U.S. CENTERS FOR DISEASE CONTROL AND PREVENTION

2025 CDC Training for Vaccine-Preventable Disease (VPD) Surveillance

Session Content

- Meningococcal Disease
- Invasive Pneumococcal Disease
- *Haemophilus influenzae*
- Tetanus
- Pertussis
- Diphtheria
- Surveillance Indicators

Objectives

- Identify the 3 main levels of the national surveillance system for vaccine-preventable diseases.
- Describe the concept of surveillance indicators.
- Discuss the importance of case identification for surveillance.
- Describe appropriate mechanisms for surveillance.
- Describe the appropriate application of case definitions, including clinical description and case classification.
- List the most appropriate laboratory test(s) for surveillance.
- List epidemiologically important data to collect for surveillance.
- Describe one way that this educational activity will improve contributions as a team member.

Meningococcal Disease

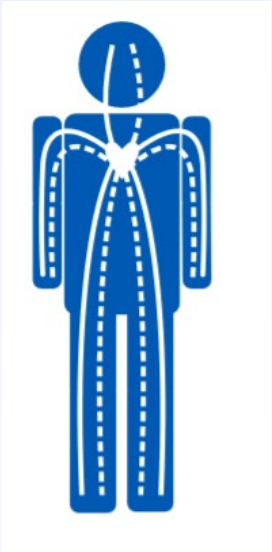
Surveillance Objectives: *Neisseria meningitidis*

- To characterize the burden of meningococcal disease in the United States
- To evaluate changes in the epidemiology of meningococcal disease over time
- To monitor the impact of meningococcal vaccines
- To guide public health policy and development of prevention and control strategies
- To monitor the molecular epidemiology of *Neisseria meningitidis*

Invasive meningococcal disease has three main clinical presentations

Invasive meningococcal disease has three main clinical presentations

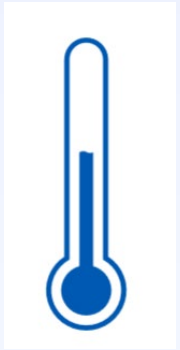
Meningitis



Bacteremia

Pneumonia

Early meningococcal disease symptoms are non-specific



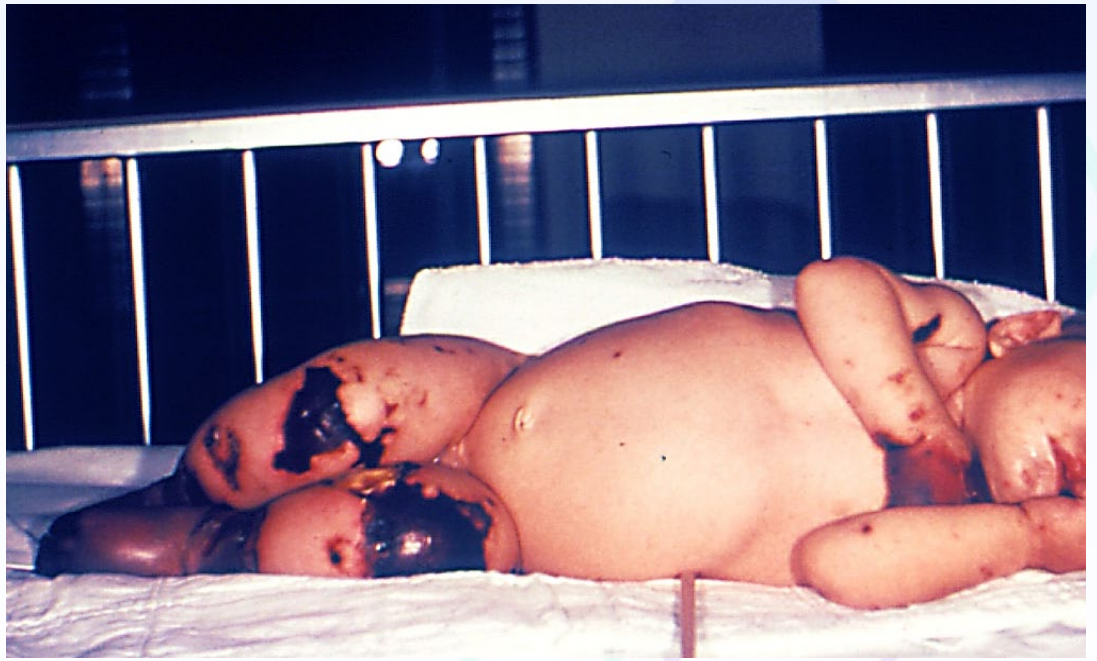
Nausea/ Vomiting

Stiff Neck

Fever

Early meningococcal disease symptoms are non-specific

Invasive disease is rapidly progressive



Even with treatment, morbidity and mortality are high

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~10-15%

of cases are fatal

Even with treatment, morbidity and mortality are high

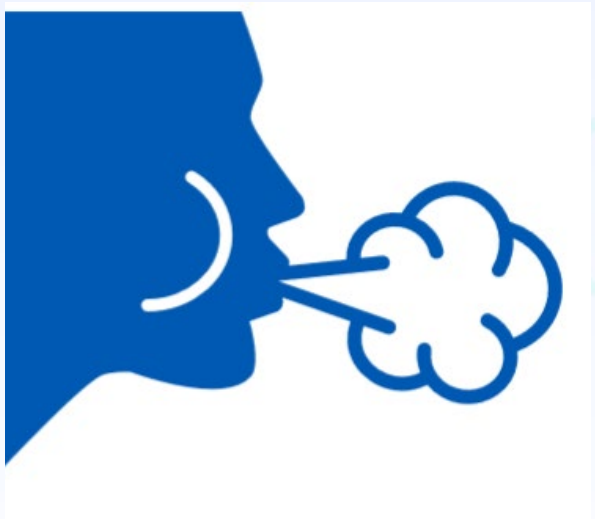
~10-15%

of cases are fatal

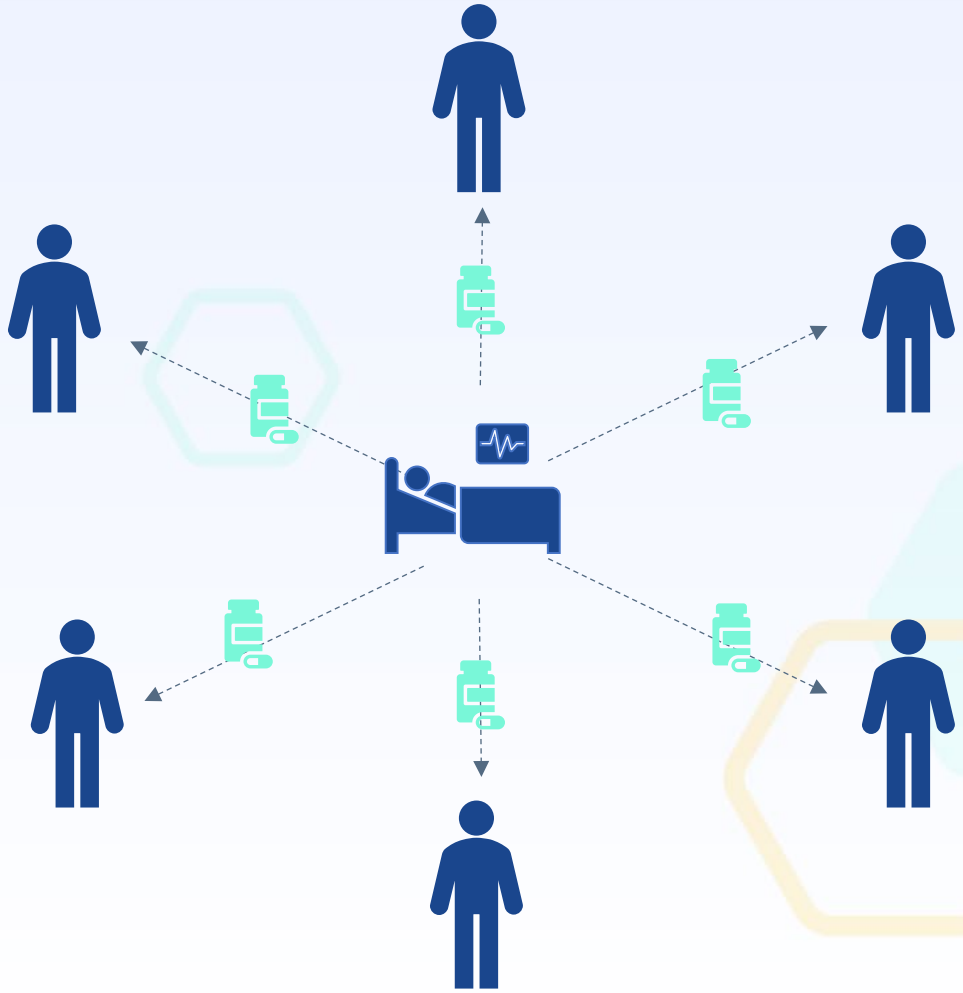
10-20% of survivors

have permanent sequelae

Meningococcal disease is transmitted person-to-person

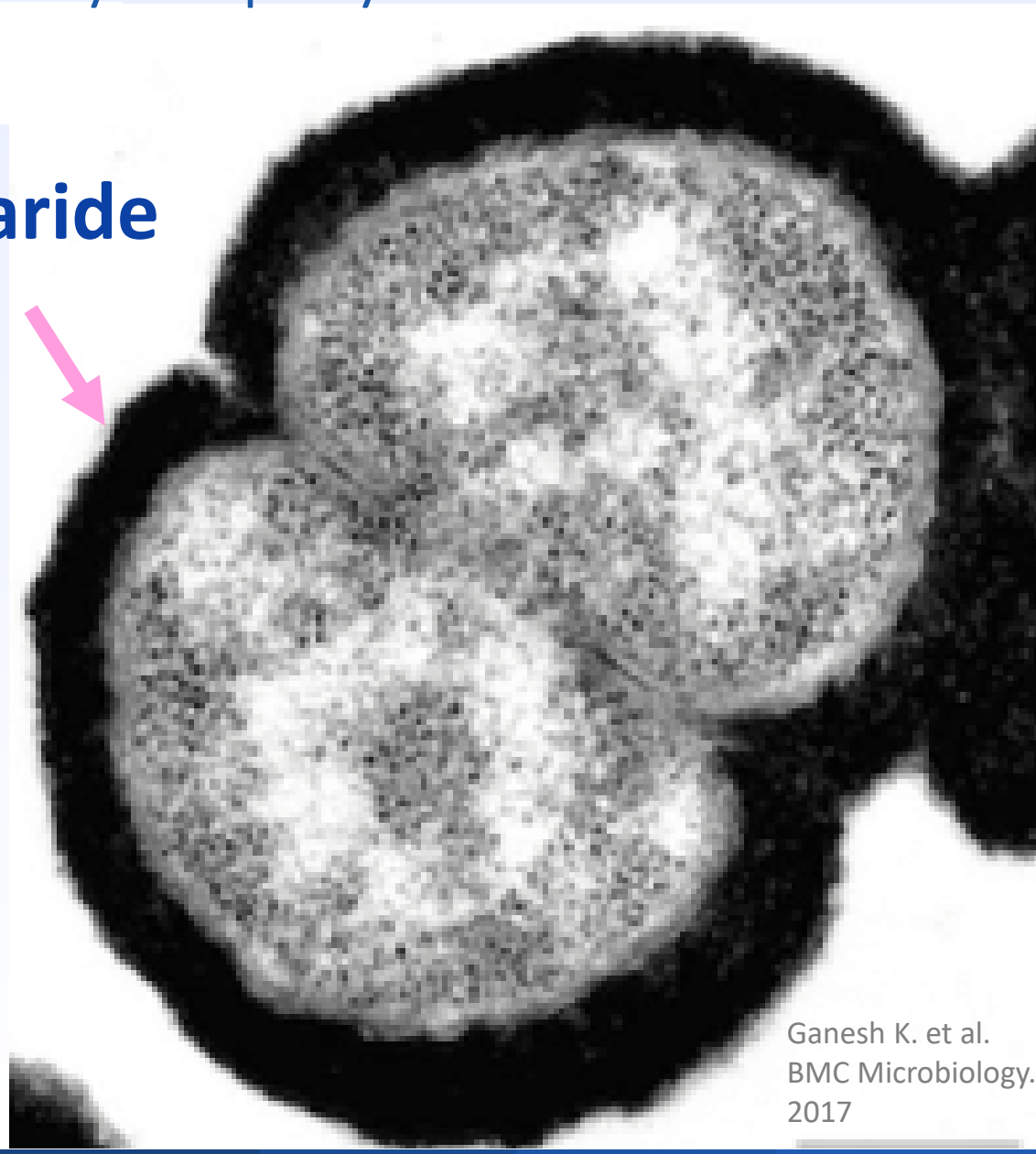


Antibiotic prophylaxis recommended for close contacts



Neisseria meningitidis is classified by its polysaccharide capsule

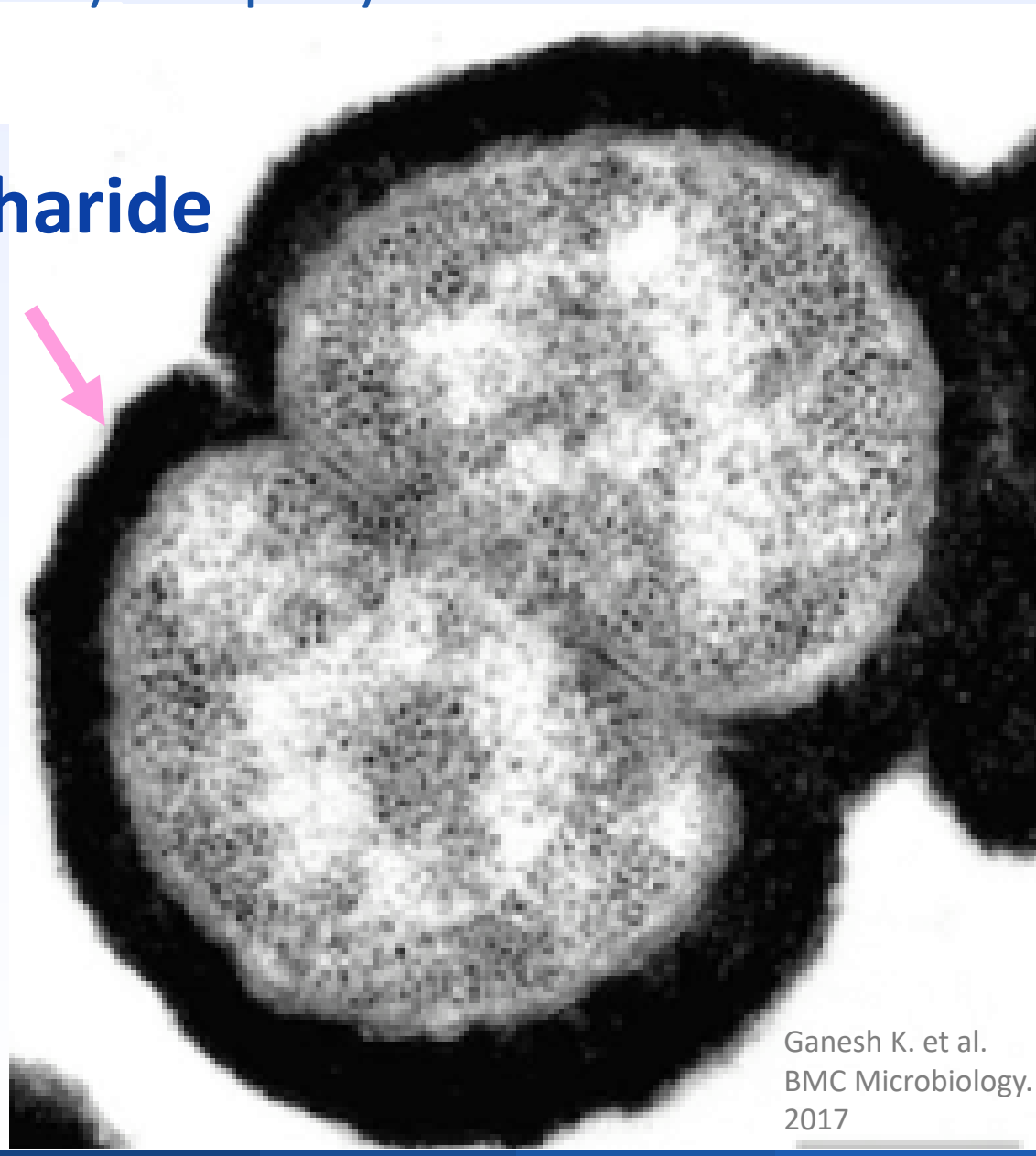
Polysaccharide capsule



Ganesh K. et al.
BMC Microbiology.
2017

Neisseria meningitidis is classified by its polysaccharide capsule

- **6 serogroups (A, B, C, W, X, and Y) cause most invasive disease worldwide**
  - B, C, and Y cause most disease in the US



