



VT#12 October IP GenEpi-BIoTrain

# EU perspective on surveillance of pertussis

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4 November 2024

# Specific objectives of this session

1. Work of ECDC on surveillance of B. pertussis and response to outbreaks
2. Recent epidemiology of B. pertussis in the EU/EEA
3. Overview of vaccination schedules and vaccine coverage in the EU/EEA

# Pertussis (whooping cough)

*Bordetella pertussis*, (*B. parapertussis*, *B. holmseii*)

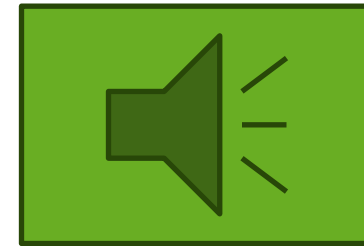
Air borne, highly contagious  
Incubation period 7-10 days

## Clinical symptoms

New-borns: cough, apnoea, cyanosis

Children: violent cough, post-tussive vomiting, spasms, whoop

Adults: mild cough



*Ref: UK Health Security Agency*

## Complications

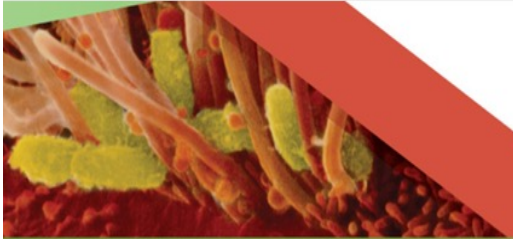

death / intracranial haemorrhage / encephalopathy / pneumonia / urinary incontinence / hernias

## Early treatment

**Prevention through immunisation remains the best defence**

# Outline / work of ECDC

- **Surveillance in EU/EEA**
  - Indicator based surveillance on annual basis
    - Annual epidemiological reports (AER)
    - ATLAS visualisation
  - Event-based surveillance (Epidemic Intelligence)



SURVEILLANCE REPORT

## Pertussis

Annual Epidemiological Report for 2022

### Key facts

- In 2022, 2 623 cases of pertussis were reported by 29 EU/EEA countries.
- Two countries (Germany and Poland) accounted for 60% of all reported cases.
- The notification rate in 2022 was 0.7 cases per 100 000 population, which slightly increased compared with 2021, after a major decrease in cases in 2019 and in 2020 during the COVID-19 pandemic.
- Infants below the age of one year were the most affected age group, with the highest notification rate of 4.0 per 100 000 population, followed by rates in 1–4-year-olds (2.6 per 100 000 population). Individuals ≥ 15 years of age accounted for 70% 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 and ten countries' vaccination programmes include more than one booster – including the pertussis component – in individuals above the age of 18 years.

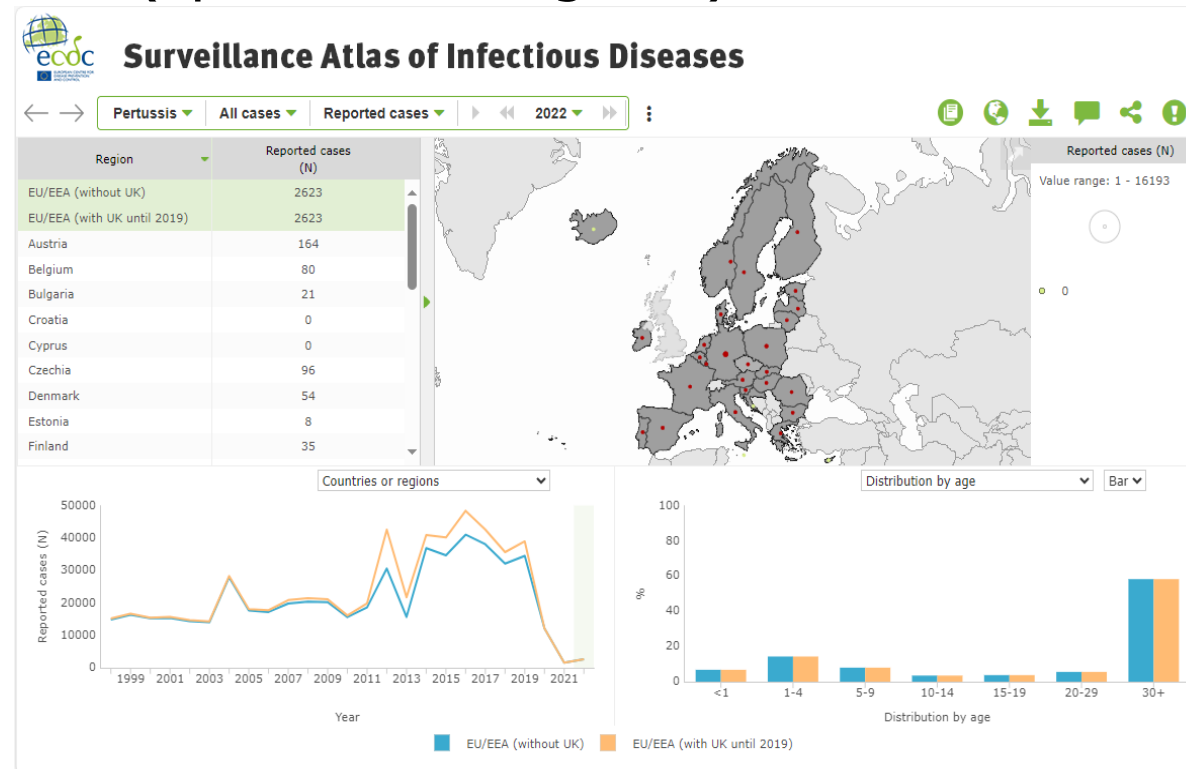
### Introduction

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.

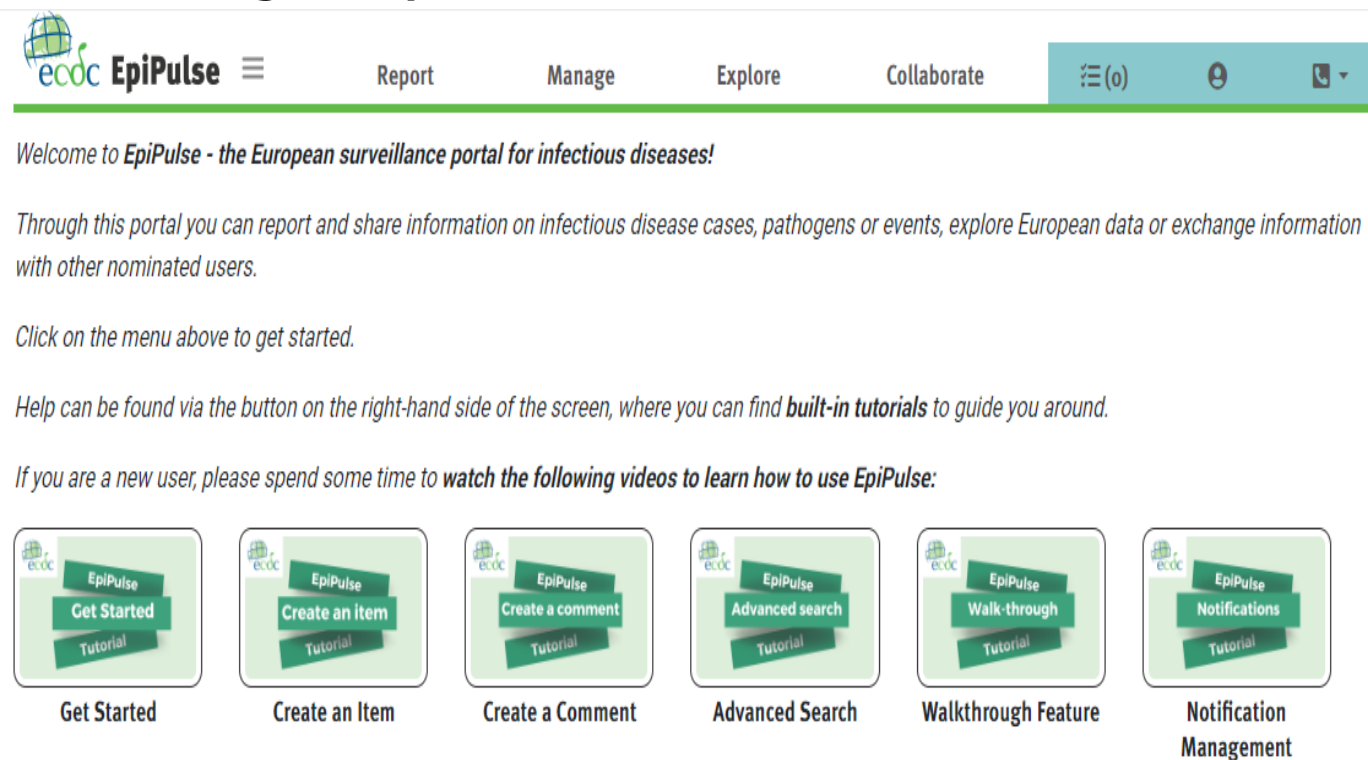
# Outline / work of ECDC

- **Surveillance in EU/EEA**
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# Outline / work of ECDC

- **Surveillance in EU/EEA**
  - Indicator based surveillance on annual basis
    - Annual epidemiological reports (AER)
    - [ATLAS](#) visualisation
  - Event-based surveillance (Epidemic Intelligence)
- **Response activities**
  - [EpiPulse platform](#)
  - RRAs (Rapid Risk Assessments)



The screenshot shows the EpiPulse portal interface. At the top, there is a navigation bar with the EpiPulse logo and menu items: Report, Manage, Explore, Collaborate, and a user profile icon. Below the navigation bar, a welcome message reads: "Welcome to EpiPulse - the European surveillance portal for infectious diseases!". This is followed by a paragraph: "Through this portal you can report and share information on infectious disease cases, pathogens or events, explore European data or exchange information with other nominated users." Below this, it says: "Click on the menu above to get started." and "Help can be found via the button on the right-hand side of the screen, where you can find built-in tutorials to guide you around." At the bottom, there is a section titled "If you are a new user, please spend some time to watch the following videos to learn how to use EpiPulse:" followed by six video thumbnails. Each thumbnail has a title and "Tutorial" written on it. The titles are: "Get Started", "Create an Item", "Create a Comment", "Advanced Search", "Walkthrough Feature", and "Notification Management".

ecdc EpiPulse

Report Manage Explore Collaborate

Welcome to EpiPulse - the European surveillance portal for infectious diseases!

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- Get Started
- Create an Item
- Create a Comment
- Advanced Search
- Walkthrough Feature
- Notification Management

# Outline / work of ECDC

- **Surveillance in EU/EEA**

- Indicator based surveillance on annual basis
  - Annual epidemiological reports (AER)
  - [ATLAS](#) visualisation
- Event-based surveillance (Epidemic Intelligence)

- **Response activities**

- [EpiPulse platform](#)
- RRAs (Rapid Risk Assessments)

- **Pertussis laboratory network**

- European Reference Laboratory Network for Pertussis (ERLNPert-Net)
  - Aim: to improve diagnosis, detection, identification and characterisation of *B. pertussis* in MS and unify surveillance, notification and reporting at European level.
  - EQAs and capacity building in the MS
- EURL- DIPE (launch 2025)

# Outline / work of ECDC

- **Overview of vaccination schedules and policies in EU/EEA**
  - Vaccine scheduler



The screenshot displays the ECDC Vaccine Scheduler web application. At the top left is the ECDC logo. The main heading is "Vaccine Scheduler". Below this is a banner image of a syringe on a grid with the text "Vaccine schedules in all countries in the EU/EEA". The interface is divided into two main sections: "Quick search" and "Advanced search".

