SURVEILLANCE

Invasive pneumococcal disease

Annual Epidemiological Report for 2022

Key facts

- In 2022, 17 700 confirmed cases of invasive pneumococcal disease (IPD) were reported in the European Union/European Economic Area.
- The crude notification rate was 5.1 cases per 100 000 population, similar to 2018 and 2019.
- Age-specific rates were highest in infants under one year old (13.4 confirmed cases per 100 000 population) and in adults 65 years old and above (12.6 confirmed cases per 100 000 population), with higher rates reported in males than females among all age groups.
- The most common serotypes were 3, 8, 19A, 22F, 6C, 23B, 9N, 4, 23A 11A, and 15A (in order of decreasing frequency), accounting for 73.9% of typed isolates.
- Of cases under five years old for whom serotype information was available, approximately 46% were caused by a serotype included in the 13-valent pneumococcal conjugate vaccine (PCV13). This proportion has increased over the last five years.
- Among cases 65 years old and above, approximately 71% of cases with serotype information available were caused by serotypes included in the 23-valent polysaccharide vaccine (PPV23). The proportion caused by the serotypes included in PCV13 was 41%.

Introduction

Pneumococcal diseases are symptomatic infections caused by the bacterium *Streptococcus pneumoniae* (*S. pneumoniae*), commonly referred to as pneumococcus. The term 'invasive pneumococcal disease' (IPD) is used for more severe and invasive pneumococcal infections, such as bacteraemia, sepsis, meningitis and osteomyelitis. Pneumococcal infections and IPD are major causes of communicable disease morbidity and mortality in Europe and globally, with the highest burden of disease found in young children and the elderly. A large proportion of IPD is vaccine preventable.

S. pneumoniae is classified into serotypes based on the polysaccharide capsule antigens. More than 90 immunologically distinct serotypes are known, and structurally related serotypes are grouped together and labelled alphabetically (e.g. 6A, 6B). Some serotypes possess distinct epidemiological properties and some serotypes are more common than others. Different serotypes are covered by different vaccines, as shown in Table 1. Vaccine recommendations vary across European Union/European Economic Area (EU/EEA) countries in terms of which vaccines are/have been used and which age groups are targeted [1].

Methods

This report is based on data for 2022 retrieved from The European Surveillance System (TESSy) on 2 February 2024. TESSy is a system for the collection, analysis and dissemination of data on communicable diseases.

For a detailed description of the methods used to produce this report, refer to the Methods chapter of the 'ECDC Annual Epidemiological Report [3]. An overview of the national surveillance systems is available online [4].

A subset of the data used for this report is available through ECDC's online 'Surveillance Atlas of Infectious Diseases [5].

In 2022, 29 EU/EEA countries reported data on IPD. Twenty-seven countries used the 2018 (11 countries), 2012 (6), or 2008 (10) EU case definition. For one country, the case definition was unknown/not specified and for one other it was reported as 'other'. The 2018, 2012 and 2008 case definitions do not differ, with the exception of the note on antimicrobial resistance that was added to the 2018 case definition [6].

National IPD surveillance systems were heterogeneous. Of the 29 countries reporting data, 23 conducted surveillance with compulsory reporting and national coverage. One country conducted surveillance with comprehensive reporting (Iceland, system coverage not specified), two used voluntary comprehensive systems (Hungary, Italy) and three used voluntary sentinel systems (Belgium, France, the Netherlands). Prior to 2022, data from Spain were reported from a Spanish voluntary surveillance system from the National Reference Laboratory covering 80% of the population; however, from 2022, 100% of the population have been covered by a compulsory surveillance system. The population coverage of the Belgian surveillance system is unknown, so notification rates were not calculated. For France, notification rates between 2000 and 2012 were calculated using an estimate that 82% of the population were covered by the surveillance system; from 2013 onwards, notification rates were calculated using between 79–85% of the total population (with the exact proportion updated yearly). In 2022, the proportion used was 85%. Data from the Netherlands were reported from a Dutch voluntary surveillance system from the National Reference Laboratory. This system covered 25% of the Dutch population up to 2019 and 28% of the population from 2020 onwards. Germany had a voluntary, laboratory-based surveillance system and did not report data to ECDC [7]. All countries except Belgium, Bulgaria and Croatia reported case-based data [4].

