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hpsc

Annual Epidemiological Report

February 2024

Streptococcus Pneumoniae (invasive) in Ireland, 2023

Key Facts

- In 2023, 433 confirmed cases of invasive pneumococcal diseases (IPD) were reported in Ireland, among which there were 19 (4.4%) IPD related deaths; case fatality ratio among all IPD notifications was 4.6% (20/433).
- The incidence rate was 8.4 per 100,000 population, an increase compared to 2022 (7.3 per 100,000 population).
- Age specific incidence rates (ASIR) were highest in those aged 85 years and over (49.7 per 100,000 population), followed by those aged 75-85 and 65-75 years (35.9 and 17.5 per 100,000 population respectively).
- In 2023, 82.1% of the confirmed IPD notifications had an isolate submitted for serotyping.
- The most common serotypes in adults were 8, 3, 19A, 9N, 4 and 22F. In children <5 years of age, the predominant serotypes were 19A, 3, 10A, 23B.
- In 2023, compared to 2008, the greatest impact due to PCV has been seen in children <5 years of age where the incidence due to PCV7 serotypes has declined by 97.8% (p<0. 001). The incidence of disease due to the additional six serotypes covered by the PCV13 declined by 40% (p<0. 001) in those <2 years of group.
- A significant indirect impact was also observed in those aged 65 years and older with declines in incidence of serotypes from the PCV7 serotypes in 2023, compared with 2008 (87%; p<0. 001).
- An increase in incidence due to non-vaccine types was also seen in all age groups in 2023 compared with 2008. In particular the incidence rate increased in those aged 65 and over.

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Table of Contents

Background

Invasive *Streptococcus pneumoniae* infection is a notifiable disease in Ireland; clinicians and laboratories are legally obliged to notify this infection. For the purposes of this report the term invasive pneumococcal disease (IPD) will be used to describe these infections. IPD includes meningitis, bloodstream infection (BSI) with and without pneumonia, and invasive disease of other sterile sites.

For this report notification data for IPD was extracted from Computerised Infectious Disease Reporting (CIDR) system on 14th February 2024. These figures may differ slightly from those previously published due to ongoing updating of notification data on CIDR. For the 2012-2023 notifications, the 2012 HPSC case definition for IPD was used. For calculation of incidence rates, we have used 2022 census data from the Central Statistics Office (CSO) for calculating rates in 2020-2023. This has resulted in differences from rates calculated in previous years' reports as CSO 2016 data were used in those reports.

Surveillance

A number of different initiatives are in place in Ireland for the surveillance of IPD. Data on IPD notifications are collated using CIDR. Enhanced surveillance (including outcome, risk factors, vaccination, serotype) of IPD notifications is undertaken by Departments of Public Health. A separate surveillance strand (EARS-Net project), involving the microbiology laboratories and HPSC, is used to monitor in detail the antimicrobial resistance profiles of invasive *S. pneumoniae* isolates from blood and/or cerebrospinal fluid (CSF). EARS-Net laboratories can also collect additional information, including risk factors, admission and outcome for each patient notified with *S. pneumoniae* isolate. These data are collated by HPSC through the Enhanced Surveillance of Bloodstream Infection (ESBSI) system. In order to improve data quality, regular processes for cross-checking CIDR data with other data sources were established in 2012. To identify missing IPD notifications and/or missing information, CIDR data were linked to the typing database and additional information on either of these systems, which is missing or incomplete in CIDR, was collated.

Since April 2007, the Irish Pneumococcal Reference Laboratory (IPRL) has provided a typing service to Irish laboratories for all invasive *S. pneumoniae* isolates. This is a collaborative project involving the Royal College of Surgeons in Ireland/Beaumont Hospital,

Children's Health Ireland at Temple Street and HPSC. In addition, in 2019 HPSC was invited to participate in a collaborative project between the World Health Organization (WHO) and International Vaccine Access Centre (IVAC) at Johns Hopkins Blomberg School of Public Health (JHSPH) in the USA called PSERENADE (Pneumococcal Serotype Replacement and Distribution Estimation). This project aims to assess the impact of pneumococcal conjugate vaccine (PCV) on IPD incidence and serotype distribution in the setting of mature PCV10/PCV13 programmes on a global level.

Pneumococcal conjugate vaccine

In September 2008, the 7-valent pneumococcal conjugate vaccine (PCV7) (protects against seven types of pneumococcal bacteria) was introduced into the Irish infant immunisation schedule at 2, 6 and 12 months of age. A catch-up campaign was also implemented at that time, targeting children <2 years of age. In December 2010, the 13-valent PCV vaccine (protects against 13 types of pneumococcal bacteria) (PCV13) replaced PCV7 in the infant schedule. (1) In December 2016, due to the introduction of the new meningococcal B vaccine (Men B) into routine immunisation, the third dose of PCV13 was shifted to 13 months of age for children born on or after 1st October 2016.

