

SURVEILLANCE REPORT

Pertussis

Annual Epidemiological Report for 2023

Key facts

- In 2023, 26 033 cases of pertussis were reported by 29 EU/EEA countries.
- Two countries (Croatia and Denmark) accounted for more than 40% of all reported cases.
- The notification rate in 2023 was 6.7 cases per 100 000 population, which was a significant increase compared to the previous three years, but lower than 2019, when it was 9 cases per 100 000 population.
- Adolescents between 10 and 14 years and infants below the age of one year were the most affected age group, with notification rates of 34.1 and 33.4 per 100 000 population. Individuals aged ≥ 15 years accounted for 52% 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 the prevention of severe disease and deaths among infants younger than six months old through well-adapted and implemented vaccination programmes. As of May 2025, 25 countries have implemented maternal immunisation programmes, while booster vaccination for adolescents (10 to 19 years) have been implemented in 24 countries, and in 13 countries for adults (18 years and above).

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 10 days after infection, but can 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 pertussis might be more difficult to diagnose in these groups as well as in very young infants.

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Methods

This report is based on data for 2024 retrieved from EpiPulse Cases on 12 March 2025. EpiPulse Cases is a system for the collection, analysis and dissemination of data on communicable diseases that has replaced The European Surveillance System (TESSy) in October 2024.

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 2023, 29 European Union/European Economic Area (EU/EEA) countries reported data on pertussis to EpiPulse Cases. 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]; only pertussis data due to *Bordetella pertussis* are reportable according to the EU case definition. Belgium and Bulgaria reported aggregate data in 2023. 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) the cases below the age of one year identified through the ECDC study PERTINENT (Pertussis in Infants in Europe) were reported to ECDC as part of the annual data collection and are included in ECDC's outputs. Germany reported data on pertussis for the first time in 2014, after nationwide reporting became mandatory in March 2013.

Epidemiology

Geographic distribution

For 2023, 29 EU/EEA countries reported 26 033 pertussis cases, of which 93% were classified as confirmed, 3% as probable and 4% as possible. Four countries (Denmark, Croatia, the Netherlands, and Austria) accounted for 64% of all reported cases, with the highest number of cases reported by Denmark (29%) and Croatia (23%) (Table 1). In Denmark, all of cases reported were confirmed cases while in Croatia 94%, in the Netherlands 98% and in Austria 95%. The EU/EEA notification rate was 6.7 per 100 000 population, which was substantially increased from < 1 per 100 000 population 2021 and 2022. It was the second highest reported in the past five years which was highest in 2019 (9.0 per 100 000 population). Notably, notification rates increased in all reported countries compared to previous year except in Bulgaria, Hungary, and Iceland, where the notification rates remained the same. The largest increases were observed in Croatia (from 0.0 to 124.8), Denmark (from 0.9 to 102.1), Austria (from 1.8 to 30.7), Norway (from 0.8 to 21.9) and the Netherlands (from 1.6 to 16.5) per 100 000 population, with Croatia having been the only country with zero reported cases in 2022 (Figure 1).

Among the 27 countries that reported case-based data, 17 had a higher proportion of cases in people younger than 18 years old than aged 18 years and above. On the other hand, higher proportions of cases among people aged 18 years and above were reported in eight countries: Czechia (62%), Germany (68%), Greece (78%), Latvia (64%), Malta (100%, total cases: 4), Norway (53%), Slovakia (77%), and Sweden (56%).