Epidemiology

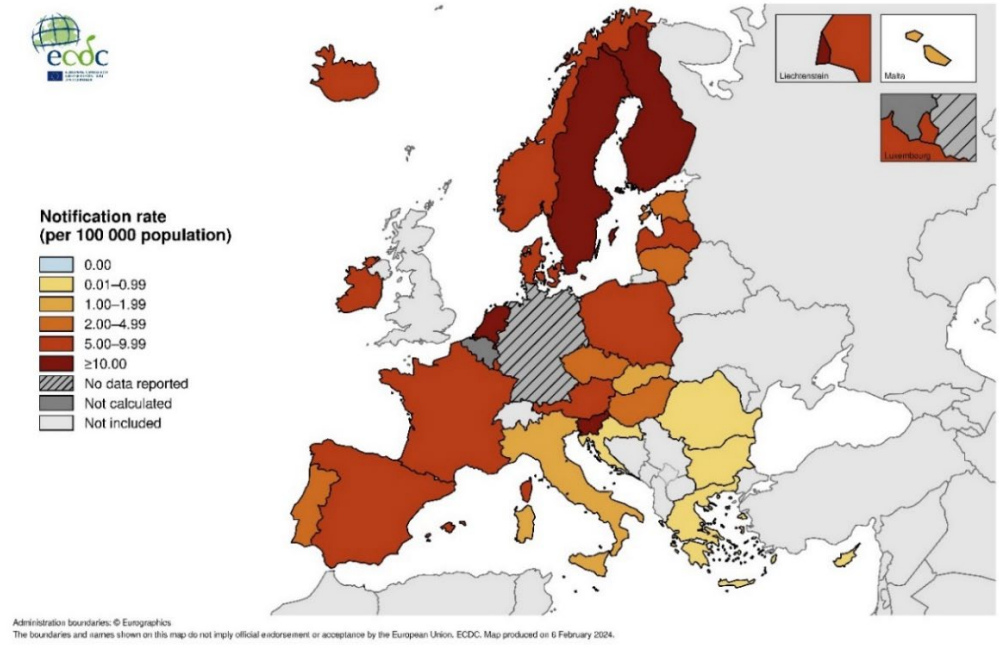
In 2022, 17 700 confirmed cases of IPD were reported by 29 EU/EEA countries. The crude notification rate was 5.1 cases per 100 000 population (Table 1). The highest number of confirmed cases were reported by France (3 387 cases), followed by Spain (3 132) and Poland (2 214). The highest notification rates were reported in Sweden (12.2 cases per 100 000 population), the Netherlands (11.4), Slovenia (10.6) and Finland (10.5) (Table 1, Figure 1). Many countries in the southern and eastern parts of the EU had low notification rates.

Table 1. Confirmed invasive pneumococcal disease cases and rates per 100 000 population by country and year, EU/EEA, 2018–2022

Country	2018		2019		2020		2021		2022	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Austria	611	6.9	615	6.9	355	4.0	398	4.5	558	6.2
Belgium	1 553	NRC	890	NRC	940	NRC	845	NRC	1 457	NRC
Bulgaria	24	0.3	34	0.5	11	0.2	3	0.0	7	0.1
Croatia	21	0.5	30	0.7	10	0.2	1	0.0	9	0.2
Cyprus	17	2.0	12	1.4	4	0.5	3	0.3	7	0.8
Czechia	535	5.0	481	4.5	247	2.3	264	2.5	472	4.5
Denmark	799	13.8	639	11.0	370	6.4	353	6.0	553	9.4
Estonia	43	3.3	61	4.6	24	1.8	15	1.1	34	2.6
Finland	761	13.8	748	13.6	318	5.8	309	5.6	582	10.5
France	3 862	7.0	3 907	7.4	2 193	4.1	2 067	3.7	3 387	5.9
Germany	NDR	NRC	NDR	NRC	NDR	NRC	NDR	NRC	NDR	NRC
Greece	42	0.4	47	0.4	17	0.2	18	0.2	28	0.3
Hungary	331	3.4	294	3.0	192	2.0	277	2.8	388	4.0
Iceland	30	8.6	41	11.5	20	5.5	17	4.6	36	9.6
Ireland	514	10.6	419	8.5	246	5.0	177	3.5	375	7.4
Italy	1 553	2.6	1 671	2.8	499	0.8	472	0.8	1 032	1.7
Latvia	76	3.9	83	4.3	67	3.5	70	3.7	125	6.7
Liechtenstein	NDR	NRC	NDR	NRC	NDR	NRC	1	2.6	5	12.7
Lithuania	65	2.3	0	0.0	0	0.0	25	0.9	88	3.1
Luxembourg	1	0.2	1	0.2	32	5.1	41	6.5	63	9.8
Malta	31	6.5	20	4.1	9	1.7	2	0.4	7	1.3
Netherlands	688	16.0	593	13.7	379	7.8	339	6.9	563	11.4
Norway	581	11.0	599	11.2	295	5.5	318	5.9	539	9.9
Poland	1 355	3.6	1 621	4.3	629	1.7	955	2.5	2 214	5.9
Portugal	397	3.9	490	4.8	251	2.4	241	2.3	414	4.0
Romania	74	0.4	72	0.4	25	0.1	10	0.1	39	0.2
Slovakia	98	1.8	124	2.3	55	1.0	35	0.6	92	1.7
Slovenia	276	13.4	280	13.5	175	8.3	187	8.9	224	10.6
Spain	2 365	6.3	2 465	6.6	1 031	2.7	795	2.1	3 132	6.6
Sweden	1 408	13.9	1 345	13.1	648	6.3	731	7.0	1 270	12.2
EU/EEA (30 countries)	**18 111**	**5.6**	**17 582**	**5.6**	**9 042**	**2.8**	**8 969**	**2.7**	**17 700**	**5.1**
United Kingdom[a]	6 555	9.9	5 622	8.4	NDR	NRC	NA	NA	NA	NA
EU/EEA (31 countries)	**24 666**	**6.3**	**23 204**	**6.1**	**9 042**	**2.8**	**NA**	**NA**	**NA**	**NA**

Source: Country reports.
NA: not applicable; NDR: no data reported; NRC: no rate calculated.
[a] No data from 2020 onwards were reported by the United Kingdom, due to its withdrawal from the EU on 31 January 2020.