Since January 2014 one dose of PCV13 is recommended for individuals of all ages at high risk of invasive pneumococcal disease (those with asplenia, hyposplenia (including splenectomy, sickle cell disease, haemoglobinopathies, and coeliac disease); cancer patients under hospital supervision; chronic renal disease or nephrotic syndrome; cochlear implant candidates and recipients; complement deficiency (particularly C1-C4); CSF leaks (congenital or complicating skull fracture or neurosurgery); haematopoietic stem-cell transplant; immunosuppressive conditions (e.g. some B- and T-cell disorders, HIV infection, leukaemia, lymphoma), and those receiving immunosuppressive therapies1 or corticosteroids; intracranial shunt; solid organ transplant). Two doses of PCV13 two months apart is recommended for those if response may be blunted e.g. asplenia/hyposlenia. (1)

Vaccine uptake

National PCV vaccination coverage is monitored in children at 12 and 24 months of age. Following PCV introduction in 2008, uptake of the recommended number of doses among the first cohorts vaccinated was high, at 88% and 89% for children aged 12 months in 2009 and 2010, respectively. Higher uptake was reported for subsequent birth cohorts, with between 90-92% of children at 12 and 24 months of age reported as being age appropriately vaccinated since 2011. Uptake of three doses of PCV by 12 and 24 months of age decreased after pandemic for Q3 2023 and was 85.6% and 83.1%, respectively. However, information on vaccinations for Q3 2023 was not provided by one CHO area and uptake expected to be higher. (2)

Pneumococcal polysaccharide vaccine

One dose of pneumococcal polysaccharide vaccine (PPV23) is recommended for all those aged 65 years and older, and for those other age groups at increased risk of pneumococcal infection since 1996. (1)

Methods

Case definition of IPD

IPD case classification has changed over time. Between 2004 and 2011, in individuals with clinically compatible symptoms, the isolation or detection of *S. pneumoniae* from a normally sterile site was classified as a confirmed case; detection of *S. pneumoniae* antigen from a sterile site was classified as probable and detection from non-sterile site was classified as a possible case. In 2012, the previously used probable case definition became no longer applicable and any case in which *S. pneumoniae* antigen was detected from a normally sterile site was classified as confirmed and detection in urine was classified as possible. In July 2015, the case definition of *S. pneumoniae* was again amended; only those cases of IPD meeting the laboratory criteria were classified as confirmed cases, and urinary antigen detection (possible cases) is no longer notifiable. (3)

Definition of vaccine failure

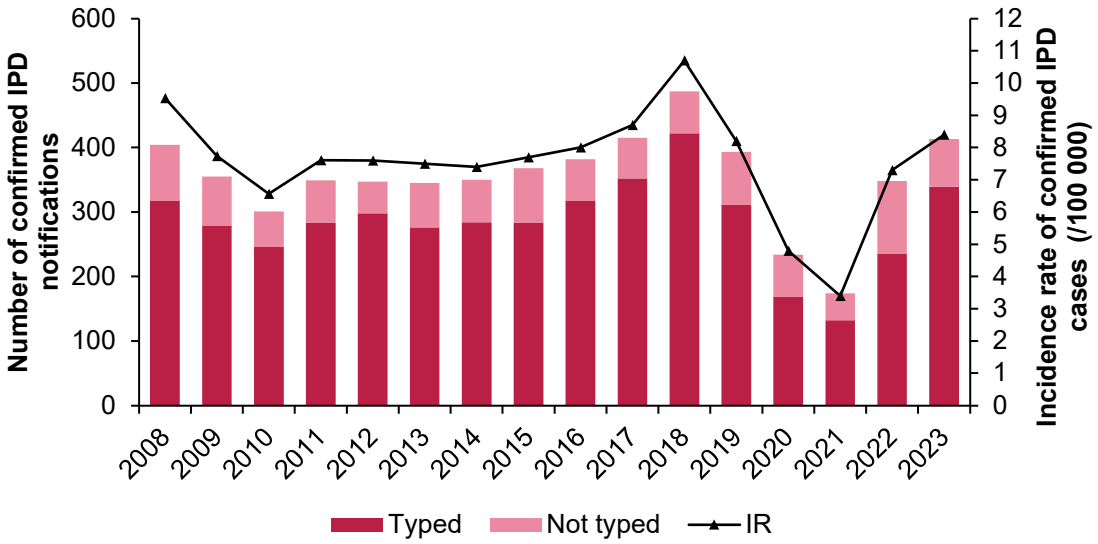
PCV vaccine failure was defined as a confirmed IPD case in a child caused by a PCV-serotype who has completed a PCV immunisation course appropriate for his/her age and disease onset is ≥14 days after last dose of PCV.