Ganesh K. et al. BMC Microbiology. 2017

Risk factors for meningococcal disease

Risk factors for meningococcal disease

Pathogen Virulence Factors

capsule, adhesins, nutrient acquisition factors, endotoxin release

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capsule, adhesins, nutrient acquisition factors, endotoxin release

Host Factors

deficiencies in terminal complement pathway, asplenia, HIV infection

Risk factors for meningococcal disease

Pathogen Virulence Factors

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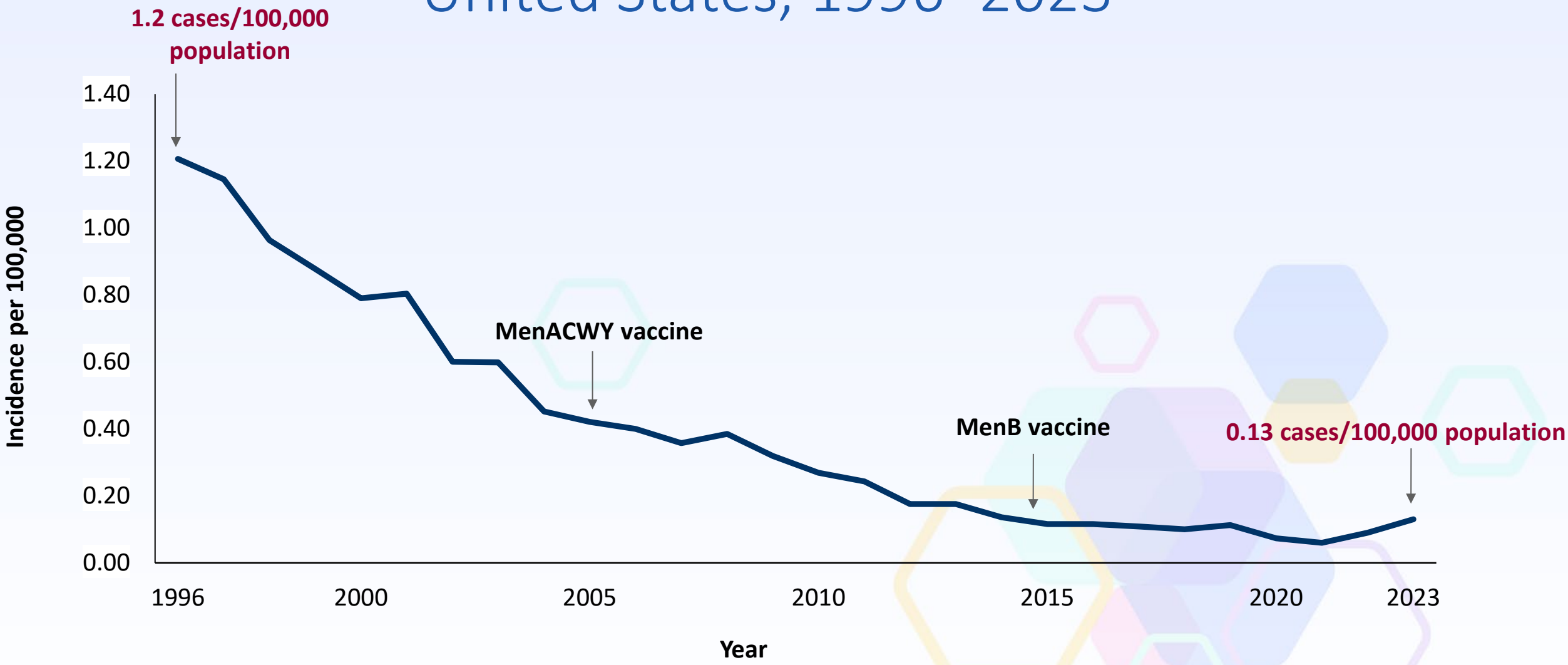
Host Factors

deficiencies in terminal complement pathway, asplenia, HIV infection

Population/ Environmental Factors

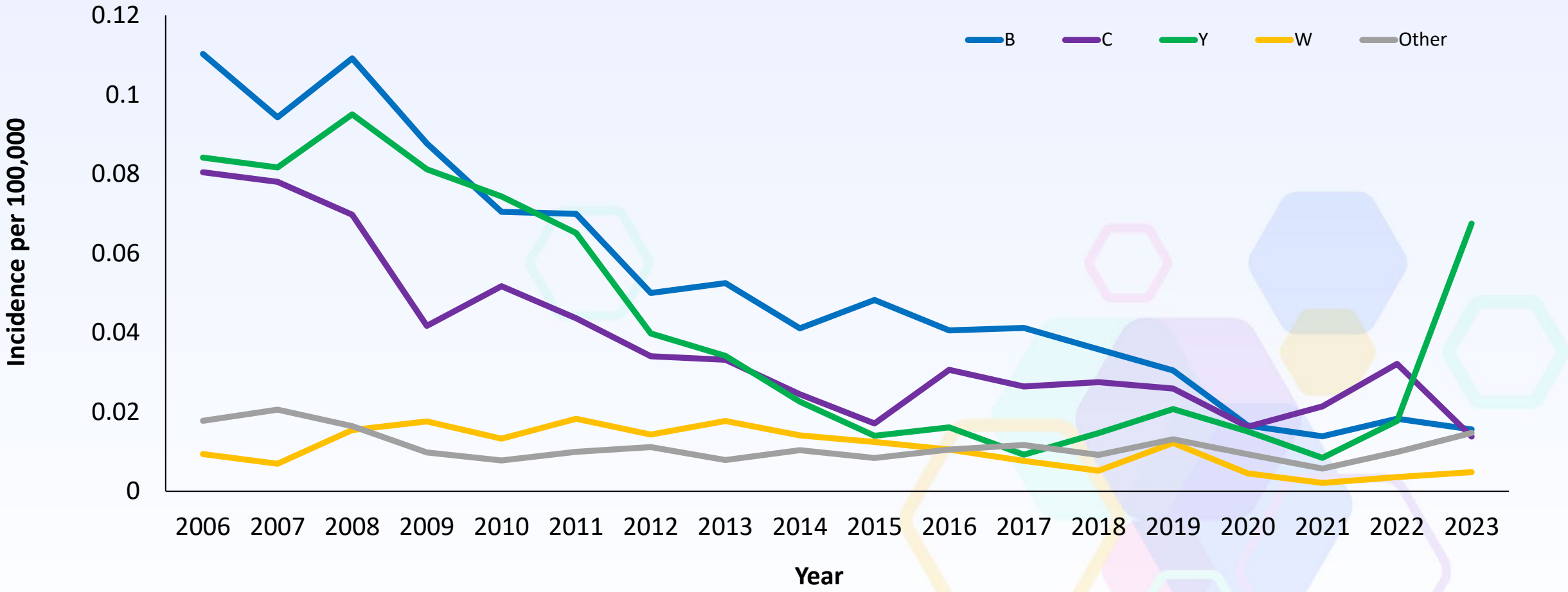
household exposure, crowding, demographic and socio-economic factors, active/passive smoking, concurrent upper respiratory infections

Meningococcal Disease Incidence – United States, 1996–2023*



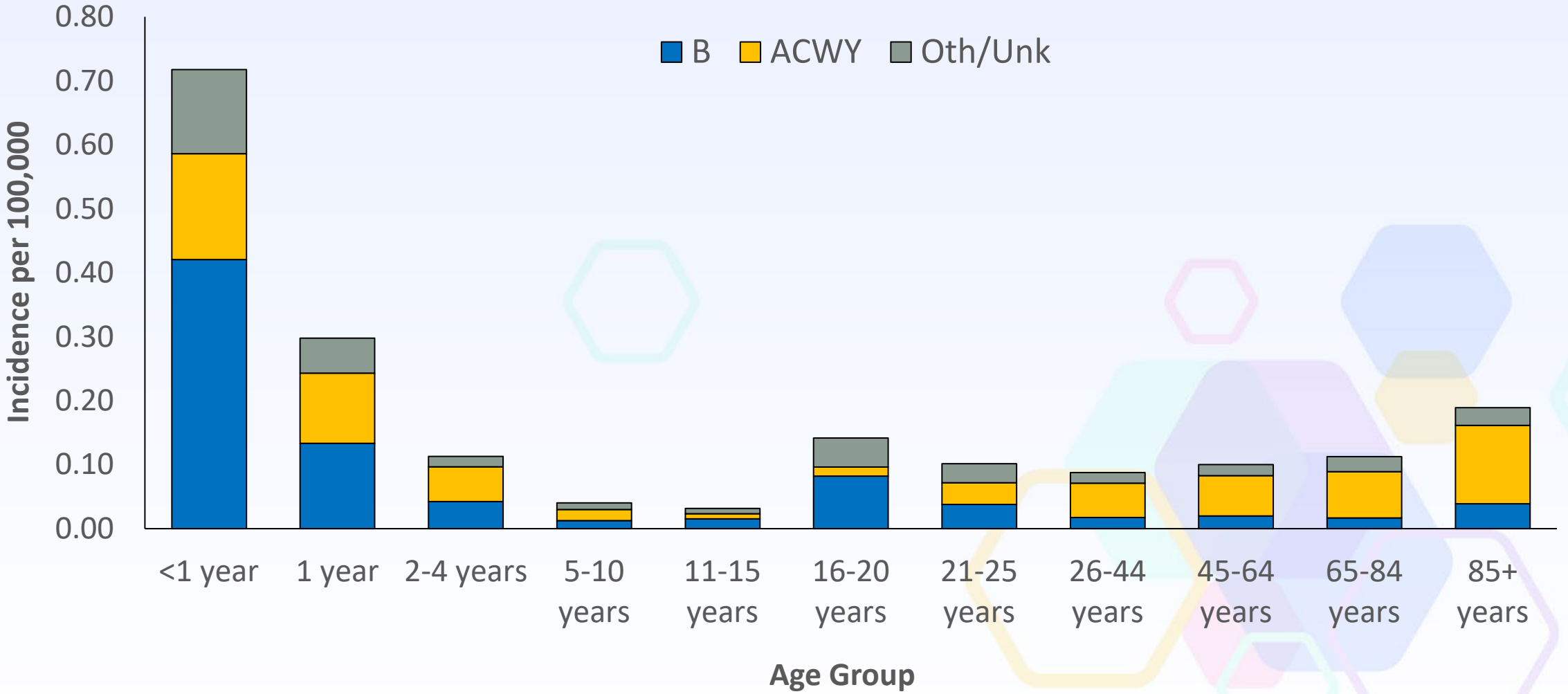
Abbreviations: MenACWY vaccine = quadrivalent (serogroups A, C, W, and Y) meningococcal conjugate vaccine; MenB vaccine = serogroup B meningococcal vaccine
Source: 1996–2023 NNDSS Data. *2023 NNDSS data are preliminary.

Trends in Meningococcal Disease Incidence by Serogroup – United States, 2006–2023*



Source: NNDSS data with additional serogroup data from Active Bacterial Core surveillance (ABCs) and state health departments
*2023 data are preliminary

Average Annual Meningococcal Disease Incidence by Age Group and Serogroup—United States, 2014–2023



Source: NNDSS data with additional serogroup data from ABCs and state health departments
*2023 data are preliminary.

Antibiotic-resistant N. meningitidis

- Resistance to ciprofloxacin is an increasing concern

- Jurisdictions seeing ciprofloxacin-resistant cases should consult guidance* on the CDC website for when to discontinue use of ciprofloxacin for prophylaxis

* Public Health Strategies for Antibiotic-resistant *Neisseria meningitidis*; Selection of Antibiotics as Prophylaxis for Close Contacts of Patients with Meningococcal Disease in Areas with Ciprofloxacin Resistance — United States, 2024

Licensed Meningococcal Vaccine Products, U.S.

Vaccine	Type	Manufacturer	Serogroups	Ages
~~Menactra~~	~~Conjugate – Diphtheria toxoid~~	~~Sanofi Pasteur~~	~~A, C, W, Y~~	~~9 months–55 years~~
Menveo	Conjugate –CRM_{197}	Novartis/GSK Vaccines	A, C, W, Y	2 months–55 years 10-55 years (1 vial)
MenQuadfi	Conjugate –Tetanus toxoid	Sanofi Pasteur	A, C, W, Y	≥2 years
Trumenba	Protein	Pfizer Vaccines	B	10–25 years
Bexsero	Protein	Novartis/GSK Vaccines	B	10–25 years
Penbraya	Combination MenACWY+MenB	Pfizer Vaccines	A,B,C,W,Y	10–25 years

Current ACIP MenACWY vaccine recommendations

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Adolescents

- Dose 1 at 11-12 yrs
- Booster dose at age 16 yrs

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People ≥2mo old at increased risk

- Complement deficiency, asplenia, HIV
- Microbiologists, college freshmen, military recruits
- People who travel to/reside in hyperendemic or epidemic countries

Current ACIP MenACWY vaccine recommendations

Adolescents

- Dose 1 at 11-12 yrs
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People ≥2mo old at increased risk

- Complement deficiency, asplenia, HIV
- Microbiologists, college freshmen, military recruits
- People who travel to/reside in hyperendemic or epidemic countries

People at increased risk during an outbreak

Current ACIP MenB vaccine recommendations

People ≥10 yrs old at increased risk

- Complement deficiency, asplenia
- Microbiologists
- During an outbreak

Current ACIP MenB vaccine recommendations

People ≥10 yrs old at increased risk

- Complement deficiency, asplenia
- Microbiologists
- During an outbreak

Adolescents

At age 16-23 yrs

(preferably at 16-18 yrs)

based on shared clinical decision-making

Meningococcal Disease Surveillance in the U.S.

