

## SURVEILLANCE REPORT

# Pertussis

## Annual Epidemiological Report for 2021

### Key facts

- In 2021, 1 578 cases of pertussis were reported by 29 EU/EEA countries.
- Three countries (Austria, Germany and Poland) accounted for 69% of all reported cases.
- The notification rate in 2022 was 0.4 cases per 100 000 population, which was the lowest rate in over a decade.
- Infants below the age of one year were the most affected age group, with the highest notification rate followed by 1-4-year-olds. Individuals  $\geq 15$  years of age accounted for 77% of all cases reported.
- The clinical presentation of pertussis in adolescents and adults may be mild and is often not recognised, which contributes to bacterial circulation in the population. This poses a transmission risk to infants who are too young to have completed the primary pertussis vaccination series.
- The objectives of pertussis prevention and control include prevention of severe disease and deaths among infants < six months of age through well-adapted and implemented vaccination programmes. As of April 2024, 22 countries have implemented maternal immunisation programmes. The vaccination programmes in ten countries include more than one booster dose - including the pertussis component - in individuals above the age of 18 years.

## Introduction

Pertussis is a highly infectious bacterial disease involving the respiratory tract. It is caused by a bacterium (*Bordetella pertussis* or *Bordetella parapertussis*) that is found in the mouth, nose and throat of an infected person. It is also known as whooping cough.

Symptoms usually appear seven to ten days after infection but may also appear up to 21 days later. Initially, symptoms resemble those of a common cold, including sneezing, runny nose, low-grade fever and a mild cough. Within two weeks, the cough becomes more severe and is characterised by episodes of numerous rapid coughs, followed by a crowing or high-pitched whoop. These episodes frequently end with the expulsion of a thick, clear mucous, often followed by vomiting. They initially occur at night and then become more frequent during the day and may recur for one to two months. In young infants, the typical 'whoop' may never develop, and the coughing fits may be followed by brief periods when breathing stops. After this phase, the coughing fits become less frequent and less severe, and the infant gradually gets better, although this can take up to three months.

Adolescents, adults, or partially-immunised children generally have milder or atypical symptoms, so in these groups, in addition to very young infants, pertussis might be more difficult to diagnose.

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## Methods

This report is based on data for 2021 retrieved from The European Surveillance System (TESSy) on 11 April 2024. TESSy is a system for the collection, analysis and dissemination of data on communicable diseases. Only cases due to *B. pertussis* are included in the EU cases definitions for pertussis.

An overview of the national surveillance systems is available online [1].

A subset of the data used for this report is available through the interactive Surveillance atlas of infectious diseases [2].

In 2021, 29 European Union/European Economic Area (EU/EEA) countries reported data on pertussis to TESSy. Liechtenstein has never reported pertussis data to ECDC.

The majority of countries reported case-based data in accordance with the EU case definition, based on comprehensive passive surveillance systems with national coverage [3,4]. Belgium, Bulgaria and the Netherlands reported aggregate data in 2021. Belgium operates a voluntary sentinel-laboratory-based surveillance system covering the entire population. France operates a hospital-based sentinel surveillance system, which includes only infants below the age of six months; for 2018 (in addition to 2016 and 2017 in previous reports) cases under one year old were identified through the ECDC study PERTINENT (Pertussis in Infants in Europe) and were reported to ECDC as part of the annual data collection and are included in the present analysis and other ECDC outputs. Germany reported data on pertussis for the first time in 2014, after nationwide reporting became mandatory in March 2013.