Epidemiology

Focusing on the confirmed IPD notifications, 433 cases were notified in 2023 (8.4/100,000; 95% CI 7.6 - 9.2/100,000), an increase of 13.4% in the number of cases compared with 2022 (7.3/100,000; 95% CI 6.5 - 8.0/100,000; 375 cases) (Figure 1). In 2023, the incidence of confirmed IPD was lower by 11.6% compared with 2008 (9.5/100,000; 95% CI 8.6 – 10.5/100,000; 404 cases) (Figure 1).

In 2023, 82.1% (339/413) of cases had an isolate submitted for serotyping, more than the proportion of cases in 2022 (67.5%) and 2021 (75.9%), and in 2008 and 2009, when 79% of notifications had an isolate typed. Twenty cases were confirmed by PCR only (Figure 1). In 2023, 66.7% of notifications (20/30) relating to children <5 years of age had an isolate submitted for serotyping; 11 cases were confirmed by PCR.

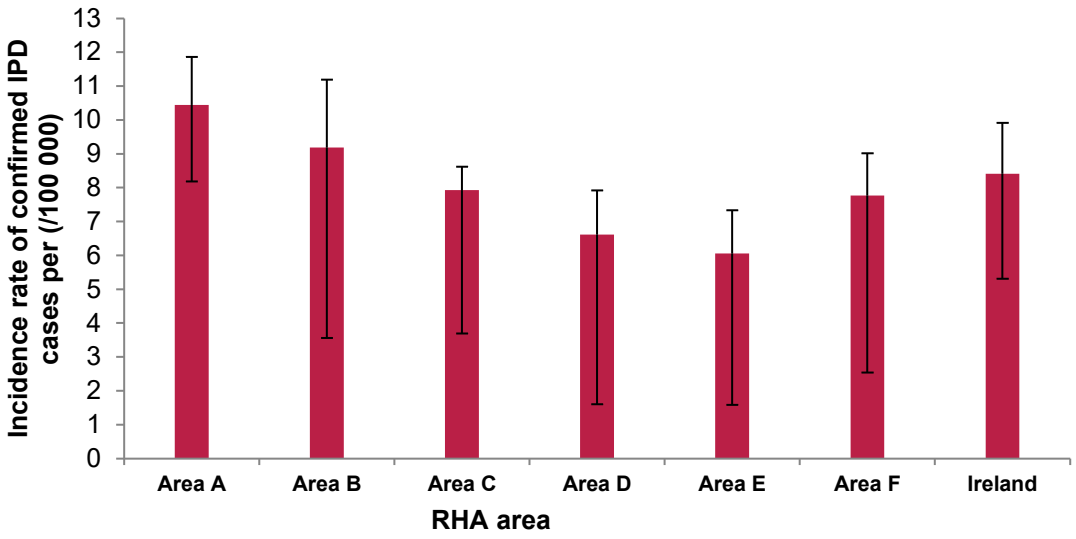
Figure 1. Number of confirmed invasive pneumococcal disease (IPD) notifications by typing status and the incidence rate (IR) of confirmed IPD in Ireland, 2008-2023



Data source: CIDR

During 2023, the incidence rates by RHA area ranged from 6.1 per 100,000 (Area E) to 10.4 per 100,000 (Area A) (Figure 2). However, the incidence rates in each of the six areas were not statistically different from the national rate.

Figure 2. Crude incidence rate of confirmed invasive pneumococcal disease notifications by RHA area, 2023



