Massachusetts Department of Public Health

Pertussis Update

March 13, 2025

Angela Fowler, MD, MPH | Associate Medical Director for Vaccine Preventable Diseases

Christine Nguyen, MPH | Epidemiologist

Presenter Disclosure Information

We, Christine Nguyen and Angela Fowler, have been asked to disclose any relevant relationships with commercial entities that are either providing financial support for this program or whose products or services are mentioned during my presentation.

We have no relationships to disclose.

We may discuss the use of vaccines in a manner not approved by the U.S. Food and Drug Administration, but in accordance with ACIP recommendations.

Agenda

- Background and Microbiology
- Epidemiology
- Clinical Features
- Diagnosis and Testing
- Treatment and Post-Exposure Prophylaxis
- Vaccination
- Reporting to DPH

Background and Microbiology

Background

- Emerged as a pandemic (and later as an endemic) disease 500–600 years ago

- 1400's - First description of pertussis by a Persian physician, Bahā' al-Dawlah
  - Described three epidemics, 1484-95 CE & 1501 CE in his book, The Summary of Experiences (1501 CE)
  - *"epidemic cough… the intensity of cough was to such an extent that it did not cease until vomiting occurred and weakness developed. And children became unconscious, and many people, old and young, died in the first epidemic because of this fainting and the intensity of cough"*

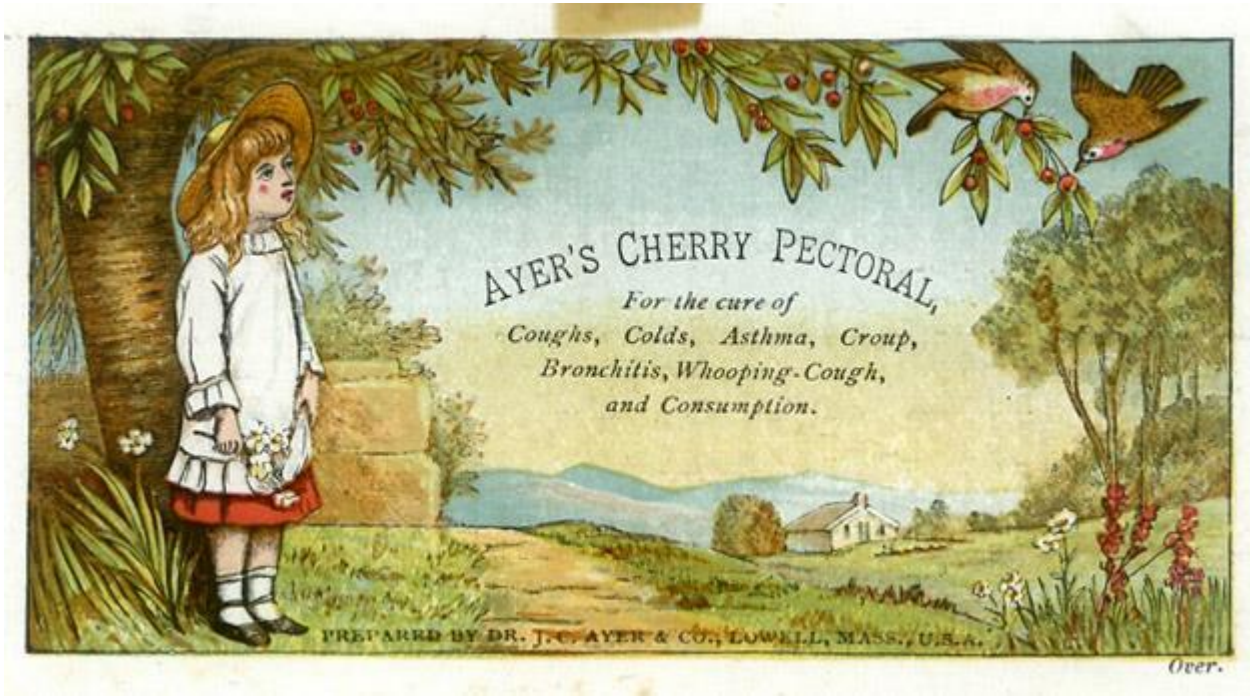
Fig. 1. A page of the Bahā'al-Dawlah's *Khulā at al-Tajārib* (The Summary of Experience). Ibn 'Abd al-'Azim Mu ammad Samī' al-Tabib completed this copy in 1832.
Courtesy US National Library of Medicine.

Background

- 1500’s - The first recorded outbreak in Europe is believed to have occurred in Paris in 1578. Described by French physician Guillaume de Baillou, who called it "tussis convulsiva."

- 1900 - Belgian bacteriologists Jules Bordet and Octave Gengou isolated the bacterium responsible for pertussis

- Early 1900’s - Pertussis killed 5 of every 1000 children before their first birthday



Ayer’s Cherry Pectoral – “cure” for whooping cough, c 1870-1906, Museum of Health Care

Microbiology and Transmission

- Pertussis or whooping cough
- Respiratory illness caused by a fastidious, gram-negative coccobacillus *Bordetella pertussis*
- Other *Bordetella* species (*Bordetella parapertussis*, *Bordetella bronchiseptica*, and *Bordetella holmesii*) may cause a clinical syndrome like whooping cough but generally less severe
- The bacterium produces pertussis toxin, which is a protein-based exotoxin that is a key virulence factor in infection.
- Spread by respiratory droplets - transmitted by coughing, sneezing, or sharing breathing space for extend periods of time. The risk of transmission is greatest during the first/catarrhal stage of illness

Epidemiology

Pertussis Cases in the U.S.