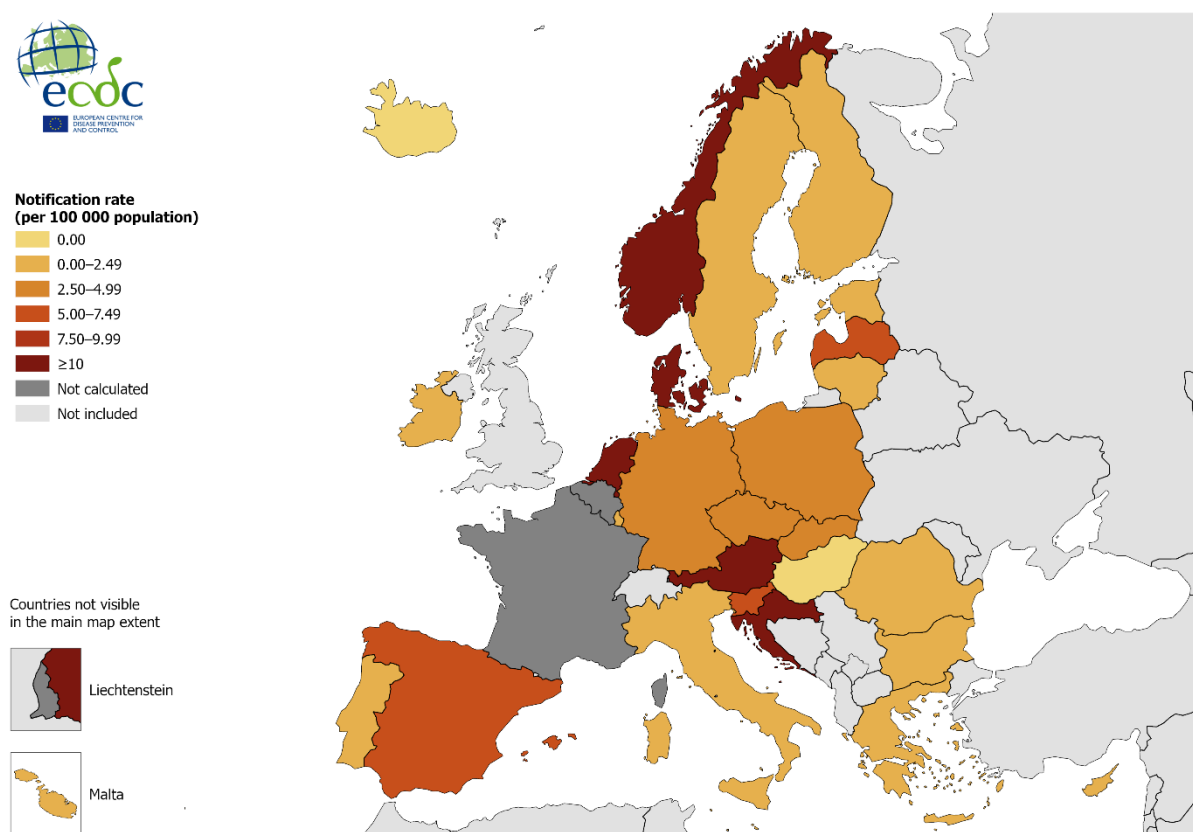
Table 1. Pertussis cases and rates per 100 000 population by country and year, EU/EEA, 2019–2023