Figure 1. Confirmed invasive pneumococcal disease cases per 100 000 population by country, EU/EEA, 2022

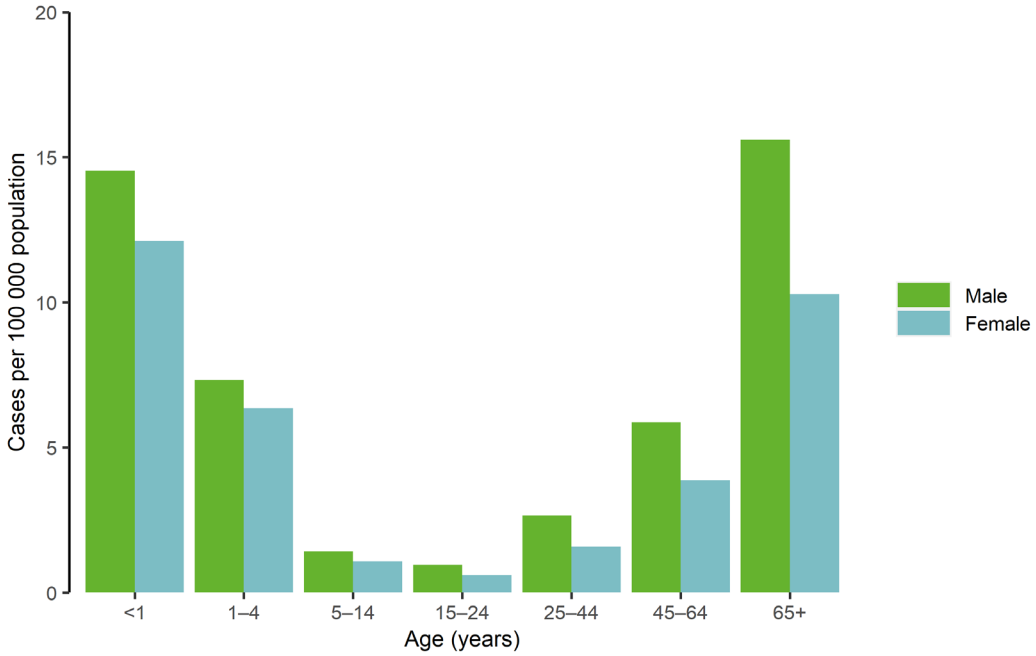


Source: Country reports

Age and gender

In 2022, IPD was predominantly reported in older adults and infants, with 12.6 confirmed cases per 100 000 population in adults 65 years old and above and 13.4 confirmed cases per 100 000 population in infants under one year old (Figure 2). The rates of disease were lowest in the 15–24 years age group (0.8 confirmed cases per 100 000 population). The notification rate was higher in males in all age groups. The overall male-to-female ratio was 1.3:1.

Figure 2. Confirmed invasive pneumococcal disease cases per 100 000 population, by age and gender, EU/EEA, 2022

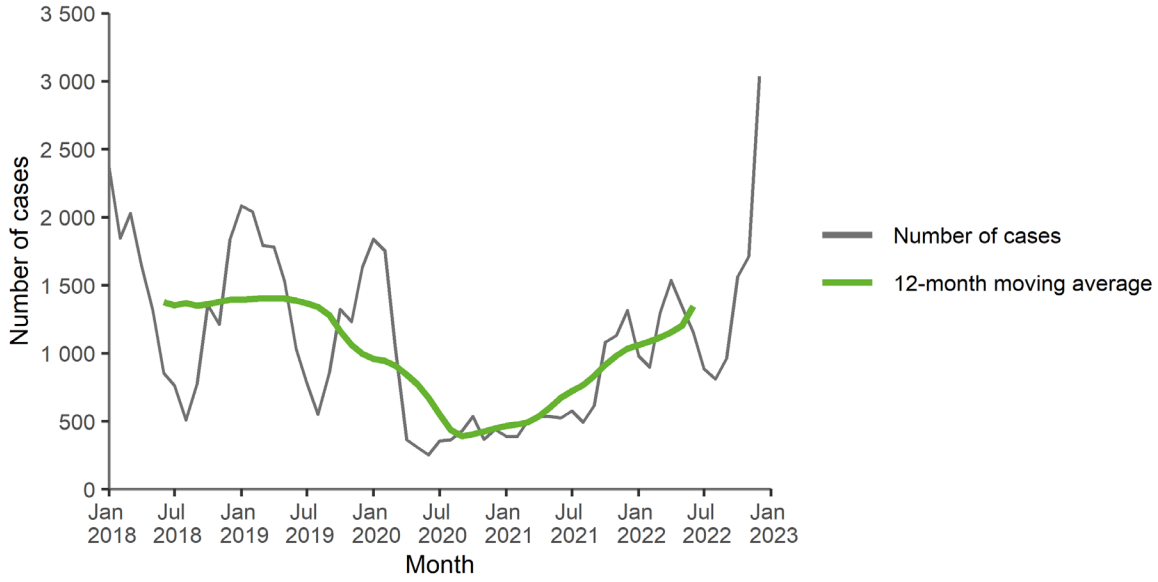


Source: Country reports from Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.

