



## Perspective

## Recent increase in infant pertussis cases in Europe and the critical importance of antenatal immunizations: We must do better...now



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## ABSTRACT

Recent months have seen an increase in pertussis cases in several countries across the Northern and Southern hemispheres. The lack of immune stimulation during the COVID-19 pandemic due to the reduced circulation of *Bordetella pertussis*, the pathogen responsible for pertussis, is likely to have led to increased population susceptibility which has been magnified the typical three to five yearly cyclical peaks in activity. Maternal immunization for pertussis proves highly effective in protecting infants under three months of age. It's also critical for immunizers and parents to maintain high and timely immunization uptake to ensure infants receive maximum early protection when they are most at risk of severe disease.

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## Introduction

Pertussis is a highly contagious respiratory infection that is easily spread through droplets via coughing or sneezing [1]. It poses a significant risk to neonates and young infants, and, in the absence of vaccination, may lead to severe illness and even death.

Symptoms onset is 7-10 days after infection but may manifest up to 21 days later. The illness can initially resemble a common cold, with symptoms of sneezing, runny nose, low-grade fever, and a mild cough. This may then progress to persistent cough with a characteristic whooping sound that gave pertussis its common name, whooping cough, as the patient breathes through a swollen glottis. During coughing episodes, the patient may turn blue and vomit, with several coughing fits occurring in quick succession and causing exhaustion. These coughing fits can be triggered by eating, laughing, or crying and are usually worse at night. Pertussis is feared for its potential to cause permanent disability or death

due to complications, including neurological and pulmonary. Infants under six weeks with pulmonary hypertension are at the highest risk of death.

Infected individuals are most contagious during the first three weeks of coughing, although coughing spells can last for several months ("100-day cough"). Treatment involves antibiotics to manage the infection and prevent further spread of the bacteria which, to be most effective, must begin early in the course of disease, ideally during the first one to two weeks before the episodes of rapid coughing occur [2].

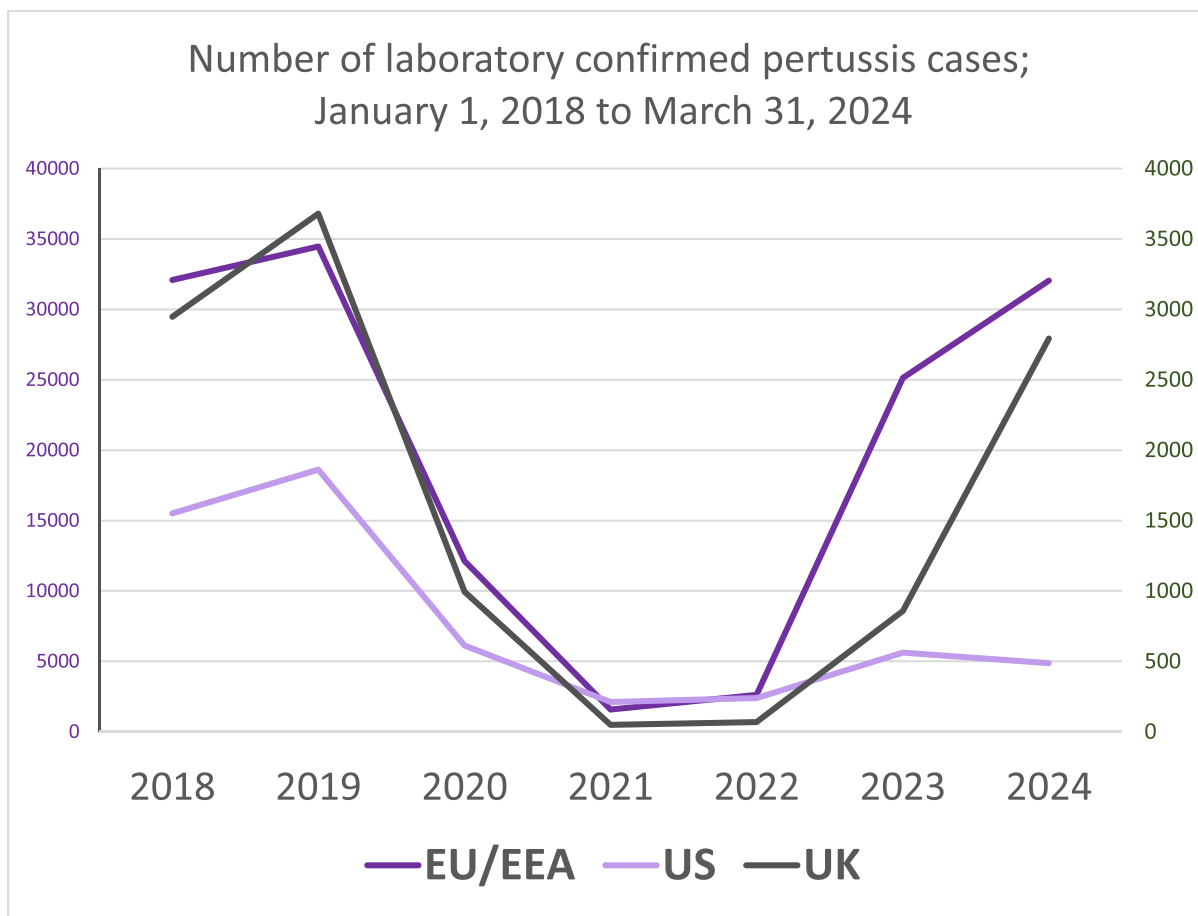
There are no pertussis vaccines licensed or recommended for newborns at birth. To protect young infants, maternal pertussis antibodies are transferred transplacentally [3,4]. The best prevention methods include vaccinating mothers during pregnancy, ensuring people around the infant are up to date with their pertussis vaccines, and administering the childhood pertussis vaccine series on time [3,4].