Country	2019		2020		2021		2022		2023		
	Number	Rate	Number	Rate	Number	Rate	Number	Rate	Number	Rate	ASR
Austria	2 233	25.2	632	7.1	129	1.4	164	1.8	2 791	30.7	33.4
Belgium	690	NRC	124	NRC	16	NRC	80	NRC	1 046	NRC	NRC
Bulgaria	72	1.1	27	0.4	3	0.0	21	0.3	20	0.3	0.4
Croatia	57	1.4	10	0.3	7	0.2	0	0.0	4 806	124.8	144.6
Cyprus	2	0.2	8	0.9	2	0.2	0	0.0	2	0.2	0.2
Czechia	1 347	12.6	696	6.5	51	0.5	96	0.9	494	4.6	4.7
Denmark	3 691	63.6	2 390	41.0	80	1.4	54	0.9	6 058	102.1	104.6
Estonia	135	10.2	44	3.3	13	1.0	8	0.6	30	2.2	2.3
Finland	557	10.1	290	5.2	33	0.6	35	0.6	130	2.3	2.5
France	36	NRC	34	NRC	0	NRC	4	NRC	41	NRC	NRC
Germany	9 485	11.4	3 212	3.9	776	0.9	1 191	1.4	2 318	2.7	2.8
Greece	20	0.2	8	0.1	0	0.0	1	0.0	9	0.1	0.1
Hungary	7	0.1	13	0.1	0	0.0	2	0.0	2	0.0	0.0
Iceland	6	1.7	0	0.0	0	0.0	0	0.0	0	0.0	0.0
Ireland	164	3.3	66	1.3	5	0.1	7	0.1	18	0.3	0.3
Italy	755	1.3	189	0.3	5	0.0	62	0.1	132	0.2	0.3
Latvia	719	37.4	340	17.8	9	0.5	46	2.5	111	5.9	6.0
Liechtenstein	NDR	NRC	NDR	NRC	NDR	NRC	NDR	NRC	NDR	NRC	NRC
Lithuania	26	0.9	68	2.4	0	0.0	2	0.1	7	0.2	0.3
Luxembourg	10	1.6	3	0.5	3	0.5	3	0.5	15	2.3	2.4
Malta	15	3.0	10	1.9	0	0.0	0	0.0	4	0.7	0.7
Netherlands	5 885	34.1	1 124	6.5	153	0.9	276	1.6	2 943	16.5	17.2
Norway	2 536	47.6	812	15.1	38	0.7	44	0.8	1 201	21.9	22.1
Poland	1 629	4.3	753	2.0	182	0.5	371	1.0	922	2.5	2.6
Portugal	83	0.8	33	0.3	3	0.0	9	0.1	21	0.2	0.2
Romania	110	0.6	18	0.1	1	0.0	9	0.0	16	0.1	0.1
Slovakia	702	12.9	700	12.8	92	1.7	109	2.0	221	4.1	4.0
Slovenia	129	6.2	42	2.0	6	0.3	51	2.4	123	5.8	6.6
Spain	2 585	5.5	206	0.4	39	0.1	72	0.2	2 414	5.0	5.7
Sweden	782	7.6	269	2.6	11	0.1	13	0.1	138	1.3	1.3
EU/EEA (30 countries)	34 468	9.0	12 121	3.2	1 657	0.4	2 730	0.7	26 033	6.7	7.1
United Kingdom	3 680	5.5	NDR	NRC	NA	NA	NA	NA	NA	NA	NA
EU/EEA (31 countries)	38 148	8.5	12 121	3.2	NA	NA	NA	NA	NA	NA	NA

Source: country reports; ASR: age-standardised rate; NDR: no data reported; NRC: no rate calculated; NA: not applicable.

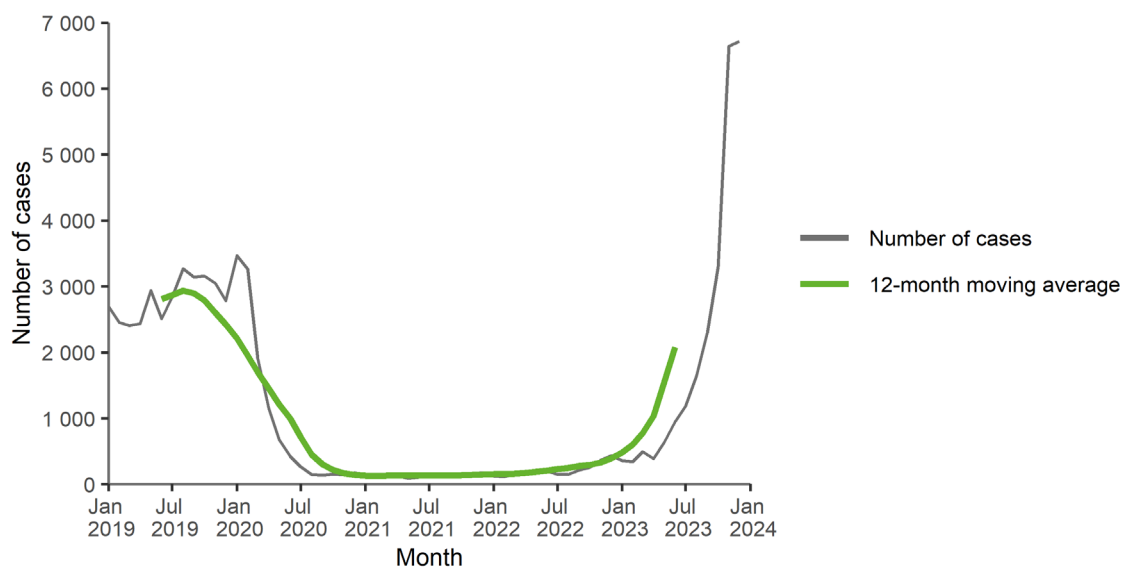
No data from 2020 onwards were reported by the United Kingdom, due to its withdrawal from the EU on 31 January 2020.