Seasonality and trend

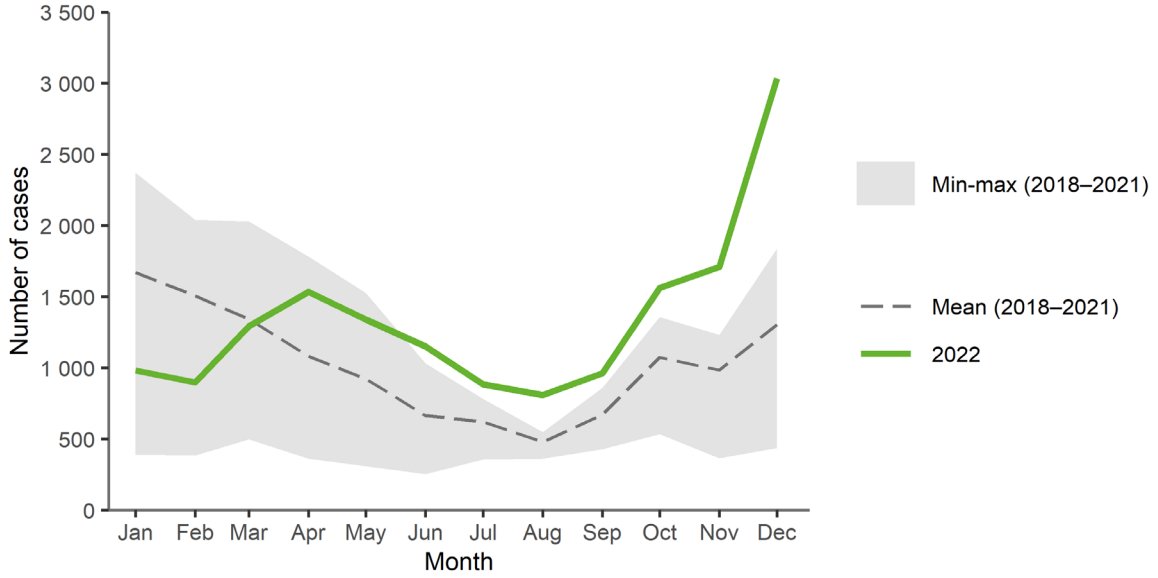
The seasonal distribution of IPD cases typically follows a pattern similar to many other respiratory diseases: case numbers are usually lowest during summer and then increase rapidly with the onset of autumn, peaking during the winter months (Figure 3). Compared with 2018 and 2019, there was a sharp decrease in the number of reported cases during 2020 and 2021, coinciding with the COVID-19 pandemic (Figure 3). The number of cases increased over autumn/winter of 2021–2022, and an atypical increase also occurred in spring 2022 (Figures 3 and 4). In autumn and winter 2022, a sharp increase in cases was observed, peaking at 3 046 cases in December 2022. The seasonal activity in 2022 was unusual compared with the mean 2018–2021 activity (Figure 4); however, the mean is heavily influenced by the decrease in overall and seasonal activity during 2020 and 2021.

Figure 3. Confirmed invasive pneumococcal disease cases by month, EU/EEA, 2018–2022



Source: Country reports from Austria, Cyprus, Czechia, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.

Figure 4. Confirmed invasive pneumococcal disease cases by month, EU/EEA, 2022 and 2018–2021



Source: Country reports from Austria, Cyprus, Czechia, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.

Vaccination status

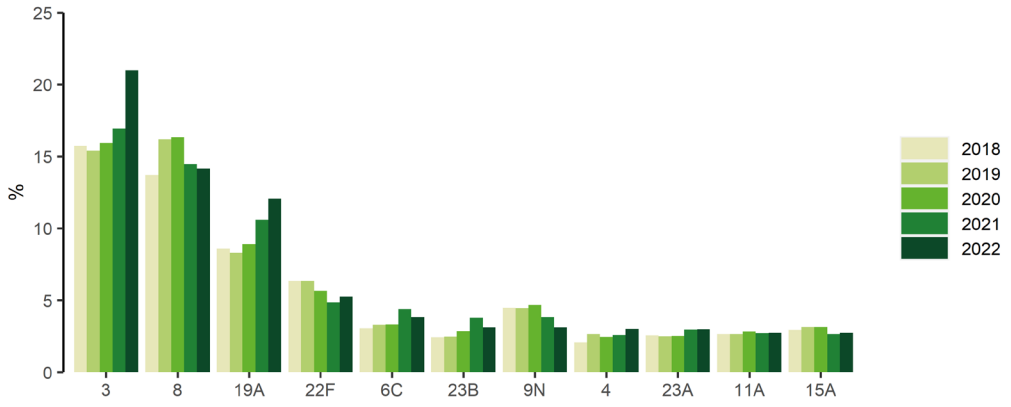
The granularity of data collected in relation to vaccination status for the study period is limited. Vaccination status was reported for 36.3% (6 428/17 700 cases) of the IPD cases reported in 2022. Of these, 70.3% (4 516 cases) were unvaccinated, 23.2% (1 492) had received between one to four doses of a PCV or PPV vaccine, and another 6.5% (420) were reported as vaccinated with an unknown number of doses.