## Pertussis resurgence after COVID-19

Measures implemented to control the spread of COVID-19 between March 2020 and July 2021 also affected the transmission of other infectious diseases, including *Bordetella pertussis*, the

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**Figure 1.** Laboratory confirmed cases of pertussis in England, US, and EU/EEA: January 2018 to March 2024 (2023, 2024 provisional data). Sources: Pertussis epidemiology in England 2024–GOV.UK ([www.gov.uk](http://www.gov.uk)) and ECDC Surveillance Atlas of infectious diseases EU/EEA (ECDC) and Pertussis cases by year—CDC.

pathogen responsible for pertussis. The increase in population susceptibility as a result of reduced transmission of *B. pertussis*, commonly termed immunity debt, has been proposed as a potential reason for the current resurgence of pertussis after the removal of all COVID-19 mitigation measures [5].

In 2019, the World Health Organization reported a prepandemic pertussis incidence rate of 29.8 per million [6]. These rates significantly dropped during the pandemic, falling to 9.2 in 2020 and 4.6 in 2021, before rising to 10 in 2022 and 22.8 in 2023 [6]. In Europe, pertussis cases surged, with over 25,000 cases reported in 2023 and already more than 32,000 between January and March 2024 [7]. Such high annual numbers were reported in the previous peak years of 2016 (41,026) and 2019, highlighting the typical cyclical nature of pertussis (34,468) [7] (Figure 1).

Between 2011 and 2022, a total of 103 deaths were reported, with 69 (67%) fatalities in infants and 25 (24%) in adults aged 60 and older, in the EU/EEA. Notably, 64 infant deaths occurred in <6-month-olds, with most deaths occurring in one-month-old infants [7]. From January 2023 to April 2024, there have already been 19 deaths: 11 (58%) in infants and eight (42%) in older adults. In Finland, the diphtheria-tetanus-pertussis vaccine is also recommended, preferably in late pregnancy [26]. In Norway, new policy changes have been recently implemented, such as offering the pertussis vaccine to pregnant women during the 24-week prenatal check-up starting in May 2024 [27]. Similarly, in Bulgaria, free immunization of pregnant women against pertussis between the 27th and 36th gestational week of pregnancy has been recently ap-

proved [28], and the Slovak Republic has also recommended pertussis vaccination for pregnant women [29]. Table 1 lists the vaccination coverage (%) in EU/EEA countries, Serbia and the UK, from 2018 to 2023.

In Europe, **Denmark** initially reported a resurgence of pertussis cases in May and June 2023, sadly with the death of a prematurely born infant at two months of age [8]. In **England**, on a background of a small and gradual decline in childhood vaccine uptake over the past decade alongside falls in maternal vaccine uptake and additional short-term declines in vaccination rates during the COVID-19 pandemic [9], the UK Health Security Agency (UKHSA) reported that there were 4793 new pertussis cases diagnosed in England during January and April 2024 [10] (Figure 1). This is notably higher than 858 total cases reported in the entirety of 2023 and marks the re-emergence of pertussis after a prolonged period which included historically low levels instigated by COVID-19 control measures [10].