Reported Pertussis Cases

2023: **7,063** 2024: **35,435**

Reported Pertussis Cases and Percent Hospitalization by Age Group

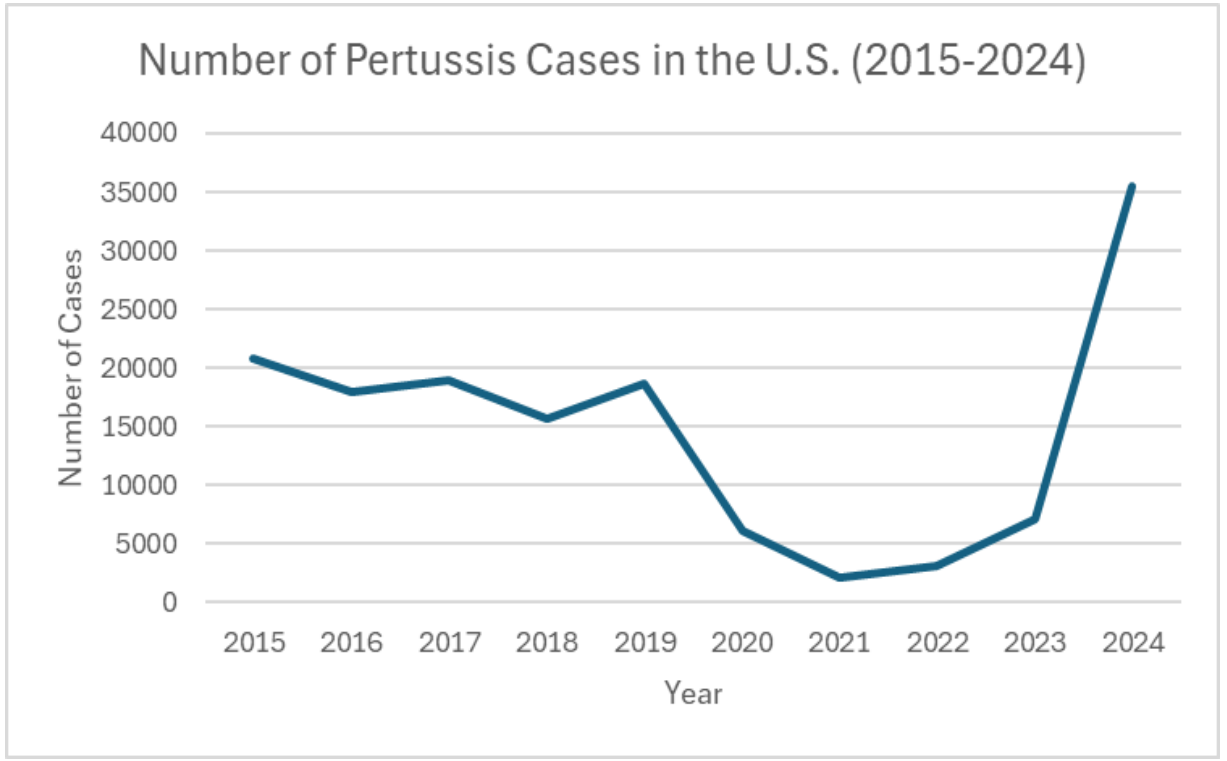
Age	No. of Cases (% of total)	Age Inc /100,000	% Hospitalized by age**
< 6 mos	1,573 (4.4)	85.4	33.4
6-11 mos	1,150 (3.2)	62.4	11.2
1-6 yrs	6,539 (18.5)	28.7	3.5
7-10 yrs	4,945 (14.0)	30.7	1.4
11-19 yrs	15,194 (42.9)	39.5	1.1
20+ yrs	6,026 (17.0)	2.4	10.3
Unknown Age	8 (0.0)	N/A	N/A
Total	**35,435 (100)**	**10.6***	**4.9**

*Total incidence per 100,000 calculated from 35,427 cases with age reported.
**Calculated from those with known hospitalization status.

Reported Pertussis Deaths

Age	Deaths*
Cases, aged < 1 yr	6
Cases, aged ≥ 1 yr	4
Total	**10**

*Confirmation of deaths is ongoing and may result in changes to the final count for 2024.



National Center for Immunization and Respiratory Diseases. Division of Bacterial Diseases. 2024 Provisional Pertussis Surveillance Report. https://www.cdc.gov/pertussis/media/pdfs/2025/01/pertuss-surv-report-2024_PROVISIONAL-508.pdf. March 2025.
CDC – Pertussis Cases by Year (1922-2022). https://www.cdc.gov/pertussis/php/surveillance/pertussis-cases-by-year.html. March 4, 2025.

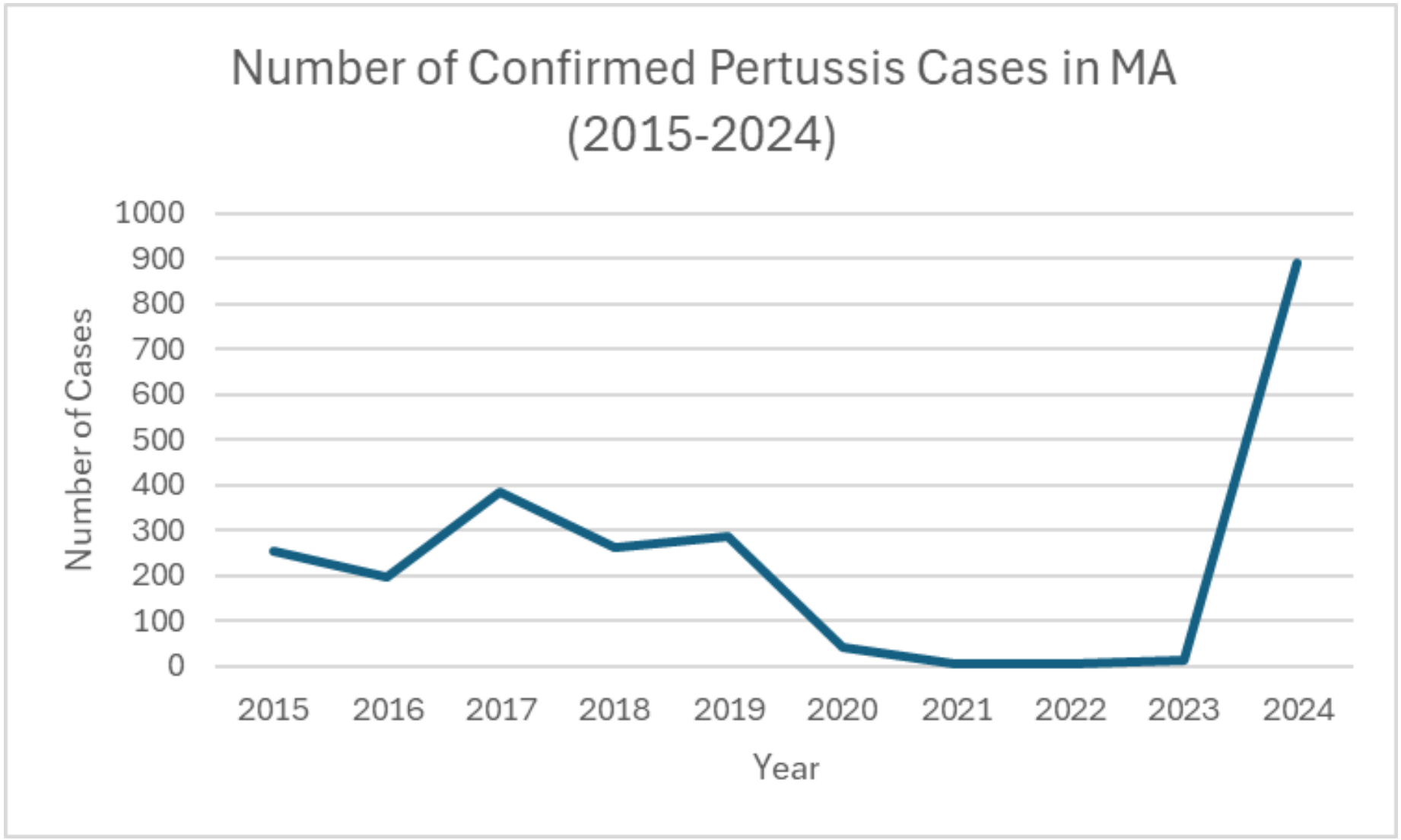
Vaccine-Preventable Diseases in Massachusetts, 2015-2024*