**Quick search**

Country: -- Select a country --  
Age group:  Child  Adult  
[View schedule ▶](#)

**Advanced search**

**Immunisation schedules by target disease**

Disease: -- Select a disease --  
In: All EU/EEA countries  
[View schedule ▶](#)

**Compare national immunisation schedules**

Compare: -- Select a country --  
With: -- Select a country --  
Age group:  Child  Adult  
[View schedule ▶](#)

# Outline / work of ECDC



- **Overview of vaccination schedules and policies in EU/EEA**
  - [Vaccine scheduler](#)
- **Special studies**
  - Vaccine Effectiveness studies (infants)
    - Pertinent (Pertussis in Infants European Network)
  - Seroprevalence studies (adults)
- **Other relevant ECDC activities**
  - Scientific advice (incl. NITAGs and EMA liaison)
  - Communications on immunisation: training tools and materials for healthcare professionals to build continued skills and knowledge on vaccination
    - European Virtual Academy, [ECDC Virtual Academy \(europa.eu\)](#)
    - European Vaccination Information Portal (EVIP), [European Vaccination Information Portal / Home page | European Vaccination Information Portal \(vaccination-info.eu\)](#)

# Surveillance of pertussis in EU/EEA

# Surveillance of pertussis in EU/EEA

- **Annual data reporting** to TESSy (*now EpiPulse Cases*)
  - Ongoing data collection up to 2023
  - EU case definition since 2002 (updated 2008, 2012 & 2018 – similar across updates)
  - Only cases due to *B. pertussis* are included
  - 30 MS reporting data
  - Enhanced Variables collected in TESSy
    - Vaccination status
    - Hospitalisation
    - Laboratory method

# 2018 EU case definition of pertussis

## Clinical Criteria

Any person with a cough lasting at least two weeks AND — at least one of the following three:

- **Paroxysms of coughing esp if increases during the night**
- Inspiratory 'whooping'
- Post-tussive vomiting OR
- Any person diagnosed as pertussis by a physician OR
- Apnoeic episodes in infants

## Laboratory Criteria

At least one of the following three:

- Isolation of *Bordetella pertussis* from a clinical specimen
- Detection of *Bordetella pertussis* nucleic acid in a clinical specimen
  - \* **from nasopharyngeal samples**
- *Bordetella pertussis* specific antibody response
  - \***results need to be interpreted according to vaccination status**

## Epidemiological Criteria

An epidemiological link by human to human transmission

# EU case definition of pertussis

## Case Classification

- 1. Possible case** : Any person meeting the clinical criteria
- 2. Probable case** : Any person meeting the clinical criteria with an epidemiological link
- 3. Confirmed case** : Any person meeting the clinical and the laboratory criteria

*COMMISSION IMPLEMENTING DECISION (EU) 2018/945 of 22 June 2018*

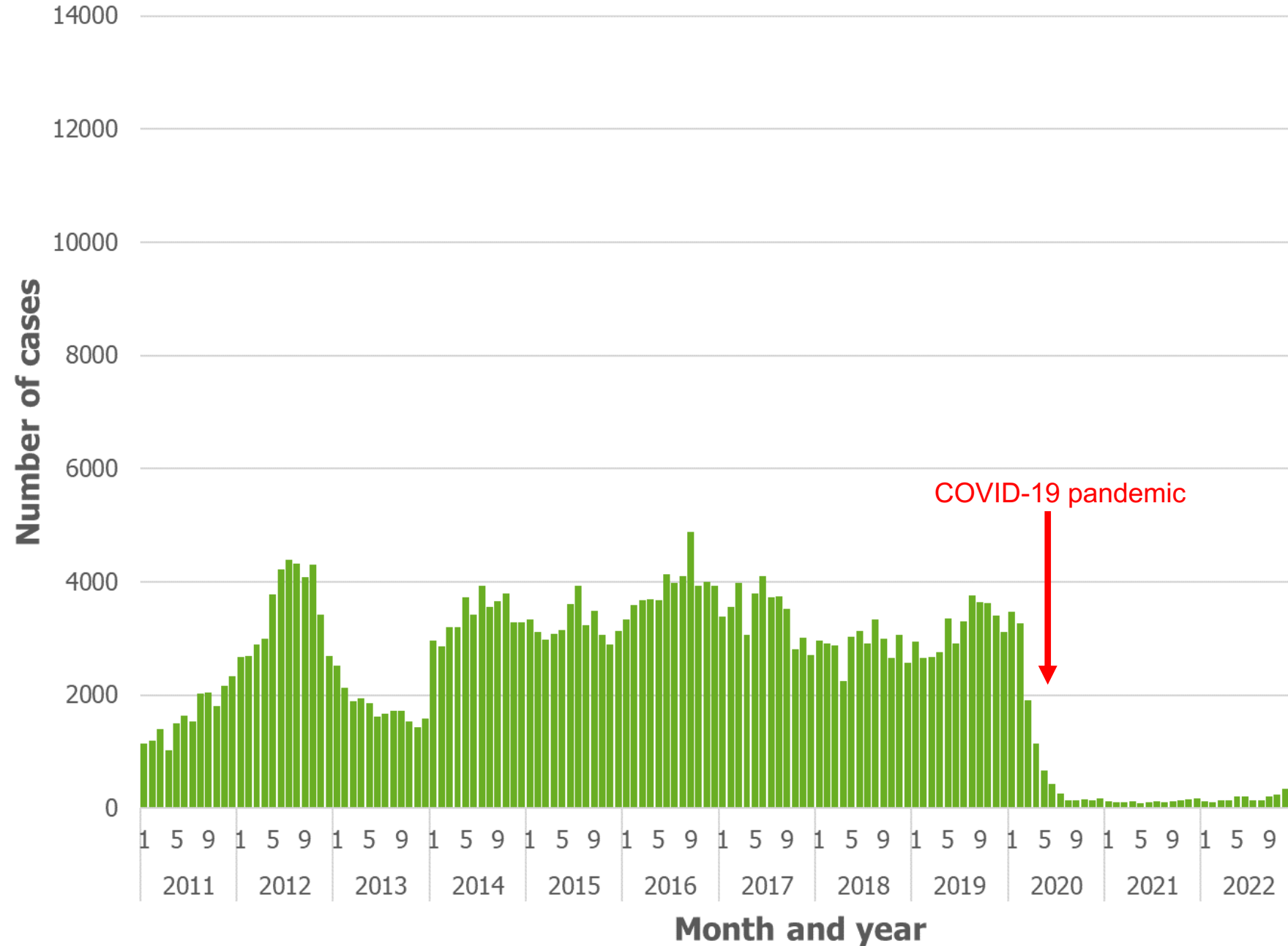
# Surveillance systems across EU/EEA

- Majority report **case-based data**
- 25 **compulsory** reporting, **comprehensive** system, **passive** surveillance
- 2 **compulsory** reporting, **comprehensive** system, **active** surveillance
- 2 **voluntary** reporting, **sentinel** system, **active** surveillance
- Mix of reporting source (laboratories, physicians, hospital, other)
- Mix of case definitions used (EU 2008/2012/2018 or other)

Country	Compulsory (Cp), voluntary (V), other(O)	Comprehensive (Co), sentinel (Se), other(O)	Active (A), passive (P)	Case-based (C), aggregated (A)	Data reported by				Case definition used
					Laboratories	Physicians	Hospitals	Others	
Austria	Cp	Co	P	C	Y	Y	Y	Y	EU-2008
Belgium	V	Se	A	A	Y	N	N	N	Not specified
Bulgaria	Cp	Co	P	C	Y	Y	Y	Y	EU-2018
Croatia	Cp	Co	P	C	Y	Y	Y	Y	EU-2012
Cyprus	Cp	Co	P	C	N	Y	N	N	EU-2008
Czechia	Cp	Co	A	C	Y	Y	Y	N	EU-2008
Denmark	Cp	Co	P	C	Y	N	N	N	EU-2008
Estonia	Cp	Co	P	C	Y	Y	Y	N	EU-2018
Finland	Cp	Co	P	C	Y	N	N	N	EU-2012
France	V	Se	A	C	Y	Y	Y	N	Not specified
Germany	Cp	Co	P	C	Y	Y	Y	Y	Other
Greece	Cp	Co	P	C	Y	Y	Y	.	EU-2018
Hungary	Cp	Co	P	C	Y	Y	Y	N	EU-2012
Iceland	Cp	Co	P	C	Y	Y	.	.	EU-2018
Ireland	Cp	Co	P	C	Y	Y	Y	N	EU-2012
Italy	Cp	Co	P	C	N	Y	Y	N	Other
Latvia	Cp	Co	P	C	Y	Y	Y	N	EU-2018
Lithuania	Cp	Co	P	C	Y	Y	N	N	EU-2018
Luxembourg	Cp	Co	P	C	Y	Y	N	N	EU-2018
Malta	Cp	Co	P	C	Y	Y	Y	Y	EU-2018
Netherlands	Cp	Co	P	A	Y	Y	N	Y	EU-2008
Norway	Cp	Co	P	C	Y	Y	Y	N	EU-2012
Poland	Cp	Co	P	C	Y	Y	Y	N	EU-2008
Portugal	Cp	Co	P	C	N	Y	N	N	EU-2018
Romania	Cp	Co	P	C	N	N	Y	N	EU-2018
Slovakia	Cp	Co	A	C	Y	Y	Y	N	EU-2018
Slovenia	Cp	Co	P	C	Y	Y	Y	N	EU-2008
Spain	Cp	Co	P	C	N	Y	Y	N	EU-2012
Sweden	Cp	Co	P	C	Y	Y	N	N	EU-2012