Notification rates for Belgium and France are not calculated, as these countries have surveillance systems that are voluntary and sentinel, respectively.

Figure 1. Pertussis cases per 100 000 population by country, EU/EEA, 2023

Seasonality and trend

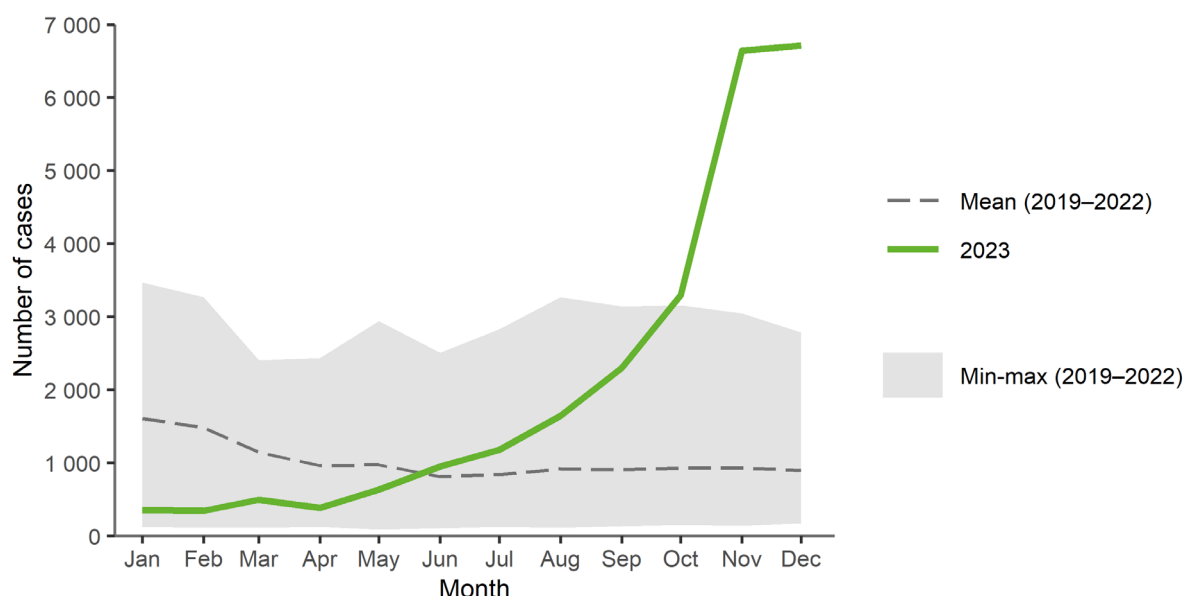
In the five-year period between 2019 and 2023, there was a spike in spring 2020, and then numbers drastically decreased to a very low level until the end of 2022 (Figure 2).

Figure 2. Pertussis cases by month, EU/EEA, 2019–2023

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

In 2023, the number of cases remained low until April and increased dramatically from May onwards, peaking in November and December (Figure 3).

