increasing from six to seven.

From 2017 to 2020 the Southern region consistently had the lowest annual incidence rate, while the Midland region consistently had the highest annual incidence rate.

SEROTYPE DISTRIBUTION

Table 9 shows, by age group, the number and proportion of the 350 cases referred to ESR in 2020 caused by each of the serotypes included in PCV7, PCV10 and PCV13, and any other serotypes as well as those of which serotype was not available.

The most common serotypes in 2020 were 19A (71 cases), 8 (58 cases), 12F (31 cases) and 3 (25 cases). 19A and 3 serotypes are covered by the PCV13 vaccine, while 8 and 12F serotypes are covered by the 23PPV vaccine.

Among the <5 years age group 54.1% of cases (n=20) were due to PCV13 serotypes.

In the <2 years age group, 10 (45.4%) cases of IPD were due to a PCV13 serotype (Table 9). Nine of the cases in this age group were serotype 19A and one was serotype 3.

Ten (66.7%) cases of IPD in the 2–4 years age group were due to a PCV13 serotype, nine were serotype 19A and one was serotype 3. There were no cases due to a PCV10 serotype in the <5 years age group.

Among the ≥65 years age group, 70.1% (n=94) of cases were due to PPV23 serotypes. Of the IPD cases among children <5 years of age, 24.3% (n=9) would have been covered by the PPV23 vaccine but were not covered by the PCV13 vaccine. Of the cases aged 5–64 years, 74% (n=134) were of serotypes which are covered by one of the four vaccines and 48% would have been covered by the 23PPV vaccination serotypes which are not covered by the other vaccinations.

In 2020, 3.1% (n=11) of cases were serotypes covered by PCV7, 5.1% (n=18) by PCV10, 32.5% (n=114) by PCV13 and 77% (n=268) by PPV23.

Table 9. Number and percentage of invasive pneumococcal disease cases by serotype, serotypes covered by PCV7, PCV10 and PCV13, and age group, 2020

Serotype	<2 years		2–4 years		<5 years[a]		5–64 years		≥65 years[b]		Total	
	Cases	%[c]	Cases	%[c]	Cases	%[c]	Cases	%[c]	Cases	%[c]	Cases	%[c]
4	0	0	0	0	0	0	2	1.1	1	0.8	3	0.9
6B	0	0	0	0	0	0	0	0	1	0.8	1	0.3
9V	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	1	0.6	0	0	1	0.3
18C	0	0	0	0	0	0	0	0	0	0	0	0
19F	0	0	0	0	0	0	1	0.6	4	3.0	5	1.4
23F	0	0	0	0	0	0	0	0	1	0.8	1	0.3
PCV7	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**2.2**	**7**	**5.3**	**11**	**3.1**
1	0	0	0	0	0	0	1	0.6	0	0	1	0.3
5	0	0	0	0	0	0	0	0	0	0	0	0
7F	0	0	0	0	0	0	5	2.8	1	0.8	6	1.7
PCV10	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**3.3**	**1**	**0.8**	**7**	**2.0**
3	1	4.5	1	6.7	2	5.4	10	5.6	13	9.8	25	7.1
6A	0	0	0	0	0	0	0	0	0	0	0	0
19A	9	40.9	9	60.0	18	48.6	27	15.0	26	19.5	71	20.3
PCV13	**10**	**45.4**	**10**	**66.7**	**20**	**54.1**	**37**	**20.6**	**39**	**29.3**	**96**	**27.4**
6C	0	0	1	6.7	1	2.7	3	1.7	2	1.5	6	1.7
7C	1	4.5	0	0	1	2.7	2	1.1	2	1.5	5	1.4
8	2	9.1	0	0	2	5.4	40	22.2	16	12.0	58	16.6
9N	0	0	0	0	0	0	3	1.7	3	2.3	6	1.7
10A	3	13.6	0	0	3	8.1	2	1.1	1	0.8	6	1.7
10F	0	0	0	0	0	0	0	0	0	0	0	0
11A	0	0	0	0	0	0	6	3.3	4	3.0	10	2.9
12F	2	9.1	1	6.7	3	8.1	21	11.7	7	5.3	31	8.9
13	0	0	0	0	0	0	2	1.1	1	0.8	3	0.9
15A	0	0	0	0	0	0	2	1.1	8	6.0	10	2.9
15B	0	0	0	0	0	0	6	3.3	2	1.5	8	2.3
15C	0	0	0	0	0	0	0	0	1	0.8	1	0.3
16F	0	0	0	0	0	0	8	4.4	3	2.3	11	3.1
17F	0	0	0	0	0	0	0	0	2	1.5	2	0.6
18A	0	0	0	0	0	0	0	0	0	0	0	0
18F	0	0	0	0	0	0	1	0.6	0	0	1	0.3
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	1	0.6	0	0	1	0.3
22A	0	0	0	0	0	0	0	0	0	0	0	0
22F	1	4.5	0	0	1	2.7	6	3.3	8	6.0	15	4.3
23A	0	0	0	0	0	0	4	2.2	7	5.3	11	3.1
23B	1	4.5	2	13.3	3	8.1	8	4.4	4	3.0	15	4.3
31	0	0	0	0	0	0	0	0	2	1.5	2	0.6
33F	0	0	0	0	0	0	3	1.7	4	3.0	7	2.0
34	0	0	0	0	0	0	1	0.6	0	0	1	0.3
35B	0	0	0	0	0	0	0	0	3	2.3	3	0.9
35F	0	0	0	0	0	0	1	0.6	1	0.8	2	0.6
37	0	0	0	0	0	0	2	1.1	0	0	2	0.6
38	1	4.5	0	0	1	2.7	0	0	0	0	1	0.3
42	0	0	0	0	0	0	0	0	0	0	0	0
Other[d]	1	4.5	1	6.7	2	5.4	1	0.6	3	2.3	6	1.7
Non-PCV	**12**	**54.5**	**5**	**33.3**	**17**	**45.9**	**123**	**68.3**	**84**	**63.2**	**224**	**64.0**
NA[e]	0	--	0	--	0	--	10	--	2	--	12	--
Total[f]	**22**	**100**	**15**	**100**	**37**	**100**	**180**	**100**	**133**	**100**	**350**	**100**