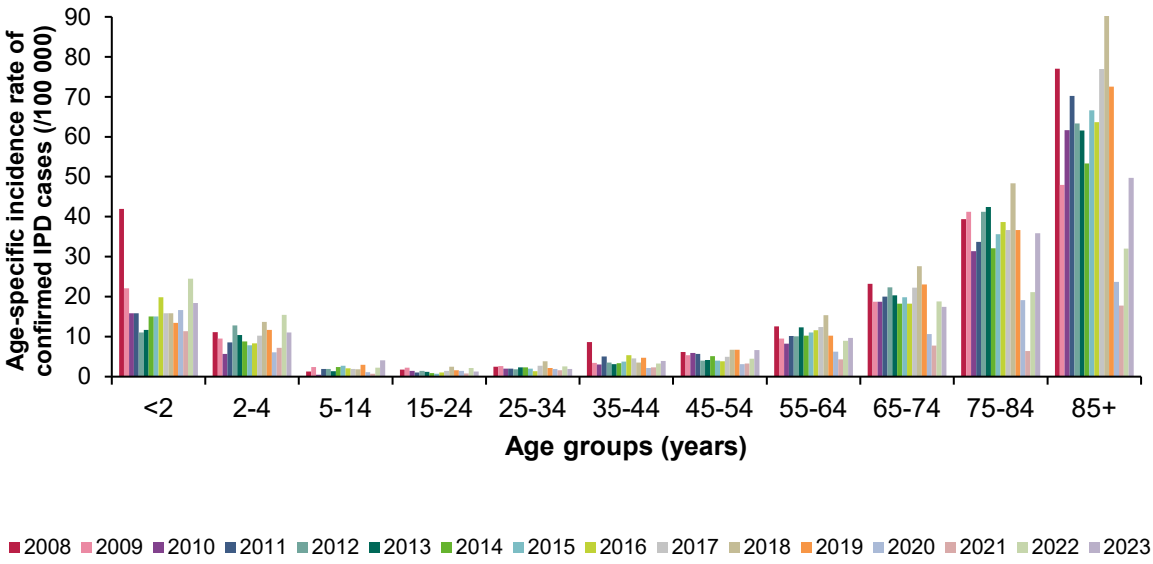
Data source: CIDR

In 2023, a clinical diagnosis was reported for 166 of the 433 confirmed cases (38.3%), which included BSI with pneumonia (n=112), meningitis (n=26), from these 9 had meningitis and BSI; and other BSI for the remainder (n=28). This reflects the reduction in the completeness of data provided in comparison to previous years. The percentage of information on clinical diagnosis and risk factors significantly decreased in comparison to pre pandemic years. For the years during pandemic in 2020, 2021, 2022 it decreased to 46.6%, 29.4% and 26.7% respectively. In 2018, 2017, 2016, 2015 and 2014, the clinical diagnosis was reported for 438 of the 510 (86%), 388 of the 415 (94%), 313 of the 381 (82%), 229 of the 368 (62%) and 168 of the 350 (48%) confirmed cases, respectively).

Slightly more males (n=242, 55.9%) than females were reported with IPD. The median age of cases was 63 years (range 2 months to 95 years). Those aged 65 years and older accounted for approximately half of cases (48.3%, n=209). Within this age category the age specific incidence rate (ASIR) was highest in the oldest age groups; ≥85 years of age (49.7/100,000; n=42); 75-84 year age group (35.9/100,000; n=90); 65-74 year age group

(17.5/100,000; n=77) (Figure 3). In children <2 years of age the ASIR was 18.4 cases per 100,000 population (n=21). A statistically significant decline (97%) in IPD incidence was seen in this age group when compared with 2008 (42/100,000; n=52; p<0.0000), highlighting the positive impact of the introduction of PCV7 and PCV13 in 2008 and 2010 respectively (Figure 3).

Figure 3. Age specific incidence rate of confirmed invasive pneumococcal disease notifications by age group, in Ireland, 2008-2023



Data source: CIDR

Medical risk factors for IPD were reported for 145 (33.5%) confirmed cases; 57 cases (13.2%) did not have an identified risk factor; for the remaining 231(53.3%) cases this information was either unknown or not specified. The main medical risk factors reported included chronic lung disease (n=61; 42.1%), chronic heart disease (n=45; 31.0%), immunosuppressive condition or therapies (n=30; 20.7%), chronic liver disease (n=9; 6.2%) and renal diseases (n=16; 11.0%). It should also be noted that being aged 65 years and older is also a recognised IPD risk factor; 209 (48.3%) cases in 2023 were in this age group, of whom 94 (45.0%) also reported a medical risk factor.

IPD death notifications

The outcome field was completed in 44.1% (n=191) of the IPD notifications in 2023, versus 87.1% in 2018, 97% in 2017, 85% in 2016, 56% in 2015 and 39% in 2014. Among those whose outcome was reported, case fatality ratio among IPD notifications overall was 10.5% (20/191); for 7 (35%) patients who died, the cause of death was reported as directly due to

IPD, in one patient it was not due to IPD, for seven patients cause of death was pending or awaiting a coroner's report. For the remaining five, the cause of death was not specified or was unknown. Most of these deaths (n=19) occurred in adults (age range 43-95 years) and one in a child under 18 years of age.

Impact of pneumococcal conjugate vaccines (PCV)

Serotyping data from the IPRL were used to assess the impact of the PCV programme on the distribution and burden of *S. pneumoniae* serotypes associated with IPD. In 2023, of the 433 confirmed IPD notifications reported in CIDR, 20 were confirmed by PCR only, 413 (82.1% 339/413) had isolates sent for serotyping; 9.7% of IPD infections were due to PCV7 serotypes (4, 6B, 9V, 14, 18C, 19F and 23F); 21.5% were associated with the six additional serotypes included in PCV13 (1, 3, 5, 6A, 7F and 19A); the remaining 68.8% of infections were due to non- PCV13 vaccine types.