# Number of pertussis cases, EU/EEA, Jan 2011 to Dec 2022

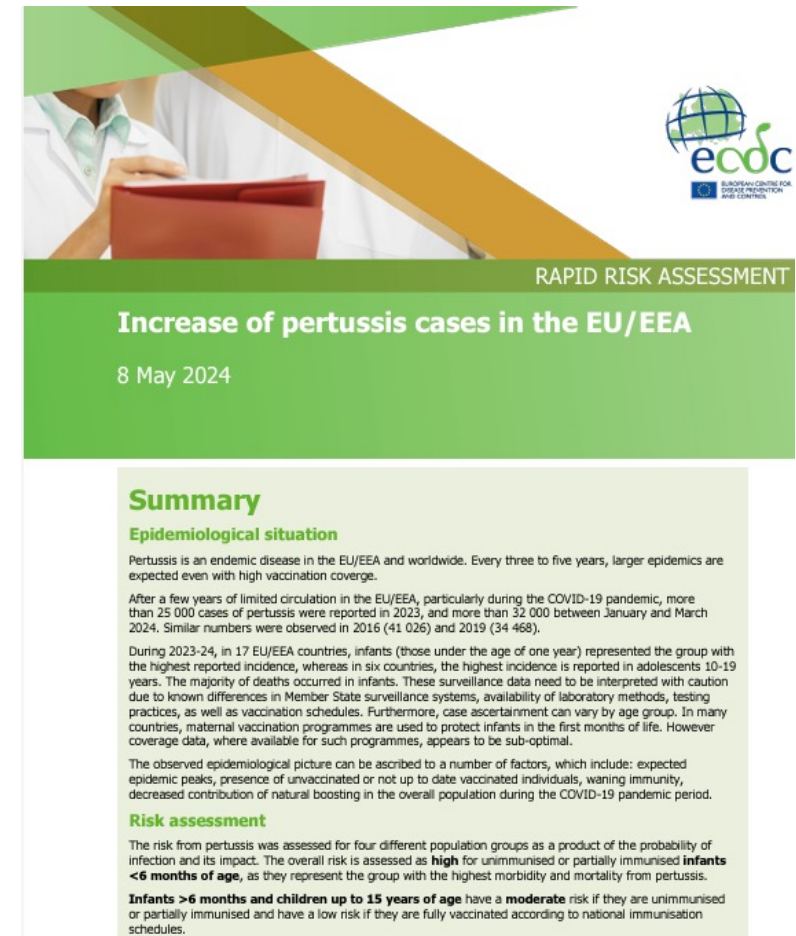


2012-2019:  
average  
38 145 cases/year

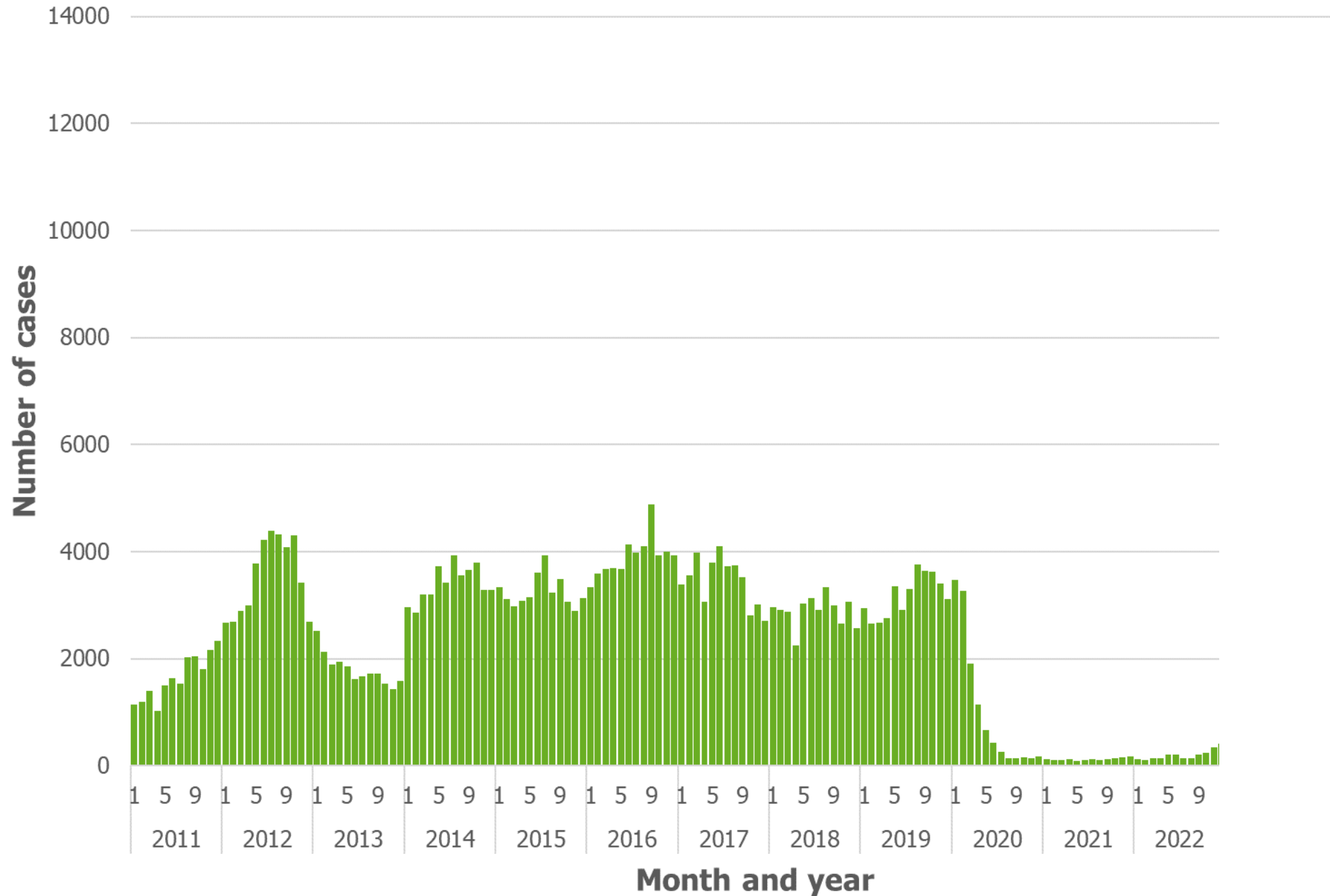
2021-2022:  
average  
2 100 cases/year

# Rapid Risk Assessment (RRA) on increase of pertussis cases in the EU/EEA

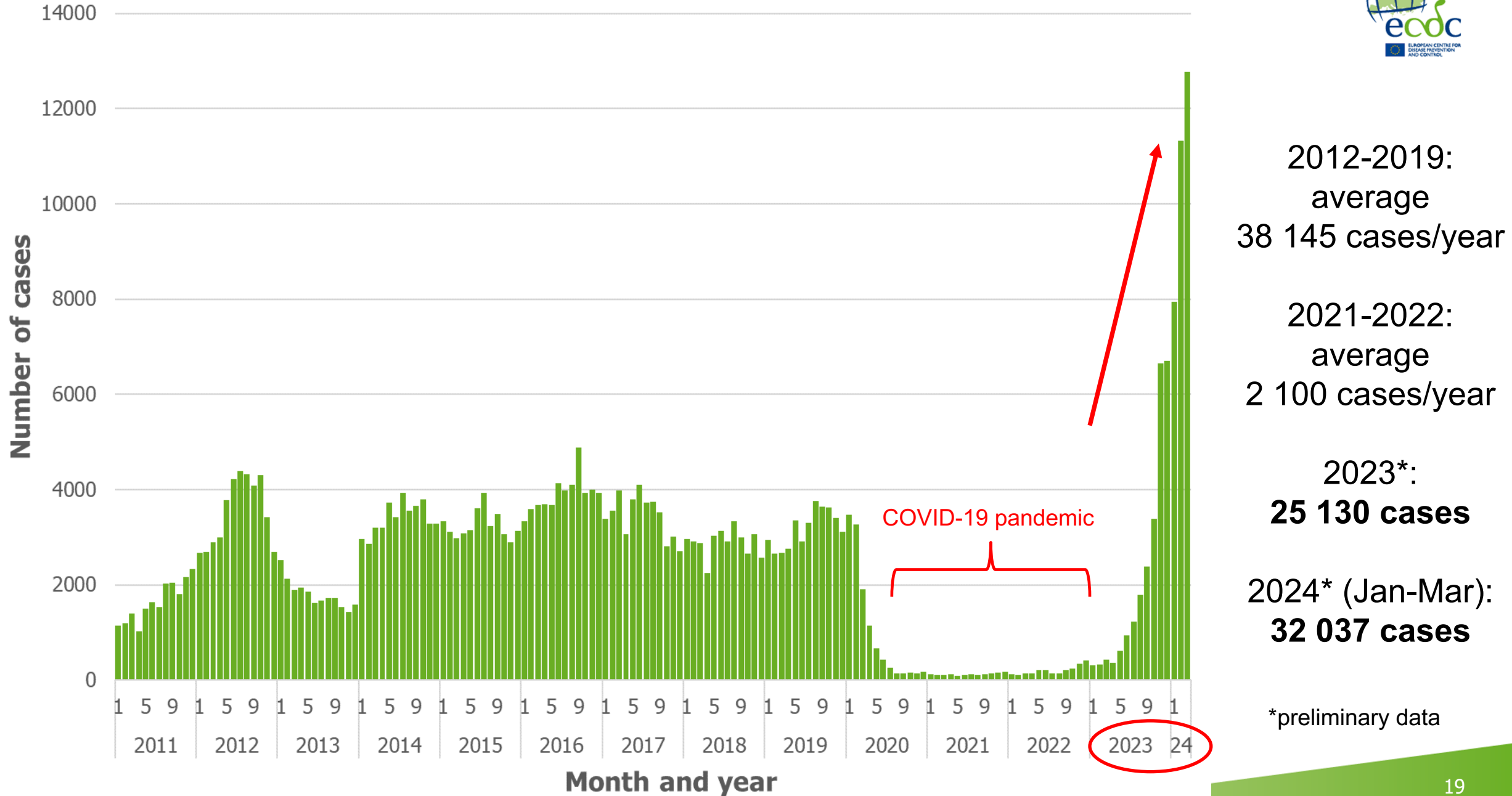
- From late 2023/early 2024, media & other sources reporting increasing pertussis cases in some EU/EEA countries
- Internal response team (IRT)- **exceptional data collection** for RRA
  - ECDC requested EU/EEA countries report 2023-2024 data (aggregated cases by month/year & total deaths by age group) Received Jan 2023-Mar 2024 data from 27 countries though EpiPulse  
*(\*data are preliminary & subject to change following validation)*
  - Combined historical data ( $\leq 2022$ ) + ad-hoc (2023-2024) data for analysis



# Number of pertussis cases, EU/EEA, Jan 2011 to Mar 2024



# Number of pertussis cases, EU/EEA, Jan 2011 to Mar 2024



**slido**

Please download and install the Slido app on all computers you use

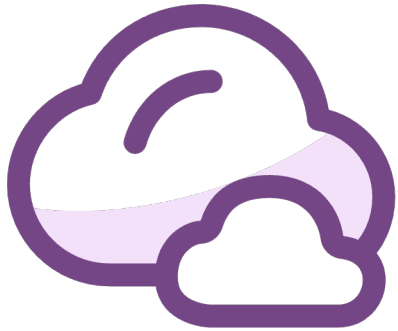


**Have you seen an increase in pertussis cases in your countries over the last year?**

① Start presenting to display the poll results on this slide.

**slido**

Please download and install the Slido app on all computers you use



**Can you think of potential reasons for this upsurge in case in EU/EEA?**

① Start presenting to display the poll results on this slide.