[a] Aggregated age group.
[b] Among the cases in the ≥65 years age group, 71% 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] Includes non-typeable serotypes.
[e] Includes cases where serotype information was not available
[f] Total number of isolates from culture-positive cases referred to ESR for serotyping for each age group.

Trends in the rates of disease due to PCV7, PCV10 and PCV13 and all other serotypes for the different age groups are shown 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 decreases in IPD rates due to PCV10 serotypes in all age groups, with a greater decrease for PCV7 serotypes.

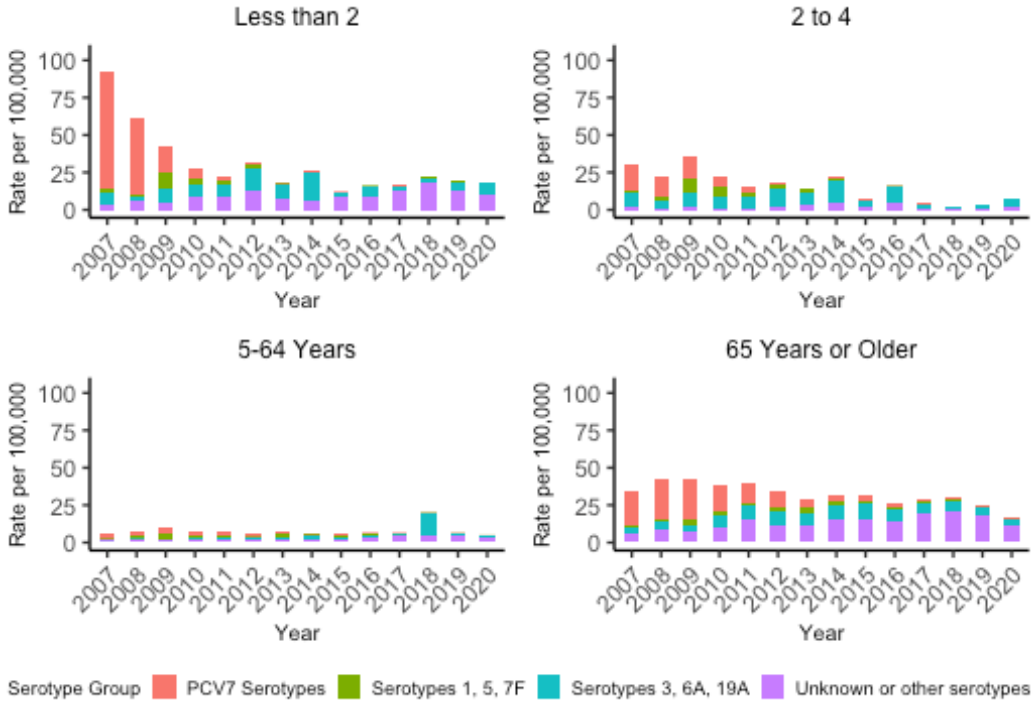
In 2020, while the overall incidence rate of IPD cases decreased there was approximately a 10% increase in the number of 19A serotype cases between 2019 (n=65) and 2020 (n=71).