According to the UKHSA, eight infants in England died after developing whooping cough during the first four months of 2024 [10,11]. The first infant death since 2019 was reported in the last quarter of 2023 in England. Additionally, the **Netherlands** has also reported 4 infant deaths within a six-week period in 2024 [12]. In **Northern Ireland**, there were 72 confirmed cases of pertussis by March 11, 2024, 527 cases by April 21, 2024, and 1425 cases by May 26, 2024, compared with only two cases between 2021 and 2023, with the Public Health Agency urging pregnant women and parents of young children to get vaccinated to help curb the cur-

**Table 1**  
DTP vaccination coverage (%) in EU/EEA countries, Serbia and the UK, from 2018 to 2023.

May 2024, Diphtheria tetanus toxoid and pertussis (DTP) vaccination coverage (%) in EU/EEA, UK and Serbia														
	Data Source	DTP1						DTP3						
		2023	2022	2021	2020	2019	2018	2023	2022	2021	2020	2019	2018	
Austria	ADMIN													
	OFFICIAL		90.84	95.83	95		90.3		83.5	86.36	84.61			84.9
Belgium	ADMIN		91	96	95	93	90		84	86	85	85	85	
	OFFICIAL	98.4	98.4	98.4	98.5	98.5	99.1	97.5	97.5	97.5	97.3	97.3	97.8	97.8
Bulgaria	ADMIN	95.02	93.93	92.37	94.26	95.6	94.5	92.39	91.37	89.48	91.24	92.8	91.5	
	OFFICIAL	95.02	93.93	92.37	94.26	95.6	94.5	92.39	91.37	89.48	91.24	92.8	91.5	
Croatia	ADMIN													
	OFFICIAL													
Cyprus	ADMIN	100												
	OFFICIAL	100	98.43	99.7	99.7	99.7	99.8	95	78.39	95.9	95.9	95.9	98.6	98.6
Czechia	ADMIN	96.26												
	OFFICIAL	96.26												
Denmark	ADMIN	97.12	96.8	97.22	96.52	97	97							
	OFFICIAL	97.72	97.6	97.8	97.1	97	97.2	96.34	95.76	95.83	96.04	96	96	96
Estonia	ADMIN	73.04	85.52	91.18	92.26	92.5	93.3							
	OFFICIAL	73.4	85.5	91.18	92.26	92.5	93.3	72	85	89.51	91	91.4	91.9	91.9
Finland	ADMIN	98												
	OFFICIAL	97	97	98		98	98.6	92	91	89		91	91	91
France	ADMIN	98.8	98.8	99.2										
	OFFICIAL	98.8	98.8	99.2				96.3	96.4	96.4			96.3	96.3
Germany	ADMIN			98.05	98.49	98.5	98.5							
	OFFICIAL			98.05	98.49	98.5	98.5							
Greece	ADMIN	100	100	100	100	100	100							
	OFFICIAL													
Hungary	ADMIN	99.95	99.96	99.97	99.96	99.9	99.9							
	OFFICIAL	99.95	99.96	99.97	99.96	99.9	99.9	99.89	99.86	99.85	99.88	99.9	99.9	99.9
Iceland	ADMIN	95.45	95.4	96.66	95.64	94.8	97							
	OFFICIAL	95.45	95.4	96.66	95.64	94.8	97	92.43	92.16	91.99	93.36	92.55	91	91
Ireland	ADMIN													
	OFFICIAL													
Italy	ADMIN				93.65	94.99	95							
	OFFICIAL				93.65	94.99	95							
Latvia	ADMIN	97.88	99.83	95.93	99.36	98.81	97							
	OFFICIAL	97.88	99.83	95.93	99.36	98.81	97	98.14	95.2	94.41	100.24	99.99	96	96
Lithuania	ADMIN	93.23	93.2	92.94	95.49	95.5	95.3							
	OFFICIAL	93.23	93.2	92.94	95.49	95.5	95.3	90.01	89.98	90.05	91.35	92.1	92.3	92.3
Luxemburg	ADMIN			100	100		99.8							
	OFFICIAL			100	100		99.8							
Malta	ADMIN	99.13	98.62	99.2	98.85	98.33	99							
	OFFICIAL	99.13	98.62	99.2	98.85	98.33	99	98.26	98.42	99.01	98.43	98.16	97	97
Netherlands	ADMIN													
	OFFICIAL													
Norway	ADMIN	98.98	97.9	98.3	98.38	100	100							
	OFFICIAL	98.98	97.9	98.3	98.38	100	100	96.4	96.63	96.81	97.06	97	96	96
Poland	ADMIN			48.8	48.8									
	OFFICIAL			48.8	48.8									
Portugal	ADMIN													
	OFFICIAL													
Romania	ADMIN	64.11	89.3	96.58	67.95	67.87	94.4							
	OFFICIAL	64.11	89.3	96.58	67.95	67.87	94.4	40.44	79.88	94.18	57.13	53.39	93.3	93.3
Serbia	ADMIN													
	OFFICIAL													
Slovakia	ADMIN	96.26	96.51	97										
	OFFICIAL	96.26	96.51	97										
Slovenia	ADMIN													
	OFFICIAL													
Spain	ADMIN	97.32	97.66	95.8	97.53	98.15	98.15							
	OFFICIAL	97.32	97.66	95.8	97.53	98.15	98.15	92.91	93.3	92.4	94.3	94.75	93.4	93.4
Sweden	ADMIN		96.5	98.3	98.2	98.3								
	OFFICIAL	96.3	96.5	98.3	98.2	98.3		96	94.3	97.6	97.3	97.5	97.4	97.4
UK of Great Britain & N. Ireland	ADMIN													
	OFFICIAL													
European Region	ADMIN		97	97	97	97	98							
	OFFICIAL		97	97	97	97	98							
European Region	ADMIN													
	OFFICIAL													