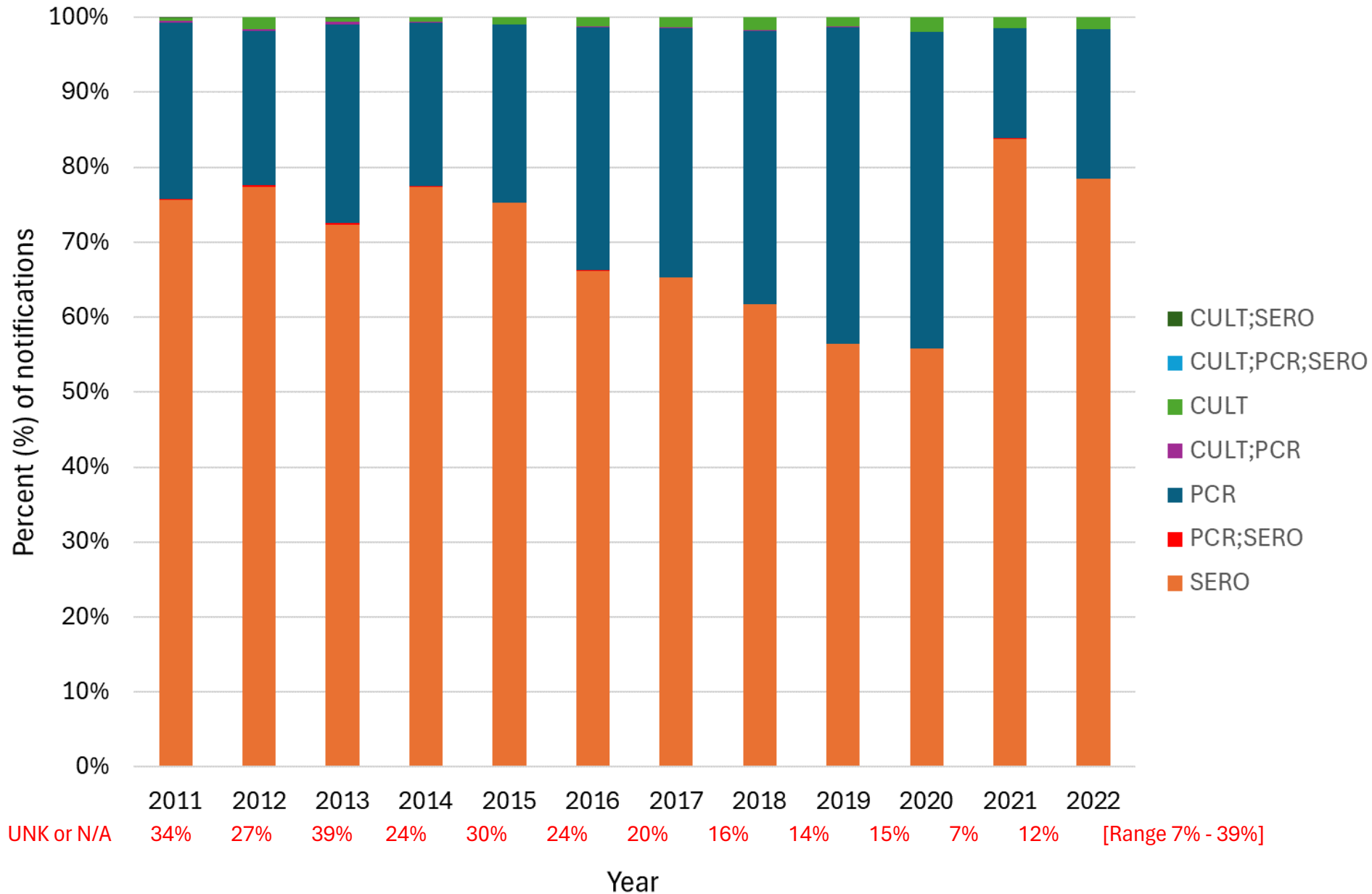
# Hypotheses

- Impact of the pandemic:
- <2020: endemic transmission- expected peaks -↑population immunity
- 2020-2022: low transmission = lack of natural boosting
- 2023-2024: increased the proportion of the population susceptible

Possibly also changes in:

- Historical changes in vaccination programs & coverage
- Testing (↑PCR capacity/multiplex panels post pandemic)
- Media leading to increased awareness → ↑case detection → ↑reporting/cases
- Circulating *B. pertussis* populations

# Pertussis cases by laboratory method, 2011-2022

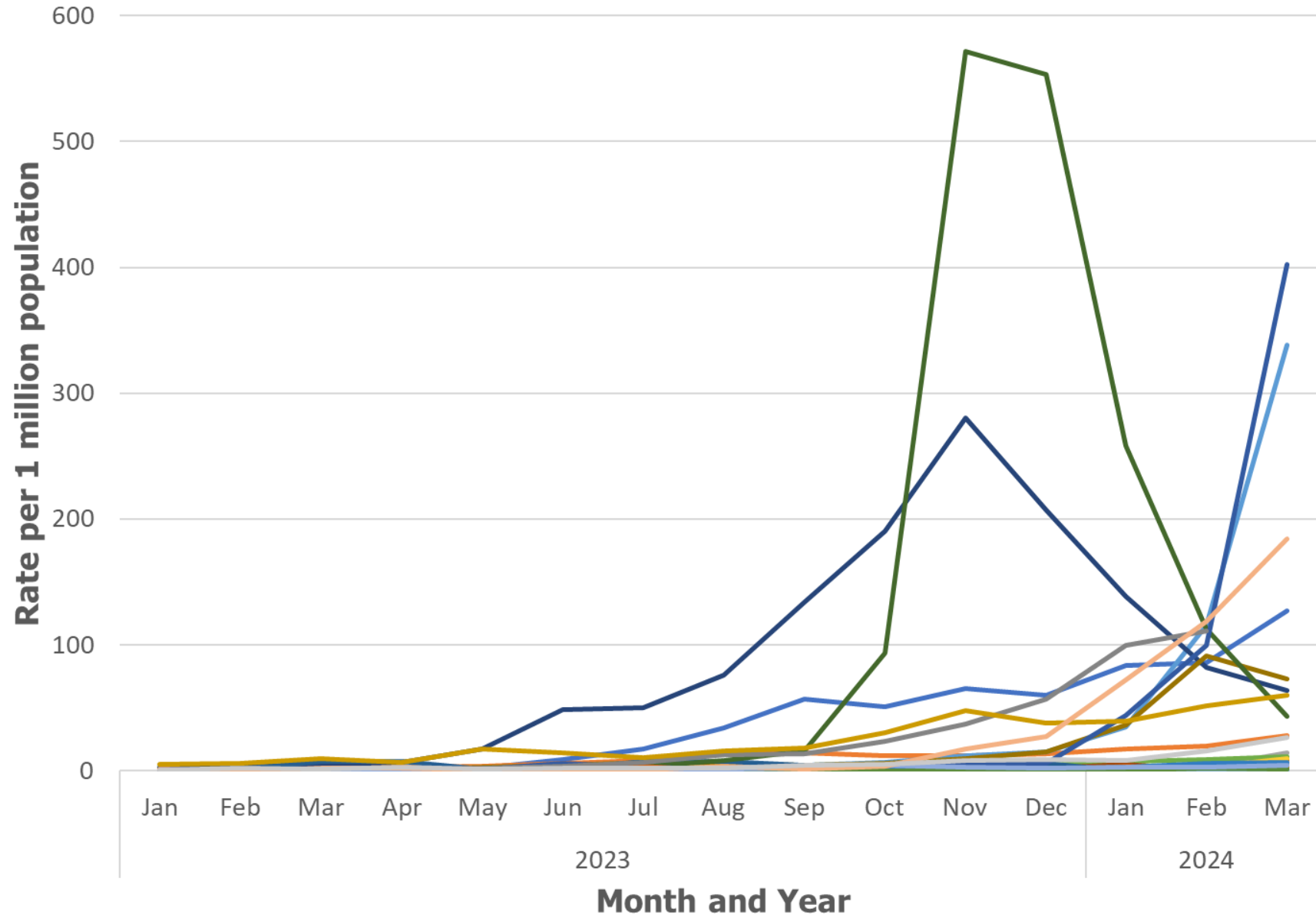


2015-2019  
↓ serology  
↑ PCR

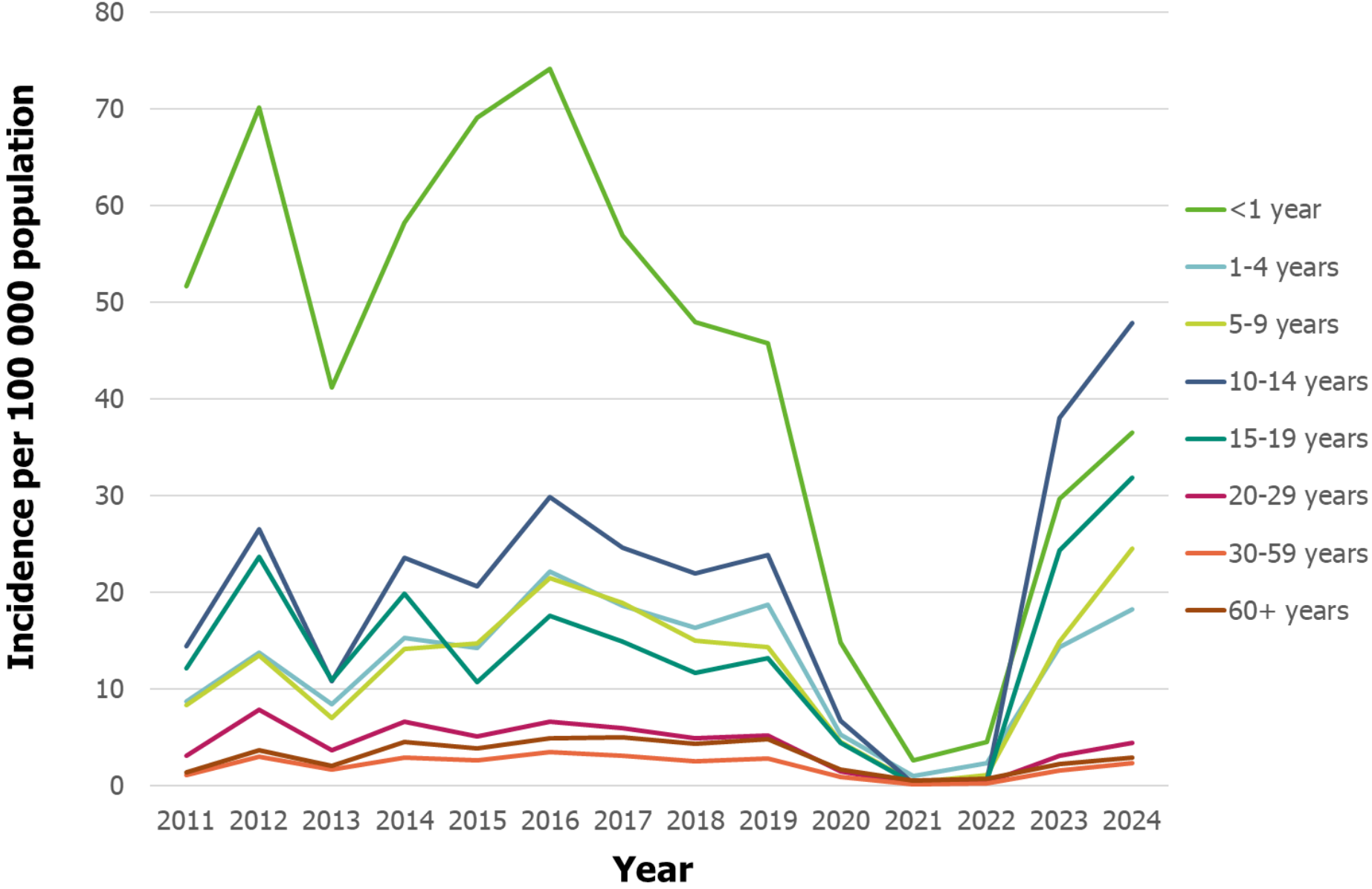
2021-2022  
↑ Serology

2023-2024  
?