The largest decrease for PCV7 and PCV10 serotypes has been in the <5 years age group with no PCV7 or PCV10 serotype cases reported since 2017. There have also been reductions in PCV7 serotype cases in those 5–64 years of age with a decrease from 10% of cultures sent for serotyping being PCV7 in 2017 to 2% in 2020.

Among the 5–64 years age group the proportion of cases serotyped that were PCV10 has also decreased from 28% in 2017 to 6% in 2020 (prior to 2020, serotype 19A was included in analysis of PCV10 serotype vaccines, due to PCV10 being registered as providing cross-protection to 19A, however, in this report serotype 19A has been analysed as a PCV13 serotype, statistics from previous years have also been updated to reflect this change.

Among the ≥65 years age group of those with available serotype information 5% were of PCV7 serotypes, demonstrating minimal change from 2017 with a reduction from 7% and no change from 2019. Between 2017 to 2020 there have been reductions in the proportion of serotypes covered by PCV10, decreasing from 28% to 6%.

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, 2006–2020



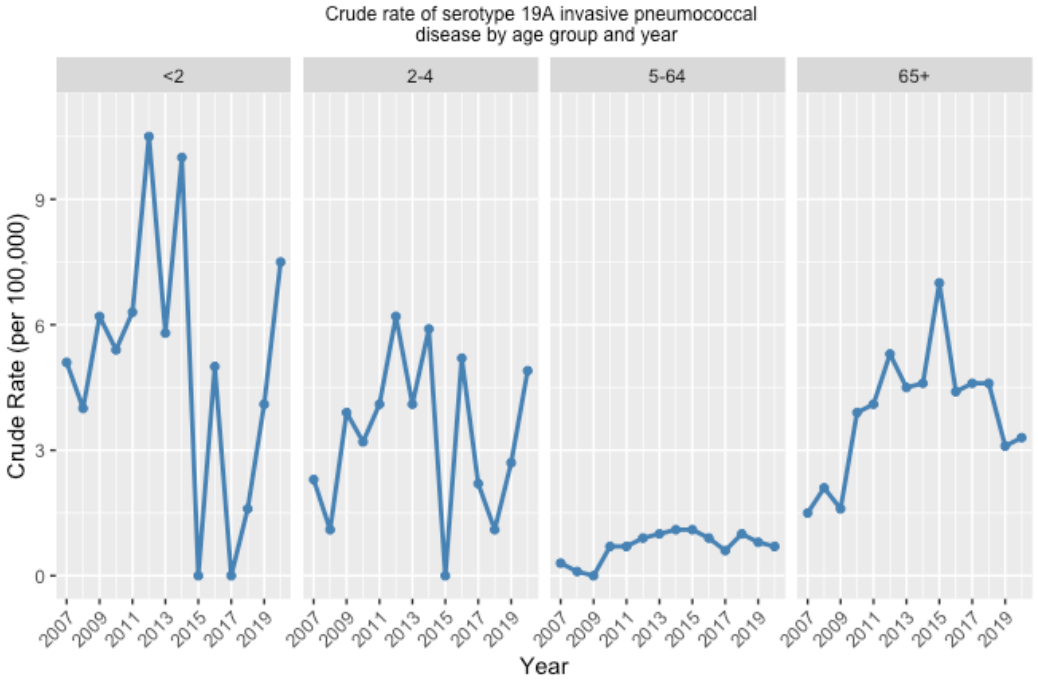
Note: 'PCV7 serotypes' are cases due to serotypes covered by PCV7 (4, 6B, 9V, 14, 18C, 19F and 23F); 'Serotypes 1, 5, and 7F' are cases due to the additional serotypes covered by PCV10; 'Serotypes 3,19A and 6A' are cases due to the additional

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

PCV13-Specific Serotypes

Serotype 19A was the most prevalent serotype in 2020, with a total of 71 cases. Despite the significant decrease in IPD cases in 2020, secondary to COVID-19 restrictions, the number of cases that were serotype 19A have continued to increase. 19A has been the most prevalent serotype since 2011. Rates of serotype 19A increased in all age groups in 2020 compared to 2019, except in the 5–64 years age group (Figure 6). The annual incidence rate of 19A IPD cases in the <2 years and 2–4 years age groups have quadrupled between 2018 and 2020 (from 1.6 to 7.5 per 100,000 and from 1.1 to 4.9 per 100,000 respectively). In the 5–64 years and ≥65 years age groups there has been a decreasing trend in the rates of serotype 19A IPD cases from 2018 to 2020 (1.0 to 0.7 per 100,000 and 4.4 to 3.3 per 100,000, respectively).