Since introducing PCV7 to the Irish childhood immunisation schedule towards the end of 2008, there has been a substantial reduction in the overall burden of IPD disease associated with serotypes included in the vaccines in use. Reductions in the incidence of IPD due to PCV7 serotypes have been seen in all age groups (Figure 4a). Overall, the incidence of IPD due to PCV7 serotypes has significantly declined in 2023 compared with 2008 (85% decline, p<0. 001). The greatest impact has been seen in children <5 years of age where the incidence due to PCV7 serotypes has declined by 98% (p<0.001) (Figure 4a). In 2023 the incidence of disease due to the additional six serotypes covered by the PCV13 declined by 40% in children <2 years of age compared with 2008 (Figure 4b). An increase in incidence due to non-vaccine types (NVTs) was also seen in 2023 compared with 2008. In those aged 65 years and older there was a significant increase (p<0. 001) in incidence rates. There has been increase also in the incidence of NVTs among other age groups (Figure 4c).

Figure 4. Age specific incidence rate by age group of confirmed invasive pneumococcal disease cases due to (a) PCV7 serotypes, (b) the additional six serotypes covered by PCV13 and (c) non-vaccine types, in Ireland, 2008-2023.

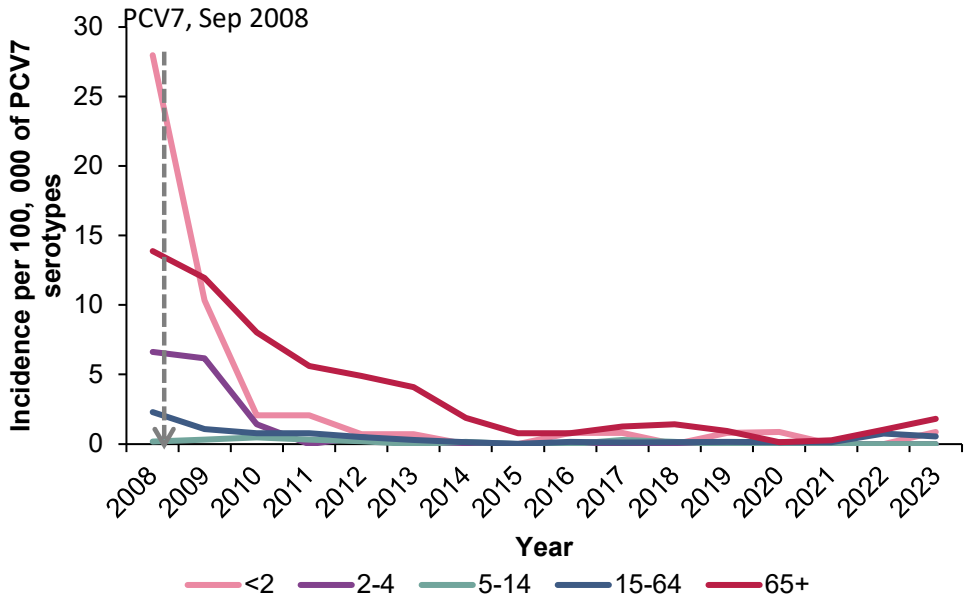


Figure 4a

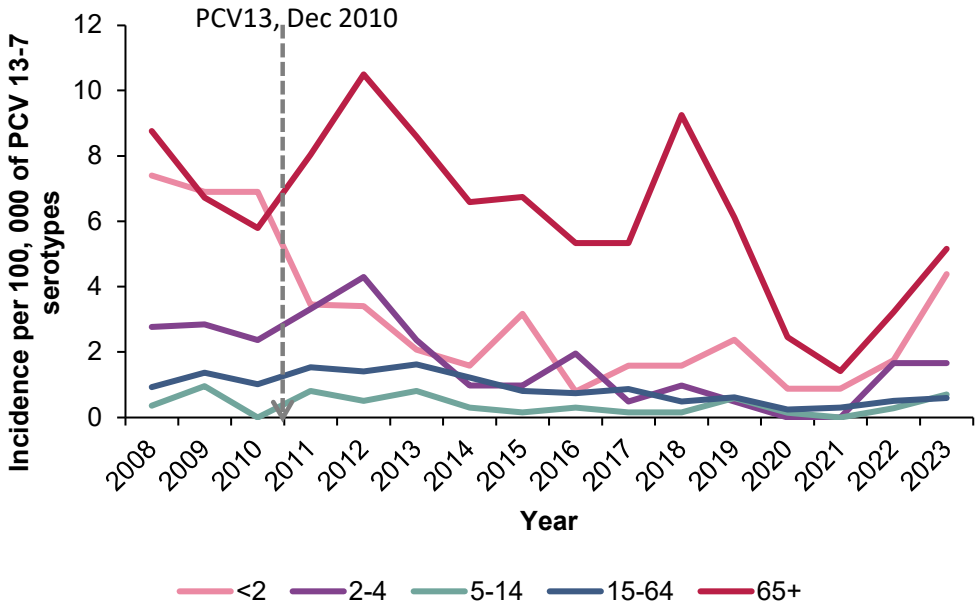


Figure 4b

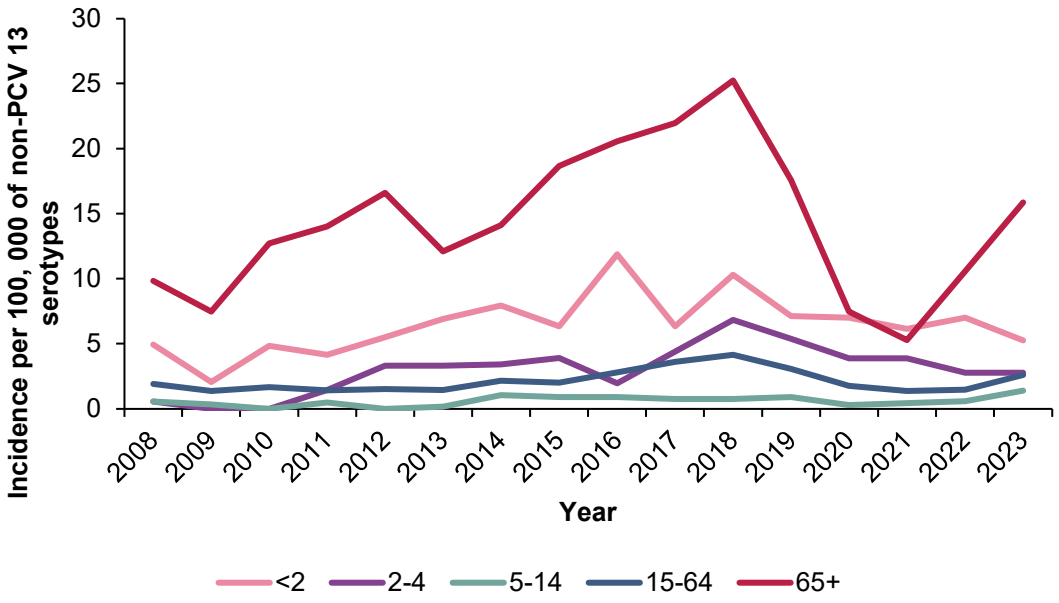
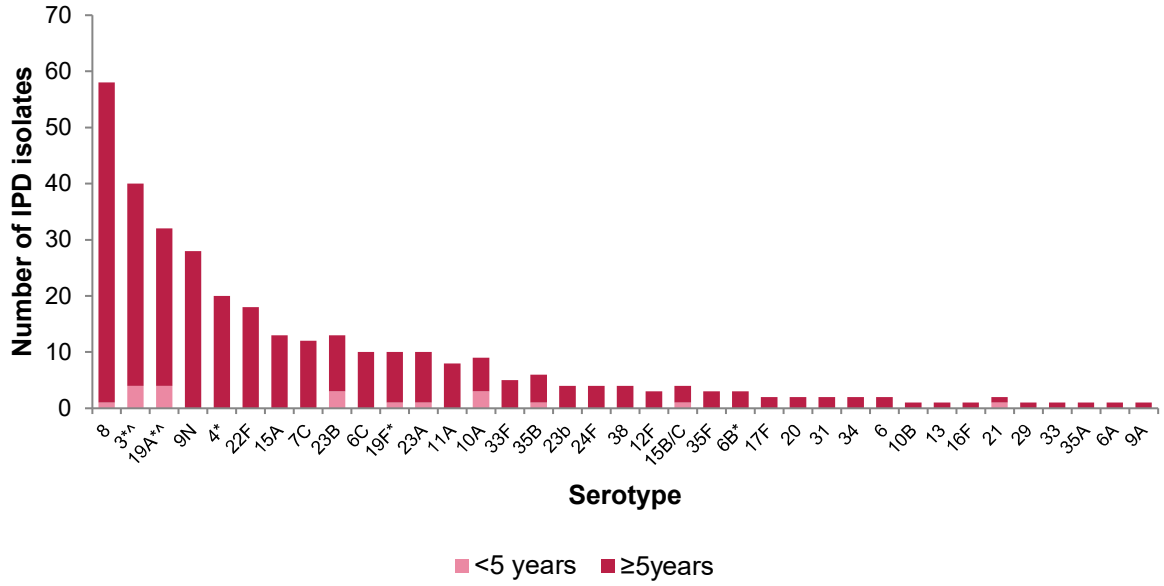


Figure 4c

Data source: Irish Pneumococcal Reference Laboratory

The predominant serotypes in circulation in 2023, were 8, 3,19A (3 and 19A included in PCV13 and PPV23; 8 included to PPV23), followed by serotypes 9N (non vaccine type; NVT) and 4 (included in PPV23 and PCV13 vaccine). In children <5 years of age, the predominant serotypes were 19A, 3, 10A, 23B (19A and 3 included in PCV13; 10A, 23B both NVTs). All these serotypes accounted for 70% of the isolates serotyped in this age group (Figure 5).