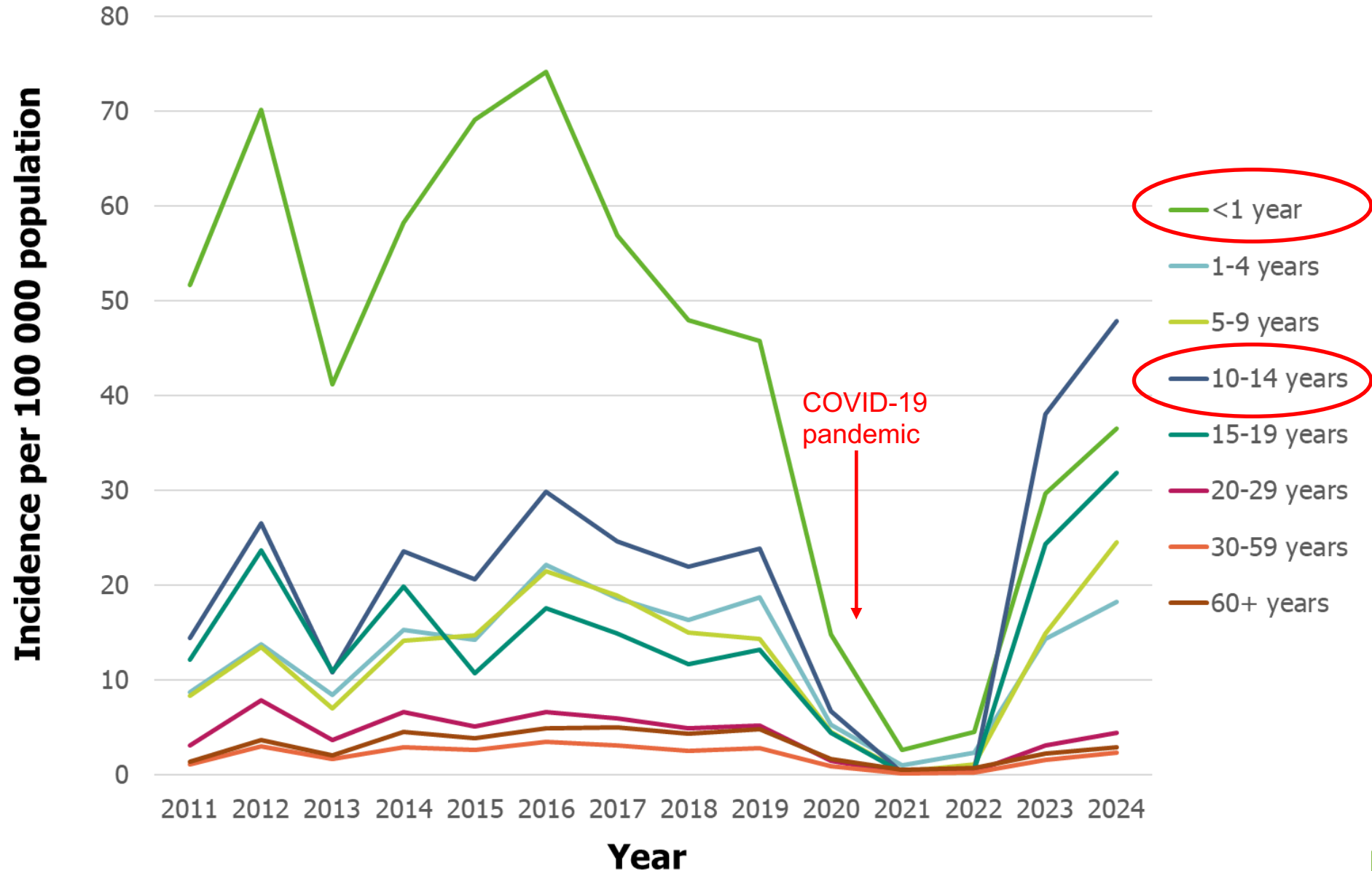
# Incidence of pertussis cases (per million population) by country, EU/EEA, Jan 2023 – Mar 2024



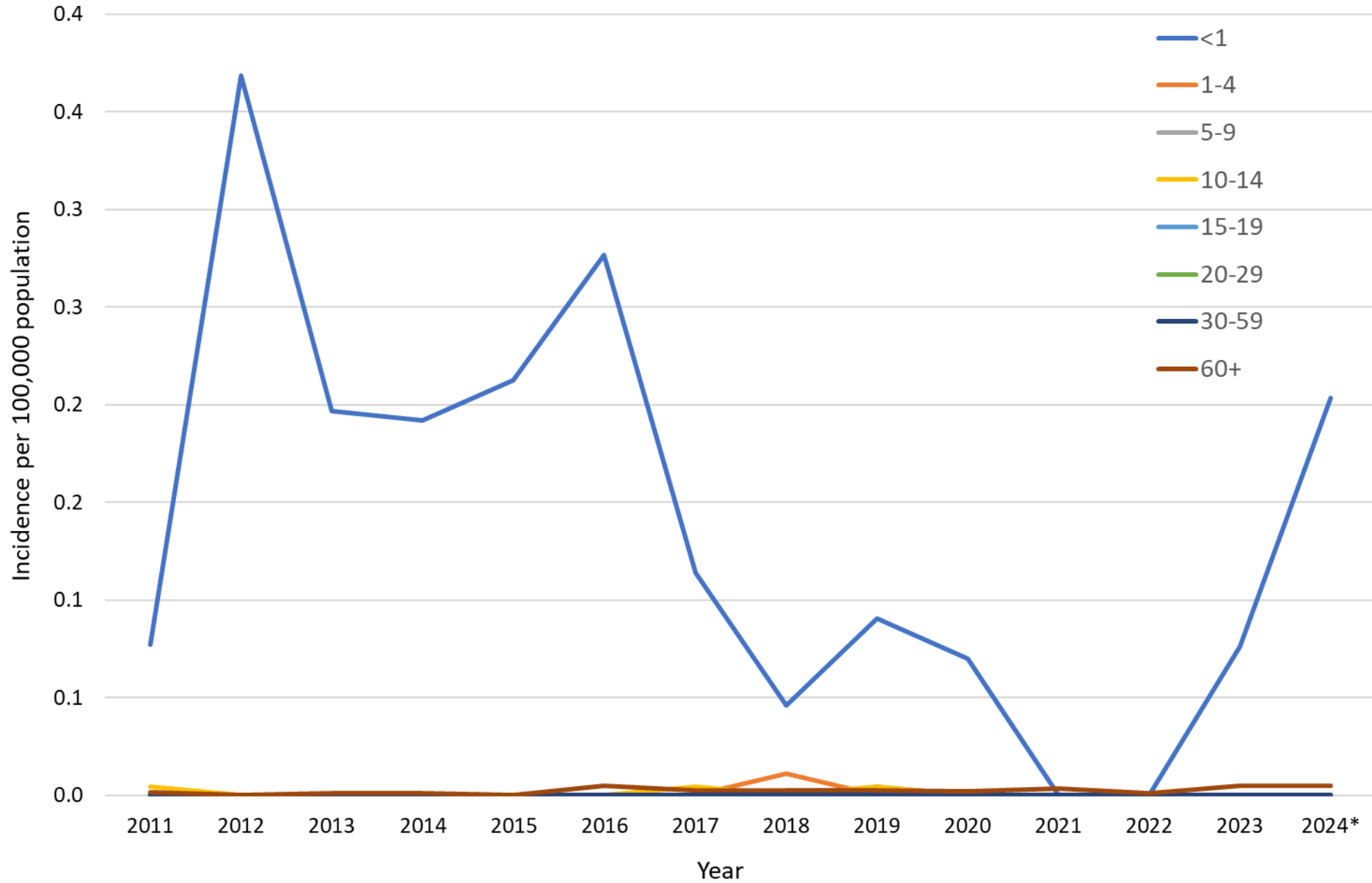
# Incidence of pertussis cases (per 100,000 population) by age group, EU/EEA, Jan 2011 to Mar 2024



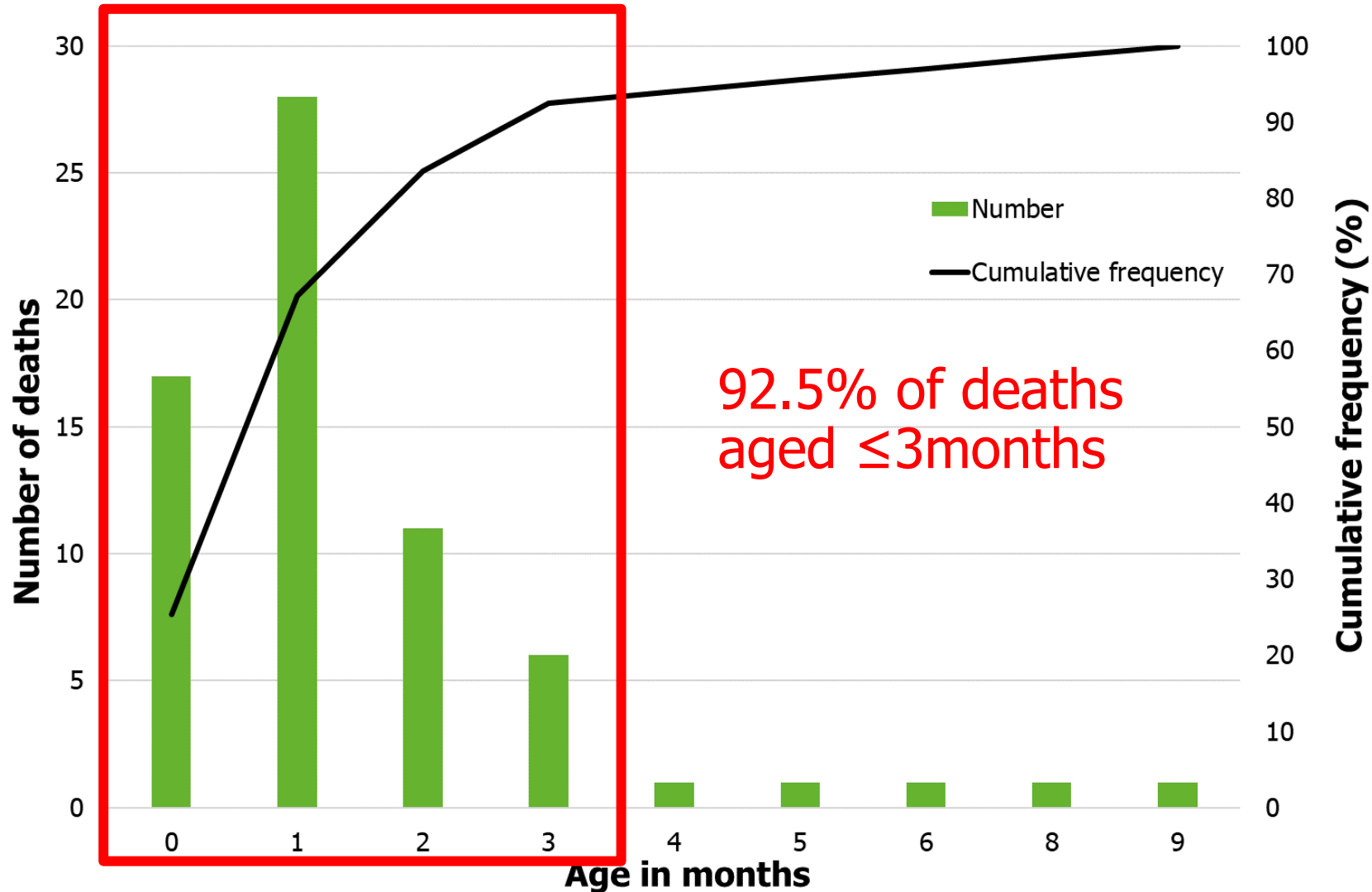
# Incidence of pertussis cases (per 100,000 population) by age group, EU/EEA, Jan 2011 to Mar 2024



# Incidence of deaths by age group, EU/EEA, Jan 2011 – Mar 2024

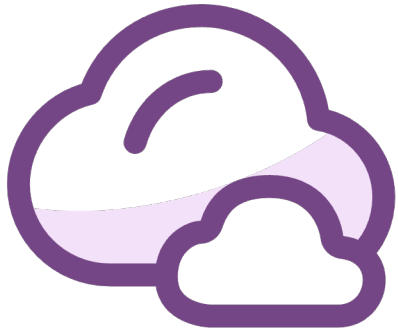


# Deaths among infants, by age in months, 2011-2022, EU/EEA



**slido**

Please download and install the  
Slido app on all computers you use



**Can you identify what are the  
high risk group for pertussis  
in the EU/EEA?**

① Start presenting to display the poll results on this slide.