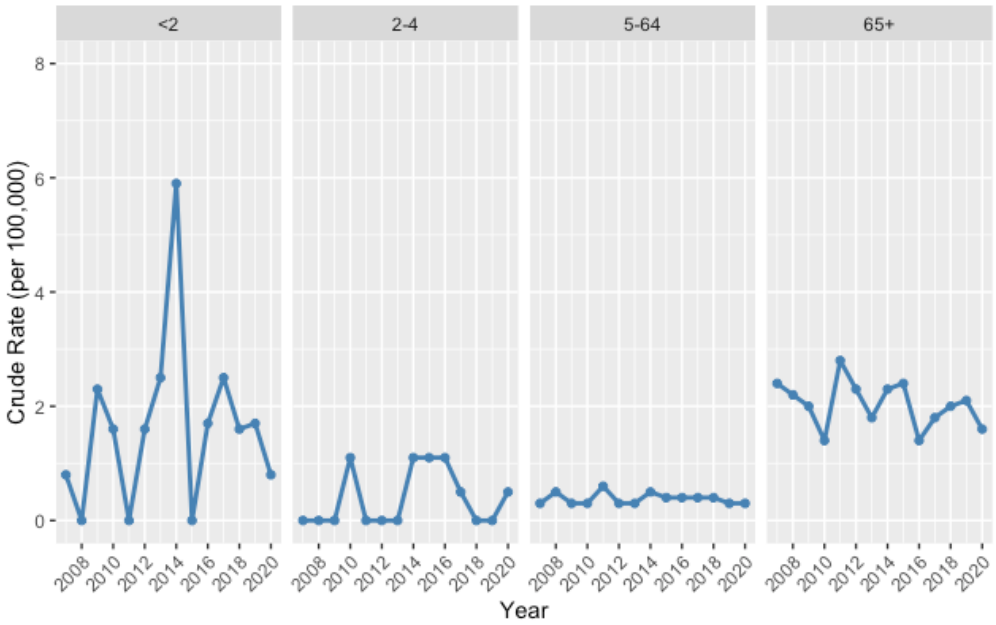
Figure 6. Rate per 100,000 population of invasive pneumococcal disease due to serotype 19A by age group and year, 2007–2020



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 crude rate for serotype 3 was low in all age groups in 2020 (less than 2 cases per 100,000 population) (Figure 7). The rates decreased in the <2 years age group and ≥65 years age group, compared to 2019 (1.7 to 0.8 per 100,000 population and 2.1 to 1.6 per 100,000 population respectively). In the 5–64 years age group the crude rate of serotype 3 has remained consistently low since 2007 ranging from 0.3 to 0.6 per 100,000 population.

Figure 7. Rate per 100,000 population of invasive pneumococcal disease due to serotype 3 by age group and year, 2007–2020



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. Rates for the <2 and 2–4 years are based on less than five cases and are considered unstable.

There were no cases of serotype 6A in 2020.

ANTIMICROBIAL SUSCEPTIBILITY

Table 10 shows the antimicrobial susceptibility of the 170 isolates from culture-positive IPD cases tested by ESR in 2020. 34.1% of isolates were resistant to penicillin (meningitis breakpoints) and 0.6% were cefotaxime resistant. Among the penicillin-resistant isolates (meningitis breakpoints), 6.9% (4/58) were multiresistant to at least three additional antibiotics, most commonly co-trimoxazole, erythromycin and tetracycline.

Due to the change to EUCAST susceptibility testing methods in 2016, not all susceptibility testing results from 2016 to 2020 are directly comparable with those for earlier years. However, the rates of penicillin resistance (based on the CLSI and EUCAST meningitis resistance breakpoint of MIC ≥0.12 mg/L) and the rates of cefotaxime resistance (based on the CLSI non-meningitis resistance breakpoint and the EUCAST resistance breakpoint of MIC ≥4 mg/L) are comparable and therefore trends in these rates of resistance for the 2011–2020 period were compared. Penicillin resistance has significantly increased from a low of 14.1% in 2011 to 34.1% in 2020 (*p* value < 0.001). In contrast, there has been a decrease in rates of cefotaxime resistance.

All isolates were susceptible to moxifloxacin, rifampicin and vancomycin. Rifampicin susceptibility has been tested since 2010, with no resistance identified.