- National Notifiable Diseases Surveillance System (NNDSS)
- Active Bacterial Core surveillance (ABCs)

Enhanced Meningococcal Disease Surveillance

- Enhanced Meningococcal Disease Surveillance implemented in 2015
- Part of the Epidemiology and Laboratory Capacity (ELC) Vaccine-Preventable Diseases (VPD) Surveillance Project
- Goals:
  - Collect data on key variables at CDC for monitoring meningococcal disease epidemiology and informing vaccine policy decisions
  - Collect meningococcal isolates from all cases
- Data and isolates are routinely collected from all state health departments and several large jurisdiction health departments

Case Definition for National Reporting of Meningococcal Disease

- **Confirmed Case:**
  - Isolation of *N. meningitidis*
    - From a normally sterile body site (e.g., blood, cerebrospinal fluid (CSF), less commonly, synovial, pleural, pericardial fluid); or
    - From purpuric lesions
  - Detection of *N. meningitidis*-specific nucleic acid in a specimen obtained from a normally sterile body site (e.g., blood, CSF), using a validated polymerase chain reaction (PCR) assay
- **Probable case:**
  - Detection of *N. meningitidis* antigen
    - In formalin-fixed tissue by immunohistochemistry (IHC); or
    - In CSF by latex agglutination

Critical Data for Meningococcal Disease Case Investigations

- Demographic
- Clinical
- Risk factors
- Laboratory testing to identify serogroup
- Vaccination history

Invasive Pneumococcal Disease

Pneumococcal Disease

- Caused by *Streptococcus pneumoniae*
- A leading cause of bacterial pneumonia, meningitis, and bacteremia worldwide
- Groups at increased risk for pneumococcal disease include:
  - Children age <5 years
  - Older adults
  - Persons with chronic or immunocompromising medical conditions
- Invasive pneumococcal disease (IPD)
  - Defined as pneumococcus isolated from a sterile site (e.g., blood)
  - Less frequent, but more severe form of infection
- Estimated 30,000 IPD cases and 3,000 deaths annually in the United States[1]
- Over 100 serotypes of *S. pneumoniae*
  - Serotypes vary in their ability to cause disease

[1] https://www.cdc.gov/abcs/bact-facts/data-dashboard.html

Surveillance Objectives: Invasive Pneumococcal Disease (IPD)

- Measure the burden of IPD among persons of all ages
- Characterize national and local IPD trends
- Track emerging antibiotic resistance
- Evaluate the impact of pneumococcal vaccines on disease burden
- Inform future vaccine development

Pneumococcal Vaccines

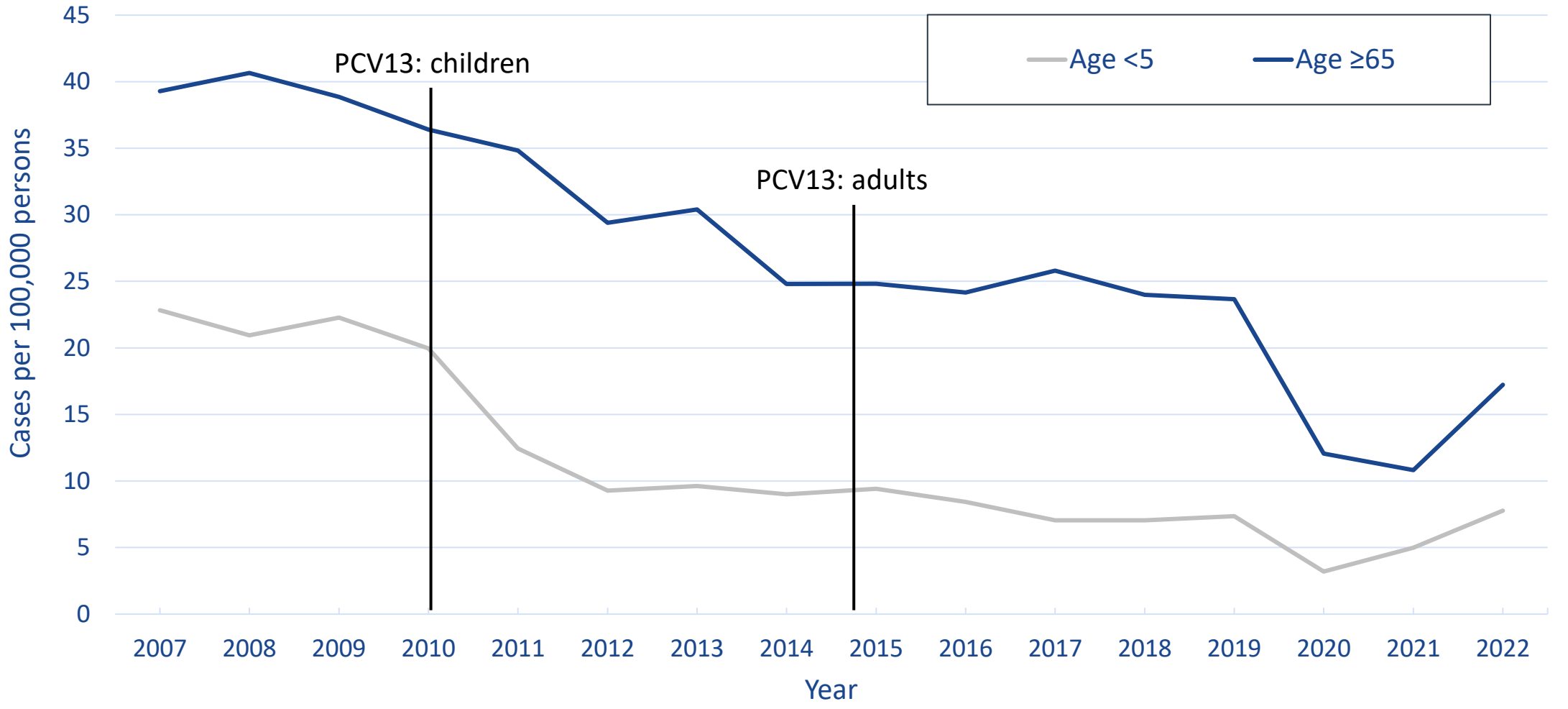
- **Polysaccharide Vaccine**
  - PPSV23, available since 1983
- **Conjugate Vaccines**
  - PCV7, introduced in 2000
  - PCV13, introduced in 2010
  - 3 new higher-valency vaccines introduced in the past 3 years (2021-2024)
    - PCV15, PCV20 (children and adults)
    - PCV21 (adults)

CDC Surveillance Platforms: IPD

- **Active Bacterial Core Surveillance (ABCs)**
  - Active, laboratory and population-based surveillance
  - 10 sites in U.S. (~10% of U.S. population)
  - Obtain ~90% of isolates for routine serotyping and antimicrobial susceptibility testing (AST)
- **Nationally Notifiable Diseases Surveillance System (NNDSS)**
  - All U.S. reporting jurisdictions
  - Enhanced IPD surveillance is an optional activity through ELC
  - Efforts made to obtain serotype, AST, and vaccination history

Sources: https://www.cdc.gov/abcs/about/surv-areas-and-populations.html
https://www.cdc.gov/nndss/index.html

IPD incidence rate, by age group, 2007 – 2022



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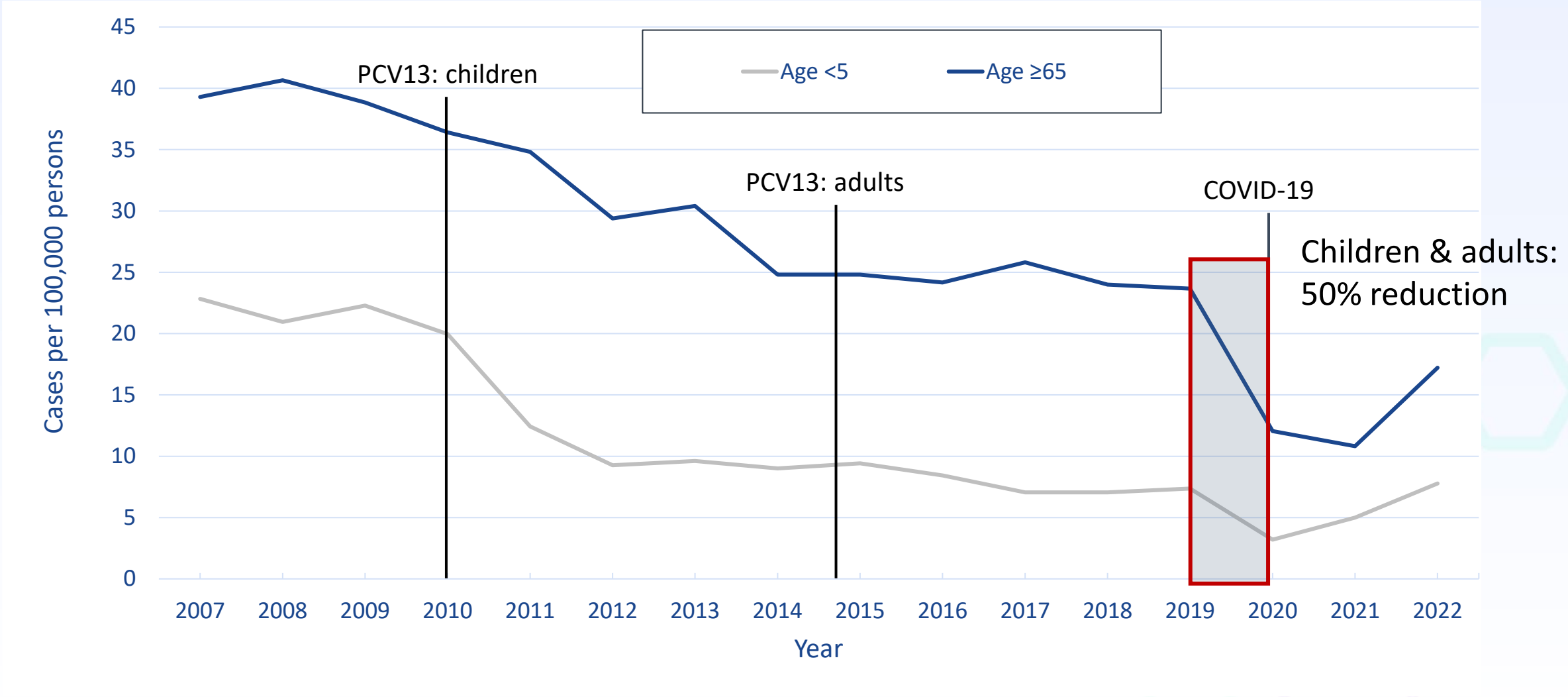

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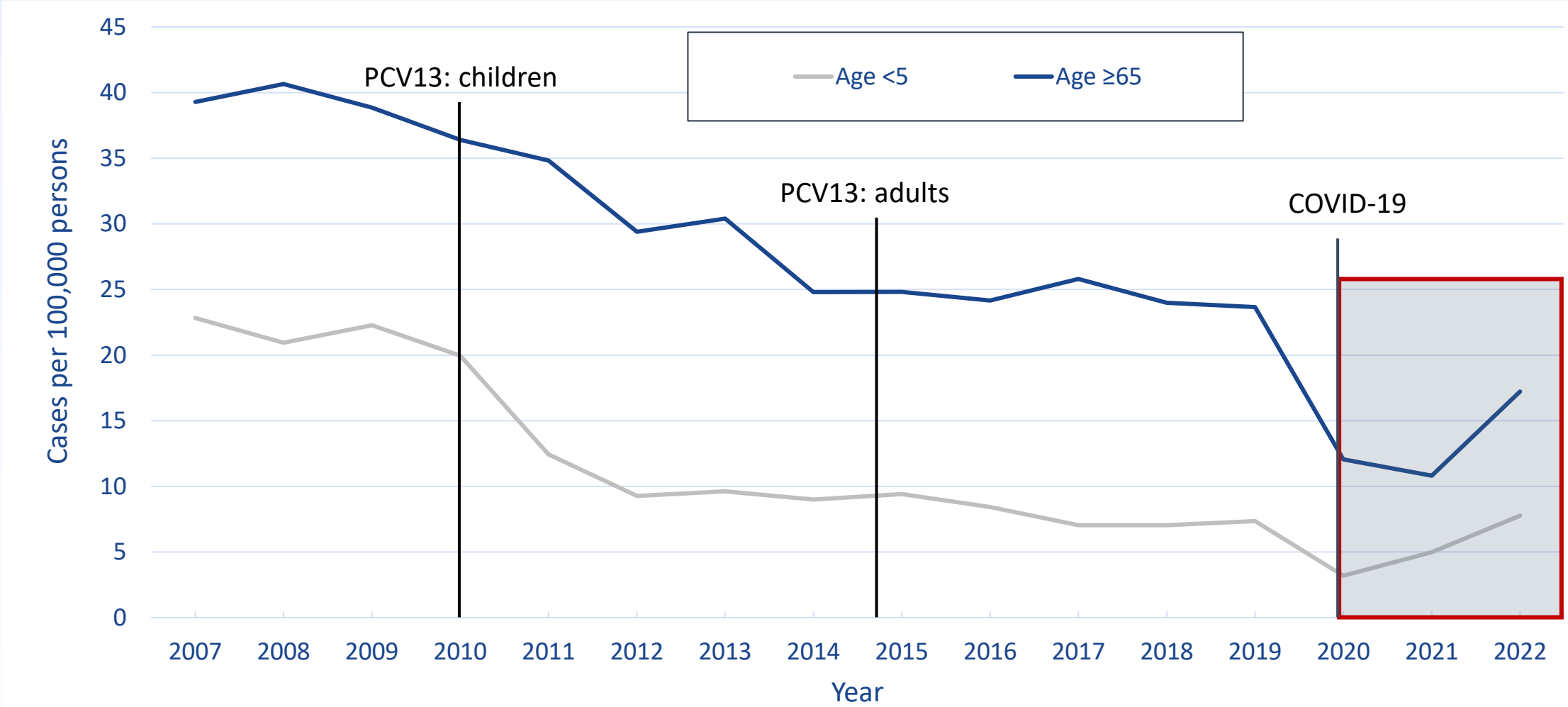

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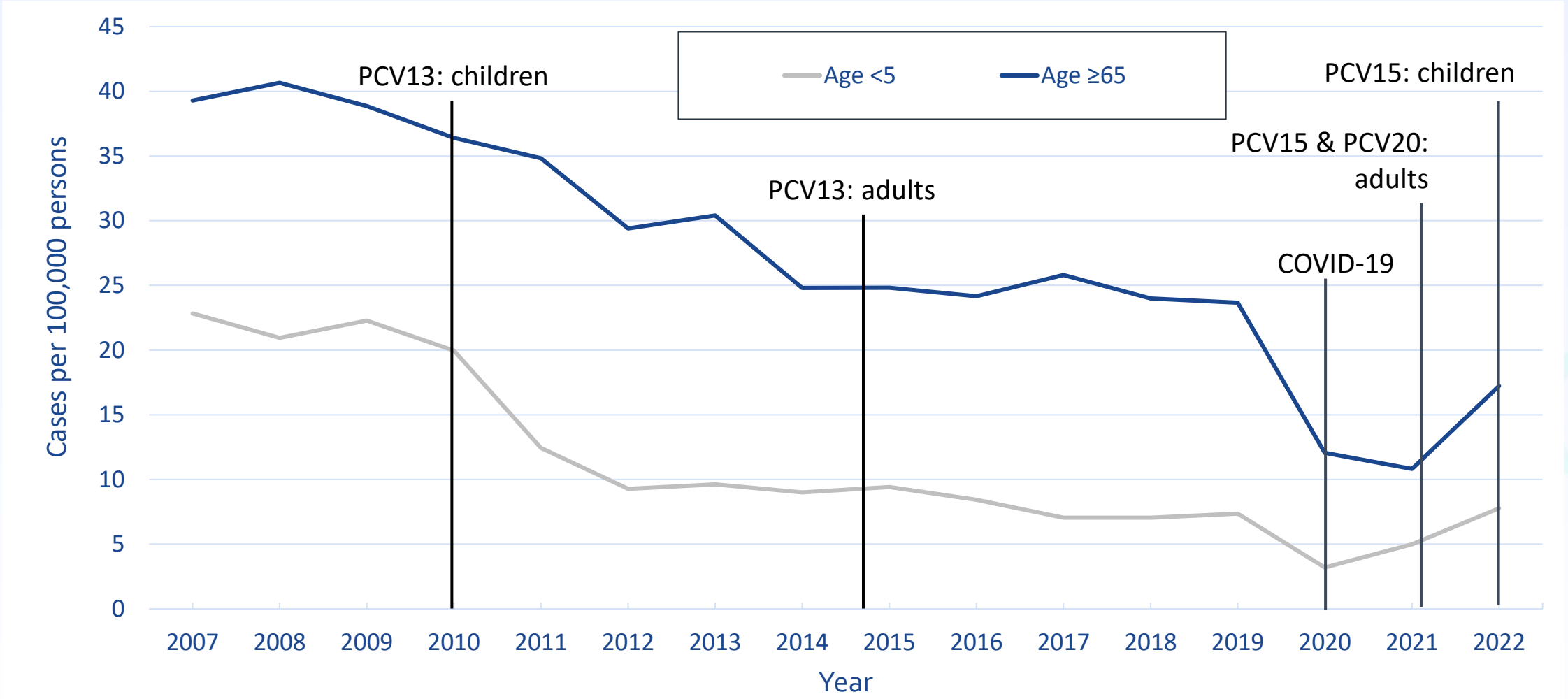


CSTE case definition for national reporting of IPD

- **Confirmed:**
  Isolation of *S. pneumoniae* from a normally sterile site (e.g., blood, cerebrospinal fluid, or, less commonly, joint, pleural or pericardial fluid) in a person of any age. (Event code 11723)

- **Probable:**
  Identification of *S. pneumoniae* from a normally sterile body site by a culture independent diagnostic test (CIDT) without isolation of the bacteria.