# What is the risk associated with the observed increase of pertussis in the EU/EEA?

**Table 1. Assessment of the risk associated with pertussis infection in the EU/EEA, by population**

	Infants < 6 months	Infants > 6 months - children 15 years	Adolescents >16 years and persons up to 64 years of age	Persons ≥65 years, and/or younger persons with chronic respiratory conditions, or immunosuppression*
Probability	High	Moderate	Moderate	Moderate
Impact	High	Low	Low	Moderate
Overall risk	<b>High</b>	<b>Moderate</b>	<b>Moderate</b>	<b>Moderate</b>

The risk from pertussis was assessed as a product of the probability of infection and its impact.

The overall risk is assessed as

- **Infants <6 months of age** → **high** risk for unimmunised or partially immunised infants, as they represent the group with the highest morbidity and mortality from pertussis
- **Infants >6 months and children up to 15 years of age** have a moderate risk if they are unimmunised or partially immunised and have a low risk if they are fully vaccinated according to national immunisation schedules.
- **Older adolescents >16 years and adults up to 64 years of age** have a moderate risk which is reduced to low if they have recently received a booster dose.
- **Older adults (≥65 years of age) and persons of any age with underlying conditions** such as asthma, chronic obstructive pulmonary disease (COPD) or immunosuppression, have an overall moderate risk from pertussis, having a moderate probability of infection and moderate impact (i.e. a higher probability of experiencing severe illness than individuals in the younger age/group).

# Recommendations:

- Timely and full **completion of primary immunisation & booster doses**
- **Maternal immunisation** to prevent disease and death in infants
- Actions to **strengthen** disease surveillance, early detection & control
- Employ **risk communication** on the disease & **importance of vaccination**, and strategies to promote vaccine acceptance & uptake



*Rapid Risk Assessment "Increase of pertussis in the EU/EEA"*

# Pertussis Vaccination in EU/EEA

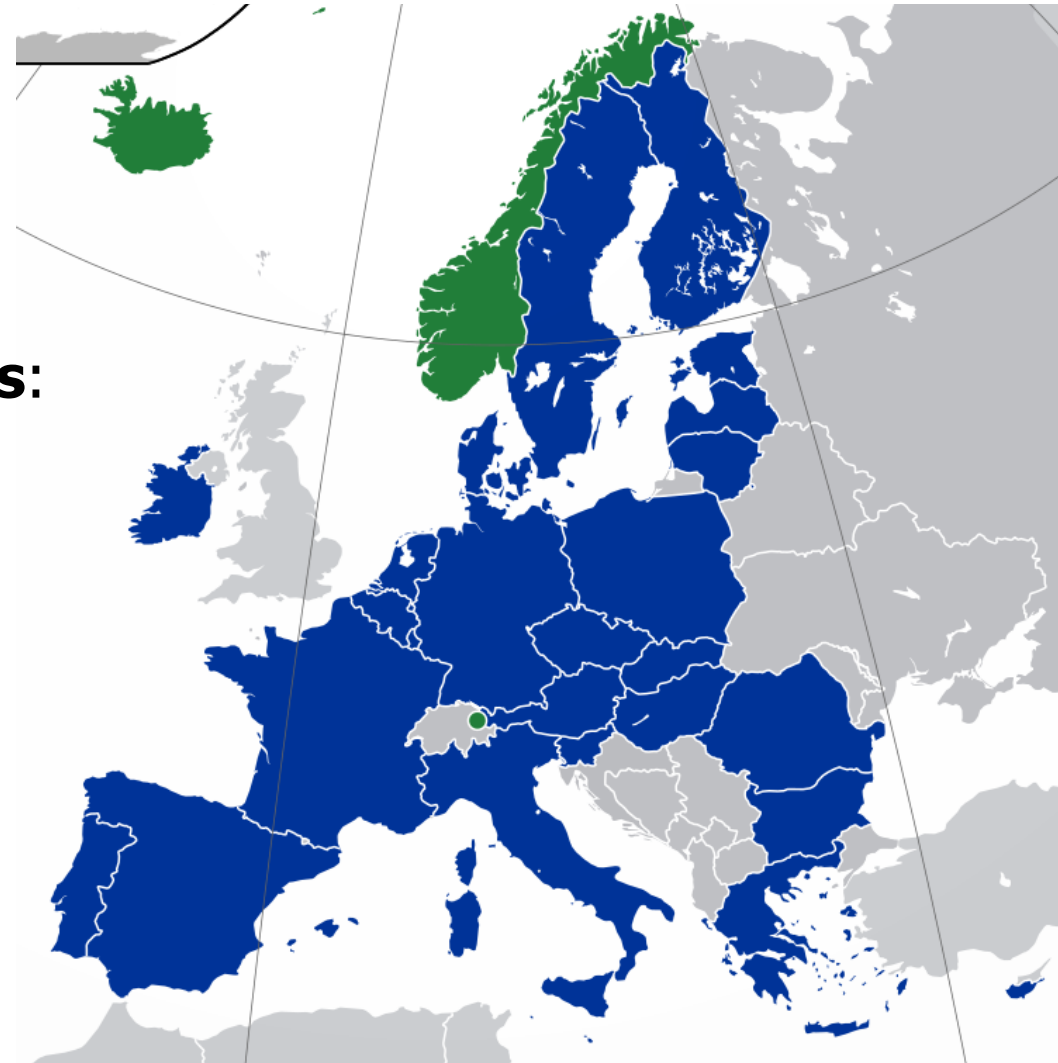
# Pertussis vaccination in the EU/EEA

Each MS is responsible for health of their population, including public health response, surveillance, vaccination programs, laboratory capacity etc

Vaccination programs in EU/EEA are **heterogeneous**:

- Primary series  $\pm$  booster/s  $\pm$  adult  $\pm$  pregnancy
  - Number of doses
  - Timing

Note: vaccines, recommendations & coverage have changed over time



# ECDC monitoring platform

<https://vaccine-schedule.ecdc.europa.eu/>



## Pertussis: Recommended vaccinations

◀ Back to search    📄 Export to spreadsheet

- General recommendation
- Recommendation for specific groups only
- Catch-up (eg if previous doses missed)
- Vaccination not funded by the National Health system
- Mandatory vaccination

	Months														Years											
	2	3	4	5	6	8	10	11	12	13	15	16	18	19-20	2	3	4	5	6	7	8	9	10	11	12	13
Austria		acP	acP					acP <sup>1</sup>												acP						
Belgium	acP	acP	acP							acP									acP							
Bulgaria	acP	acP	acP								acP <sup>5</sup>								acP						acP	
Croatia	acP		acP		acP					acP									acP <sup>6</sup>							
Cyprus		acP		acP	acP						acP							acP						acP		
Czechia		acP <sup>9</sup>	acP					acP											acP				acP			
Denmark		acP		acP					acP										acP							
Estonia		acP	acP	acP											acP				acP							
Finland		acP		acP					acP								acP									

# Primary series & first booster



All 30 countries have primary series ± first booster:

- 2p+1 in 17 countries
- 3p+0 in one country
- 3p+1 in 12 countries

Age of third dose varies:

- Between 4-6 months in 13 countries
- Between 7-12+ months in 17 countries

Country	Infant programme	
	Type of primary schedule including first booster	Age third dose*
Austria	2p+1	11-12m
Belgium	3p+1	4m
Bulgaria	3p+1	4m
Croatia	3p+1	6m
Cyprus	3p+1	6-8m
Czechia	2p+1	11-13m
Denmark	2p+1	12m
Estonia	3p+1	6m
Finland	2p+1	12m
France	2p+1	12m
Germany	2p+1	11m
Greece	3p+1	6m
Hungary	3p+1	4m
Iceland	2p+1	12m
Ireland	3p+0	6m
Italy	2p+1	10m
Latvia	3p+1	6m
Liechtenstein	2p+1	12m
Lithuania	3p+1	6m
Luxembourg	2p+1	11m
Malta	3p+1	4m
Netherlands	2p+1	5m
Norway	2p+1	12m
Poland	3p+1	5-6m
Portugal	3p+1	6m
Romania	2p+1	11m
Slovakia	2p+1	10m
Slovenia	2p+1	11-18m
Spain	2p+1	11m
Sweden	2p+1	12m

# Adult boosters

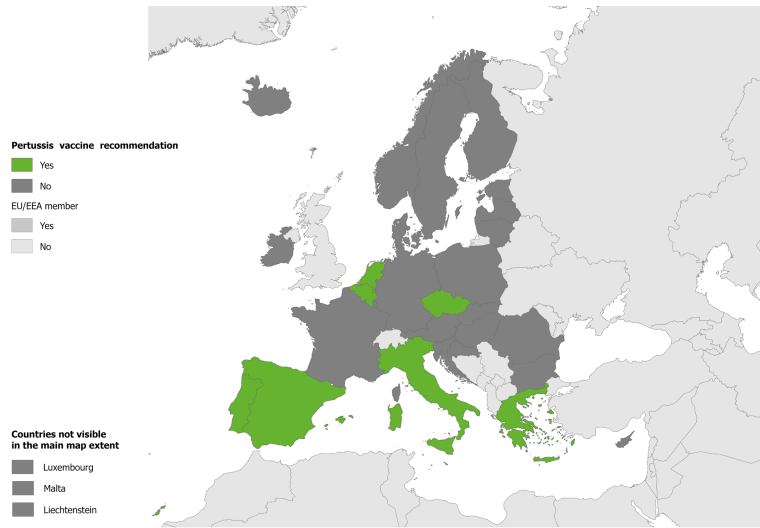
An adult booster recommended by 13 countries:

- Every 10 years (7 countries)
- At certain age (19y or 25y) (4 countries)
- One booster in adulthood (3 countries)

Country	Adult programme
Austria	Every 10y
Belgium	Every 10y
Bulgaria	
Croatia	
Cyprus	
Czechia	One booster dose in adulthood
Denmark	
Estonia	
Finland	At age 25y
France	At age 25y
Germany	One booster dose in adulthood
Greece	Every 10y
Hungary	
Iceland	
Ireland	
Italy	At age 19y and then every 10y
Latvia	
Liechtenstein	At age 25y
Lithuania	
Luxembourg	Every 10y
Malta	
Netherlands	
Norway	Every 10y
Poland	Every 10y
Portugal	
Romania	
Slovakia	
Slovenia	One booster dose in adulthood
Spain	
Sweden	