## Epidemiology

### Geographic distribution

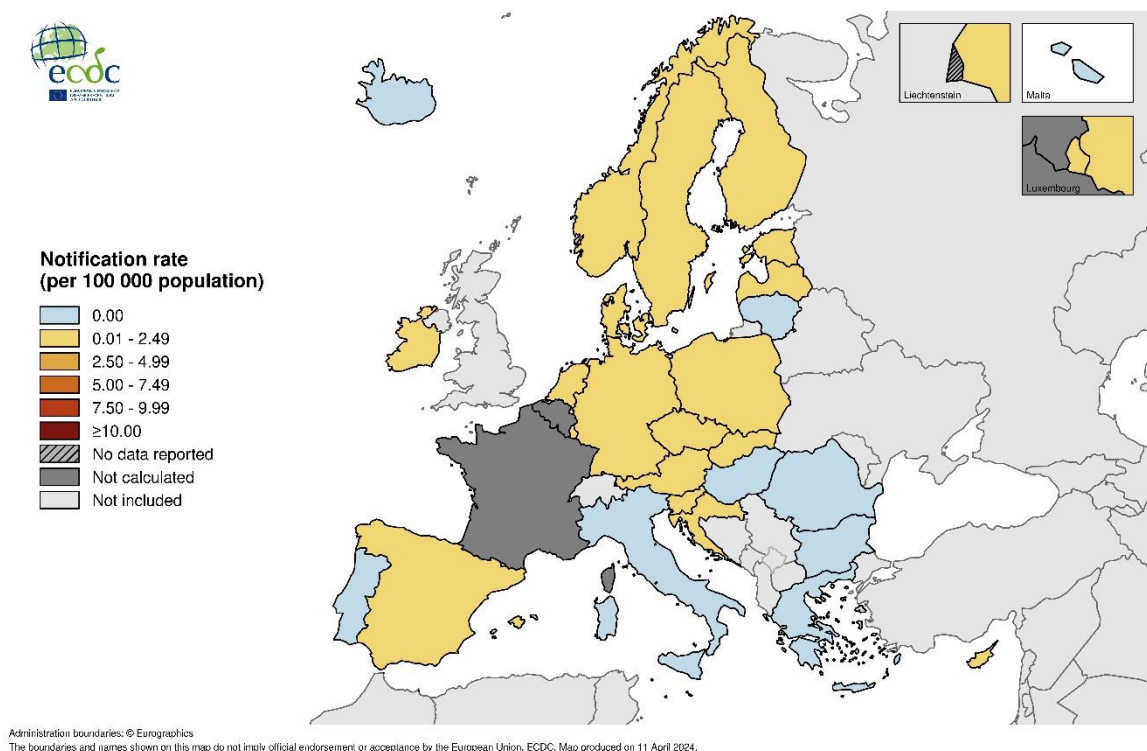
For 2021, 29 EU/EEA countries reported 1 578 pertussis cases, of which 1 414 (90%) were classified as confirmed, 22 (1%) as probable and 141 (9%) as possible and one with unknown classification. Three countries (Austria, Germany and Poland) accounted for 69% of all reported cases with the majority of cases reported by Germany (49%) (Table 1). In Germany, 99% of all cases were confirmed cases, in Austria 97 % and in Poland 35% of all cases were confirmed. The EU/EEA notification rate was 0.4 per 100 000 population, which was more than ten-fold lower compared to the pre-COVID-19- pandemic reporting period (2018-2019), and the lowest rate observed in the last ten years. In 2021, no country reported an increased notification rate compared with the previous year. Slovakia reported the highest notification rate with 1.7 cases per 100 000 population, followed by Austria and Denmark, where notification rates were 1.4 notified cases per 100 000 population (Figure 1).

**Table 1. Pertussis cases (confirmed, probable and possible cases) and notification rates per 100 000 population by country and year, EU/EEA, 2017–2021**