Source: https://ndc.services.cdc.gov/case-definitions/invasive-pneumococcal-disease-2017/

Core data for IPD case investigation

- Demographic
- Clinical
- Vaccination History
- Risk factors [1]

[1] https://www.cdc.gov/pneumococcal/hcp/clinical-overview/index.html

Resources for serotyping and antimicrobial susceptibility testing (AST) of *S. pneumoniae* isolates

- **State public health or commercial/clinical labs**
  - Polymerase Chain Reaction (PCR)
  - Phenotypic (Quellung)
  - Whole-Genome Sequencing (WGS)
- **CDC Antibiotic Resistance Laboratory Network (ARLN)**
  - 2 CDC-funded reference laboratories
  - Perform CLIA[1] approved serotyping and AST on isolates that meet certain criteria
- **CDC *Streptococcus* Laboratory**
  - Perform non-CLIA[1] serotyping and AST
  - Outbreak investigations or isolates with unusual resistance features

[1]CLIA- Clinical Laboratory Improvement Amendments

Resources for serotyping and antimicrobial susceptibility testing (AST) of *S. pneumoniae* isolates

CDC PCR serotyping protocol:
https://www.cdc.gov/strep-lab/php/pneumococcus/serotyping-using-pcr.html

Antibiotic Resistance Laboratory Network (ARLN):
https://www.cdc.gov/antimicrobial-resistance-laboratory-networks/php/about/testing-services.html

ARLN pneumococcal testing information:
https://www.cdc.gov/antimicrobial-resistance-laboratory-networks/media/pdfs/Clinical-Labs_Strep-Isolates-FS-508.pdf

CDC *Streptococcus* Laboratory (non-CLIA) pneumococcal testing information:
https://www.cdc.gov/strep-lab/php/testing-request/index.html

Invasive Pneumococcal Disease Presentation- Chicago

Chicago Department of Public Health

Haemophilus influenzae

Haemophilus influenzae

- Encapsulated or unencapsulated
- Polysaccharide capsule
  - Six antigenically distinct types designated by the letters a through f
- Unencapsulated strains referred to as nontypeable

Clinical Syndromes

- **Invasive disease:** bacteremia, meningitis, epiglottitis, cellulitis, septic arthritis, pneumonia*
- **Non-invasive disease:** ear infections and bronchitis

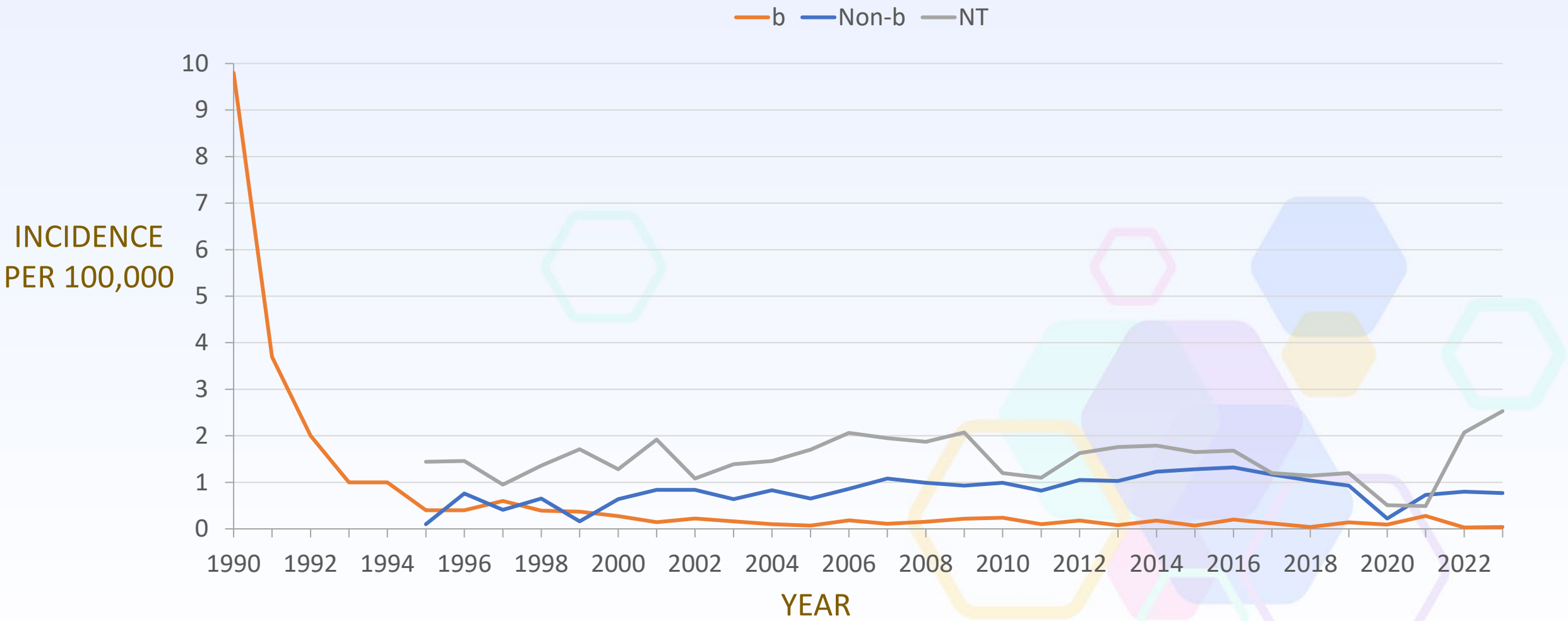
* Pneumonia is considered invasive when *H. influenzae* also infects the blood or pleural fluid.

Haemophilus influenzae Type b (Hib) in the U.S.

- Pre-vaccine era (before 1990*):
  - Estimated 20,000 cases of invasive Hib disease annually among children younger than 5 years of age
  - Leading cause of bacterial meningitis
- Post-vaccine introduction (1990–present)
  - 20 to 40 cases reported per year among children younger than 5 years of age

*The first polysaccharide Hib vaccine was introduced in the United States in 1985, followed by conjugate Hib vaccines in 1987 and 1989.

Invasive *H. influenzae* Disease among Children Aged <5 Years—United States, 1990–2023



Sources: 1990–1994: https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6301a1.htm?s_cid=rr6301a1_w. Data not available on non-b or nontypeable strains.
1995–2023: Active Bacterial Core Surveillance. 2023 Data is preliminary

Diagnosis of *H. influenzae*

- Identification of *H. influenzae* from a normally sterile site:
  - Culture for the isolation of *H. influenzae*, OR
  - Polymerase chain reaction (PCR) for the detection of *H. influenzae*-specific nucleic acid
- Serotyping should be performed for every case of invasive disease
  - Not all PCR assays can detect and differentiate *H. influenzae* serotypes
  - Laboratories performing PCR are encouraged to also perform culture or save clinical specimens for further testing

H. influenzae Serotyping

- Serotype b is the only serotype preventable by vaccination
- Chemoprophylaxis is recommended for close contacts of serotype b disease
- Serotype b disease in a vaccinated person may prompt additional evaluation of the person's immune system
- Laboratory support for *H. influenzae* serotyping is available through state public health laboratories

Invasive *H. influenzae* Disease Case Investigation: Information to Collect

- Demographic information
- Clinical data
  - Clinical syndrome
  - Dates of hospitalization
  - Outcome of the illness
- Results of laboratory testing
  - Serotype
  - Specimen source
  - Date of first positive culture
  - Antibiotic susceptibility
- Vaccination status (cases of Hib or unknown serotype)
  - Date
  - Manufacturer
  - Lot number
- Risk factors for Hib disease
  - Child care attendance
  - Race and ethnicity

Invasive Hib disease: Control Measures

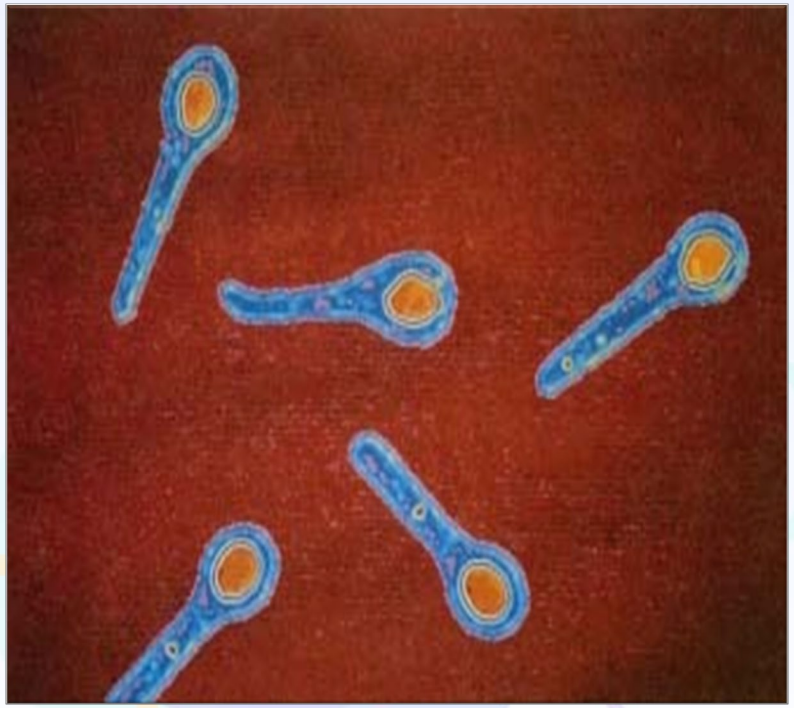
- Rifampin chemoprophylaxis recommended for:
  - All household contacts, if the household has at least one:
    - Member aged <4 years who is not fully vaccinated
    - Member aged <18 years who is immunocompromised, regardless of vaccination status
  - Childcare contacts, regardless of age and vaccination status, when
    - Two or more cases of invasive Hib disease have occurred within 60 days **and**
    - Unimmunized or underimmunized children attend the facility
  - Index patients who are
    - Treated with an antibiotic other than ceftriaxone or cefotaxime **and**
    - Aged <2 years

- For cases of invasive *H. influenzae* type a disease, the American Academy of Pediatrics (AAP) Red Book states clinicians may consider using a similar chemoprophylaxis approach as for invasive Hib disease

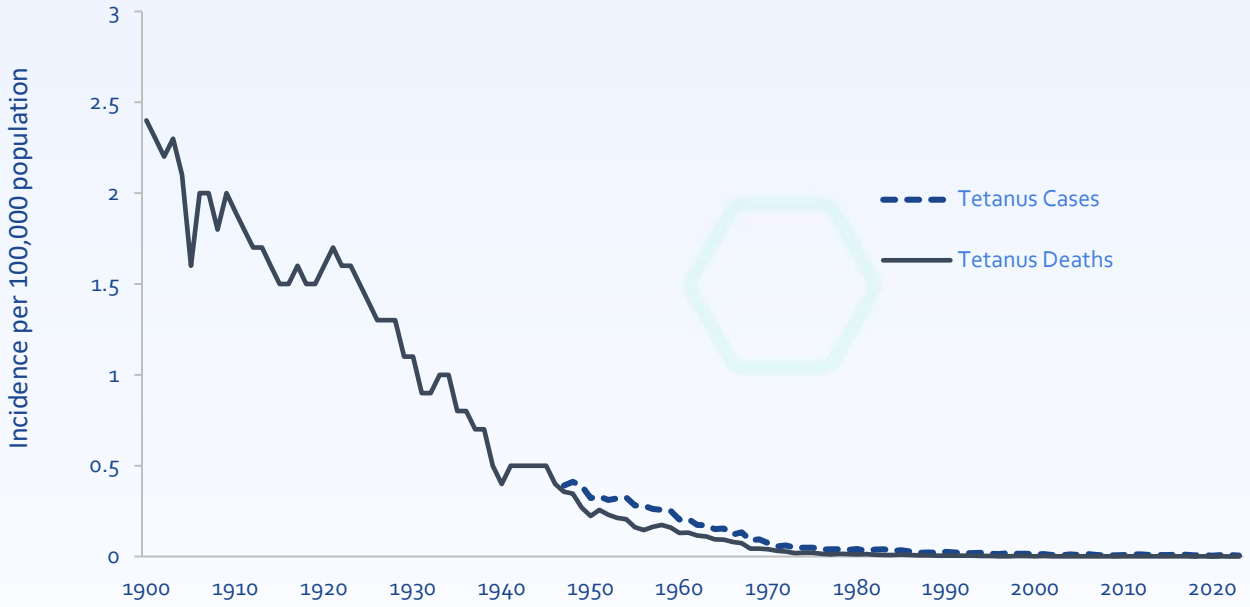
Tetanus

Tetanus Disease

- Caused by spore-forming bacterium *Clostridium tetani* that is common in the environment including in soil, dust, and manure
- *C. tetani* enter the body, germinate, and produce a potent toxin, tetanospasmin
- Uncommon but acute, potentially fatal, disease characterized by generalized rigidity, convulsive spasms of skeletal muscles, and trismus (lockjaw)
- Tetanus is not transmitted from person to person (non-communicable)

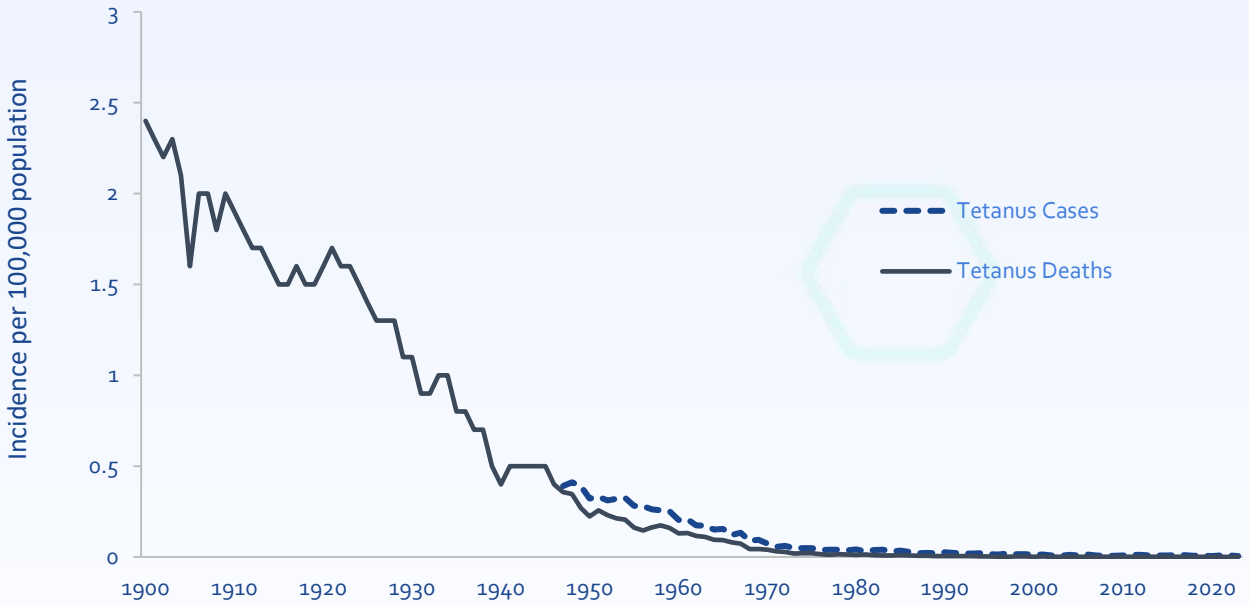


Reported Tetanus Cases and Deaths



Mortality and incidence rates of tetanus reported in the United States, 1900–2022

Reported Tetanus Cases and Deaths



Mortality and incidence rates of tetanus reported in the United States, 1900–2022

During 2013-2022:

- Each year:
  - ~ 27 tetanus cases
  - ~ 1 tetanus death
- Highest incidence among people aged >80 years
- All tetanus-related deaths among patients aged >60 years

Tetanus-toxoid-containing vaccines in the U.S.