Table 10. Antimicrobial susceptibility among isolates from invasive pneumococcal disease cases, 2020

Antibiotic	EUCAST clinical breakpoints[a]			Susceptibility (%)		
	S[b]	I[b]	R[b]	S[b]	I[b]	R[b]
	Minimum inhibitory concentration (MIC, mg/L)					
Penicillin						
meningitis	≤0.06	-	≥0.12	65.9	-	34.1
non-meningitis[c]	≤0.06	0.12–2	≥4	65.9	32.4	1.8
Cefotaxime	≤0.5	1–2	≥4	97.7	1.8	0.6
	Zone diameter (mm)					
Chloramphenicol	≥21	-	≤20	100.0	-	0.0
Clindamycin[d]	≥19	-	≤18	95.3	-	4.7
Co-trimoxazole	≥13	10–12	≤9	78.2	0.0	21.8
Erythromycin	≥22	19–21	≤18	93.5	0.0	6.5
Moxifloxacin	≥22	-	≤21	100	-	0.0
Rifampicin	≥22	17–21	≤16	100	0.0	0.0
Tetracycline	≥25	22–24	≤21	93.5	0.6	5.9
Vancomycin	≥16	-	≤15	100	-	0.0

[a] European Committee on Antimicrobial Susceptibility Testing [21] .
[b] S: susceptible, I: susceptible dose dependent, and R: resistant.
[c] EUCAST also provide several additional dose-specific penicillin breakpoints for pneumonia. Based on the susceptible breakpoint (MIC ≤0.5) for a dose of 1.2 g 6 hourly, 95.9% of isolates would be categorised as susceptible.
[d] The percentage resistant given is for constitutive clindamycin resistance. No isolates had inducible clindamycin resistance.

Penicillin and cefotaxime resistance among isolates from cases in the different age groups is shown in Table 11. Penicillin resistance was higher among isolates from cases <5 years old (65%) than 5–64 year-olds (30.0%).

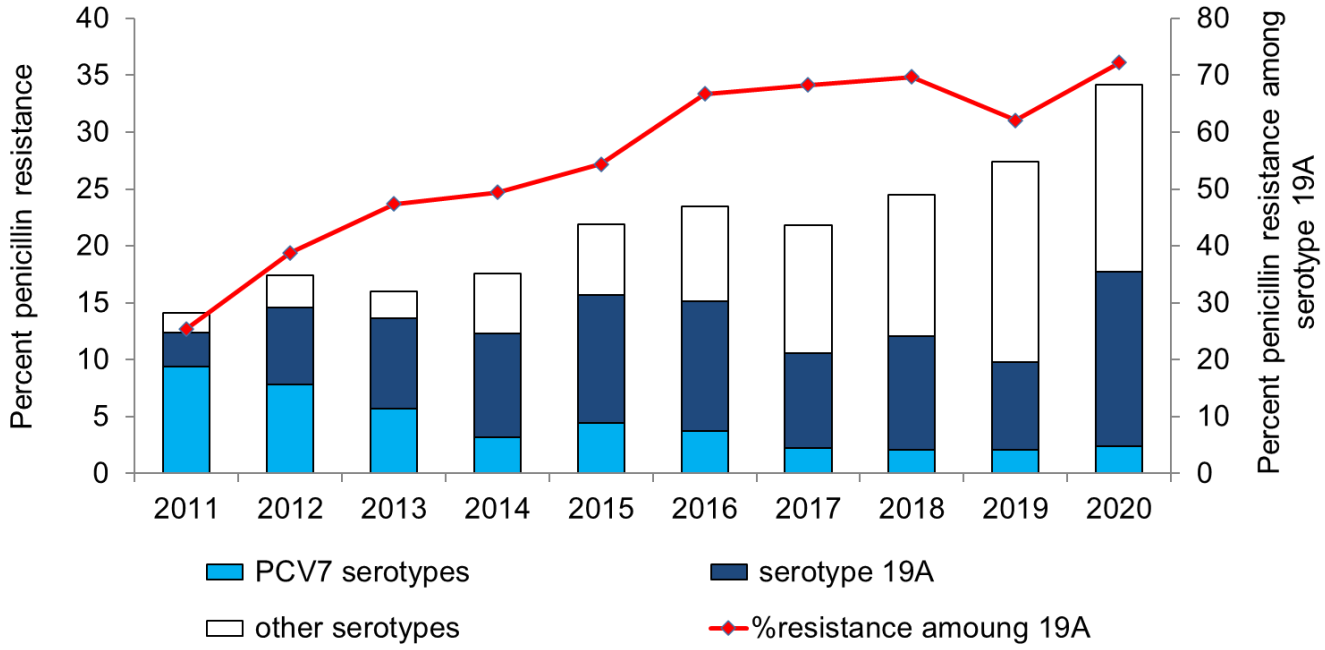
Table 11. Penicillin and cefotaxime resistance among isolates from invasive pneumococcal disease cases, 2020