Country	2017		2018		2019		2020		2021	
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate
Austria	1 411	16.1	2 202	25.0	2 233	25.2	632	7.1	129	1.4
Belgium	1 038	NRC	853	NRC	690	NRC	124	NRC	16	NRC
Bulgaria	116	1.6	114	1.6	72	1.0	27	0.4	3	0.0
Croatia	78	1.9	129	3.1	57	1.4	10	0.2	7	0.2
Cyprus	17	2.0	0	0.0	2	0.2	8	0.9	2	0.2
Czechia	667	6.3	752	7.1	1 347	12.6	696	6.5	51	0.5
Denmark	1 068	18.6	1 023	17.7	3 691	63.6	2 390	41.0	80	1.4
Estonia	56	4.3	69	5.2	135	10.2	44	3.3	13	1.0
Finland	401	7.3	477	8.7	557	10.1	290	5.2	33	0.6
France	100	NRC	140	NRC	36	NRC	34	NRC	0	NRC
Germany	16 193	19.6	12 494	15.1	9 485	11.4	3 212	3.9	776	0.9
Greece	40	0.4	18	0.2	20	0.2	8	0.1	0	0.0
Hungary	15	0.2	23	0.2	7	0.1	13	0.1	0	0.0
Iceland	20	5.9	15	4.3	6	1.7	0	0.0	0	0.0
Ireland	263	5.5	118	2.4	164	3.3	66	1.3	5	0.1
Italy	964	1.6	962	1.6	755	1.3	189	0.3	5	0.0
Latvia	94	4.8	159	8.2	719	37.4	340	17.8	9	0.5
Liechtenstein	NDR	NRC	NDR	NRC	NDR	NRC	NDR	NRC	NDR	NRC
Lithuania	21	0.7	27	1.0	26	0.9	68	2.4	0	0.0
Luxembourg	18	3.0	9	1.5	10	1.6	3	0.5	3	0.5
Malta	8	1.7	6	1.3	15	3.0	10	1.9	0	0.0
Netherlands	4 505	26.4	4 312	25.1	5 885	34.1	1 124	6.5	74	0.4
Norway	2 424	46.1	2 476	46.8	2 536	47.6	812	15.1	38	0.7
Poland	3 061	8.1	1 548	4.1	1 629	4.3	753	2.0	182	0.5
Portugal	115	1.1	60	0.6	83	0.8	33	0.3	3	0.0
Romania	95	0.5	93	0.5	110	0.6	18	0.1	1	0.0
Slovakia	191	3.5	376	6.9	702	12.9	700	12.8	92	1.7
Slovenia	214	10.4	213	10.3	129	6.2	42	2.0	6	0.3
Spain	4 069	8.7	2 681	5.7	2 585	5.5	206	0.4	39	0.1
Sweden	805	8.1	739	7.3	782	7.6	269	2.6	11	0.1
United Kingdom	4 513	6.9	3 557	5.4	4 489	6.7	NDR	NRC	NA	NA
<b>EU/EEA</b>	<b>42 580</b>	<b>9.4</b>	<b>35 645</b>	<b>7.9</b>	<b>38 957</b>	<b>8.7</b>	<b>12 121</b>	<b>3.2</b>	<b>1 578</b>	<b>0.4</b>

Source: Country reports; ASR: age-standardised rate; NDR: no data reported; NRC: no rate calculated.

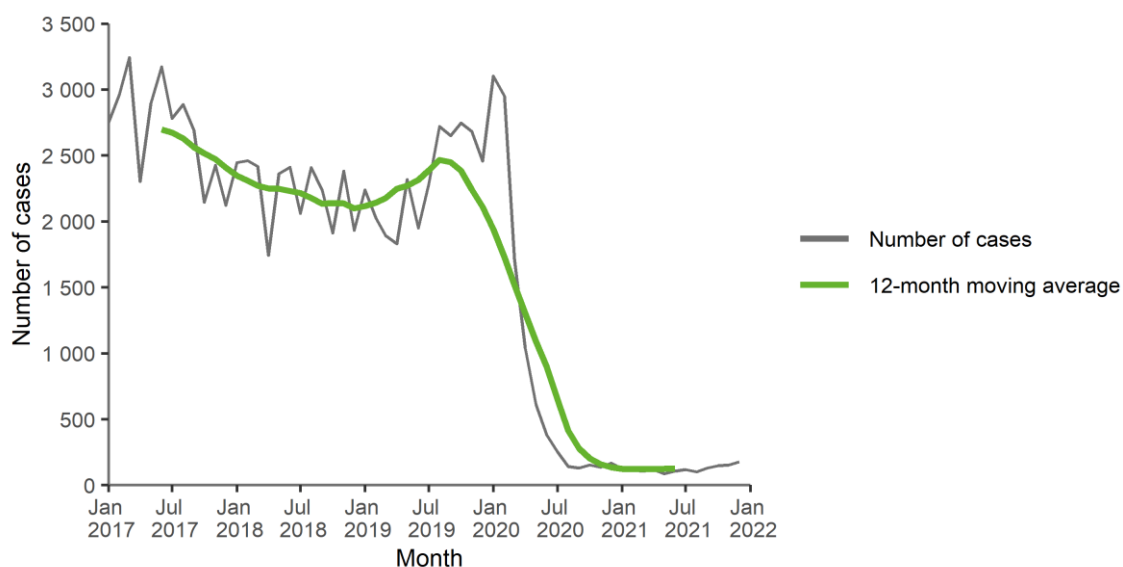
**Figure 1. Confirmed, probable and possible pertussis cases per 100 000 population by country, EU/EEA, 2021**