Serotype

Among EU/EEA countries that reported serotyping data in 2022, serotype was reported for 52.3% (9 256 cases) of cases. The 11 most common serotypes, in order of decreasing frequency, were: 3, 8, 19A, 22F, 6C, 23B, 9N, 4, 23A, 11A and 15A (Figure 5). These 11 serotypes accounted for 73.9% of all cases with a known serotype in 2022.

For countries that reported serotyping data consistently for each year of the reporting period, the distribution of serotypes between 2018 and 2022 is presented in Figure 5. Compared with 2018, there was an increase in serotypes 3, 19A and 6C in 2022, by 33%, 40% and 27%, respectively. During the same period, a decrease was observed in serotypes 22F and 9N, by 17% and 31%, respectively.

Figure 5. Distribution of confirmed serotyped cases of invasive pneumococcal disease, most common serotypes, EU/EEA[a], 2018–2022



Source: Country reports from Austria, Czechia, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain and Sweden.
[a] The United Kingdom are excluded from 2018 and 2019 to allow comparison across all years.

The distribution of serotypes varied according to the age groups affected. The five most common serotypes in each age group are presented in Table 2. For cases under one year old, serotypes 3, 19A, 8, 10A and 24F were predominant. Serotypes 19A and 3 were the most common in the one to four years age group. Serotypes 3, 8 and 19A were most common in individuals above five years old.

Table 2. Proportion of confirmed cases of invasive pneumococcal disease for the five most frequent serotypes in each age group, EU/EEA, 2022

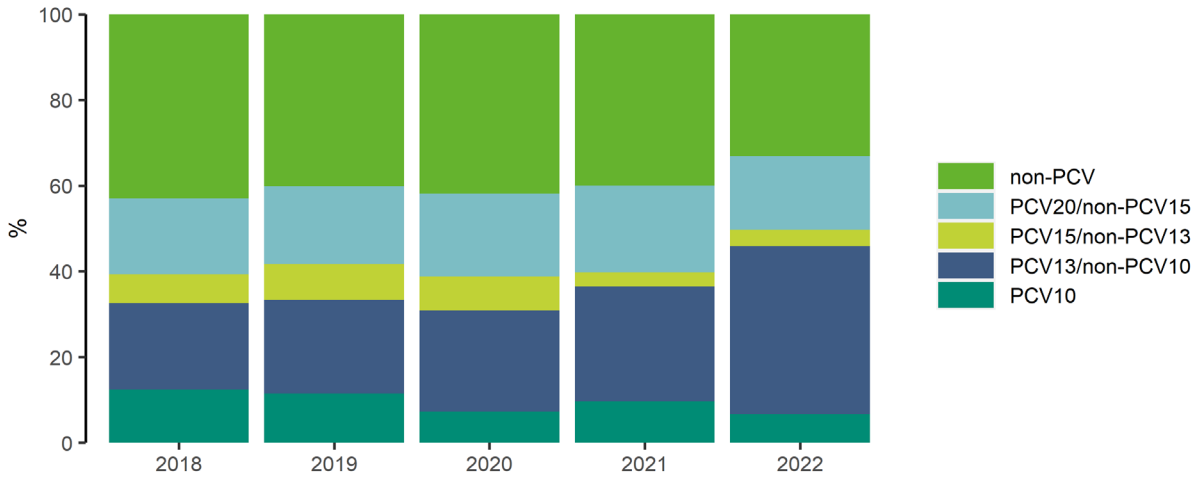
Age group (years)													
<1		1–4		5–14		15–24		25–44		45–64		65+	
Serotype	%	Serotype	%	Serotype	%	Serotype	%	Serotype	%	Serotype	%	Serotype	%
3	11.7	19A	24.8	3	18.6	8	35.6	8	21.3	3	21.1	3	22.4
19A	10.5	3	20.3	19A	17.0	19A	13.0	3	17.9	8	18.3	8	11.3
8	9.9	10A	6.6	8	10.8	3	10.3	19A	15.5	19A	9.7	19A	11.1
10A	7.4	24F	6.6	23B	5.2	4	8.2	4	6.8	22F	5.5	22F	5.8
24F	6.8	23B	4.0	22F	4.6	22F	3.4	22F	4.5	4	5.0	6C	4.9

Source: Country reports from Austria, Czechia, Denmark, Estonia, Finland, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain and Sweden.

In 2022, 6.6% of cases in children under five years old with serotype information were caused by a PCV10 serotype, 39.3% by a PCV13/non-PCV10 serotype, 3.8% by a PCV15/non-PCV13 serotype, 17.2% by a PCV20/non-PCV15 serotype and 33.1% by a serotype not included in any current PCV vaccine. The serotypes included in each vaccine formulation are shown in Annex 1.