Data are current as of 3/4/2025 and are subject to change.

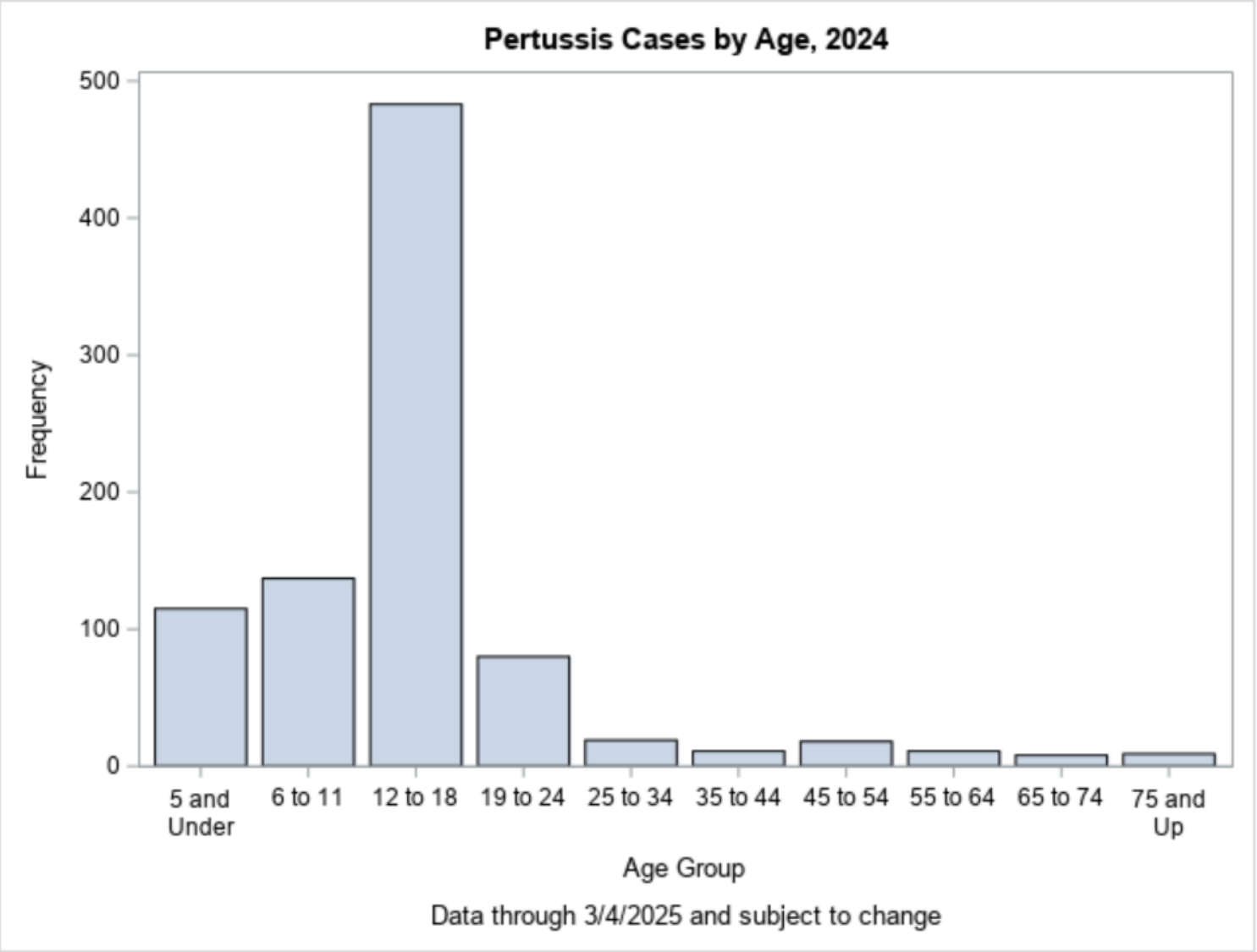
Disease	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Measles[1]	0	1	0	2	3	1	0	0	0	1
Mumps[1]	6	258	192	44	64	19	2	9	7	14
Rubella[1]	0	0	1	0	0	0	0	0	0	0
Meningococcal Disease	12	11	10	21	15	10	9	13	10	11
Pertussis	253	198	383	262	287	42	5	5	14	**891**
Hib[2] <5	0	1	2	1	0	0	0	1	2	0
Hepatitis A	34	64	53	373	193	31	19	27	41	32
Hepatitis B (Acute)	33	33	53	47	38	16	14	24	36	44
Tetanus[1]	0	0	0	0	1	1	1	0	1	1
Diphtheria	0	0	0	0	0	0	0	0	0	0
Polio	0	0	0	0	0	0	0	0	0	0
Pneumococcal Disease <5	20	31	21	26	23	14	19	30	18	13
Varicella[1]	356	290	380	293	299	93	99	100	153	168