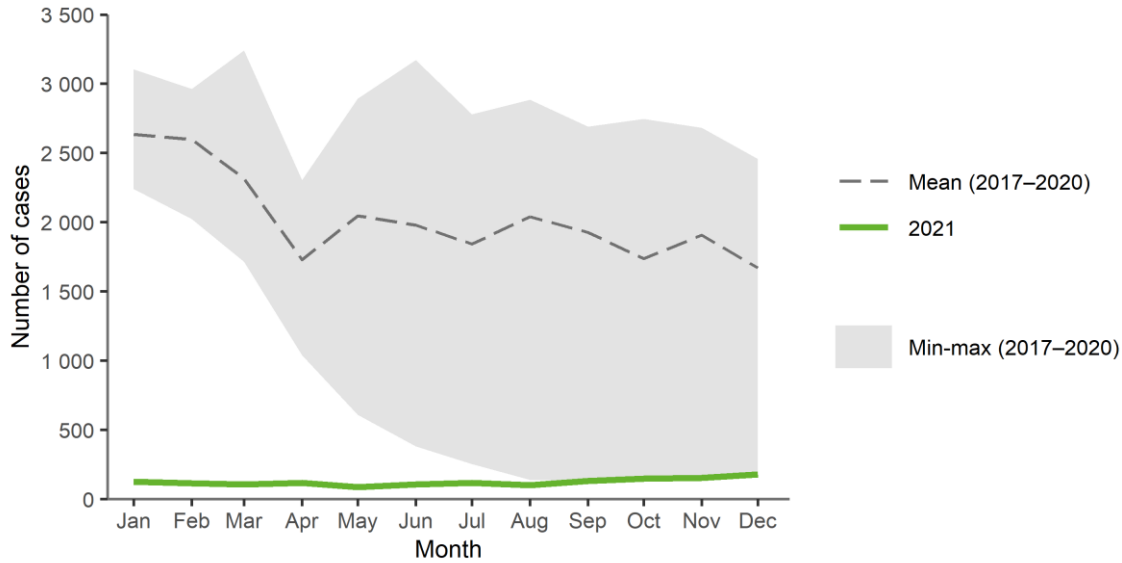
## Seasonality and trend

In the five-year period between 2017 and 2021, case numbers were relatively stable between 2017 and January 2020. After a peak in spring 2020, numbers drastically decreased to a very low level until the end of 2021 (Figure 2). In 2021, low levels of cases were reported with a slight increase starting in August until end of the year (Figure 3).