Showing the percentage in the target population who have received one dose (DTP1) or 3 doses (DTP3) of the combined diphtheria, tetanus toxoid and pertussis-containing vaccine in a given year. Countries are instructed to report routine immunization coverage using the administrative method (ADMIN), based on registry data of administered doses; only doses incorporated in the national immunization schedule are included. Immunization coverage figures from the administrative system can be biased or inaccurate. OFFICIAL estimates may be based on administrative data, surveys, or other sources. WHO/UNICEF Estimates of National Immunization Coverage (WUENIC).

Source: WHO.

rent outbreak [13]. In **Wales**, pertussis cases also rose rapidly during the first few weeks of 2024, reaching 135 cases compared with about 200 in the whole of 2023 [14].

In **Spain**, between October 4, 2023 (week 41) and April 11, 2024 (week 15), 11,175 cases of whooping cough and 4 deaths have been reported [15]. Among the deaths were a three-month-old premature infant whose mother had not been vaccinated during pregnancy, and a two-month-old premature infant whose mother was vaccinated five days before delivery [15]. In **Czechia**, which has about one-fifth of Spain's population, a total of 9370 pertussis cases were reported to the State Health Institute from the beginning of the year till April 21, 2024, and 3 deaths, which included a neonate [16]. The number of cases reported in Czechia is the largest in the country's past 60 years. According to Dr Milan Jovanovic Batut Public Health Institute, in **Serbia**, two unvaccinated children aged two and a half months and three months have already died in 2024, increasing the total to 4 deaths since January 2023 [17,18]. An infant too young to have been vaccinated also died of pertussis in **Belgium** in October 2023 [19]. Croatia has also reported 6443 cases of pertussis from January 1 to April 19, 2024 [20].

Pertussis remains endemic worldwide, with peaks in disease occurring every three to five years, even in countries with high vaccination coverage against pertussis. With 15,275 cases reported in January 2024, a 15-fold increase over the same period in 2023, pertussis remains a pressing public health issue in **China** [21]. **Australia** is also facing a pertussis outbreak, with more than 4400 cases reported by the end of April 2024, versus less than 2445 annual cases reported in 2023 [22]. In the **US**, elevated pertussis activity has been observed across multiple areas, according to the National Notifiable Diseases Surveillance System, with a total of 4864 cases reported from January 1 to May 25, 2024. This is 2.8 times higher than the 1746 cases reported during the same period in 2023 [23], although currently cases remain below prepandemic levels (Figure 1).