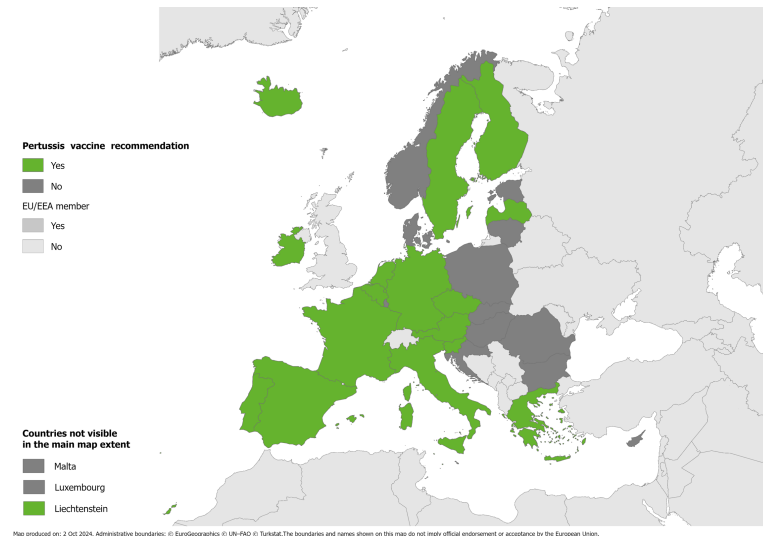
# Recommendations for pertussis vaccination during pregnancy, 2019, 2023 and 2024

## 2019



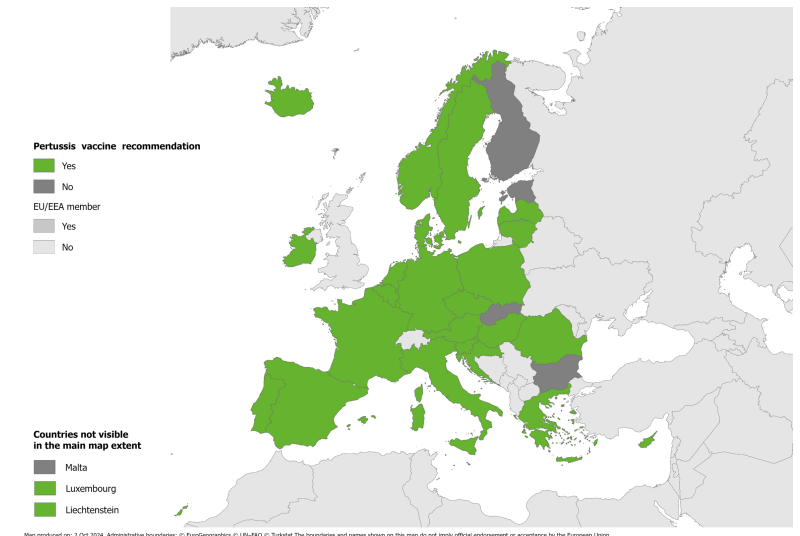
7 countries

## 2023



17 countries

## 2024



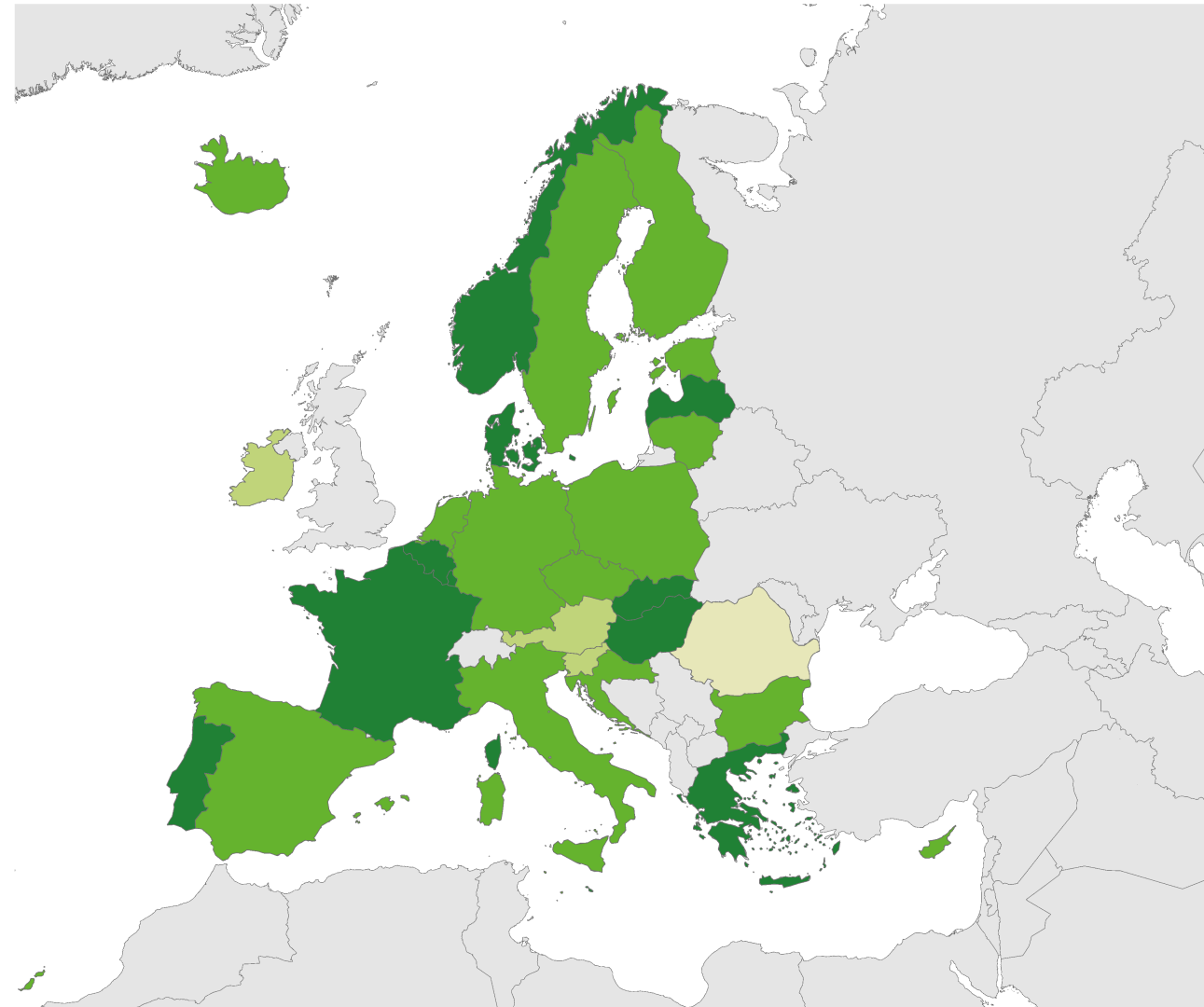
25 countries

# Coverage among pregnant women

Nine countries provided vaccination coverage data in April 2024\*.  
Coverage estimates **ranged between 1.6% and 88.5%**

Country	Year of estimates	Vaccination coverage (%)
Belgium	2023	64.3 (Flanders 85%; Wallonia 38.9%; Brussels 31.1%)
Czechia	2023	1.6
Denmark	2023	69
Germany	2021	39.7
Ireland	2019	49.9
Portugal	2023	84
Romania	2023	8.8
Slovenia	2023	6.5
Spain	2023	88.5

# Vaccination coverage (%) of DTP3 vaccines, EU/EEA, 2023

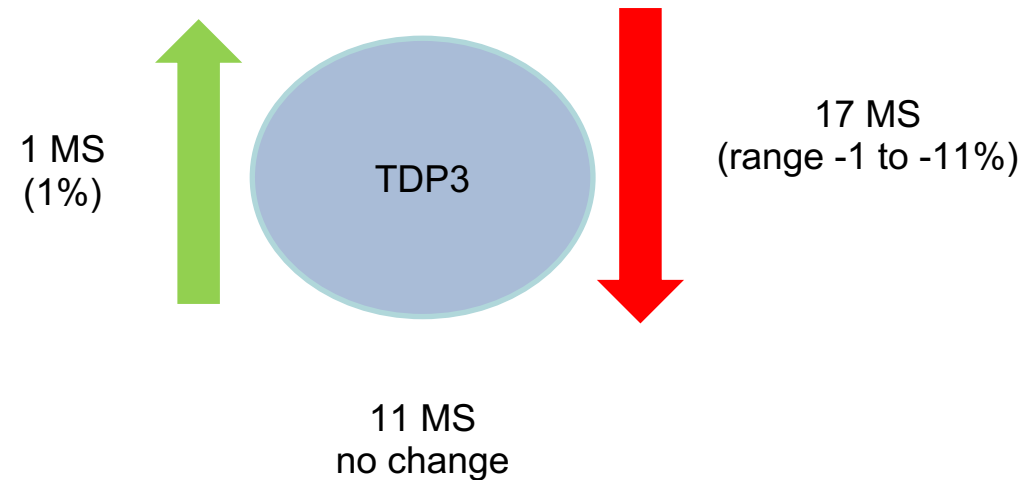


**DTP3 93%**  
Range 78%-99%

Map produced on: 23 Oct 2024. Administrative boundaries: © EuroGeographics © UN-FAO © Turkstat. The boundaries and names shown on this map do not imply official endorsement or acceptance by the European Union.

# Vaccination coverage (%) of DTP3 vaccines, EU/EEA, comparison 2023 vs 2019

Vaccination coverage 93% (2023) vs 95% (2019)



# Complementary studies

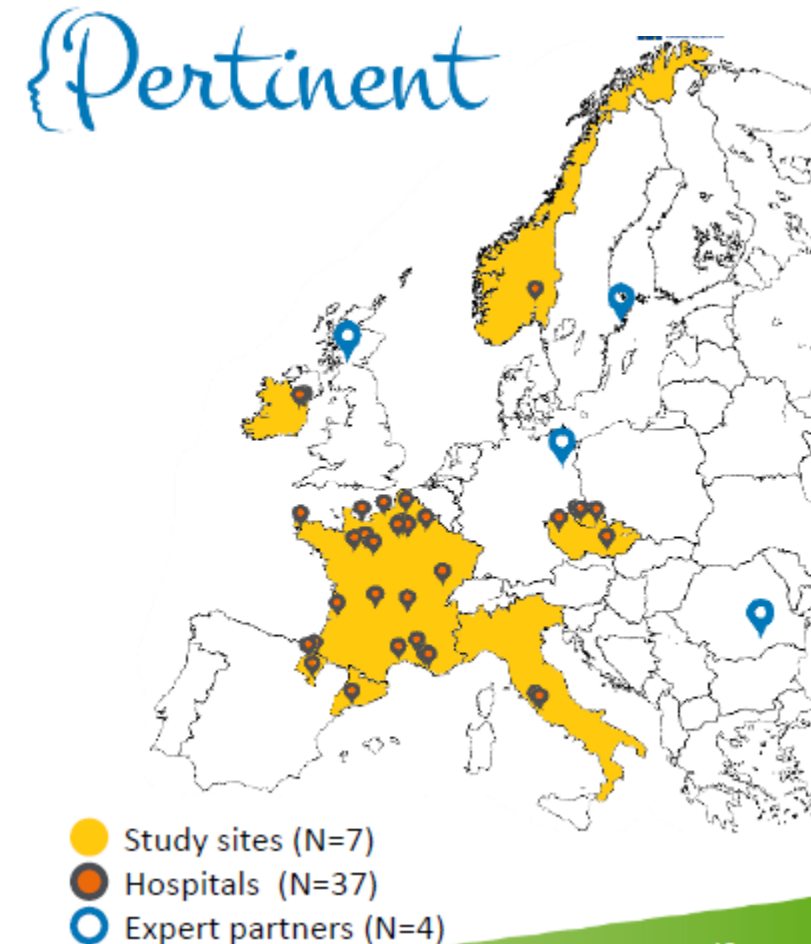
# Pertinent: Pertussis in Infants European Network