Age group (years)	Penicillin		Cefotaxime			
	Resistant[a] MIC ≥0.12 mg/L		Susceptible dose dependent MIC 1–2 mg/L		Resistant MIC ≥4 mg/L	
	Number	%[b]	Number	%[b]	Number	%[b]
<2 (n=12)	6	50.0	0	-	0	-
2−4 (n=8)	7	87.5	0	-	0	-
5−64 (n=76)	21	27.6	2	2.6	0	-
≥65 (n=74)	24	32.4	1	1.4	1	1.4
All ages (n=170)	**58**	**34.1**	**3**	**1.8**	**1**	**0.6**

[a] EUCAST meningitis breakpoints; no susceptible dose dependent (I) category [21] .
[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 serotypes (Figure 8). In 2006–2007, PCV7 serotypes accounted for 92.8% of the penicillin resistance compared with just 6.9% in 2020. Conversely, other serotypes now account for the majority of penicillin-resistant invasive pneumococci. The relative contribution of serotype 19A to penicillin-resistant invasive pneumococci had decreased, from a high of 52.1% in 2015 to 28.1% in 2019. However, in 2020, serotype 19A accounted for 44.8% of the penicillin-resistant isolates (Figure 8). In recent years serotype 19A isolates were more likely to be penicillin resistant, increasing from 18.5% in 2010 to 72.2% in 2020 (Figure 8). The relative contribution of PCV serotypes among penicillin resistant isolates is decreasing as non-vaccine serotypes become more common. In 2020 the next most prevalent serotype among the penicillin-resistant isolates was type 12F, accounting for 25.8% of isolates, with 78.9% of type 12F isolates being penicillin resistant.

Figure 8. Penicillin-resistance among pneumococci from invasive disease cases, 2011–2020



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 (meningitis breakpoints). Each bar is split to indicate the proportion of the penicillin-resistant isolates that were PCV7 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

The first IPD vaccine (PCV7) was introduced to the New Zealand childhood immunisation programme in June 2008. In 2020, the overall annual incidence rate for IPD reached the lowest recorded since IPD became a notifiable disease, with an incidence rate of 6.9 cases per 100,000 population. This is nearly a 60% decrease in the overall annual incidence rate, compared to 2009 (16.2 per 100,000). Prior to 2020, the lowest rate recorded was 9.7 per 100,000 in 2015, demonstrating a 30% decrease between 2015 and 2020. Between 2016 and 2019 the annual incidence rate remained between 10.1 and 11.4 cases per 100,000.

In 2020, national and global public health measures were put into action to decrease transmission rates for COVID-19. These measures included restrictions on population sizes at gatherings, domestic and international travel restrictions, nation-wide lockdowns, mask wearing and social distancing. With the adoption of community mitigation measures not only was COVID-19 transmission reduced but rates of other infectious diseases also reduced. This phenomenon was seen globally as shown by a significant reduction in influenza rates around the world throughout 2020 [24]. Transmission of COVID-19 and *Streptococcus pneumoniae* occur through airborne droplets therefore measures introduced in response to COVID-19 were also protective against IPD [25,26]. This report demonstrates that COVID-19 control measures contributed to a reduction in the annual incidence rates of IPD in New Zealand in 2020.

After the initial introduction of PCV7, further important changes to the vaccine schedule were implemented with PCV10 introduced in 2011 and replaced by PCV13 in 2014. PCV10 was reintroduced into the childhood immunisation schedule in 2017. PCV13 is still available and funded for people who are at high risk of IPD, including high risk children and adults over 65 years [1]. Adults 65 years or older are also recommended to receive the 23PPV, however this is not funded in this group.

When examining the rates of IPD in children <5 years of age the direct impact of the introduction of PCV into the immunisation schedule is apparent. Between 2009 and 2015, there was a 76% decline in the rates of IPD in children <5 years of age (32.6 per 100,000 in 2009 to 7.8 per 100,000 in 2015). However, between 2016 and 2019 there was an increase in the rates of IPD in this age group, stabilising at 15 per 100,000 (14.7-15 per 100,000 between 2016 and 2019). This increase and stabilisation in the IPD rate may be secondary to the reintroduction of PCV10, replacing PCV13, in 2017. 2020 resulted in a significant reduction in the rate of IPD in children <5 years of age (12.1 per 100,000), compared to that between 2016 and 2019, which is likely associated with national restrictions established secondary to the COVID-19 pandemic.