[1]Measles, Mumps, Rubella, Varicella and Tetanus numbers include confirmed and probable cases to better reflect disease burden. All other diseases include confirmed cases only.
[2]Haemophilus influenzae Type b

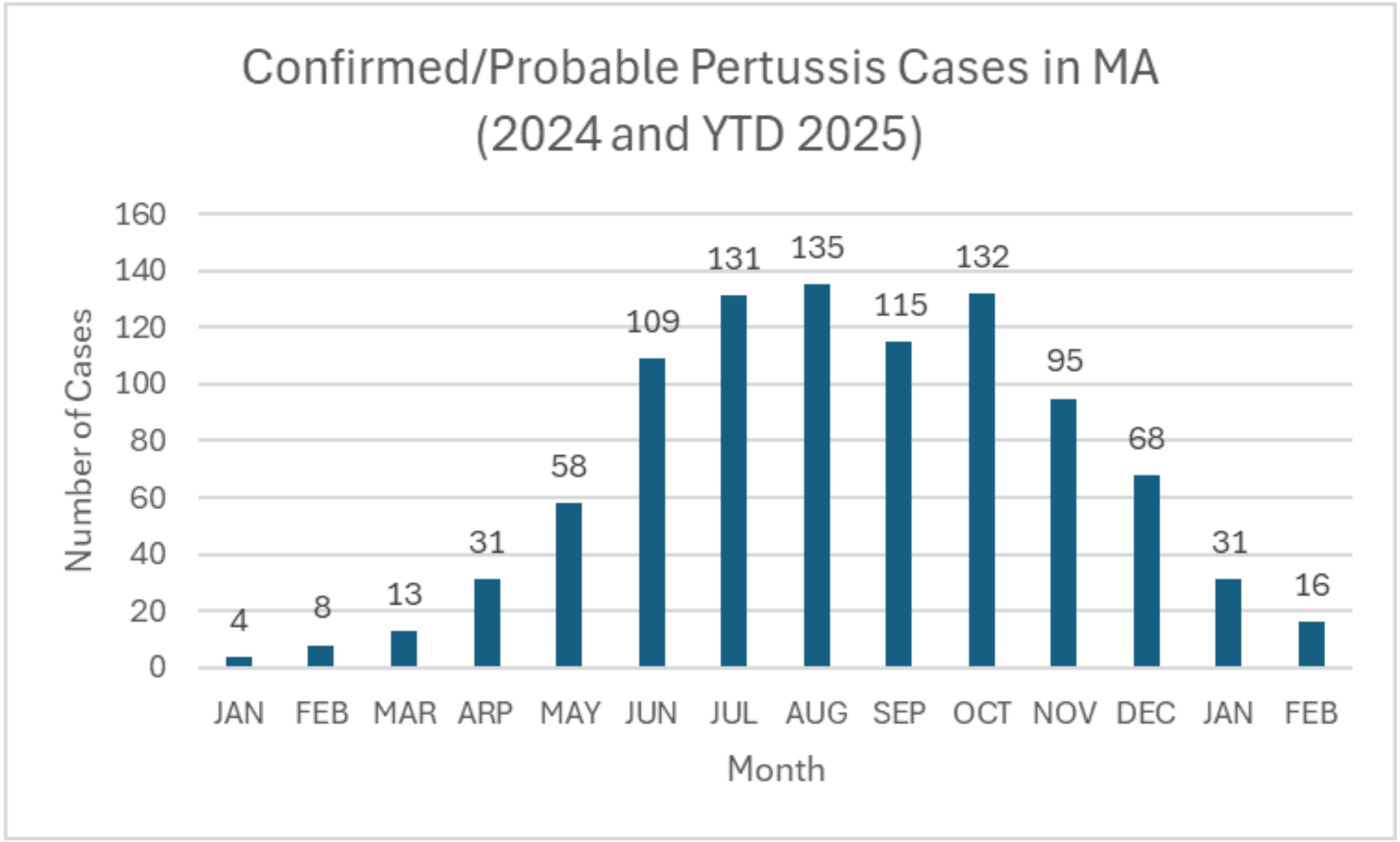
Pertussis Cases in MA Increased in 2024



2024 Pertussis Cases by Age in MA



2024-YTD 2025 Pertussis Cases by Month in MA



Clinical Features

Clinical Features – Classic Presentation

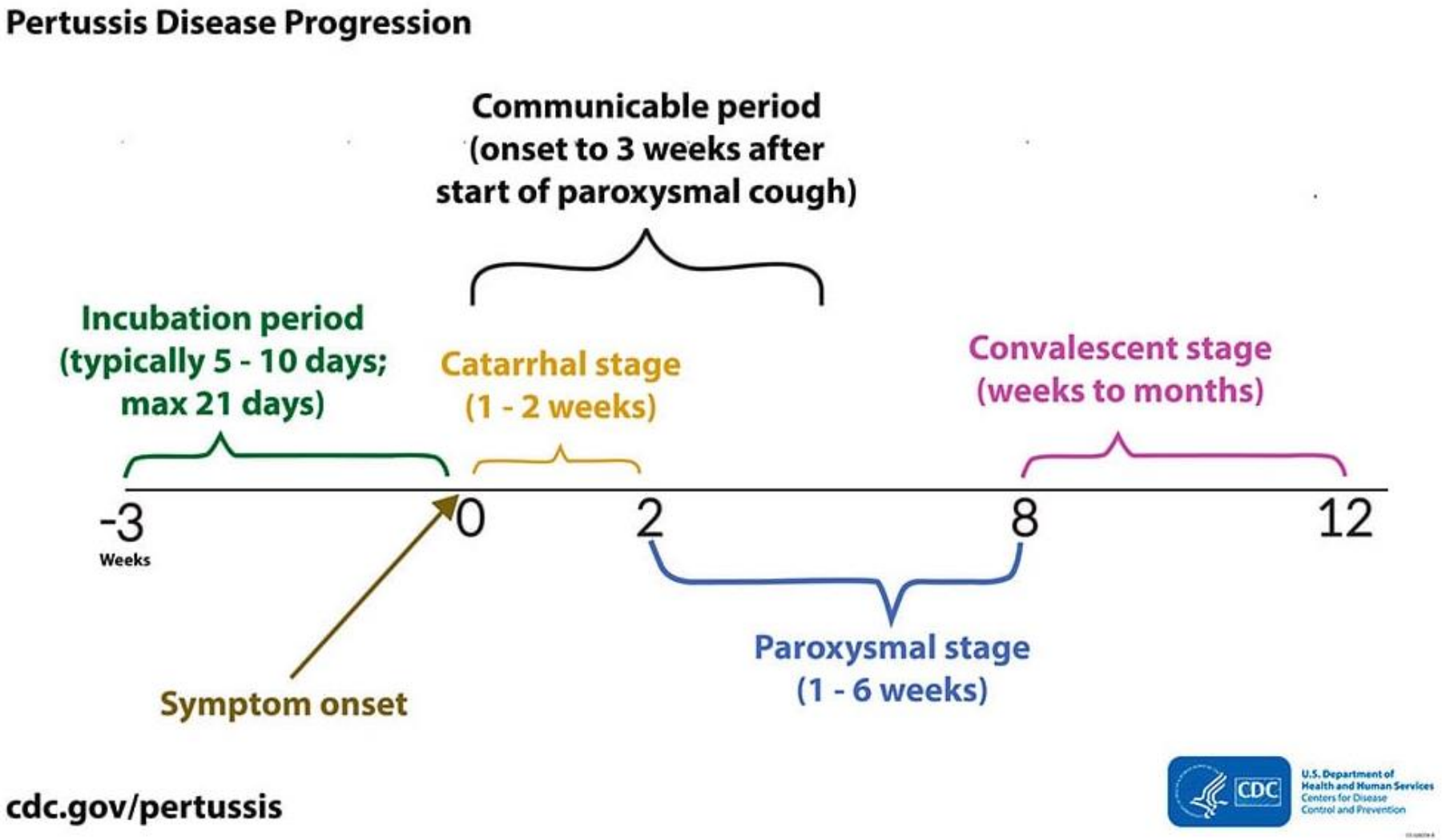
Divided into three stages:

1. Catarrhal stage – 1 to 2 weeks - similar to a viral upper respiratory infection - mild cough and coryza. Fever is uncommon; but if present, it is usually low grade.

2. Paroxysmal stage – 2 to 8 weeks – distinctive coughing spells characterized by a long series of coughs during a single expiration. May gag, develop cyanosis, and appear to be struggling for breath. The characteristic “whoop,” or noise made by the forced inspiratory effort that follows the coughing attack is not always present. Post-tussive vomiting commonly occurs.

3. Convalescent stage – the cough subsides over several weeks to months. Episodic coughing may recur or worsen with interval upper respiratory tract infections.