Neonates and young infants, particularly those too young to have completed their primary vaccination as part of the national childhood immunization program, account for the majority of pertussis-related deaths in the EU/EEA [24]. This emphasizes the importance of maternal vaccination during each pregnancy to protect newborn infants from severe illness and death until they can complete their routine primary immunizations. The UK recommendation states that the optimal window for maternal vaccination is between 20 and 32 weeks of pregnancy. However, receiving the vaccine later (ideally at least two weeks before delivery) will still be beneficial.

### Decline in maternal pertussis vaccination rates

Where recommended, antenatal immunization uptake has been suboptimal overall and particularly in the postpandemic period. Several factors likely contribute to this. Lack of awareness among parents about the risks of pertussis in newborns and the protection from maternal vaccination, and challenges in accessing vaccination, especially following a period of exceptionally low pertussis activity, are crucial issues. Vaccine hesitancy in some countries alongside has also increased questioning of vaccines offered in pregnancy following the pandemic and COVID vaccine programs.

In England, reported uptake of antenatal immunization in England has declined in recent years, with considerable geographical variation in uptake across the country from 74.7% in December 2017 to 59.5% in December 2023, though this marks an improvement from around 58% in September 2023 [25]. The calculated vaccine effectiveness against infant death for those who received the vaccine at least seven days before delivery is 92%, highlighting the critical importance of antenatal pertussis immunization in protect-

ing infants against such a severe and fatal disease are birth (UKHSA unpublished data) [25]. In England, there have been changes in the delivery model, with a shift of antenatal vaccination from primary care to maternity service providers, with the aim of improving access and opportunities for pregnant women to be vaccinated. This, however, has posed challenges in data capture, raising questions about the reliability of data transfer of vaccines administered outside of general practice back to the GP record, which is used to monitor national coverage of the program.

A decline in antenatal and infant immunization uptake is not unique to England. The current state of antenatal immunization against pertussis in Europe is focused on protecting neonates and young infants through transfer of vaccine-induced antibodies from the mother to the fetus during pregnancy. The ECDC reports that 24 EU/EEA countries recommend pertussis vaccination for pregnant women to provide immunity to newborns [7]. All EU/EEA countries, apart from Bulgaria, Estonia, Finland, Malta, and Slovakia have a recommendation in place for a booster dose of an acellular pertussis-containing vaccine with reduced antigen content during pregnancy. The recommendation is government-funded in all countries and was also introduced temporarily in Croatia and Hungary, respectively, in areas and during periods of high incidence.

In Finland, the diphtheria-tetanus-pertussis vaccine is also recommended, preferably in late pregnancy [26]. In Norway, new policy changes have been recently implemented, such as offering the pertussis vaccine to pregnant women during the 24-week prenatal check-up starting in May 2024 [27]. Similarly, in Bulgaria, free immunization of pregnant women against pertussis between the 27th and 36th gestational week of pregnancy has been recently approved [28], and the Slovak Republic has also recommended pertussis vaccination for pregnant women [29]. However, data on maternal immunization uptake are limited, with only nine countries reporting antenatal immunization uptake rates for 2023, which vary widely from 1.6% to 88.5%. According to national data, maternal vaccination coverage in Belgium varies greatly among regions (85% in Flanders, 49% in Wallonia, 37% in Brussels) [30]. This significant variability highlights the need for better data collection and efforts to increase vaccine uptake among pregnant women to effectively prevent pertussis in the most vulnerable age groups.

### Conclusion

As cases of pertussis and, in particular, severe disease and death due to pertussis in young infants continue to increase in many countries across Europe and elsewhere, clinicians, immunizers, maternity care providers, public health bodies, and policymakers need to work together to improve messaging of the life-saving potential of antenatal vaccinations. They should encourage open and clear discussions to allay any fears and provide reassurance to vaccine-hesitant pregnant women and facilitate access to antenatal vaccines for pregnant women through primary care and maternity services. These measures would ensure women can receive the vaccination at the optimal time to maximize protection for their newborn infants. The effectiveness of maternal immunization against pertussis against infant disease in babies under three months of age is estimated to be around 90% against laboratory-confirmed disease and 97% against death [31].

Parents must continue their vaccination efforts postpartum, ensuring their infants receive timely protection according to their national childhood vaccination schedules, which typically begin at two to three months of age.

### Declarations of competing interest

AK is the Vice President for academia and strategy of the RCOG. All authors declare no competing interests.

## Author contributions

AK and AS conceived the article. All authors reviewed the first draft and contributed to the final draft.

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