From 2018 to 2022, there was a substantial (96%) increase in the proportion of PCV13/non-PCV10 serotypes in children under five years old (from 17.1% in 2018 to 39.3% in 2022; Figure 6). Conversely, there were decreases in the proportions of PCV10, PCV15/non-13 and non-PCV serotypes over this five-year period. The proportion of PCV20/non-15 serotypes remained unchanged.

Figure 6. Distribution of confirmed serotyped cases of invasive pneumococcal disease in children under five years old by PCV vaccine serotypes[ab] and year, EU/EEA[c], 2018–2022



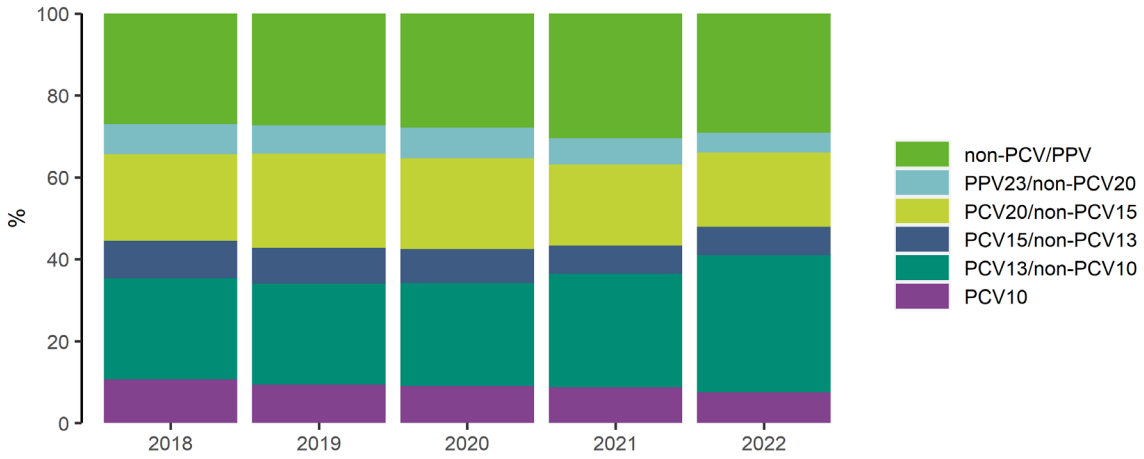
Source: Country reports from Austria, Czechia, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain and Sweden.
[a] Although serotype 6A is included in PCV13 and not in PCV10, for the purposes of this analysis it is considered a PCV10 serotype due to documented cross-protection provided by the serotype 6B antigen in PCV10.
[b] PCV15 and PCV20 were not yet authorised or used in children during this time period.
[c] Data from the United Kingdom are excluded from 2018 and 2019 to allow comparison across all years.

For cases 5–64 years old reported in 2022 with known serotype, 8.8% were caused by a PCV10 serotype, 33.0% by a PCV13/non-PCV10 serotype, 6.4% by a PCV15/non-PCV13 serotype, 21.5% by a PCV20/non-PCV15 serotype, and another 30.3% by non-PCV serotypes.

In 2022, among cases in adults 65 years old and above with serotype information, 70.8% were caused by a serotype included in the PPV23 vaccine and 29.2% by a serotype not included in the PPV23 vaccine. In comparison, 66.1% of cases were caused by serotypes included in PCV20, while only 41.0% were caused by the serotypes included in PCV13. There were incremental differences by changing vaccine composition/included serotypes: 7.5% were caused by a PCV10 serotype, 33.5% by a PCV13/non-PCV10 serotype, 6.9% by a PCV15/non-PCV13 serotype, 18.2% by a PCV20/non-PCV15 serotype, and 4.8% by a PPV23/non-PCV20 serotype (Figure 7).

From 2018 to 2022, in adults 65 years old and above, there was a 36% increase in the proportion of PCV13/non-10 serotypes, from 24.0% in 2018 to 33.5% in 2022 (Figure 7). There was also a small (8%) increase in the proportion of non-PCV/PPV serotypes, from 25.9% in 2018 to 29.2% in 2022. The proportion of all remaining serotypes decreased from 2018 to 2022.

Figure 7. Distribution of confirmed serotyped cases of invasive pneumococcal disease in adults 65 years old and above by PCV/PPV vaccine serotypes[a] and year, EU/EEA[b], 2018–2022



Source: Country reports from Austria, Czechia, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain and Sweden.
[a] Although serotype 6A is included in PCV13 and not in PCV10, for the purposes of this analysis it is considered a PCV10 serotype due to documented cross-protection provided by the serotype 6B antigen in PCV10.
[b] Data from the United Kingdom are excluded from 2018 and 2019 to allow comparison across all years.

Antimicrobial susceptibility

Antimicrobial susceptibility data were based on the reporting of susceptibility testing categories (Susceptible/Intermediate/Resistant) and minimum inhibitory concentration (MIC) data. MIC data were converted to SIR data based on EUCAST breakpoints. Penicillin susceptibility data were reported by 12 countries for 54.5% (2 816/5 168 cases) of the IPD cases. Of these, 82.3% (2 317 cases) were reported as sensitive, 4.9% (138) as intermediate and 12.8% (361) as resistant. Erythromycin susceptibility data were reported by 11 countries for 30.9% (1 599/2 954 cases) of their IPD cases. Of these, 79.4% (1 269 cases) were reported as sensitive, 1.6% (26) as intermediate and 19.0% (304) as resistant. Cephalosporin susceptibility data were reported by 11 countries for 45.6% (2 354/5 161 cases) of their IPD cases. Of these, 88.5% (2 082 cases) were reported as sensitive, 1.7% (40) as intermediate and 9.9% (232) as resistant.