For children (<7 years)		
Components	**Name**	**Manufacturer**
DTaP	DAPTACEL INFANRIX	Sanofi Pasteur GlaxoSmithKline
DTaP + IPV	KINRIX QUADRACEL	GlaxoSmithKline Sanofi Pasteur
DTaP + IPV + HepB	PEDIARIX	GlaxoSmithKline
DTaP + IPV + Hib	PENTACEL	Sanofi Pasteur
DTaP + IPV + HepB + Hib	VAXELIS	Sanofi Pasteur

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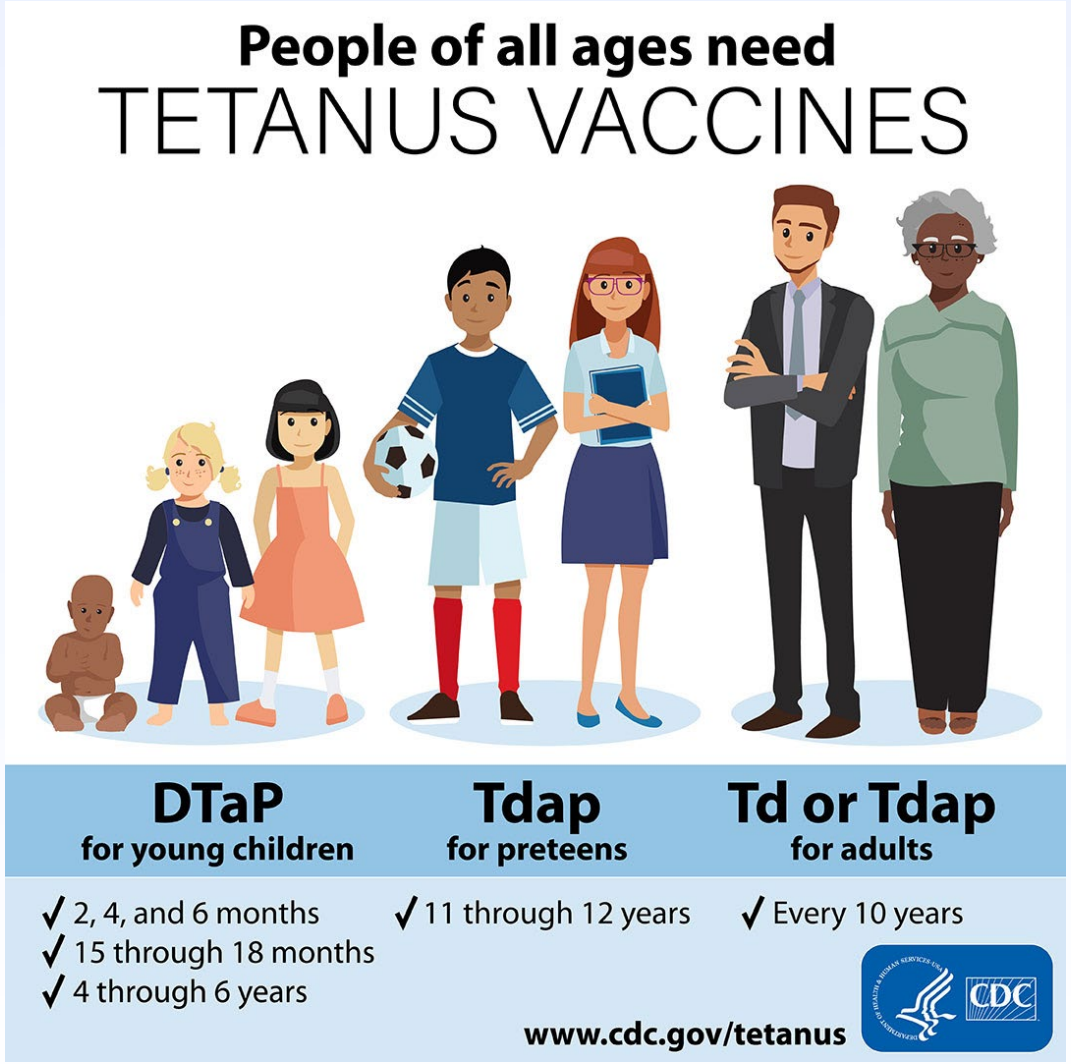
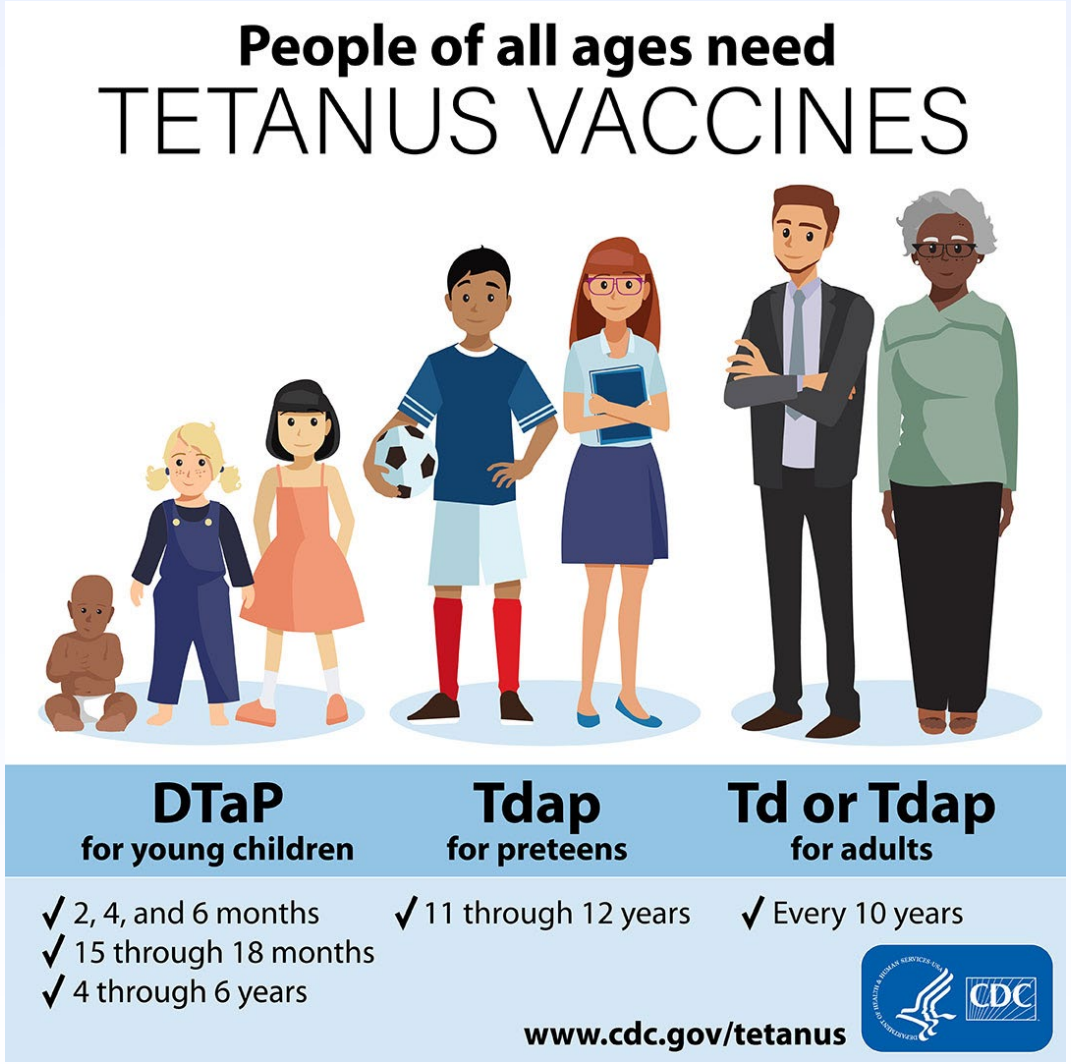
DTaP + IPV + HepB	PEDIARIX	GlaxoSmithKline
DTaP + IPV + Hib	PENTACEL	Sanofi Pasteur
DTaP + IPV + HepB + Hib	VAXELIS	Sanofi Pasteur

For older children, adolescents and adults (≥7 years)		
Components	**Name**	**Manufacturer**
Tdap	ADACEL BOOSTRIX	Sanofi Pasteur GlaxoSmithKline
Td	TENIVAC	Sanofi Pasteur

Tetanus vaccine recommendations in the U.S.



Tetanus vaccine recommendations in the U.S.



Tetanus Vaccines are Very Effective

>99% Seroprotection

Risk Factors for Tetanus

Nearly all U.S. tetanus cases today are among adults who either

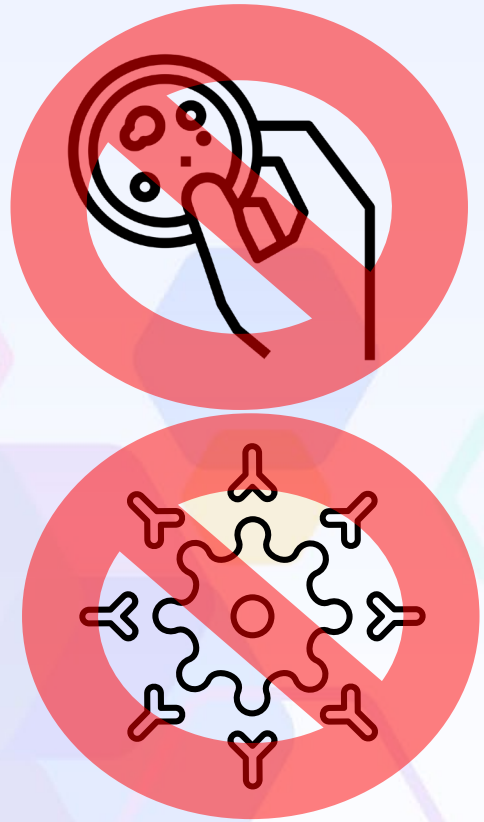
- Never received a tetanus vaccine
- Didn't stay up to date with their 10-year tetanus booster shots

Other risk factors for tetanus include:

- Being age 70 years or older
- Having diabetes
- Immunosuppression
- Using intravenous drugs

Tetanus Diagnosis

- Tetanus is a clinical syndrome.
- Diagnosis of tetanus based on clinical presentation consistent with tetanus, in the absence of an alternative or more likely cause.
- There are no diagnostic tests that can support or rule out tetanus.
  - Culture can lead to both false-positive and false-negative results.
  - Serologic studies can’t reliably evaluate individual-level tetanus immunity.

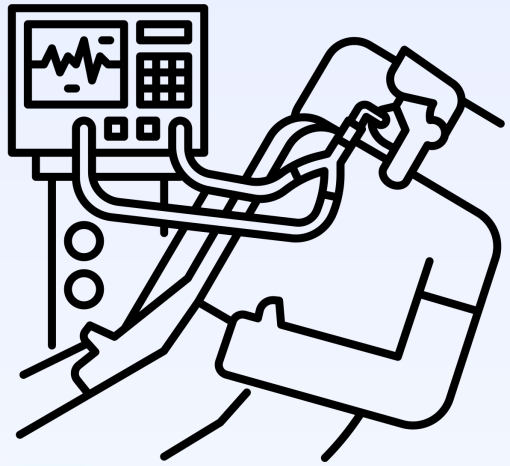


Treatment

Administer TIG

- Single, 500 international unit (IU) dose
- TIG is commercially available (not provided by CDC)
- Removes unbound tetanus toxoid but cannot affect toxin already bound to nerve endings

Maintain an airway



Control muscle spasms

Manage wounds and treat infections

Provide antimicrobial therapy

Case Definition for National Reporting of Tetanus

Probable

- In the absence of a more likely diagnosis, an acute illness with
  - muscle spasms or hypertonia, AND
  - diagnosis of tetanus by a health care provider;

OR

- Death, with tetanus listed on the death certificate as the cause of death or a significant condition contributing to death

Case Definition for National Reporting of Tetanus

Probable

- In the absence of a more likely diagnosis, an acute illness with
  - muscle spasms or hypertonia, AND
  - diagnosis of tetanus by a health care provider;

OR

- Death, with tetanus listed on the death certificate as the cause of death or a significant condition contributing to death

There is no definition for confirmed tetanus

Tetanus Case Investigation

Tetanus Surveillance Worksheet

Appendix 18

NAME (Last, First)				Hospital Record No.
Address (Street and No.)	City	County	Zip	Phone
Reporting Physician/Nurse/Hospital/Clinic/Lab Phone	Address			Phone

DETACH HERE and transmit only lower portion if sent to CDC

CDC NETSS ID | **County** | **State** | **Zip**

Birth Date (Month / Day / Year)

Age (Unknown= 999)

Age Type
0 = 0-120 years
1 = 0-11 months
2 = 0-52 weeks
3 = 0-28 days
9 = Unknown

Race
N = Native Amer./Alaska Native
A = Asian/Pacific Islander
B = African American
W = White
O = Other
U = Unknown

Ethnicity
H = Hispanic
N = Not Hispanic
U = Unknown

Sex
M = Male
F = Female
U = Unknown

Event Date (Month / Day / Year)

Event Type
1 = Onset Date
2 = Diagnosis Date
3 = Lab Test Done
4 = Reported to County
5 = Reported to State or MMWR Report Date
6 = Unknown

Reported (Month / Day / Year)

Imported
1 = Indigenous
2 = International
3 = Out of State
9 = Unknown

Report Status
1 = Confirmed
2 = Probable
3 = Suspect
9 = Unknown

HISTORY

Date Year of Onset (Month / Day / Year)

Occupation

History of Military Service (Active or Reserve)?
Y = Yes
N = No
U = Unknown

Year of Entry into Military Service

Tetanus Toxoid Vaccination History Prior to Tetanus Disease
(Exclude Doses Received Since Acute Injury)
0 = Never
1 = 1 dose
2 = 2 doses
3 = 3 doses
4 = 4+ doses
9 = Unknown

Years Since Last Dose
0 - 98
99 = Unknown

CLINICAL DATA

Acute Wound Identified?
Y = Yes
N = No
U = Unknown

Date Wound Occurred (Month / Day / Year)

Principal Anatomic Site
1 = Head
2 = Trunk
3 = Upper Extremity
4 = Lower Extremity
9 = Unspecified

Work Related?
Y = Yes
N = No
U = Unknown

Environment
0 = Home
1 = Other Indoors
2 = Farm / Yard
3 = Automobile
4 = Other Outdoors
9 = Unknown

Circumstances

Principal Wound Type
1 = Puncture
2 = Stellate Laceration
3 = Linear Laceration
4 = Crush
5 = Abrasion
6 = Avulsion
7 = Burn
8 = Frostbite
9 = Compound Fracture
10 = Other (e.g. with cancer)
Specify: _____
11 = Surgery
12 = Animal Bite
13 = Insect Bite/Sting
14 = Dental
15 = Tissue Necrosis
99 = Unknown

Wound Contaminated?
Y = Yes
N = No
U = Unknown

Depth of Wound
1 = 1 cm. or less
2 = more than 1 cm.
9 = Unknown

Signs of Infection?
Y = Yes
N = No
U = Unknown

Devitalized, Ischemic, or Denervated Tissue Present?
Y = Yes
N = No
U = Unknown

Was Medical Care Obtained For This Acute Injury

Tetanus Toxoid (TT/Td/Tdap) Administered Before Tetanus Onset

If Yes, How Soon After Injury?