The trends in IPD notification rates among children <2 years of age were similar, with a 74% decrease in the rate between 2009 and 2015 (from 46.0 per 100,000 in 2009 to 11.8 per 100,000 in 2015). The rates increased after 2015, reaching a high of 23.9 per 100,000 in 2018 and decreased again in 2020 to a rate of 18.2 per 100,000. Despite the fluctuations observed in this age group, overall, since 2009 there has been a 60% decrease in the annual incidence rate of IPD in the <2 years age group.

In the ≥65 years age group there has been nearly a 60% decrease in the annual incidence rate of IPD between 2009 and 2020, with rates decreasing from 44.0 per 100,00 in 2009 to

16.8 per 100,000 in 2020. There was a 33% decrease in the rate of IPD in this age group between 2019 and 2020, decreasing from 25.0 cases per 100,000 in 2019. In 2020, 70% of cases among those 65 and over were due to 23PPV serotypes. This remains consistent with previous years, ranging from 65-75% of cases in the ≥65 years age group being due to PPV23 between 2017 to 2019.

The decreasing trend and significant reduction in the annual incidence rate of IPD in 2020 among the ≥65 years age group is likely at least partially the result of delayed indirect effects of changes in the childhood immunisation schedule in conjunction with the COVID-19 pandemic and associated community mitigation strategies put in place. A systematic review by Shiri *et al.* established that obtaining a 50% reduction in IPD in unvaccinated groups is delayed by approximately three years (2.3 years for PCV7 serotypes and 3.6 years for PCV13 serotypes) and almost a decade was required before a 90% reduction in IPD was obtained through herd immunity (8.9 years for PCV7 serotypes and 9.5 years for PCV13 serotypes) [26]. These factors should be considered when evaluating the effectiveness of childhood immunisations on IPD rates in the total population.

Despite the overall decrease in annual incidence rate in 2020, the rate of IPD cases in children <5 years of age due to serotype 19A has quadrupled since 2018. The rate of IPD due to serotype 19A in children <2 years old increased from 1.6 per 100,000 in 2018 to 7.5 per 100,000 in 2020 and in children aged 2–4 years the rate increased from 1.1 per 100,000 to 4.9 per 100,000, respectively. The rates of 19A in the 5–64 years age group have remained steady since 2010, ranging from 0.6 to 1.1 case per 100,000. However, in the ≥65 years age group there has been more than a 50% decrease in the rate of IPD caused by serotype 19A since 2015 (7.0 cases per 100,000 in 2015 and 3.3 cases per 100,000 in 2020). The re-introduction of PCV10 to the childhood immunisation programme in 2017, replacing PCV13, could explain why those <5 years of age have been disproportionally affected by the increasing incidence of 19A. The delayed indirect effect of vaccine efficacy on unvaccinated populations may also still be contributing to the continued decrease in 19A in those ≥65 years of age. [26].

Serotype 19F is a component of PCV7 and PCV10 that elicits polysaccharide binding antibodies that cross-react with 19A. It was hypothesised that inclusion of serotype 19F in these vaccines would indirectly reduce the incidence of 19A, but the cross-reactivity was limited [27]. In several countries, there has been an increase in serotype 19A since the introduction of PCV10 to national immunisation programmes. Surveillance data for serotype 19A recorded in Finland, Brazil and Chile demonstrated an increase in 19A incidence across all age groups, illustrating limited cross-reactivity and lack of herd immunity [28]. In contrast, introduction of PCV13 to national immunisation programmes lead to significant and sustained decreases in serotype 19A incidence in several countries [28].

Since the replacement of PCV13 with PCV10 in the New Zealand childhood immunisation schedule in 2017, there has been an increase in IPD cases caused by serotype 19A in those <65 years of age. Similar trends have been observed in other countries. For example, during 2015 and 2016 PCV10 replaced PCV13 in Belgium following the National Immunization Technical Advisory Groups (NITAG) rating these two vaccines as equally effective[29]. With the re-introduction of PCV10 there was a 10-fold increase in the number of IPD cases caused by serotype 19A between 2015 and 2017 [29]. When comparing counties in Sweden, there was a 7-fold increase in serotype 19A in counties using PCV10

between 2013 and 2016, while the incidence of 19A remained consistent in counties utilising PCV13 in their childhood immunisation schedule [30]. Among those <5 years of age there were no cases of IPD in this age group in PCV13 counties, compared to an average annual incidence rate of 1.1 per 100,000 cases in counties where PCV10 was utilised [30].