**Figure 2. Confirmed, probable and possible pertussis cases by month, EU/EEA, 2017–2021**



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

**Figure 3. Confirmed, probable and possible pertussis cases by month, EU/EEA, 2021 and 2017–2020**

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

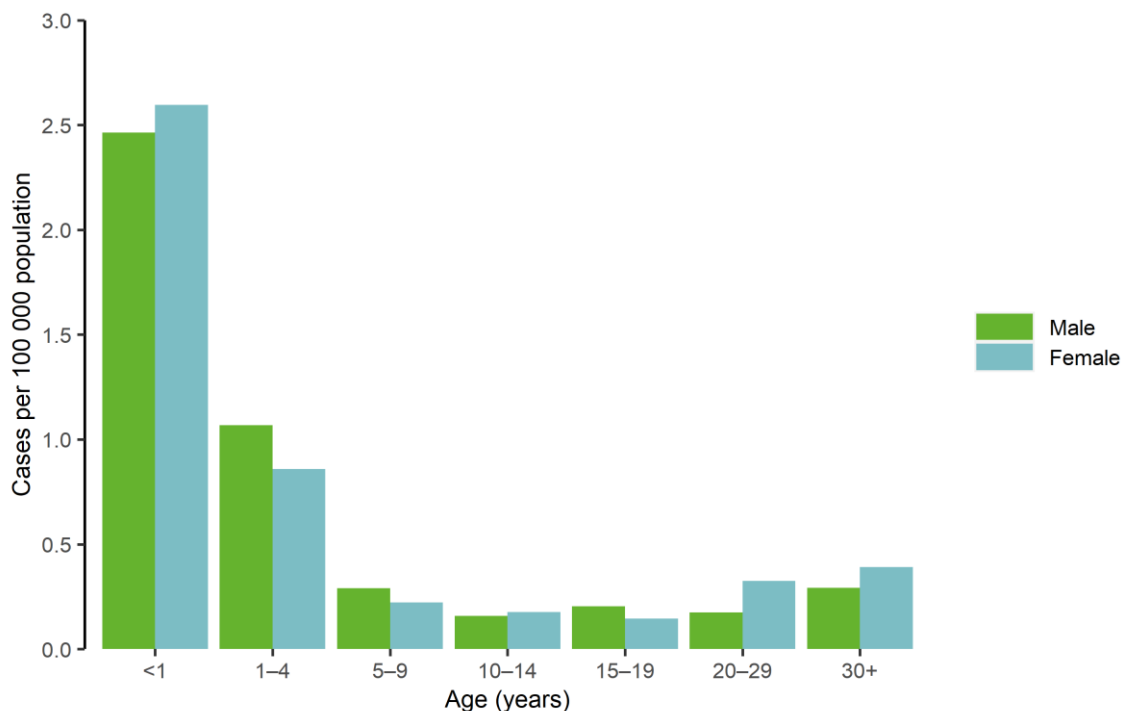
## Age and gender distribution

Information on age was available for 1 485 (94%) cases and 77% of these cases were above the age of 14 years including 67% aged 30 years or older and 10% in the age group 15 to 29 years.

The highest notification rate was observed among infants below the age of one year followed by 1–4-year-olds (Figure 4). Infants below the age of one year constituted 6% of all cases reported; 67% were <six months of age and 45% were <three months of age.

Males were overrepresented in 1–9-year-olds and in 15–19-year-olds, while females were more affected in cases below one year of age, in 10–14-year-olds and in cases  $\geq 20$  years of age (Figure 4). The overall male-to-female ratio was 0.8:1.