Tetanus Case Investigation

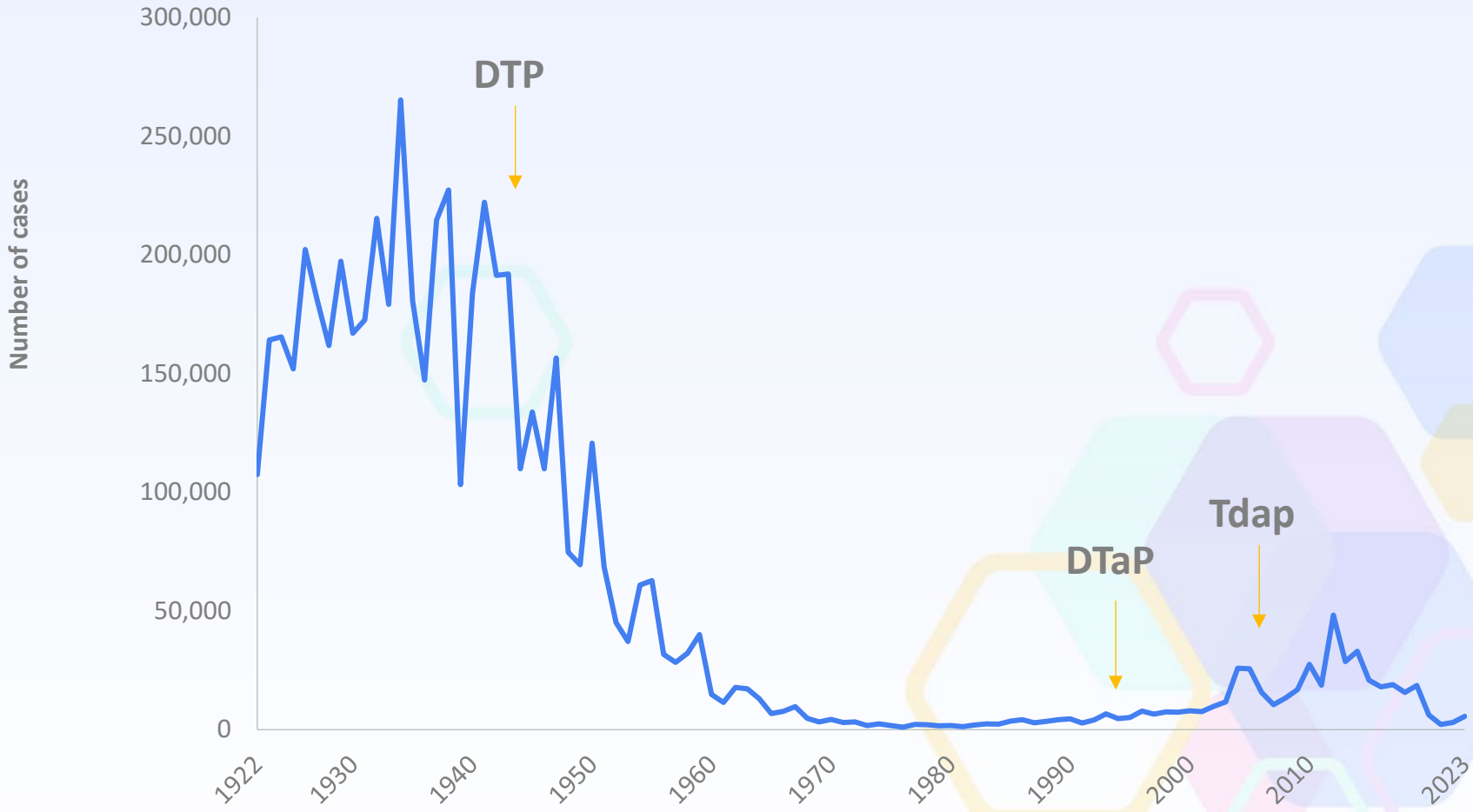
- History: Tetanus vaccination history including years since last dose.
- Clinical Data: Whether an acute wound was identified and, if so, the principal wound type.
- Medical care before onset: Given tetanus toxoid vaccine, TIG, or had wound debrided before illness onset. Associated condition (if no acute injury) and whether there is a history of diabetes or parenteral drug abuse.
- Clinical course: type of tetanus disease and whether illness resulted in death (may require follow-up longer than one month).
- Neonatal: Mother's age, mother’s tetanus vaccination history, including years since the last dose, and child’s birthplace.

Pertussis

Pertussis

- Endemic in the United States, with continued sporadic cases and community wide transmission despite high vaccination coverage
- Caused by the bacterium *Bordetella pertussis*
- Classic pertussis illness characterized by severe paroxysmal coughing sometimes followed by inspiratory whoop
- Occurs in a cyclical pattern, with the number of cases peaking every few years as immunity within the population wanes

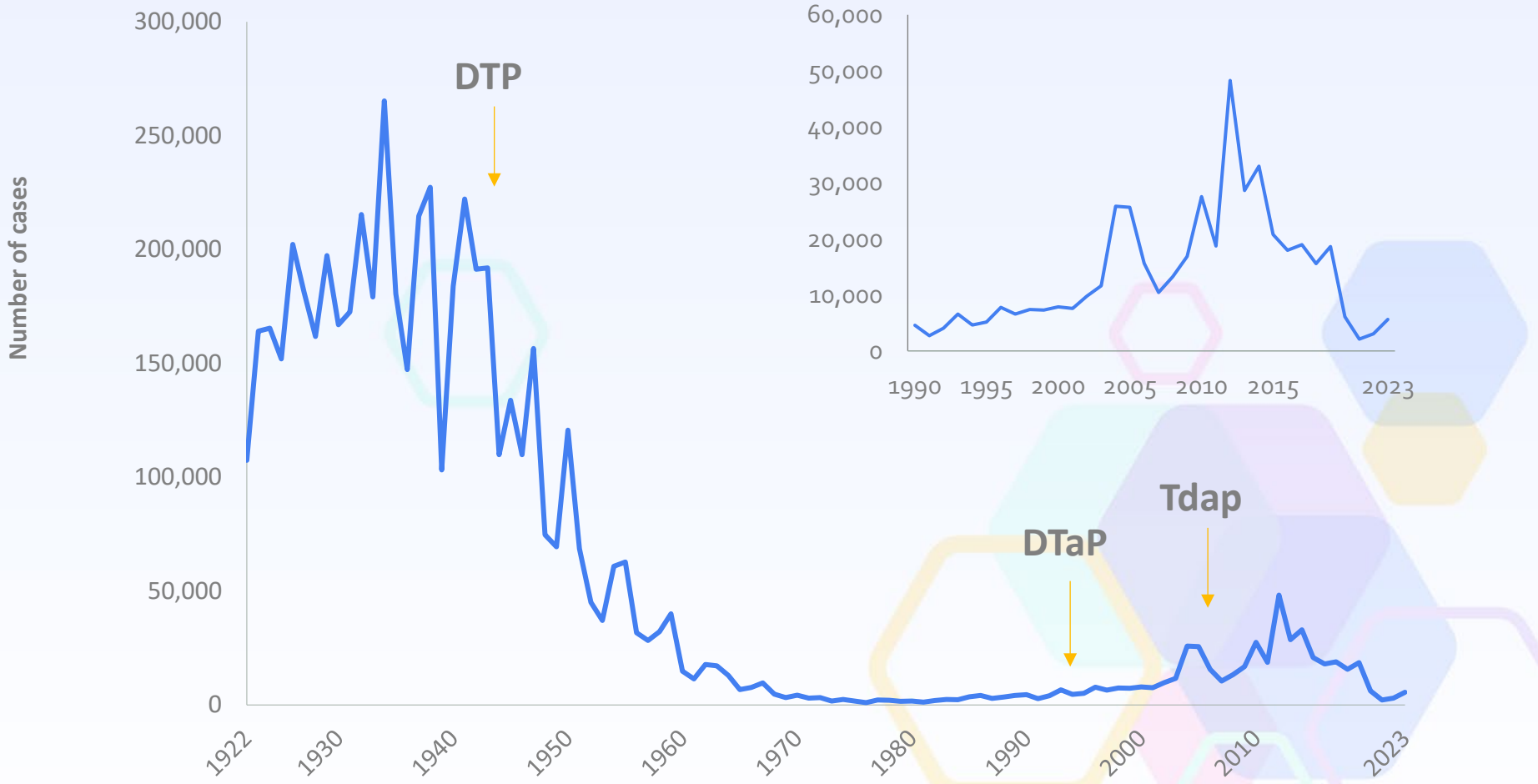
Reported NNDSS pertussis cases: 1922-2023*



*2023 data are provisional

Source: CDC, National Notifiable Diseases Surveillance System

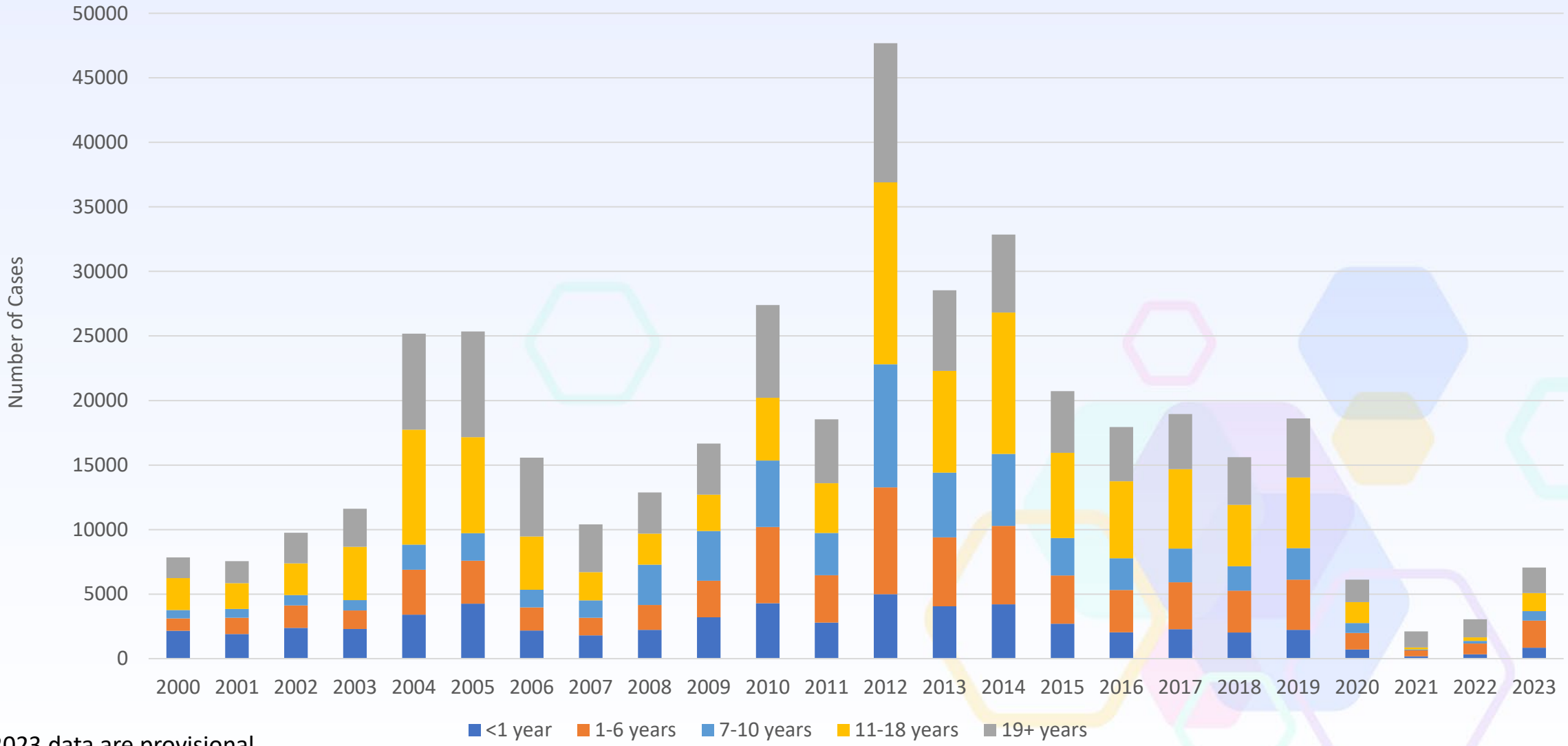
Reported NNDSS pertussis cases: 1922-2023*



*2023 data are provisional

Source: CDC, National Notifiable Diseases Surveillance System

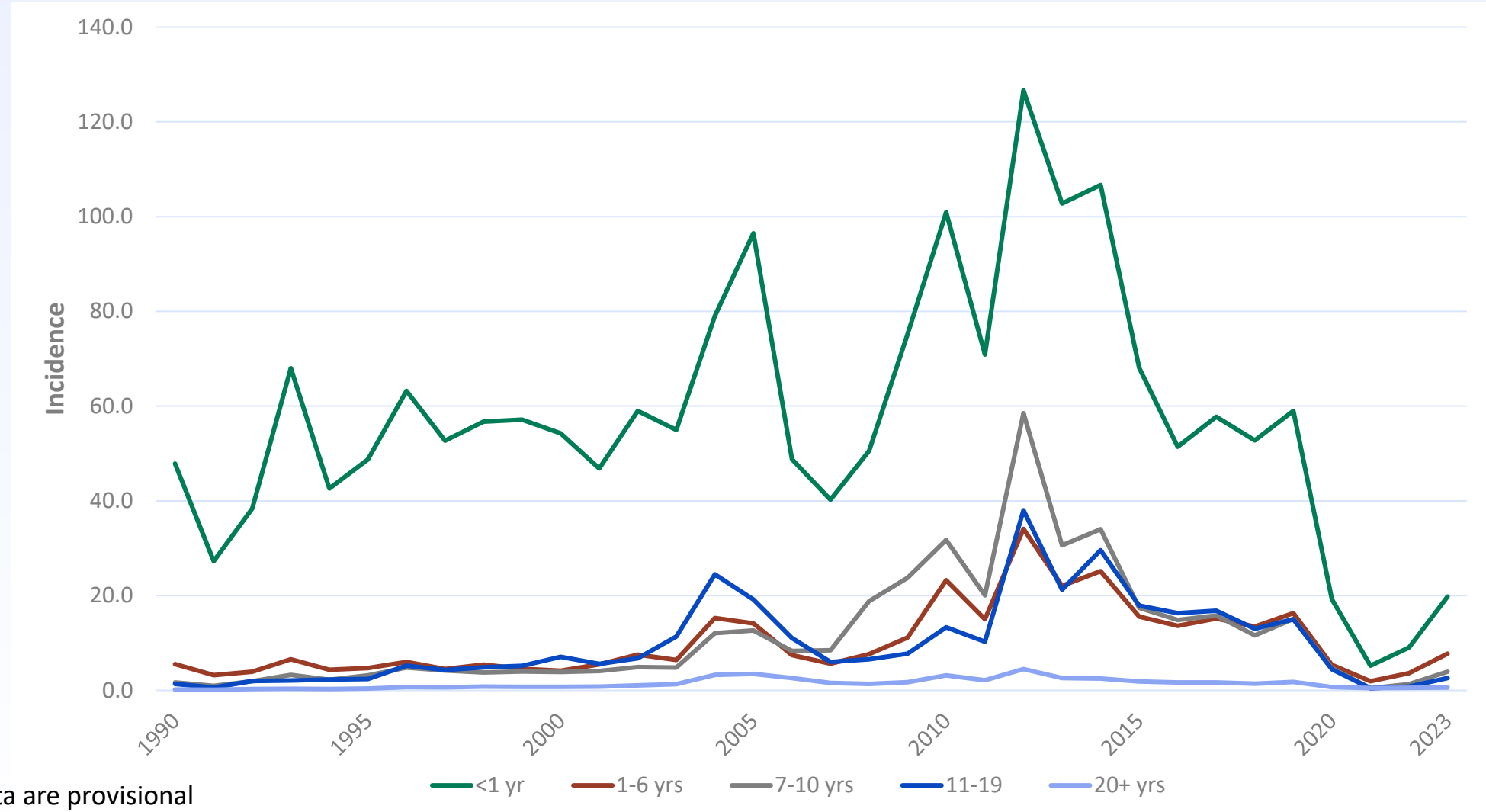
Reported Pertussis Cases by Year and Age, 2000-2023*



*2023 data are provisional

Source: CDC, National Notifiable Diseases Surveillance System

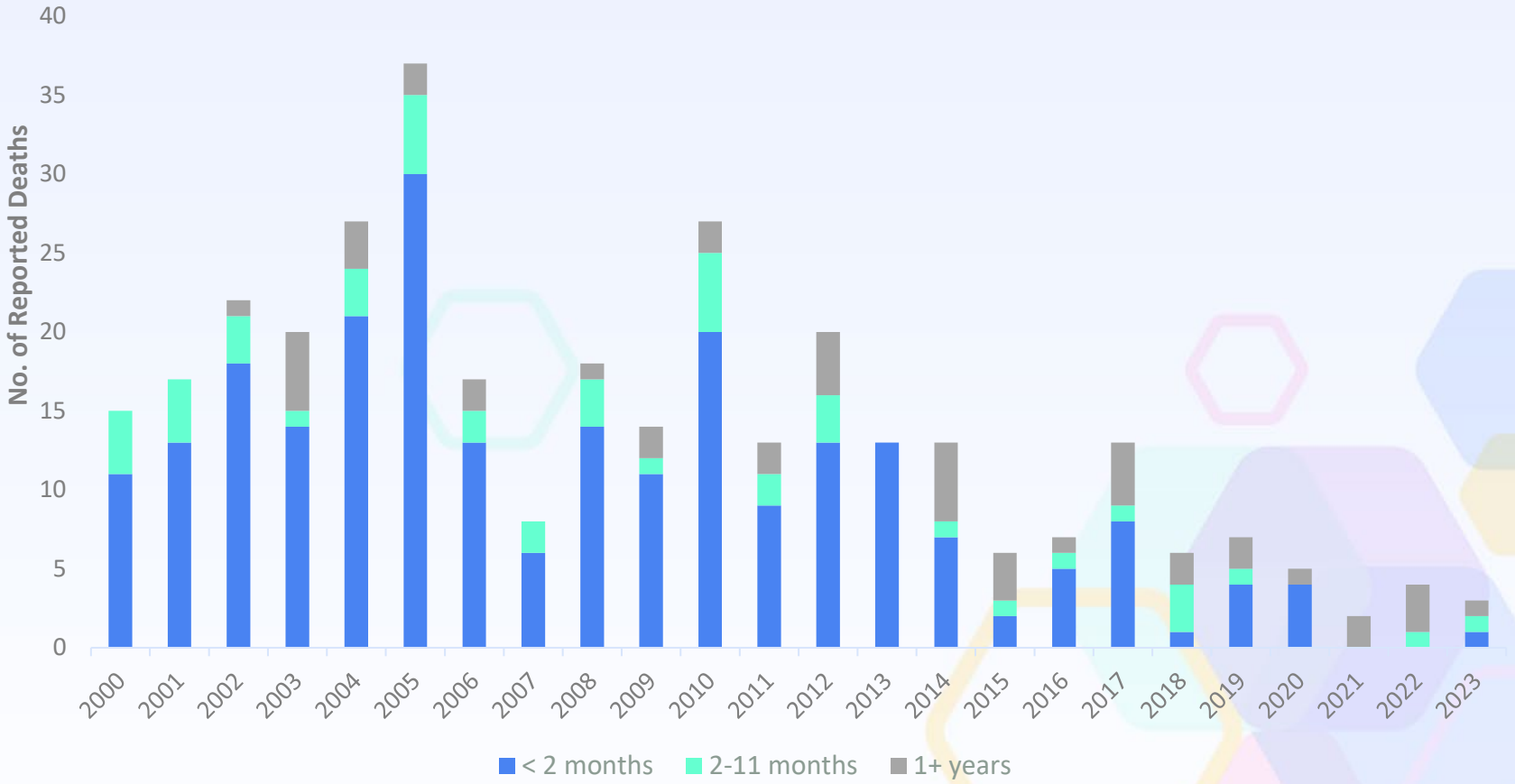
Reported pertussis incidence by age group: 1990-2023*