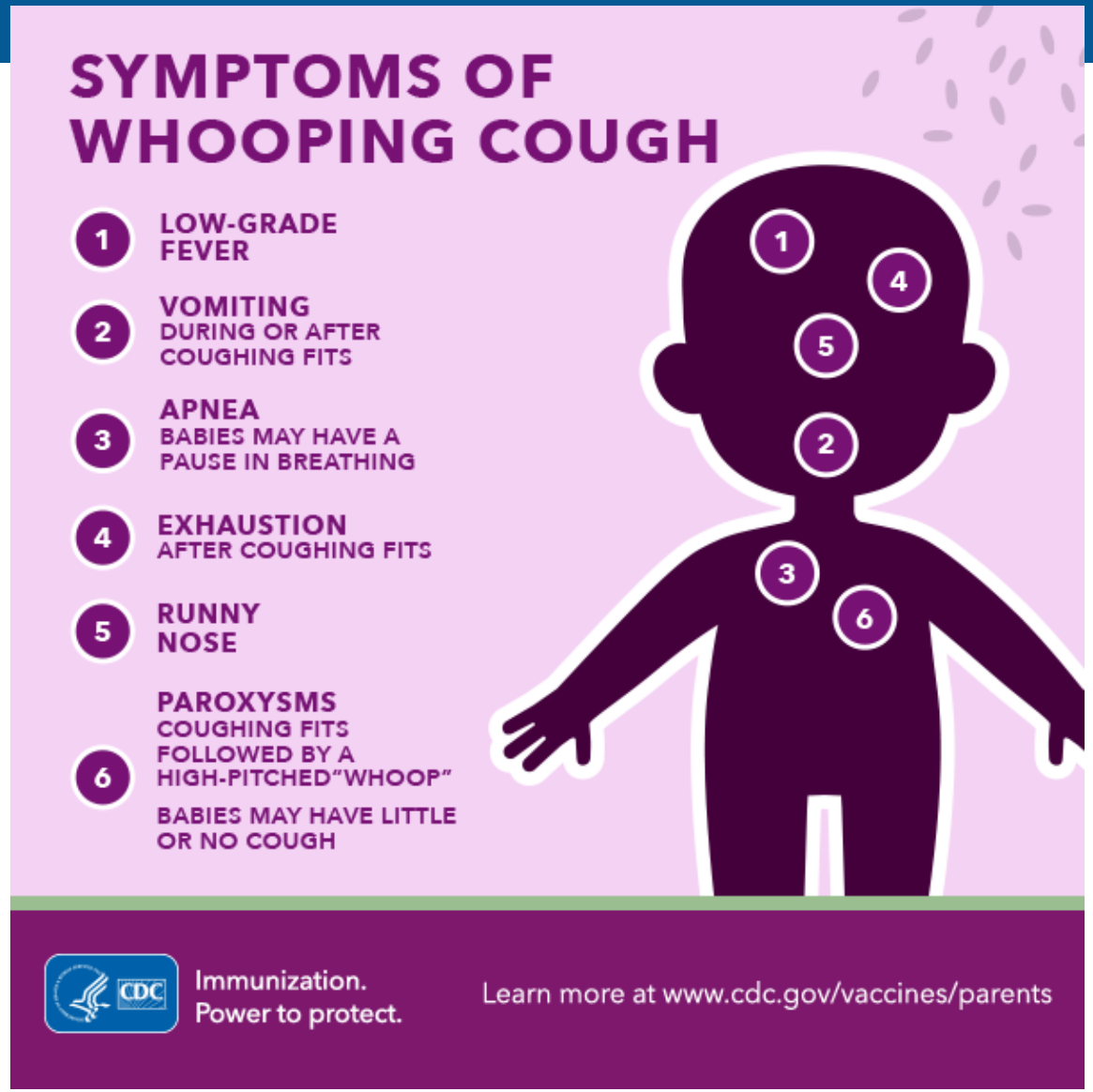
Stages of Illness



Clinical Features – Infants

- Atypical presentations of pertussis occur more often in young infants
- Because infants are at highest risk, pertussis must be considered early in the presentation of respiratory illness
- A short or absent catarrhal stage during which the infant can appear deceptively well with a mild cough and no fever, watery coryza, or sneezing
- In infants, apnea may be the only symptom, and the cough may be minimal or absent. There may be “no whoop.”

➡ Important clue - Household contact with a prolonged cough



Complications

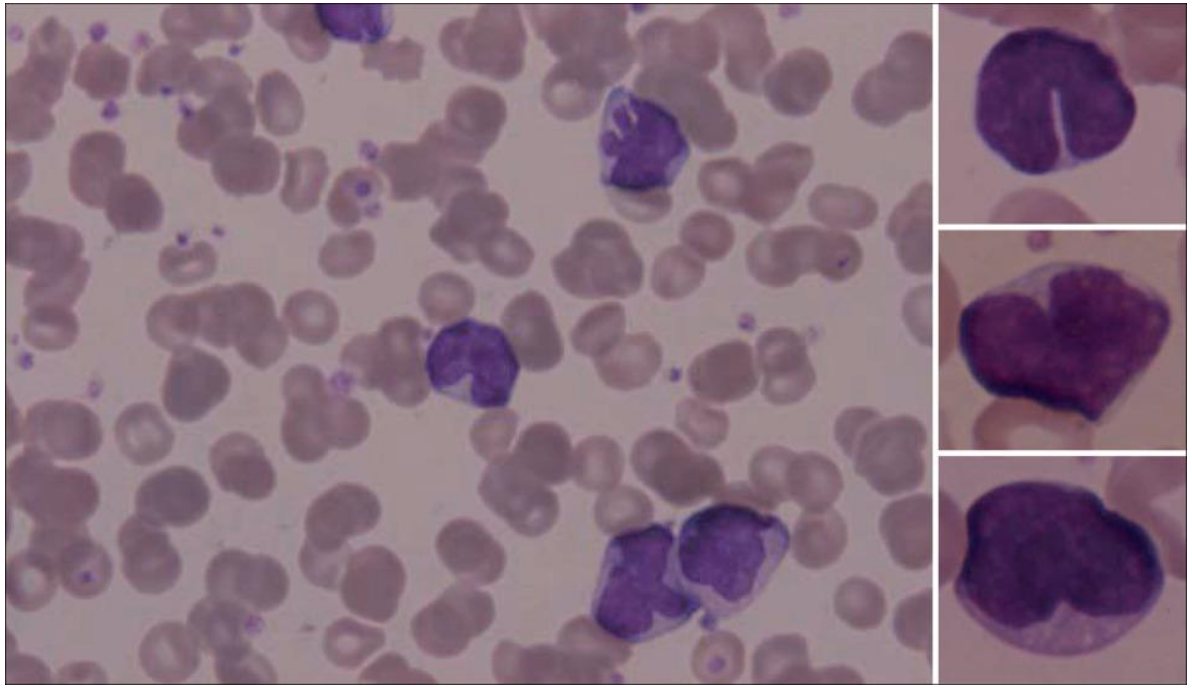
- Pneumonia
- Apnea or respiratory distress
- Seizures and encephalopathy
- Weight loss
- Pulmonary hypertension
- Hypotension/shock
- Kidney failure
- Death

Photo: https://www.cdc.gov/pertussis/hcp/clinical-signs/index.html

Clinical Signs

Lab finding – Lymphocyte predominant leukocytosis (in infants, the WBC count and lymphocyte count are directly correlated with disease severity)

CXR findings - normal or nonspecific, subtle abnormalities, such as peribronchial cuffing, perihilar infiltrates, or atelectasis



Funaki, Takanori et al, Lymphocytosis in a baby with pertussis. The Lancet Infectious Diseases, Volume 15, Issue 1, 130

Diagnosis and Testing

Diagnosis

- Acute cough illness of any duration and either:
  - PCR positive for *B. pertussis*, or
  - Culture positive for *B. pertussis*

- Elevated IgG antibodies to pertussis toxin in a person ≥11 years of age, provided that it has been ≥3 year since the last dose of pertussis-containing vaccine
  - At MA State Public Health Laboratory (MASPHL) only

Laboratory Testing

- Whenever possible, a nasopharyngeal (NP) swab or aspirate should be obtained from all suspected cases (PCR and culture)

- There are three types of acceptable diagnostic tests for pertussis:
  - Polymerase Chain Reaction (PCR) - can be an important tool for the rapid diagnosis of pertussis. PCR testing is more sensitive than culture, however PCR testing is less specific than culture.
  - Culture - a positive culture result is very specific for the diagnosis of pertussis, it is relatively insensitive
  - Serology - A single-point serologic assay has been validated at MA SPHL for persons aged 11 years or older and is used for clinical diagnosis and reporting. Only those serologic assays performed at the MA SPHL are acceptable for laboratory confirmation.