Figure 3. Pertussis cases by month, EU/EEA, 2023 and 2019–2022



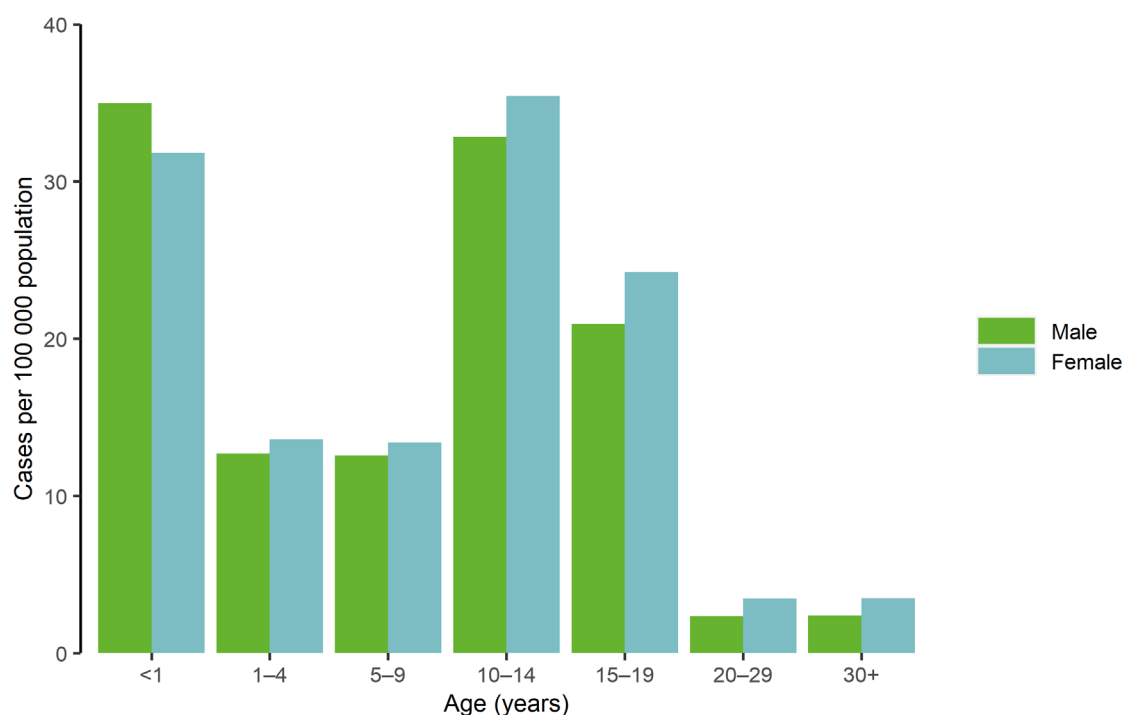
Source: Country reports from Austria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

Age and gender distribution

Information on age was available for all reported cases and 52% of these cases were above the age of 14 years, including 31% aged 30 years and above, and 21% in the age group 15 to 29 years.

The highest notification rate was observed among 10–14-year-olds (34.1 cases per 100 000 population) followed by infants below one year old (33.4 cases per 100 000 population) (Figure 4). This was the first time since 2010 that an age group other than infants below one year old had the highest incidence, albeit the difference was small. Infants below one year old constituted 4.4% of all cases reported; among those with known month of age (92.5%), 68.3% were $\leq$ six months old and 43.7% were $\leq$ three months old.

Males were overrepresented in infants under one year old, while females were more affected in all older age groups. Overall notification rates were 7.1 cases per 100 000 population for females and 6.2 cases per 100 000 population in males, with a male-to-female ratio of 0.9:1.

Figure 4. Pertussis cases per 100 000 population, by age and gender, EU/EEA, 2023