Active sentinel hospital-based surveillance

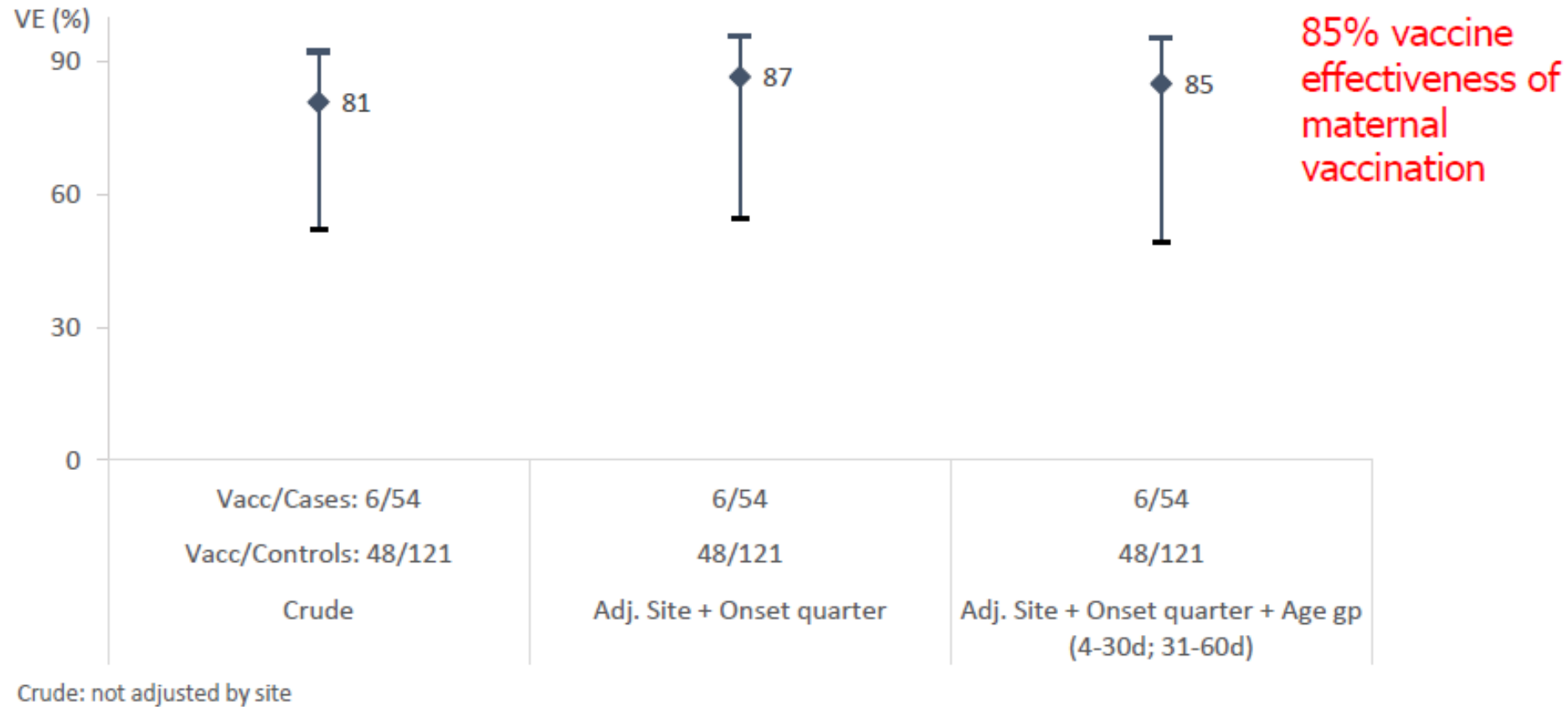
- 2015-2019
- 37 hospitals in seven sites (6 MS)
- 6% of EU infants

## Objective

- Estimate the burden of pertussis in infants <1 year in terms of incidence and severity
- Assess vaccine effectiveness against hospitalization for pertussis with regards to primary vaccination in infants but also vaccination in pregnancy



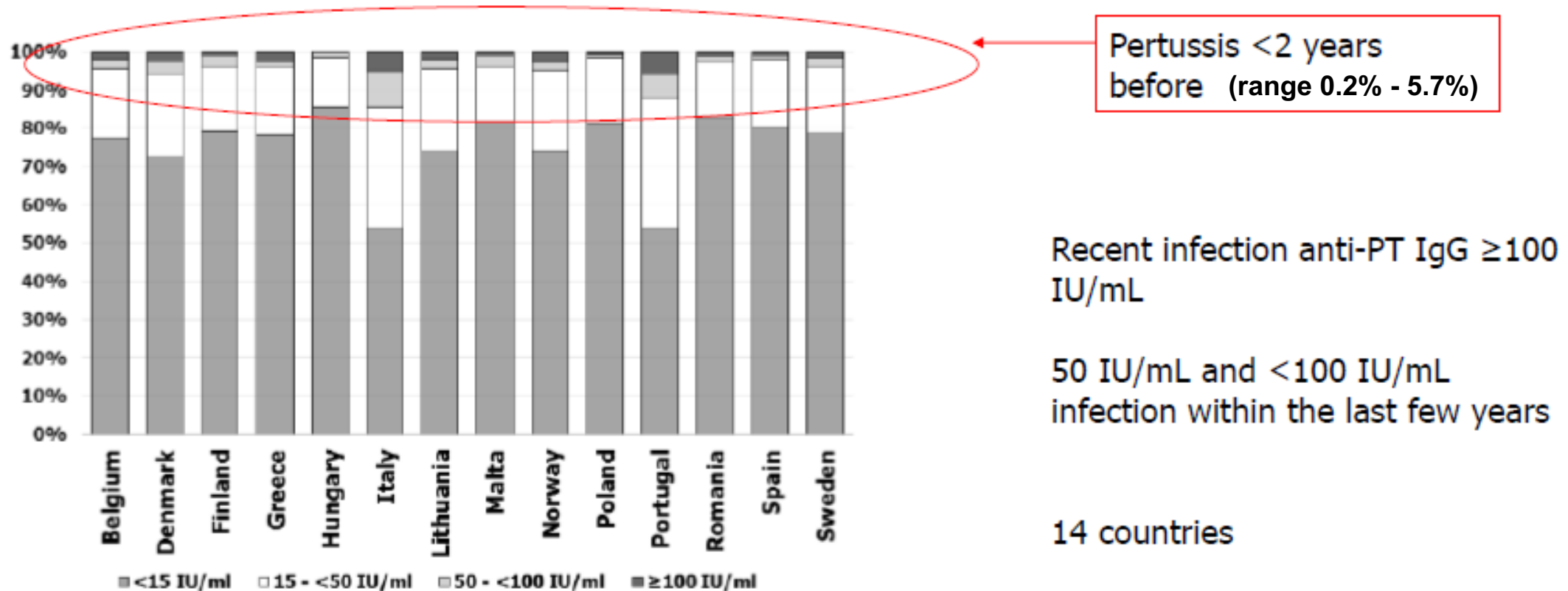
# VE of pertussis vaccination during pregnancy in infants too young to be vaccinated, restricted to aspirates (N=175), Dec 2015 – Aug 2019



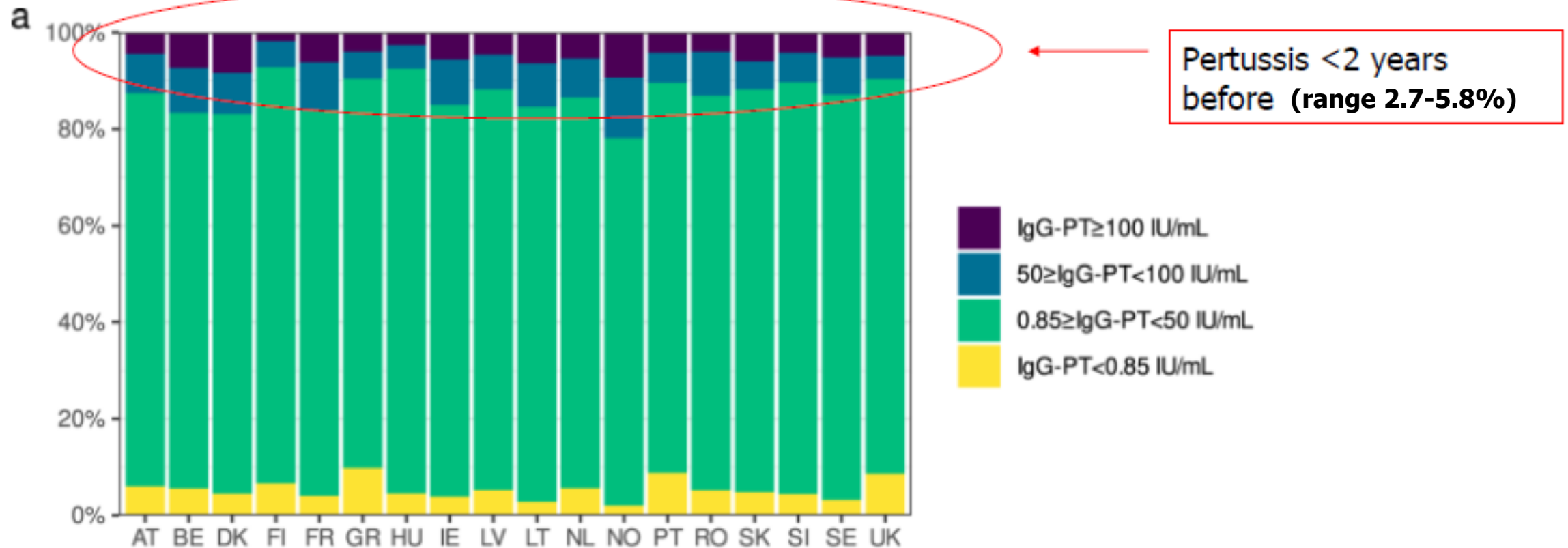
[Effectiveness of pertussis vaccination in pregnancy to prevent hospitalisation in infants aged <2 months and effectiveness of both primary vaccination and mother's vaccination in pregnancy in infants aged 2-11 months, Merdignanc et al, Vaccine, 2022](#)

# Seroprevalence studies in adults

# Relative distribution of samples by anti-PT IgG interval and by country, age 20-39 years



# Relative distribution of samples by IgG intervals and by country(40-59 years), 18 countries, 2015-2018



*Circulation of pertussis and poor protection against diphtheria among middle-aged adults in 18 European countries, Berbers et al. Nature Communication 2021*

\*new seroprevalence study on DTP antibodies in the EU/EEA is planned for take place in the next years (2025-2030) in collaboration with the EURL for Diphtheria and Pertussis

# Summary

- ECDC has a 360° approach in surveillance of pertussis in EU/EEA
  - Indicator and event based surveillance and response
  - Vaccine effectiveness (VE) studies and seroprevalence studies
  - capacity building activities (EQAs, trainings)
- Epidemiology of pertussis varies across the EU/EEA
  - Observed large **decrease** during the pandemic (2020-2022)
  - **Increase** in cases in late 2023-early 2024
    - Size of increase & age distribution vary by country\*
- Vaccination coverage DTP3 remains high in the region
- Vaccine schedules vary across the EU/EEA
- **Infants <6 months remain the focus for protection**

# References



## Resources:

[Annual Epidemiological report \(AER\) 2022](#)

[Rapid Risk Assessment: Increase of pertussis cases in the EU/EEA](#)

[Surveillance Atlas of Infectious Diseases \(europa.eu\)](#)

[Vaccine Scheduler | ECDC \(europa.eu\)](#)

[Pertussis \(whooping cough\)](#)

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VPI team in ECDC

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