- Culture and serologic testing are available at no charge at the MASPHL

Laboratory Testing Recommendations

Time Since Cough Onset	Recommended Diagnostic Testing for Patients <11 Years of Age	Recommended Diagnostic Testing for Patients ≥11 Years of Age
<14 days	NP swab for culture and PCR. Serologic testing is not valid in children <11 years of age.	NP swab for culture and PCR
14 – 28 days		Serology at MA SPHL[1] -OR Serology at MA SPHL, and consider NP swab for culture and PCR
29 – 56 days		Serology at MA SPHL

[1] Serologic results for patients ≥ 11 years old who have received Tdap within the past 3 years are not interpretable.

Clinicians should begin antimicrobial therapy prior to test results if the clinical history is strongly suggestive of pertussis or the patient is at high risk of severe or complicated disease (infants, immunocompromised individuals, individuals with chronic lung disease).

Treatment and Post–Exposure Prophylaxis

Treatment

- The earlier treatment is started, the better.
- Treatment during the first 1 to 2 weeks before coughing paroxysms occur, symptoms may be lessened.
- Antibiotic treatment is indicated in all patients with a diagnosis of pertussis who present within 3 weeks of cough onset (highest risk period for transmission).
- 3 weeks after cough onset, cough may persist but is thought to be caused by tissue damage rather than active infection.
- Because shedding can persist for up to 6 weeks, the treatment window is extended for pregnant women who are near term to prevent transmission to neonates and infants younger than 1 year of age.
- Macrolides, such as azithromycin, are first line treatment

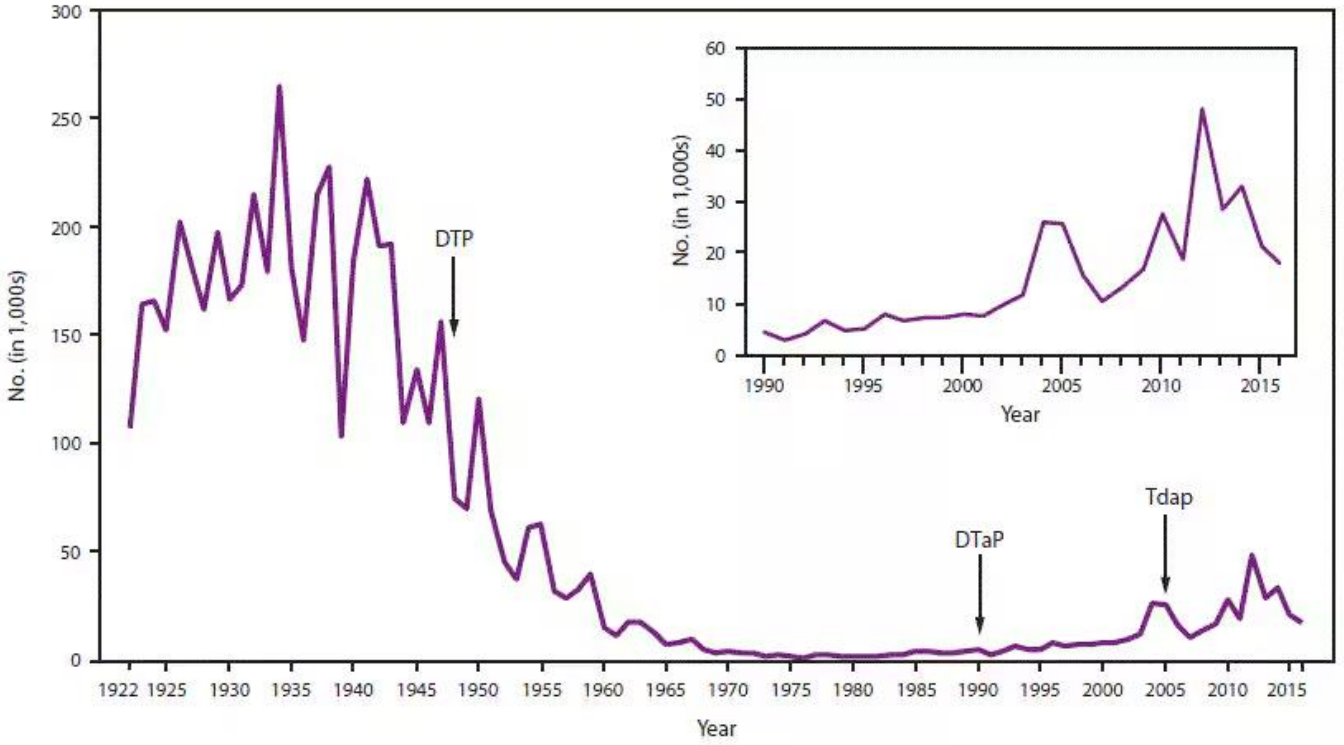
Post-exposure prophylaxis

- The primary objective of post-exposure prophylaxis (PEP) is to prevent death and serious complications in people at high risk of severe pertussis infection.
- CDC advises healthcare providers to prescribe antibiotics only when necessary. This can help reduce antibiotic resistance and protect against potential antibiotic side effects.
- CDC recommends post-exposure treatment/antibiotics for:
  - All asymptomatic household contacts of a pertussis case within 21 days of when the index case was last infectious
  - People at high risk of severe infection within 21 days of exposure to an infectious pertussis case
  - People in contact with those at high risk of severe infection within 21 days of exposure to an infectious pertussis case