Lee *et al.* established that PCV10 produced antibodies against serotype 19A through cross-reactivity with 19F, however the majority of these antibodies were not sufficiently functional in opsonisation and therefore had minimal efficacy [28,31]. PCV13 has also been proven to significantly decrease carriage of serotype 19A which would further increase herd immunity [32]. Furthermore, serotype 19A has increased potential to cause invasive disease compared to other *S. pneumoniae* serotypes, however the invasive potential is decreased with the introduction of PCV13 [33]. With the rise in 19A serotype IPD in New Zealand these factors should be taken into account.

Pacific peoples and Māori continue to be disproportionately affected by IPD across all age groups.

The highest age standardised IPD rates were among Māori and Pacific peoples (20.3 and 30.2, respectively). While in 2020, the rates decreased for Māori and European or Other ethnic groups, the IPD rate in Pacific peoples changed very little. Importantly, Māori and Pacific peoples are over-represented in the IPD cases in children <2 years of age, with 64% of cases <2 years old being these ethnicities.

In 2020, across the regions IPD rates ranged from 5.6 per 100,000 in the Southern region to 9.7 per 100,000 in the Midland region. Between 2019 and 2020 the overall decrease in rates of IPD was observed in all regions; the rate in the Northern region decreased from 9.8 to 6.8 per 100,000; Midland region from 17.4 to 9.7; Central region from 10.6 to 5.8 and Southern region from 7.2 to 5.6 per 100,000. From 2017 to 2020 the Southern region consistently had the lowest annual incidence rate, while the Midland region consistently had the highest annual incidence rate.

In 2020, the highest rate of IPD was in Wairarapa DHB (14.3 per 100,000, 7 cases). Rates of IPD in Taranaki DHB decreased approximately 50% from 17.1 per 100,000 to 8.8 per 100,000 while rates remained similar in Waikato DHB (10.0 per 100,000 in 2020, compared to 10.3 per 100,000 in 2019) and Wairarapa DHB (decreasing from 14.7 to 14.3 per 100,000). There were less than 5 cases in each of the Whanganui, Nelson Marlborough and West Coast. Compared to 2019, there was an 80% decrease in the number of cases in Nelson Marlborough (from 10 to 2 cases) and 79% decrease in Whanganui (14 to 3 cases). Despite the overall annual incidence rates declining in all regions in 2020, there was a 17% increase in the number of IPD cases in South Canterbury DHB between 2019 and 2020 (from 2 to 7 cases).

The three most common serotypes in 2020 were 19A (PCV13), 8 (non-PCV) and 12F (non-PCV). The proportion of isolates with an available serotype result that are vaccine preventable (PCV13 serotypes) was 28.4%. Among the additional PCV13 serotypes, 19A was the most prevalent serotype in 2020 and 3 was the fourth most prevalent serotype, while 6A remains uncommon in New Zealand, accounting for zero cases in 2020. IPD serotype 19A accounted for 48.6% of cases <5 years of age and 17.6% of cases in those aged ≥5 years (with known serotype). Serotype 3 accounted for 5.4% of cases <5 years of age and 7.6% of cases in those aged ≥5 years (with known serotype).

The number of children <5 years of age who were diagnosed with serotype 19A has been increasing in recent years. In 2020 there were 18 serotype 19A cases among those <5 years of age, the highest number of IPD cases due to serotype 19A since 2012. Of these cases three were unvaccinated, nine were either fully vaccinated or on schedule for their age with only PCV10. Two were under vaccinated for their age, and four were fully vaccinated with one dose of PCV10 and three doses of PCV13 (Table 6).

With the emergence of COVID-19 and associated global and national public health measures, a significant decrease in the overall annual incidence in IPD among all age groups was observed in 2020. However, the increase in incidence of IPD caused by serotype 19A in 2020 and previous years demonstrates the resurgence of 19A in the community. This should be monitored closely, especially given the invasive potential of serotype 19A.

There is a disproportionate burden of IPD for Māori and Pacific peoples, particularly in children <2 years of age, and effort should continue to be made to ensure these communities have high vaccination rates to increase protection against IPD.

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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]
CSF	☐ culture	☐ antigen detection[1]	☐ NAAT
Pleural fluid	☐ culture	☐ antigen detection[1]	☐ NAAT
Joint fluid	☐ culture		☐ NAAT
Other sterile site specimen (specify)	☐ culture		☐ NAAT

[1] refer to the case report form instructions

[2] nucleic acid amplification test

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

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