Clinical presentation

Clinical presentation was known for 8 882 (50.2%) of all cases. Of these, bacteraemic pneumonia was reported in 3 657 cases (41.2%), septicaemia in 3 350 cases (37.7%), meningitis in 1 226 cases (13.8%), and meningitis and septicaemia in 242 cases (2.7%). A further 407 cases (4.6%) had other clinical presentations.

Among infants under one year old, the most common clinical presentation was meningitis (41.8%), followed by septicaemia (26.4%) and bacteraemic pneumonia (19.6%). The most common clinical presentations in one to four-year-olds were bacteraemic pneumonia (38.0%) and septicaemia (31.6%). In adults 65 years old and above, clinical presentations were approximately equally distributed between bacteraemic pneumonia (44.7%) and septicaemia (40.7%).

Outcome

Among 7 000 cases with known outcome (39.5%) in 2022, 895 (12.8%) died. The case fatality was highest among cases 65 years old and above (17.1%) and 45–64 years (10.9%). Among infants under one year old and children one to four years old, the case fatality rates were 3.9% and 3.6%, respectively.

Among the 895 cases that died, 366 (40.9%) presented with septicaemia, 257 (28.7%) with bacteraemic pneumonia, 53 (5.9%) with meningitis, 31 (3.5%) with meningitis and septicaemia, 20 (2.2%) with other clinical presentations, and 168 (18.8%) with clinical presentation unknown.

Serotype was known for 625 (69.8%) deceased cases. The five most common serotypes reported for deceased cases (where serotype was known), in order of decreasing frequency, were 3, 19A, 8, 6C and 22F. These five serotypes accounted for 54.4% of deaths where serotype was known.

Discussion

In 2022, 29 EU/EEA countries reported a total of 17 700 cases of IPD. This was similar to 2018 and 2019, indicating that transmission and/or reporting practices have rebounded to the same level as before the COVID-19 pandemic. In 2020 and 2021, there was an approximately 50% reduction in the number of reported IPD cases compared with 2018 and 2019, which may have been due to a combination of reduced transmission following the implementation of non-pharmaceutical interventions, reduced laboratory capacity for testing, reduced public health capacity for surveillance/reporting of IPD cases, or other factors.

In 2022, the crude IPD notification rate was 5.1 cases per 100 000 population. Older adults (65 years old and above) and infants (under one year old) were the most affected age groups, with notification rates of 12.6 and 13.4 cases per 100 000 population, respectively. Notification rates varied by country, ranging from 0.1 to 12.2 cases per 100 000 population. The variation may be due to differences in healthcare systems, vaccination programmes, case ascertainment (including blood culturing practices) and reporting.

The impact of PCVs in reducing the incidence of IPD in the EU/EEA has now been observed for almost two decades. A seven-valent PCV (PCV7) was first licensed in 2001 for use in infants and young children, and EU/EEA countries began introducing the vaccine into routine childhood immunisation schedules in 2006. In 2009, the higher-valency PCV10 and PCV13 vaccines were licensed and progressively replaced PCV7 on immunisation schedules in the EU/EEA. As a result of the introduction of the PCV7 and later the PCV10/PCV13 vaccines, the incidence of the serotypes included in the vaccines declined [8-11]. Vaccination of infants and young children also resulted in indirect protection of older adults by reducing nasopharyngeal carriage and transmission in children, contributing to a decrease in morbidity and mortality in older age groups [12].

However, as the incidence of vaccine serotypes declined, incidence of non-vaccine serotypes increased, indicating serotype replacement was occurring [9, 10]. Serotype replacement has gradually reduced the impact of PCVs, as the rates of carriage and disease caused by non-vaccine serotypes have increased [10]. To address the issue of serotype replacement, vaccines continue to be developed to include more of the serotypes commonly responsible for causing IPD. A 15-valent PCV was developed, including two additional serotypes (22F & 33F) compared with PCV13. This vaccine was authorised for adults 18 years old and above in October 2021 and for children six months to under 18 years old in September 2022 [13]. Similarly, a 20-valent PCV was also developed, for which authorisation for adults 18 years old and above was granted in February 2022. In January 2024, this vaccine was also authorised for children six weeks to under 18 years old [14]. These higher-valency vaccines (PCV15/PCV20) have had limited use in the EU/EEA to date, as there have been only a few countries that have recommended the inclusion of PCV15 (for children or older adults) or PCV20 (older adults only) [1].

Overall, for the EU/EEA in 2022, approximately 46% of cases in children under five years were caused by PCV13 serotypes, and an increase in PCV13/non-10 serotypes was observed in this age group between 2018 and 2022. This highlights that existing vaccines could prevent a large majority of cases. The five serotypes accounting for 54.4% of deaths (where serotype was known) were 3, 19A, 8, 6C and 22F. Of these serotypes, 3 and 19A are included in PCV13, PCV15, PCV20 and PPV23; serotype 22F is in PCV15, PCV20 and PPV23; serotype 8 is in PCV20 and PPV23; and serotype 6C is not included in any vaccine.