*2023 data are provisional

Source: CDC, National Notifiable Diseases Surveillance System

Pertussis deaths by age group, 2000-2023*



*2023 data are provisional

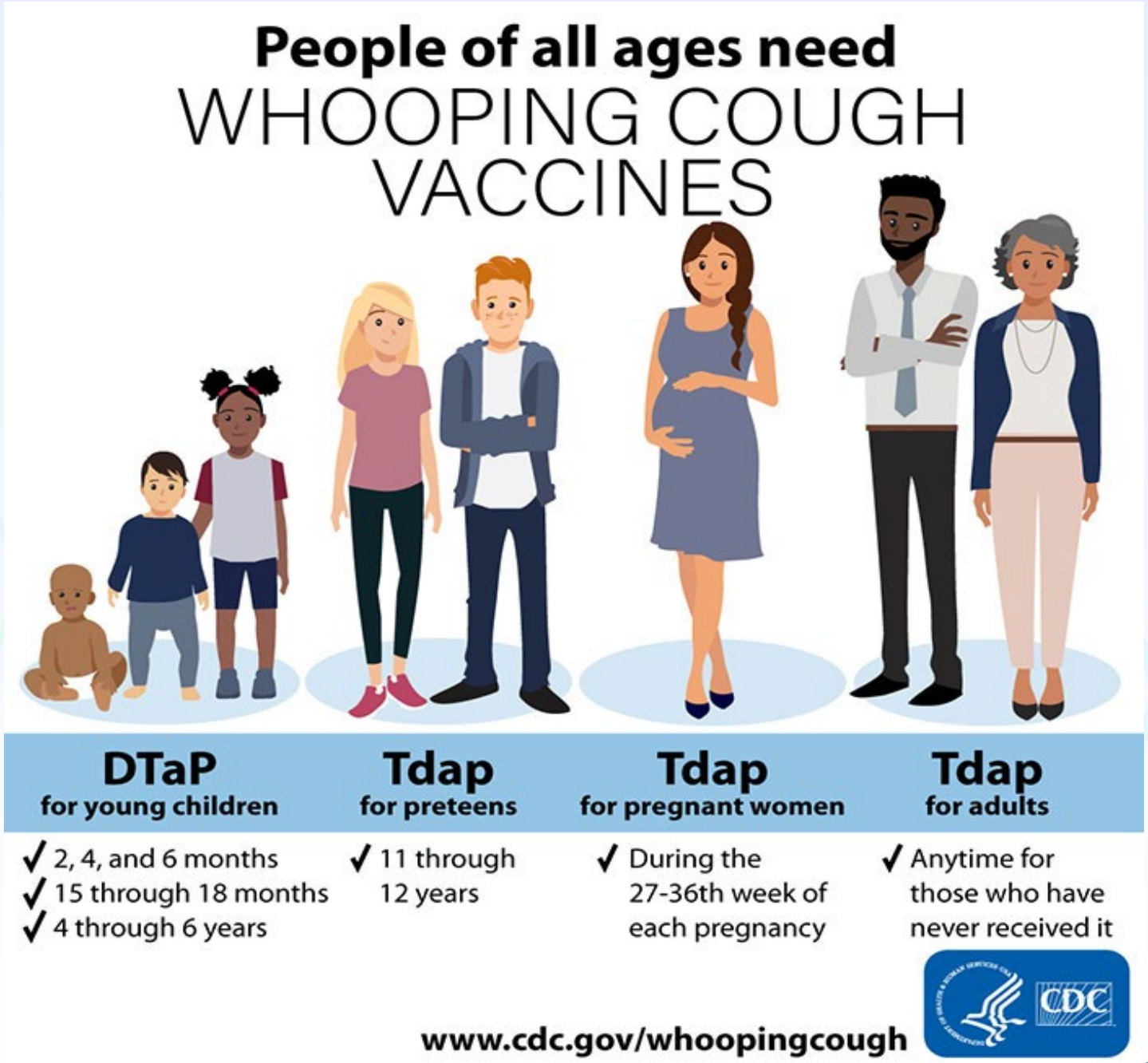
Source: CDC, National Notifiable Diseases Surveillance System

Pertussis Vaccines Currently Available in the U.S.

Pertussis-containing vaccines for children (<7 years)		
DTaP	DAPTACEL (Sanofi Pasteur)	INFANRIX (GlaxoSmithKline)
DTaP + IPV + HepB	PEDIARIX (GlaxoSmithKline)	
DTaP + IPV + Hib	PENTACEL (Sanofi Pasteur)	
DTaP + IPV	QUADRACEL (Sanofi Pasteur)	KINRIX (GlaxoSmithKline)
DTaP + IPV + Hib + HepB	VAXELIS (Merck and Sanofi Pasteur Partnership)	

Pertussis-containing vaccines for adolescents and adults		
Tdap	ADACEL (Sanofi Pasteur)	BOOSTRIX (GlaxoSmithKline)

Pertussis Vaccine Recommendations in the U.S.



Suspected Pertussis Investigation

- **Suspect pertussis in persons with cough illness >7 days who have:**
  - Coughing fits, or
  - Inspiratory whoop, or
  - Cough that induces vomiting
- **Infants may present differently than other ages**
  - Apnea
  - Little to no observable cough

Pertussis Laboratory Confirmation

- Culture testing (isolation) of *Bordetella pertussis* from a clinical specimen
- Positive polymerase chain reaction (PCR) assay
- Serologic assays for pertussis are not used for case confirmation

B. pertussis Culture

- Culture most likely to be positive if specimen is obtained within the first two weeks of cough onset
- Beyond two weeks of cough, culture sensitivity declines and the organism is less likely to be isolated
- Isolation is also less likely once the patient has received antibiotics or if they have been recently vaccinated

PCR Testing

- Most commonly used pertussis diagnostic test in the U.S.
- Optimally sensitive prior to 3 weeks of cough onset
- Rapid, sensitive, and specific
- Use only for diagnosing symptomatic patients

Critical Data for Pertussis Case Investigation

- Demographic information
- Clinical presentation
- Complications
- Pertussis vaccination history

Pertussis Vaccination History

- Date of administration
- Vaccine type
- Manufacturer
- Consider maternal Tdap history for cases <1 year old

Pertussis Surveillance Worksheet

Appendix 11

NAME (Last, First)				Hospital Record No.
Address (Street and No.)	City	County	Zip	Phone
Reporting Physician/Nurse/Hospital/Clinic/LabPhone	Address			Phone

DETACH HERE and transmit only lower portion if sent to CDC

CDC NETSS id | **County** | **State** | **Zip**

Birth Date (Month / Day / Year)

Age (Unk= 999)

Age Type: 0 = 0-120 years; 1 = 0-11 months; 2 = 0-52 weeks; 3 = 0-28 days; 9 = Age Unknown

Race: N = Native Amer./Alaskan Native; A = Asian/Pacific Islander; B = African American; W = White; O = Other; U = Unknown

Ethnicity: H = Hispanic; N = Not Hispanic; U = Unknown

Sex: M = Male; F = Female; U = Unknown

Event Date (Month / Day / Year)

Event Type: 1 = Onset Date; 2 = Diagnosis Date; 3 = Lab Test Done; 4 = Reported to County; 5 = Reported to State or MMWR Report Date; 9 = Unknown

Outbreak Associated: 999 = Unknown

Reported (Month / Day / Year)

Report Status: 1 = Confirmed; 2 = Probable; 3 = Suspect; 9 = Unknown

CLINICAL DATA

Any Cough? (Y = Yes; N = No; U = Unknown) **Cough Onset** (Month / Day / Year)

Paroxysmal Cough? (Y = Yes; N = No; U = Unknown)

Whoop? (Y = Yes; N = No; U = Unknown)

Posttussive Vomiting? (Y = Yes; N = No; U = Unknown)

Apnea? (Y = Yes; N = No; U = Unknown)

Final Interview Date (Month / Day / Year)

Cough at Final Interview? (Y = Yes; N = No; U = Unknown)

Duration of Cough at Final Interview (Days) 0–150; 999 = Unknown

COMPLICATIONS

Chest X-ray for Pneumonia (P = Positive; N = Negative; X = Not Done; U = Unknown)

Seizures Due to Pertussis (Y = Yes; N = No; U = Unknown)

Acute Encephalopathy Due to Pertussis (Y = Yes; N = No; U = Unknown)

Hospitalized? (Y = Yes; N = No; U = Unknown)

Days Hospitalized? 0-998; 999 = Unknown

Died? (Y = Yes; N = No; U = Unknown)

TREATMENT

Were Antibiotics Given? (Y = Yes; N = No; U = Unknown)

1 = Erythromycin (incl. pediazole, ilosone); 2 = Cotrimoxazole (bactrim/septra); 3 = Clarithromycin/azithromycin; 4 = Tetracycline/Doxycycline; 5 = Amoxicillin/Penicillin/Ampicillin/Augmentin/Cector/Cefixime; 6 = Other; 9 = Unknown

Date Started First Antibiotic (Month / Day / Year)

Days First Antibiotic Actually Taken 0-998; 999 = Unknown

Second Antibiotic Received See Choices for First Antibiotic Given

Date Started Second Antibiotic (Month / Day / Year)

Days Second Antibiotic Actually Taken 0-998; 999 = Unknown

LABORATORY

Was Laboratory Testing for Pertussis Done? (Y = Yes; N = No; U = Unknown)

	Result	Date Specimen Taken (Month / Day / Year)
Culture		
DFA		
Serology 1		
Serology 2		
PCR		

RESULT CODES: P = Positive; N = Negative; E = Pending; I = Indeterminate; X = Not Done; S = Parapertussis; U = Unknown

Vaccinated? (Received any doses of diphtheria, tetanus, and/or pertussis-containing vaccines) (Y = Yes; N = No; U = Unknown)

Vaccination Date | Vaccine

Date First Reported to a Health Department

Date Case Investigation Started

CDC Pertussis Post-Exposure Prophylaxis Guidance

- **Focus on high-risk contacts of the case:**
  - Household members
  - Infants
  - Pregnant women
  - People with health conditions increasing risk for severe disease
- **High-risk contacts of the exposed person**
- **More information:**

https://www.cdc.gov/pertussis/php/postexposure-prophylaxis/index.html

Diphtheria

Diphtheria Disease

- Caused by diphtheria toxin
  - Produced by certain strains of *Corynebacterium diphtheriae* – toxigenic
    - Respiratory or non-respiratory (usually cutaneous) infections
- Respiratory disease
  - Pseudomembrane over tonsils, larynx, pharynx; severe disease
- Non-respiratory disease
  - Cutaneous disease – most common
    - Non-distinctive shallow ulcers; mild disease
- Transmitted person-to-person

Diphtheria Surveillance Case Definition

Suspected: In the absence of a more likely diagnosis, an upper respiratory tract illness with each of the following:

- An adherent membrane of the nose, pharynx, tonsils, or larynx; and
- Absence of laboratory confirmation; and
- Lack of epidemiologic linkage to a laboratory-confirmed case of diphtheria;

OR

- Histopathologic diagnosis

Diphtheria Surveillance Case Definition

Confirmed:

An upper respiratory tract illness with an adherent membrane of the nose, pharynx, tonsils, or larynx, AND any of the following:

- Isolation of **toxin-producing** *C. diphtheriae* from the nose or throat; OR
- Epidemiologic linkage to a laboratory-confirmed case of diphtheria

OR

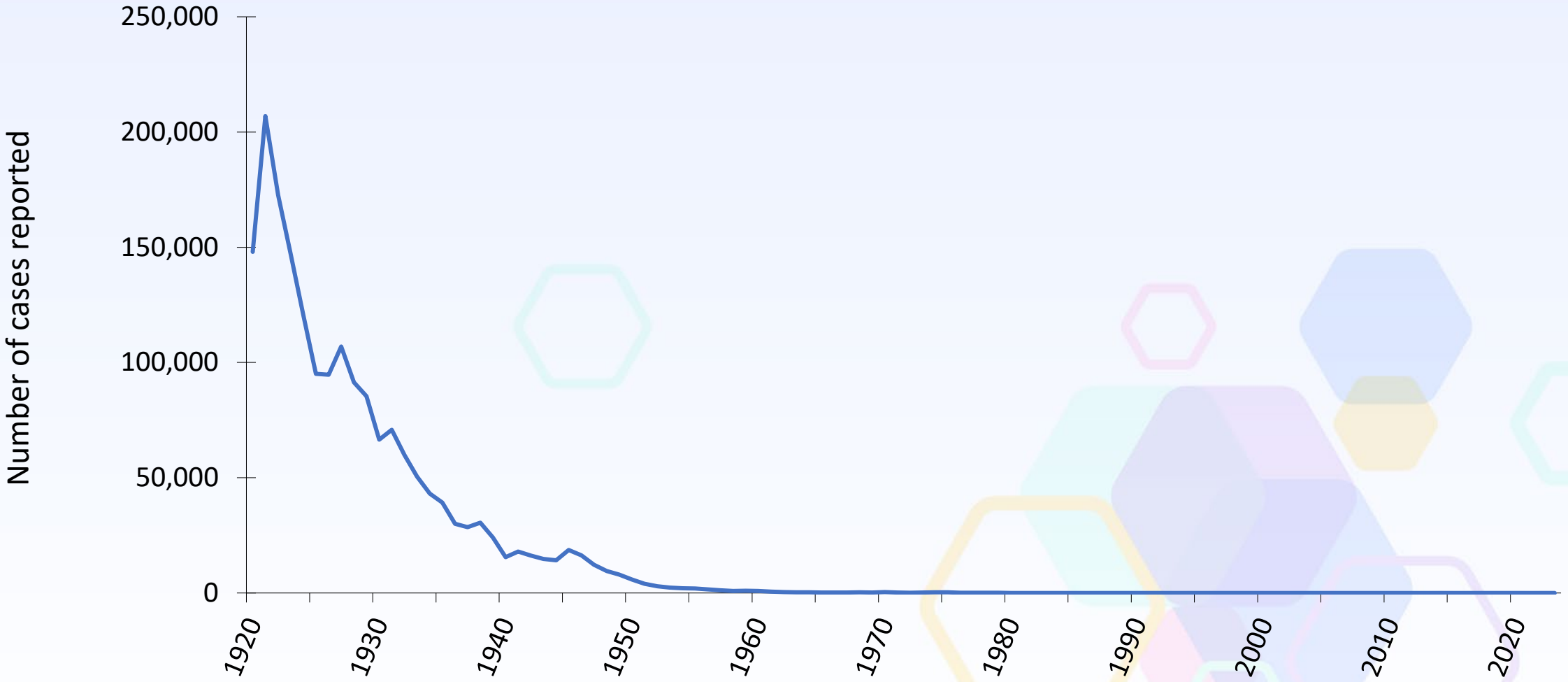
An infection at a non-respiratory anatomical site (e.g., skin, wound, conjunctiva, ear, genital mucosa) with isolation of toxin-producing *C. diphtheriae* from that site.