**Figure 4. Confirmed, probable and possible pertussis cases per 100 000 population, by age and gender, EU/EEA, 2021**

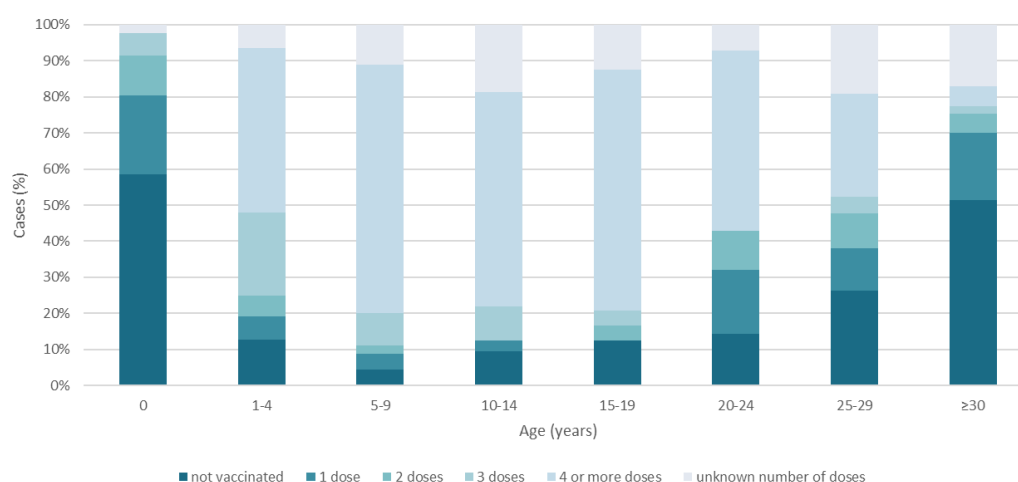


## Vaccination status

Vaccination status (reported through both case-based and aggregate datasets) was known for 1 069 cases, with age also known for 989 cases. (Figure 5). Of these cases, 401 (41%) were unvaccinated, 210 (21%) were vaccinated with one or two doses, 57 (6%) with three doses, and 182 (18%) with four or more doses. A total of 139 cases (14%) were vaccinated, but the number of doses was unknown. Among all 91 infants below the age of one year, nine (10%) had an unknown vaccination status and two (8%) were vaccinated with an unknown number of doses.

The proportion of unvaccinated cases was highest among infants below one year of age (59%) and among individuals above the age of 29 years (51%). The highest proportion of individuals vaccinated with four or more doses (69%) was in the age group of 5- to 9-year-olds, followed by the 15- to 19-year-olds age group where 67% received four or more doses.

**Figure 5. Percentage of confirmed, probable and possible pertussis cases by vaccination status and age group, EU/EEA, 2021**



## Hospitalisation status and outcome

Of 1 190 cases reported with case-based information and known hospitalisation status, 231 (19%) were hospitalised; 56 (24%) of them were under one year of age, and 44 (19%) were between one and four years, 105 (45%) were 30 years of age or older.

Of the 1 485 cases reported with case-based information, outcome was known for 1 303 (88%) cases. Three deaths were reported in a 76-year-old female, an 85-year-old female and a 95-year-old male. Among the 91 infants below one year of age, 75 (82%) had a known outcome and 66 (72%) had a known hospitalisation status.

## Laboratory confirmation

Of the 1 321 laboratory-confirmed cases with case-based information, 1 071 (81%) were confirmed by serology, 202 (15%) by PCR, 19 (1%) by culture and 27 (2%) by unknown methods. In two cases, two or more methods were used for confirmation.

The proportion of laboratory-confirmed cases was 100% in Croatia, Denmark, Estonia, Finland, Norway, Portugal, Romania, Slovenia and Slovakia.

## Discussion

The overall notification rate of pertussis remained at very low levels after a major drop of cases in 2020. Similar to other respiratory diseases for which the causative agent is transmitted by droplets, the decline may be attributed to the implementation of barrier measures in the EU/EEA to reduce the circulation of SARS-Cov-2 in the context of the COVID-19 pandemic.

Pertussis disease usually observes epidemic cycles occurring every three to five years in addition to a seasonal pattern, with most cases occurring in the spring and summer [5,6]. Since the pertussis epidemic that occurred in many EU/EEA countries in 2012 to 2019, the incidence of pertussis had remained at high levels, fluctuating between about eight to nine cases per 100 000 population, peaking in 2016 with 11 cases per 100 000 population. The overall notification rate in 2021 remains far below the rates observed before the COVID-19 pandemic, and was the lowest notification rate observed over the past decade. This could be due to several factors including possible underreporting and under-ascertainment in this period. Therefore, data should be interpreted with caution.

In 2021, infants remained the group with the highest notification rate followed by 1–4-year-old individuals, while individuals above the age of 15 years continued to account for a high proportion of cases (77%). Compared to pre-pandemic years, some epidemiological characteristics of the disease slightly differed in 2021. In 2018, the highest notification rate was also seen in infants, and followed by 10-14 years old individuals. In 2021, among cases between the age of five and 24 years, 62% had been vaccinated with four or more doses; 51% of cases above the age of 29 years were unvaccinated. Although there was no resurgence of pertussis in older children nor in adolescents or adults, the large proportion of unvaccinated or partially-vaccinated individuals 30+ years of age need further attention.