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

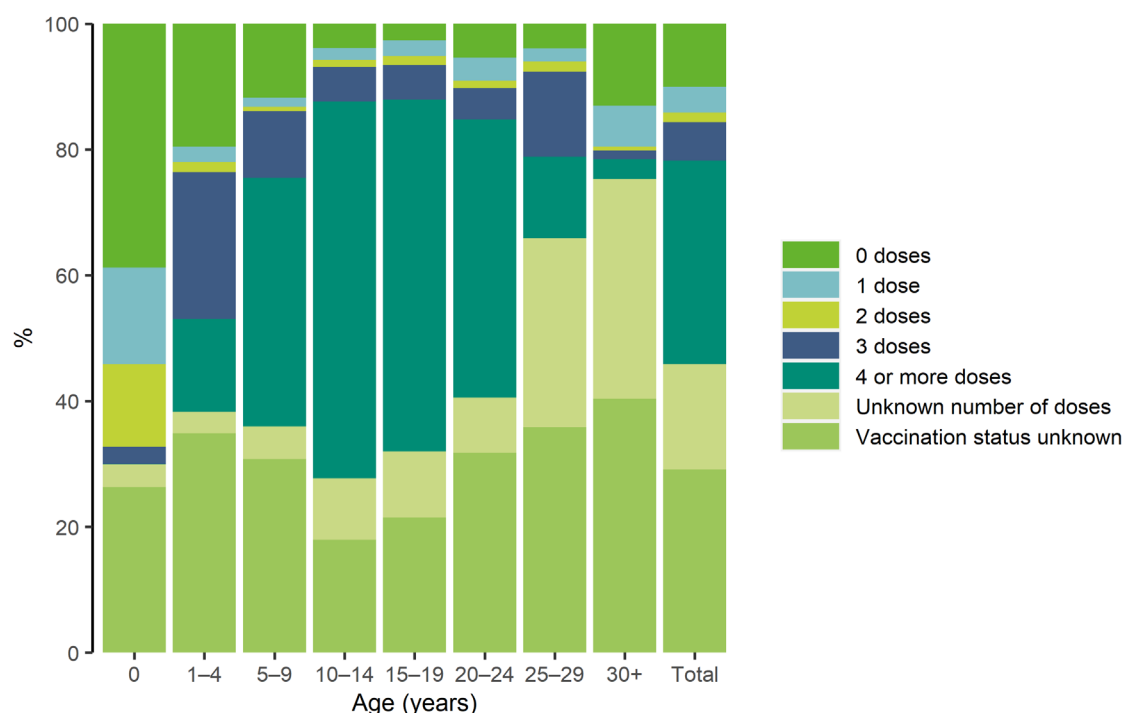
Vaccination status

Vaccination status (reported through both case-based and aggregate datasets) was known for 18 457 cases with age (Figure 5). Of these cases, 2621 (14%) were unvaccinated, 1 456 (8%) were vaccinated with one or two doses, 1 599 (9%) with three doses, and 8 412 (46%) with four or more doses. A total of 4 369 cases (24%) were vaccinated, but the number of doses was unknown. Among all 1 147 infants below the age of one year, 302 (26%) had an unknown vaccination status and 41 (4%) were vaccinated with an unknown number of doses.

The proportion of unvaccinated cases was highest among infants below one year of age (38%) and among children one to four years (19%). The highest proportion of individuals vaccinated with four or more doses was (59%) in the age group of 10- to 14-year-olds, followed by 15- to 19-year-olds, where it was 55%.

Vaccination coverage estimates for the third dose of diphtheria, tetanus toxoid and pertussis-containing vaccine (DTP3) among one-year-olds were available from WHO (WUENIC estimates). In 2023, the weighted average vaccination coverage for the EU/EEA was 92.8% (range: 79–99%). Three countries (Hungary, Luxembourg, and Portugal) reported an estimated 99% DTP3 coverage. As incidence of pertussis is returning to pre-pandemic levels, a comparison of vaccination coverage before (2019) and after (2023) the pandemic was conducted. It showed that only two countries (Belgium and France) reported an increase (1%), while seven countries (Denmark, Finland, Hungary, Luxembourg, Malta, Poland, and Portugal) had the same estimates as in 2019. The remaining countries reported lower coverage compared to 2019, ranging from 1% to 10% reduction. Nevertheless, overall coverage remains high in the EU/EEA (Table 2).

Figure 5. Percentage of confirmed, probable and possible pertussis cases by vaccination status and age group, EU/EEA, 2023



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

Hospitalisation status and outcome

Of 12 053 cases reported with case-based information and known hospitalisation status, 1 190 (10%) were hospitalised; 397 (33%) of them were aged under one year, 364 (31%) were aged 30 years or above, and 210 (18%) were between one and four years.

Outcomes were known for 23 196 (89%) of all reported cases, including 10 deaths, five in the under one year age group and five in individuals over 75 years. Deaths were reported in Austria (two cases: 79 and 83 years), Czechia (one case: 76 years), Denmark (one case: under one year), Spain (three cases: two under one year and one 82 years), France (one case: under one year), Luxembourg (one case: 86 years), and the Netherlands (one case: under one year).