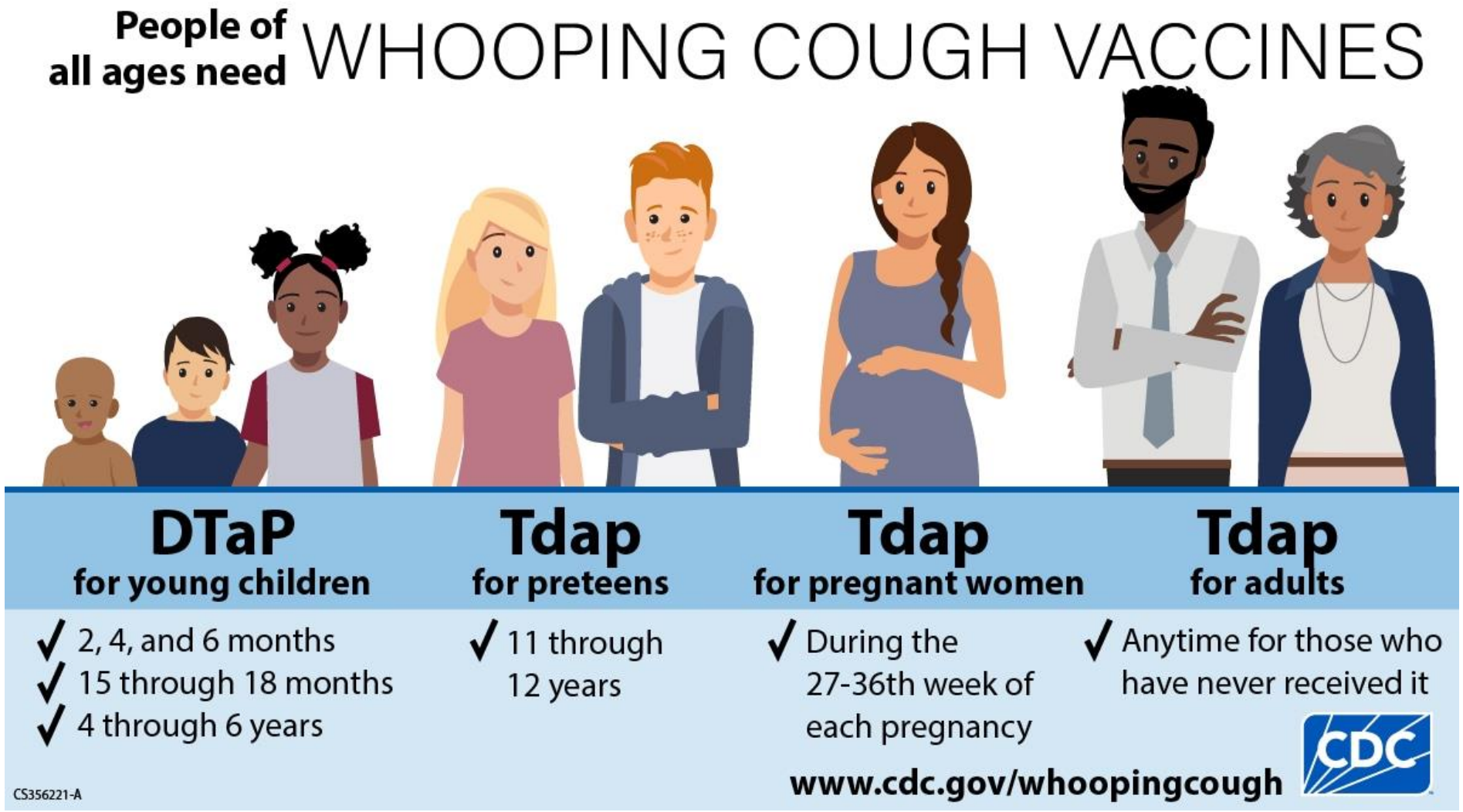
Vaccination

Vaccines

- First pertussis vaccines developed in 1914, but only became widely available in 1940's
- Introduction of vaccine associated with substantial decrease in disease incidence
- There are 2 types of combination vaccines that include protection against whooping cough:
  - DTaP
  - Tdap
- Unlike the older whole-cell pertussis vaccine, the acellular vaccine does not contain whole bacteria. Instead, it contains purified components of the pertussis bacteria, which include the pertussis toxin.



Pertussis: Vaccines



Pertussis: Vaccine Efficacy

- In studies demonstrating the efficacy of the pertussis component for children who get all 5 doses on schedule, DTaP fully protects:
  - 98% of children within the year following the last dose
  - About 71% of children 5 years after getting the last dose of DTaP

- In studies demonstrating the efficacy of the pertussis component, Tdap fully protects:
  - About 73% of adolescents in the first year after vaccination
  - About 34% of people 4 years after vaccination

- In studies demonstrating the efficacy of the pertussis component when women get Tdap during pregnancy, the vaccine prevents:
  - About 78% of pertussis cases in infants younger than 2 months old
  - About 90% of hospitalizations for infants younger than 2 months old with pertussis

Challenge Questions!

Question #1

- A pertussis outbreak is occurring in our town, with many cases happening in the schools. Is there a recommendation for boosting middle and high-school students with an additional dose of Tdap during an outbreak if students have already had 1 dose?

Question #2

- When can a student with whooping cough return to school?
- What about their close contacts?

Reporting to DPH

VPD control takes collaboration

Local Boards of Health – School Nurses – Childcare – Hospitals – Providers – Labs

Contact an Epidemiologist 24/7 at 617-983-6800

Report suspected and confirmed cases of VPDs!

- Notify patient of diagnosis/suspected diagnosis
- Provide key information to the LBOH/DPH to complete investigation

Control measures:

- Isolate patient if still infectious
- Educate patient about protecting their family and close contacts
- Inform patient that the LBOH/DPH may be calling
- Assist with notification and PEP
- Exclude susceptible individuals (staff, students, etc.)

List of Reportable Diseases

Resources

- MDPH Clinical Advisory 08-20-24
- MDPH Clinical Advisory Update 11-08-2024
- Childhood Vaccination Resources for Healthcare Providers | CDC
- MA Respiratory Dashboard
- CDC Respiratory Illness Overview
- Guide to Surveillance, Reporting and Control | Mass.gov
- Infectious Disease Case Report Forms (mass.gov)
- CDC Pink Book
- 105 CMR 300

Connect with DPH

@MassDPH

Massachusetts Department of Public Health

mass.gov/dph

Contact an Epidemiologist 24/7 at 617-983-6800

Thank you!