Figure 5. Serotype distribution of invasive *Streptococcus pneumoniae* isolates by age group (<5 or ≥5 years) in Ireland, 2023



* Denotes serotypes included in PCV7
*^ Denotes additional six serotypes included in PCV13 (PCV13-7)
Data source: Irish Pneumococcal Reference Laboratory

PCV vaccine failures

Based on data obtained through the IPD enhanced surveillance system, three PCV vaccine failures were reported in 2023, all due to serotype 19A, (included in PCV 13, not in PCV7). Since 2009, 25 vaccine failures have been reported in total in Ireland (Table 1) with 19A the most commonly reported (n=18; 72%).

Table 1. Number of vaccine failures by serotype in Ireland in 2009-2023

	Vaccine failures	Serotype
2009	0	-
2010	2	14, 19F
2011	0	-
2012	2	19A,19F
2013	3	19A
2014	2	19A
2015	2	19A
2016	2	19A, 7F
2017	2	6B, 3
2018	2	3,19A
2019	1	19A
2020	1	19A
2021	0	-
2022	3	19A
2023	3	19A

Data source: CIDR

Penicillin non-susceptible *S. pneumoniae* (PNSP)

In 2022 (latest data available), the proportion of penicillin non-susceptible invasive *S. pneumoniae* (PNSP) was 23.4%, (2.0% and 21.0% with high and intermediate level resistance, respectively) while 16.5% of isolates were resistant to erythromycin (Data source: HPSC/EARS-Net Ireland). The proportion of PNSP and isolates resistant to erythromycin increased from 2021, when 1.1% and 18.4% had high and intermediate resistance, respectively. In 2022, the proportion of *S. pneumoniae* with resistance to erythromycin slightly increased compared to 2021.

For details on the antimicrobial resistance patterns of *S. pneumoniae*, please see the link on EARS-Net slide set, 2022 https://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/europeanantimicrobialresistancesurveillancesystemearss/ears-netdataandreports/

Discussion

There was a significant increase in the incidence of confirmed cases of IPD in Ireland in 2023 compared with 2020-2022, when decrease in reported cases due to pandemic was observed. Since its introduction in 2008, PCV7 has had a significant impact in reducing the overall burden of the disease in the total population with a decline in IPD in all age groups due to serotypes covered by PCV7. This indicates both a direct and indirect/herd immunity effect which the vaccine confers on the population. The greatest impact has been in children <5 years of age where disease incidence due to PCV7 serotypes has fallen by 98%. The impact due to additional six serotypes covered by PCV13 vaccine was observed in children <2 years of age, amongst whom the reduction in the incidence of disease was 40%.

However, despite reductions in the IPD burden during childhood, the incidence of disease due to non-PCV7 serotypes has increased in other age groups before pandemic. After pandemic substantial increase of non-PCV is observed, in particular among those aged 65 and over. There has been a shift in the prevalent serotypes associated with invasive disease. Serotypes 8, 3, 19A, 9N, 4 and 22F were the predominant serotypes identified in 2023.

The pandemic on data completeness for reported IPD resulted in worsened data collection for all cases. As a result, the less proportion of IPD notifications now have data on clinical presentation, risk factors, outcome and vaccination history.

To accurately assess the impact of PCV on immunisation programmes and to monitor for and understand vaccine failures in Ireland, it is crucial that samples from sterile sites are obtained for culture and susceptibility testing. Isolates obtained by culture are required for serotyping and antibiotic susceptibility. Furthermore, it is crucial that laboratories continue to send all invasive *S. pneumoniae* isolates for typing to the IPRL with patient details to enable linkage with CIDR notification data at laboratory level. Although 82% of confirmed notifications had an isolate submitted for serotyping in 2023, 18% (n=74) did not.