Among the 1 150 infants aged below one year, 1 005 (87%) had a known outcome and 728 (63%) had a known hospitalisation status. Among those with known hospitalisation status, 397 (55%) were hospitalised.

Laboratory confirmation

Of the 18 714 laboratory-confirmed cases with case-based information, 12 470 (67%) were confirmed by PCR, 130 (0.7%) by culture, 6 111 (33%) by serology, and 2 (0.01%) by oral fluid IgG. In one case, both PCR and serology were used for confirmation. Laboratory confirmation methods were not available for 7 330 (28%) of all cases: 38% in the 10–14 years group, 20% in the 15–19 years group and 16% in adults aged 30 years and above.

The proportion of laboratory-confirmed cases was 100% in Belgium, Bulgaria, Cyprus, Denmark, Finland, France, Hungary, and Romania.

Table 2. Diphtheria tetanus toxoid and pertussis-containing vaccine (DTP3) immunisation coverage among one-year-olds (%) (WUENIC), EU/EEA, 2019–2023

Country	2019	2020	2021	2022	2023	% change ^a (2019–2023)
Austria	88	85	86	84	87	-1%
Belgium	97	98	98	98	98	1%
Bulgaria	93	91	89	91	92	-1%
Croatia	94	94	92	92	93	-1%
Cyprus	96	96	96	96	95	-1%
Czechia	97	97	94	94	90	-7%
Denmark	97	97	97	97	97	0%
Estonia	91	91	90	87	84	-8%
Finland	91	89	89	91	91	0%
France	95	96	96	96	96	1%
Germany	91	91	91	89	89	-2%
Greece	99	99	99	98	95	-4%
Hungary	99	99	99	99	99	0%
Iceland	93	93	92	92	92	-1%
Ireland	93	94	94	93	93	-1%
Italy	96	94	94	95	95	-1%
Latvia	99	99	94	95	98	-1%
Liechtenstein	NDR	NDR	NDR	NDR	NDR	NRC
Lithuania	92	91	90	90	90	-2%
Luxembourg	99	99	99	99	99	0%
Malta	98	98	99	98	98	0%
The Netherlands	94	94	95	93	92	-2%
Norway	97	97	97	97	96	-1%
Poland	95	94	94	94	95	0%
Portugal	99	99	99	99	99	0%
Romania	88	87	86	85	79	-10%
Slovakia	97	97	97	97	96	-1%
Slovenia	95	95	86	89	89	-6%
Spain	95	94	93	95	93	-2%
Sweden	98	97	98	94	94	-4%
EU/EEA average^b	94.3	93.9	93.6	93.4	92.8	NRC

Source: WHO Immunization Data Portal, WHO and UNICEF Estimates of National Immunization Coverage (WUENIC).

NDR: no data reported; NRC: no rate calculated.

^a The percentage of change was calculated for each dose as the percentage of increase or decrease between 2019 and 2023, i.e. $((\text{coverage in 2023} - \text{coverage in 2019}) / \text{coverage in 2019}) \times 100$.

Colour code: Red indicates a decrease, green indicates an increase, and black indicates no change in %.

^b EU/EEA: population weighted average vaccination coverage rate.

Discussion

The overall notification rate of pertussis disease in the EU/EEA increased strikingly in 2023, and it was the second highest in the last five years, after 2019. This resurgence was possibly due to the removal of measures against SARS-CoV-2 after the pandemic and a low level of community immunity that resulted from the reduced circulation of pertussis in the EU/EEA in recent years. The resurgence of 2023, followed by a continued resurgence in 2024, has been described in an ECDC risk assessment [5].

Pertussis disease usually observes epidemic cycles occurring every three to five years in addition to a seasonal pattern, with most cases occurring in spring and summer [6,7]. The epidemic of pertussis that occurred in many EU/EEA countries between 2012 and 2019 had shown high levels fluctuation between about eight to nine cases per 100 000 population, peaking in 2016 with 11 cases per 100 000 population. In 2023, the overall notification rate markedly increased compared to 2022 and 2021, but it did not reach the pre-pandemic level of 2019.