Unvaccinated individuals in this age group are a source of transmission to infants, who develop the most severe form of the disease. In addition, clinical suspicion in adults is low, which leads to under-ascertainment of these cases and increases the risk of transmission to infants and children. The 2018 revised version of the EU case definition for pertussis may contribute to highlighting atypical presentations in adults, adolescents and vaccinated individuals, as well as clarifying laboratory confirmation aspects [4]. It is important to test any individual with an atypical clinical presentation, including partially-vaccinated individuals.

Surveillance systems, including the proportion of laboratory-confirmed cases in EU/EEA countries, are heterogeneous and direct comparisons between countries should be made with caution.

All EU/EEA countries include pertussis vaccination in their routine childhood immunisation schedules and all except Poland are using acellular pertussis-containing vaccines for primary immunisation. In addition, an increasing number of countries have implemented a pertussis vaccination programme in pregnant women, including Austria, Belgium, Croatia, Cyprus, Czechia, Denmark, France, Germany, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Poland, Portugal, Romania, Slovenia, Spain and Sweden, and one country (Norway) is planning to implement maternal vaccination in May 2024 [7].

The current schedules in EU/EEA countries for vaccination below 24 months of age with acellular pertussis-containing vaccines can be, for the majority, divided into the following groups:

- A so-called '2p+1' schedule corresponding to two doses of primary vaccination and a booster dose, with the vaccine given at three, five and 12 months.
- A so-called '3p+1' schedule corresponding to three doses given in the first year of life, starting as early as two months, with a booster in the second year of life.

Further doses are given at the time of school entry, adolescence and adulthood varying across countries [7].

As of April 2024, adolescent and adult boosters have been implemented in many EU/EEA countries, with a number of countries (Austria, Belgium, Czechia, France, Greece, Italy, Liechtenstein, Norway) recommending more than one adult booster (i.e. after the age of 18 years) [7].

At the EU/EEA level, coverage data for the third dose of the pertussis-containing vaccine showed a decline of about 2% in the EU/EEA median vaccination coverage in 2021 compared to 2018, as reported by the World Health Organization [8]. Achieving and maintaining high vaccination coverage is key, including in a population in which the immunity was not naturally boosted during the COVID-19 pandemic. In addition, there has been evidence that the acellular pertussis vaccine may be associated with waning immunity within 5-10 years post administration, and being less able to prevent nasopharyngeal colonisation of *Bordetella pertussis* than the whole-cell vaccine or a natural infection [9,10].

The 2021 data show that there is room for further improvement on data completeness of vaccination status, as 32% of cases were reported with an unknown vaccination status, with data on infants reported with the highest proportion of completeness. Data on vaccination status of infants would benefit by being complemented with the information on vaccination status of the mother during pregnancy. Starting in 2024, ECDC will collect information on the vaccination status of mothers during pregnancy for cases less than two years of age at the time of disease onset, and on the gestational age (in weeks) if the mother has been vaccinated during pregnancy.

Since mid-2023, several EU/EEA countries have reported an increase of pertussis cases compared to pre-COVID-19- pandemic levels and continue to do so as of 12 April 2024. According to available data, the age groups mostly affected are children and younger adolescents. In addition, infants and young children who are too young to be fully vaccinated have also been affected, resulting in several deaths in this age group [11].

## Public health implications

Significant challenges remain to control pertussis in Europe. High vaccination coverage is needed to ensure indirect and direct protection of infants and young children, the two groups which tend to show the most severe symptoms.

Consideration should also be given to adolescent and adult booster doses, vaccination of healthcare workers and pregnant women, as well as ensuring that these recommendations are effectively implemented, in agreement with the national guidelines.

Despite the number of cases reported, it is likely that the burden of pertussis in Europe is still considerably underestimated. Higher quality pertussis surveillance, associated with increased awareness as well as improved access to appropriate laboratory diagnosis, may contribute to a more accurate picture of the epidemiology of pertussis and support policy decisions to mitigate the impact of vaccination.



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