The dramatic impact of PCV on the epidemiology of IPD in Ireland is similar to that being seen in other European countries, most of which have introduced this vaccine into their national immunisation programmes in the past 20 years. The emergence of serotype replacement being seen in Ireland is also being seen elsewhere in Europe. (4). On-going monitoring of serotypes in the post-implementation vaccine era is an integral part of surveillance for all countries with PCV vaccination programmes. Particularly it is important to monitor vaccine impact as new vaccines such as PCV15 or PCV 20 are already available in other countries. (5)

Public health implications

Continued good quality IPD surveillance, including the monitoring of invasive *S. pneumoniae* serotypes, is crucial in order to identify any epidemiological changes in the disease, assess the impact of PCV13 on public health, and guide further vaccination strategies, as newer expanded valency vaccines become available and changes are made to PCV coverage, e.g. age or risk factor related. Striving to improve data quality is an essential part of IPD surveillance. A pneumococcal polysaccharide vaccine which offers protection against 23 serotypes (PPV23) is already recommended for elderly and risk groups and is important to give additional protection despite a lower vaccine efficacy than the PCV.

Technical notes

Activities key to the surveillance of IPD in Ireland

Notifications: Clinicians and laboratories should notify all cases of IPD to the relevant Department of Public Health and data are inputted to the national Computerised Infectious Diseases reporting (CIDR) system for notifiable infectious diseases.

Typing: Laboratories should submit **all** invasive *S. pneumoniae* isolates to Temple Street Children's University Hospital for typing by address:

Irish Pneumococcal Reference Laboratory
which is housed with
Irish Meningitis & Sepsis Reference Laboratory,
Temple Street Children's University Hospital,
Temple Street, Dublin 1

Note: For each isolate sent to the IPRL, the patient's details are required on the form submitted in order that the results sent to the laboratory can be linked to the notification already made in CIDR.

Enhanced surveillance: Departments of Public Health perform enhanced surveillance on cases of IPD notifications and enter these data on CIDR.

Antimicrobial resistance: Laboratories should report data on antimicrobial resistance profiles of invasive *S. pneumoniae* isolates (from blood and CSF) to the European Antimicrobial Resistance Surveillance System Network (EARS-Net) at HPSC.

Laboratories: Submission of isolates for typing

For details regarding the submission of invasive *Streptococcus pneumoniae* isolates for typing, please contact:

Dr Mary Corcoran
Tel.: 01 878 4854
Email: mary.corcoran@cuh.ie

Link to sample request form:
https://www.cuh.ie/wp-content/uploads/2019/06/IMSRL-Request-Form-Edition-04.pdf

Address:
Irish Pneumococcal Reference Laboratory,
Irish Meningitis & Sepsis Reference Laboratory,
Temple Street Children's University Hospital,
Temple Street, Dublin 1

Departments of Public Health: IPD surveillance

IPD **enhanced surveillance form** is available at: https://www.hpsc.ie/a-z/vaccinepreventable/pneumococcaldisease/surveillanceforms/

Protocol for the enhanced surveillance of IPD is available at: https://www.hpsc.ie/a-z/vaccinepreventable/pneumococcaldisease/informationforhealthprofessionals/

Further information available on HPSC website

For further details on the surveillance and epidemiology of IPD in Ireland, please see:

Annual Reports on invasive *Streptococcus pneumoniae* infection available at:

https://www.hpsc.ie/a-z/vaccinepreventable/pneumococcaldisease/epidemiologicaldata/annualreportsoninvasivepneumococcaldisease/

Articles published in Epi-Insight available at: https://www.hpsc.ie/a-z/vaccinepreventable/pneumococcaldisease/publications/articles/

Posters and Presentations available at: https://www.hpsc.ie/a-z/vaccinepreventable/pneumococcaldisease/posterspresentations/

Quarterly and Annual EARSS Reports available at: https://www.hpsc.ie/a-z/microbiologyantimicrobialresistance/europeanantimicrobialresistancesurveillancesystemearss/ears-netdataandreports/

Acknowledgements

Thanks are due to all the health care professionals involved in the surveillance of IPD in Ireland. In particular, we wish to thank all the laboratory scientists, consultant microbiologists, public health doctors/nurses/surveillance scientists, and others for forwarding pneumococcal isolates and for the work involved in the surveillance of pneumococcal disease in Ireland. We are also grateful for the assistance of staff in the Departments of Clinical Microbiology at the Royal College of Surgeons in Ireland and Temple Street Children's University Hospital, Dublin, Ireland.

Report prepared by:

Jolita Mereckiene[3], Mary Corcoran[1], Prof Hilary Humphreys[2], Robert Cunney[1, 3], Stephen Murchan[3]

[1]Irish Pneumococcal Reference Laboratory, Irish Meningitis & Sepsis Reference Laboratory, Temple Street Children's University Hospital, Temple Street, Dublin 1

[2]Education and Research Centre, Royal College of Surgeons in Ireland and Beaumont Hospital

[3]Health Protection Surveillance Centre (HPSC), Dublin.

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