In 2023, individuals 10–14 years and infants under one year are the highest groups with notification rates (34.1 cases per 100 000) and (33.4 cases per 100 000) respectively followed by individuals 15–19 years age group with (22.5 cases per 100 000). Individuals above the age of 15 years accounted for a high proportion of cases in 2021 (77%) and 2022 (70%) but this decreased to (52%) in 2023 while adolescents aged between 10 to 19 years accounted for 43% of cases. Compared to the previous two years, some epidemiological characteristics of the disease slightly differed in 2023. In 2021 and 2022, highest notification rates were observed in youngest age groups less than one year and 1 to 4 years.

In 2023, 59% of cases aged 10 to 14 years and 55% of cases aged 15 to 19 years had been vaccinated with four or more doses, while 38% of cases aged under one year, 19% aged 1 to 4 years, and 13% over 29 years were unvaccinated. Unvaccinated individuals can be 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 resurgence of pertussis especially in infants and young adolescents (10 to 14 years) is a signal of the need to continue to reach and sustain high vaccination coverage and strengthen vaccination programmes including with maternal immunisation.

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. The majority of the countries with the highest notification rates were those in which adolescents (aged 10 to 14 and 15 to 19 years) and adults (30 years and above) accounted for largest proportion of laboratory-confirmed cases.

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, Sweden, and Norway [8].

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 [8].

As of May 2025, booster vaccination for adolescents (10- to 19-year-olds) is implemented in 24 EU/EEA countries, and for adults (18 years and above) in 13 EU/EEA countries [8]. At the EU/EEA level, the weighted average vaccination coverage for the third dose of the pertussis-containing vaccine remained high, with 92.8% in 2023. It was a slight decrease compared to 2022 (93.4%) but remained higher than the global average (84%) [9,10]. On the other hand, vaccination coverage for the maternal programme in reference to 2023 shows wide variation among countries (range: 2–89%, median: 50%) [5]. 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 five to 10 years following its administration, being less able to prevent nasopharyngeal colonisation of *Bordetella pertussis* than the whole-cell vaccine or a natural infection [11,12].

The 2023 data show that there is room for further improvement on data completeness of vaccination status, as ~29% cases were reported with an unknown vaccination status, which was highest among adults aged 30 and above (40%) and lowest among the 10 to 14 years age group (17%). In addition, 26% of cases among infants had an unknown vaccination status. Data on vaccination status of infants would be complemented with the information on vaccination status of the mother during pregnancy. As of 2024, ECDC has collected information on the vaccination status of mother during pregnancy for cases < 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. Moreover, there is a need for increasing awareness of pertussis and strengthening vaccination efforts among elderly age groups, who have a higher risk of severe disease [13,14].

The number of reported pertussis cases in 2023 was below the average of 2012–2019. More than 32 000 cases were reported between January and March 2024, similar to the total reported for the whole of 2023 [5].

Public health implications

Significant challenges to control pertussis in Europe remain. The life course approach for pertussis vaccination and a high vaccination coverage at national and subnational level is needed to ensure indirect and direct protection of infants and young children, the two groups which tend to show the most severe symptoms. Protection of infants who are too young to be vaccinated contributes to lower the overall morbidity and mortality of vaccine-preventable diseases [15].

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

The rise of pertussis indicates that the burden of the disease in Europe is still considerably underestimated and needs sustained attention and further actions in surveillance, vaccination, early diagnosis and treatment. Typical signs and symptoms of pertussis tend to be less specific among those who have been vaccinated, and clinicians' decisions are crucial for early diagnosis of pertussis infection. In addition, the current increase in pertussis cases in Europe raises another concern, antibiotic resistance which is a known public health problem [16] and supports enhancing surveillance systems in the EU/EEA [17]. Higher quality pertussis surveillance, associated with increased awareness as well as improved access to appropriate laboratory diagnosis, could contribute to a more accurate picture of the epidemiology of pertussis and support policy decisions to optimise the impact of vaccination.

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