National authorities consider numerous factors when contemplating changes to the vaccination schedules, including: the national/local epidemiological situation and circulation of serotypes; real word data on the performance of different vaccines (including effectiveness, safety and impact on specific groups); burden/severity of different clinical presentations associated with different serotypes; and cross-protection against different serotypes. Programmatic consideration of changes to the vaccination schedules and other parameters related to implementation (such as cost effectiveness and/or co-administration with other vaccines) are also taken into account.

Of note in 2022, compared with 2018, there was a dramatic increase in the proportion of PCV13/non-10 serotypes in children under five years old. In 2022, among infants and children under five years old, approximately 39% of cases (with known serotype) were caused by the two serotypes (3 and 19A) covered by PCV13 but not PCV10 (6A is considered a PCV10 serotype due to cross-protection from 6B). In 2018, this proportion was 17% of cases with known serotype. Further analysis and investigation are needed to determine the drivers behind the relative increase of PCV13/non-10 serotypes among young children and the impact of such change.

In addition to the PCVs, PPV23 has been available in many countries since the early 2000s, authorised for use in children under two years of age, adolescents and adults. Since its authorisation, many EU/EEA countries introduced this vaccine in national programmes for older adults and/or at-risk individuals [15]. PPV23 is effective at preventing invasive disease among adults; however, it is less effective against non-invasive disease and the duration of protection may be shorter than that of PCVs [16]. There is some evidence that immunogenicity and duration of protection can be improved with a schedule that incorporates a dose of PCV followed by a booster of PPV23 for older adults [16]. Some EU/EEA countries recommend such a combination [1]. Of note is the considerable variation in PCV/PPV23 recommendations across the EU/EEA, not only with regard to which vaccines are used, but also which individuals are considered at-risk and from what age the older adult age group begins (50, 60 or 65 years old) [1].

In 2022, among adults 65 years old and above, approximately 71% of IPD cases (with known serotype) were caused by a serotype included in PPV23 and 41% were caused by one of the serotypes included in PCV13. These proportions have been reasonably stable over the past five years. Of cases with a known outcome in 2022, the case fatality was highest among adults 65 years old and above (17.1% of all deaths). Despite PPV23 and/or PCV vaccines being recommended for older adults in many EU/EEA countries and for a long period of time, the vaccine-preventable serotypes continue to be responsible for a high proportion of IPD cases. In EU/EEA countries, availability of coverage estimates for at-risk groups and older adults is limited; however, where available (predominantly for older adults), the coverage is low, and below 30% in all countries [17]. An improvement in coverage of recommended vaccines, irrespective of which vaccine (or a combination of vaccines), may reduce the IPD burden among older adults. However, ongoing monitoring of IPD serotype trends in older adults in relation to vaccination recommendations in this age group, as well as the indirect impact of childhood vaccination recommendations, is also required.

Public health implications

Pneumococcal vaccines contain a range of serotypes that can cause IPD. Vaccination programmes in EU/EEA countries have provided significant protection against IPD caused by the vaccine serotypes, and effects extend to all age groups through the introduction of herd immunity. At the same time, the vaccines' limited serotype coverage has resulted in serotype replacement. It is therefore essential to continue monitoring circulating serotypes in order to evaluate and continuously monitor current vaccination programmes. The decision to introduce a vaccine to a routine national immunisation programme depends on context-specific factors in each country, such as disease burden, serotype distribution and cost-effectiveness. Further monitoring of antimicrobial resistance is also needed to guide vaccination strategies and antibiotic treatment of cases.

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Annex 1. Vaccine composition

There are a number of pneumococcal conjugate vaccines (PCVs) and a pneumococcal polysaccharide vaccine (PPV) currently and previously authorised for use in the EU/EEA. The available vaccine formulations protect against different serotypes (Table 1A).

Table 1A. Composition of pneumococcal conjugate vaccines (PCVs) and pneumococcal polysaccharide vaccine (PPV) currently/previously authorised in the EU/EEA, by vaccine formulation and serotype

		Serotype																						
		1	2	3	4	5	6A[a]	6B	7F	8	9N	9V	10A	11A	12F	14	15B	17F	18C	19A	19F	20	22F	23F	33F
Vaccine formulation	PCV7				X		(X)	X				X				X			X		X			X	
	PCV10	X			X	X	(X)	X	X			X				X			X		X			X	
	PCV13	X		X	X	X	X	X	X			X				X			X	X	X			X	
	PCV15	X		X	X	X	X	X	X			X				X			X	X	X		X	X	X
	PCV20	X		X	X	X	X	X	X	X		X	X	X	X	X	X		X	X	X		X	X	X
	PPV23	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X: the vaccine formulation protects against this serotype.
[a] Although serotype 6A is not included in PCV7 or PCV10, it is considered to be a PCV7/PCV10 serotype in the analysis due to documented cross-protection provided by the serotype 6B antigen in PCV7/PCV10 [2].