Diphtheria Vaccines Currently Available in the U.S.

Diphtheria toxoid–containing vaccines for children (<7 years)	
DTaP	DAPTACEL (Sanofi Pasteur) INFANRIX (GlaxoSmithKline)
DTaP + IPV + HepB	PEDIARIX (GlaxoSmithKline)
DTaP + IPV + Hib	PENTACEL (Sanofi Pasteur)
DTaP + IPV	QUADRACEL (Sanofi Pasteur) KINRIX (GlaxoSmithKline)

Diphtheria toxoid–containing vaccine for adolescents and adults	
Tdap	ADACEL (Sanofi Pasteur) BOOSTRIX (GlaxoSmithKline)
Td	DECAVAC or TENIVAC (Sanofi Pasteur) Generic (Massachusetts Biological Labs)

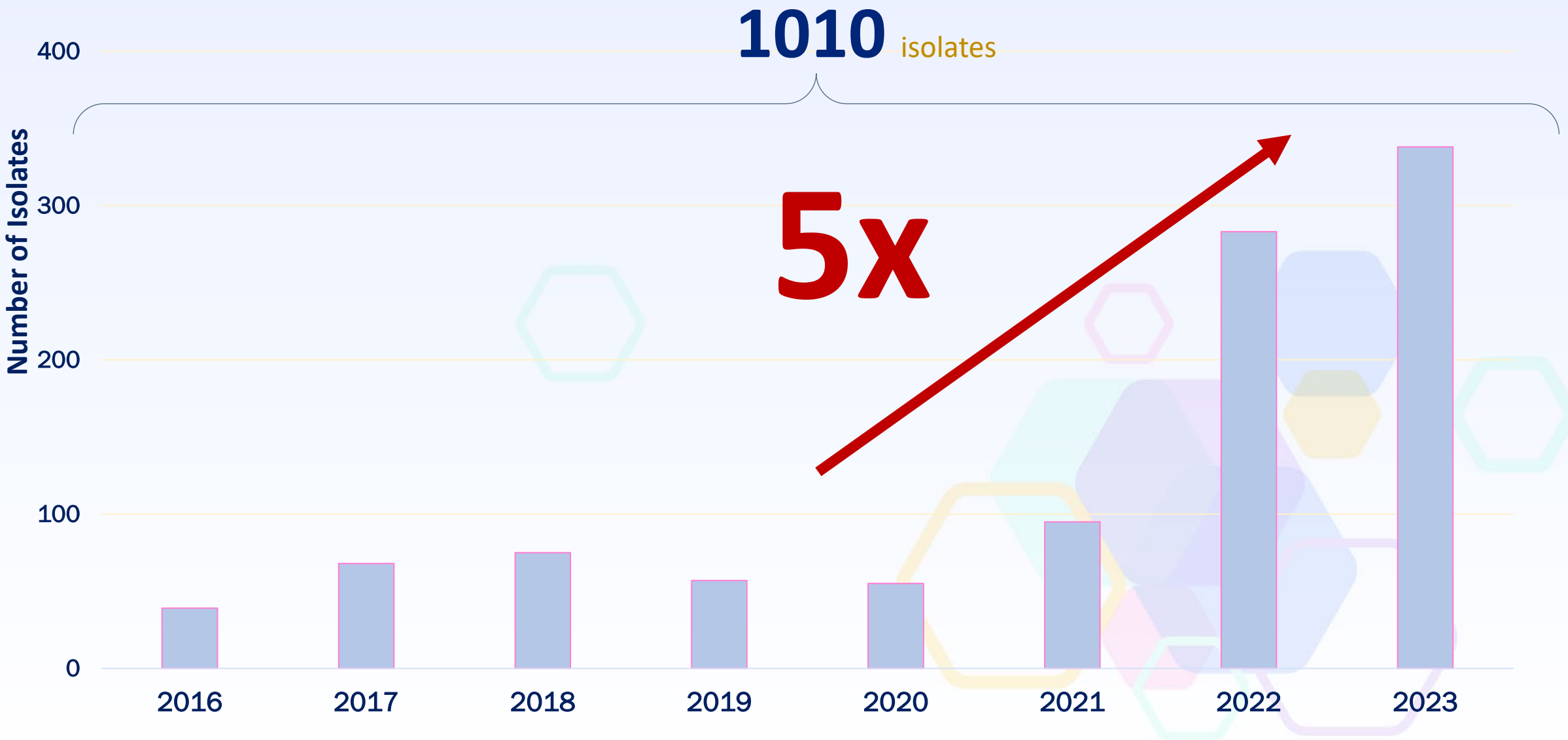
Reported Diphtheria Cases, 1920–2023, United States



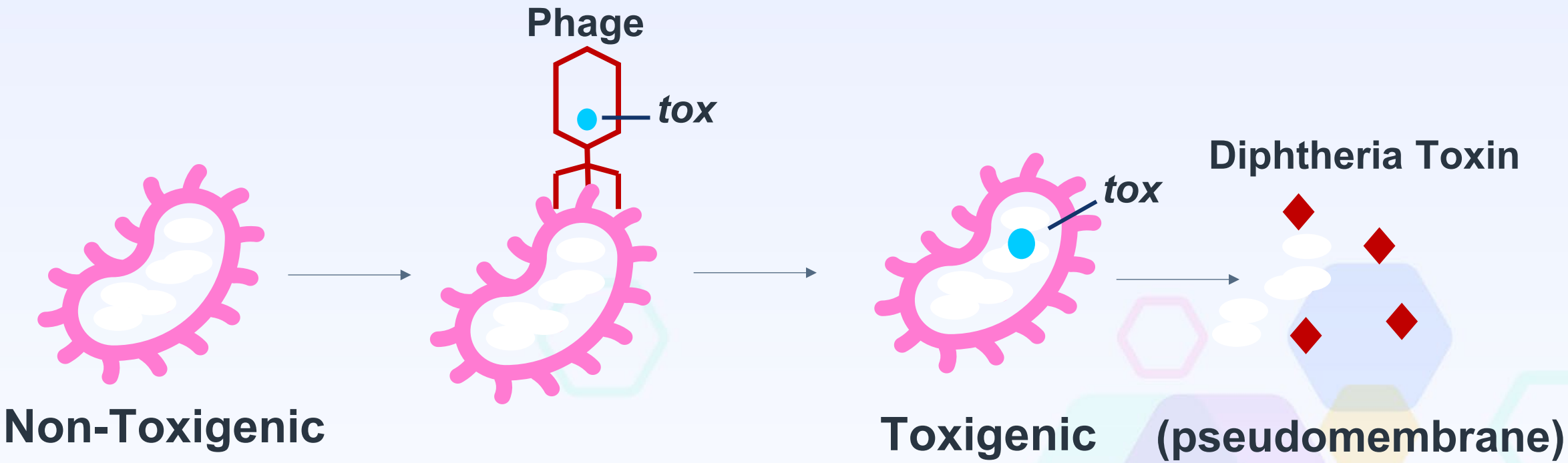
*2023 data are provisional

Source: CDC, National Notifiable Diseases Surveillance System

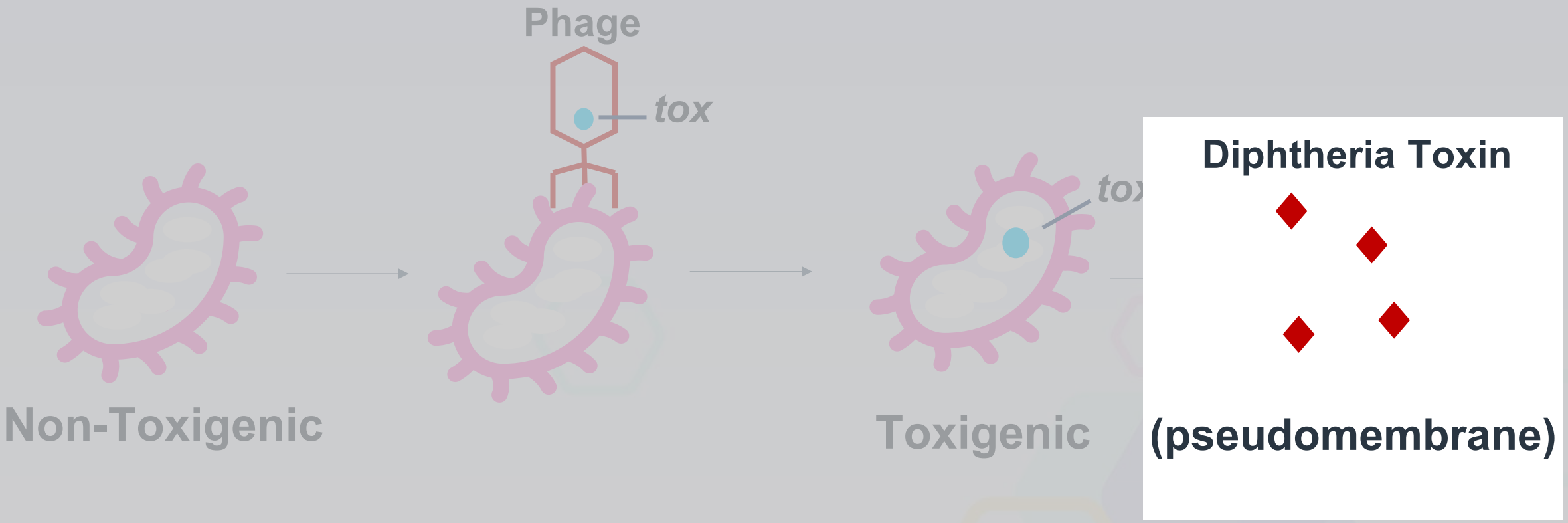
C. diphtheriae Isolates Submitted During 2016—2023



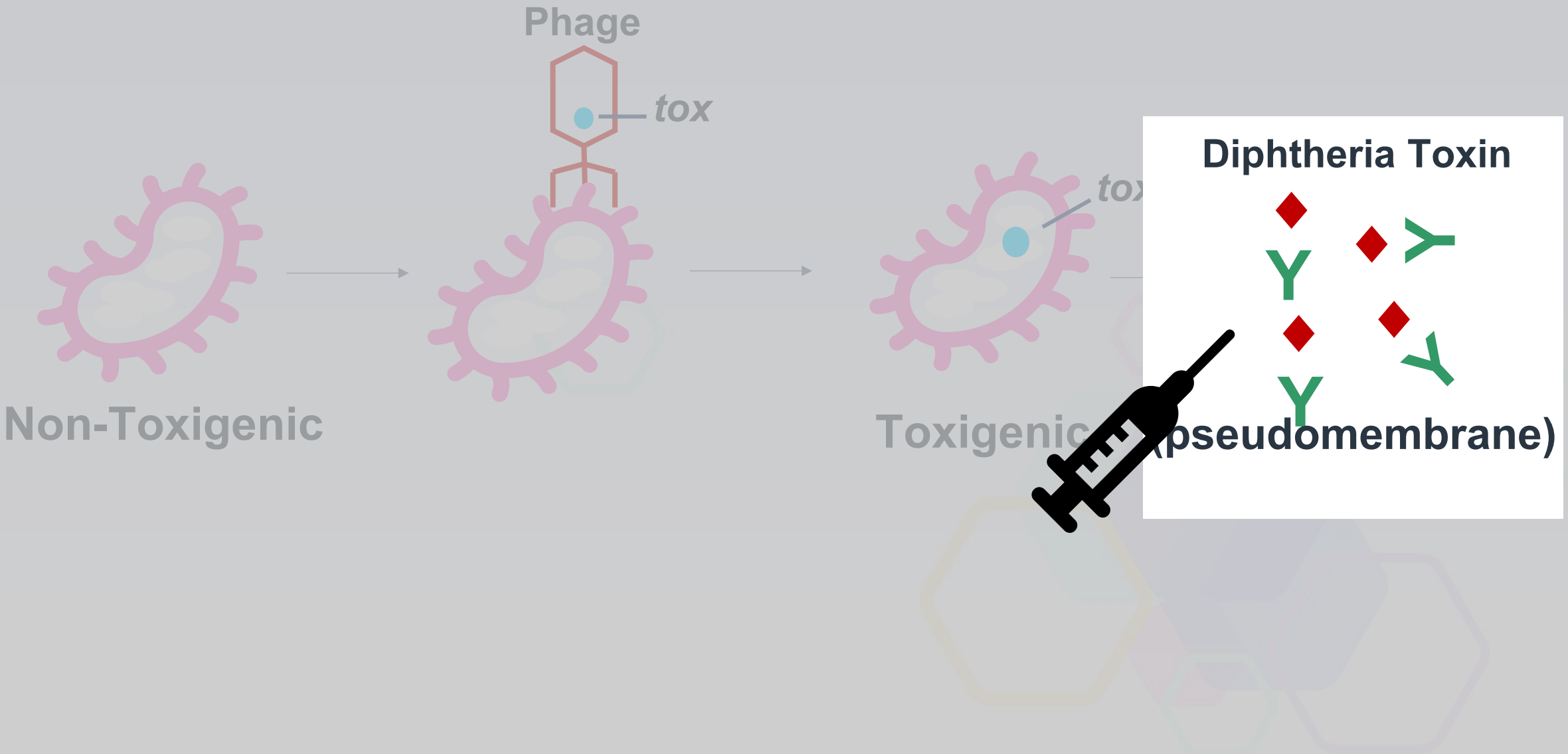
C. diphtheriae–Non-Toxigenic vs. Toxigenic



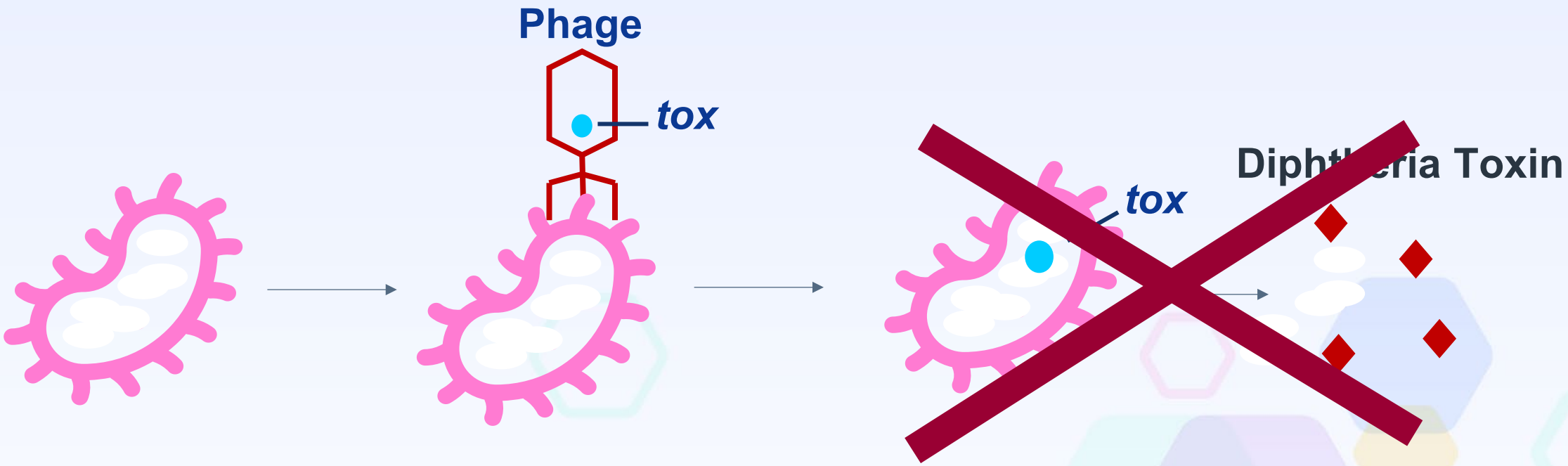
Diphtheria is caused by **diphtheria toxin**, not *C. diphtheriae* infection.



Diphtheria is a vaccine preventable disease. *C. diphtheriae* infection is not.

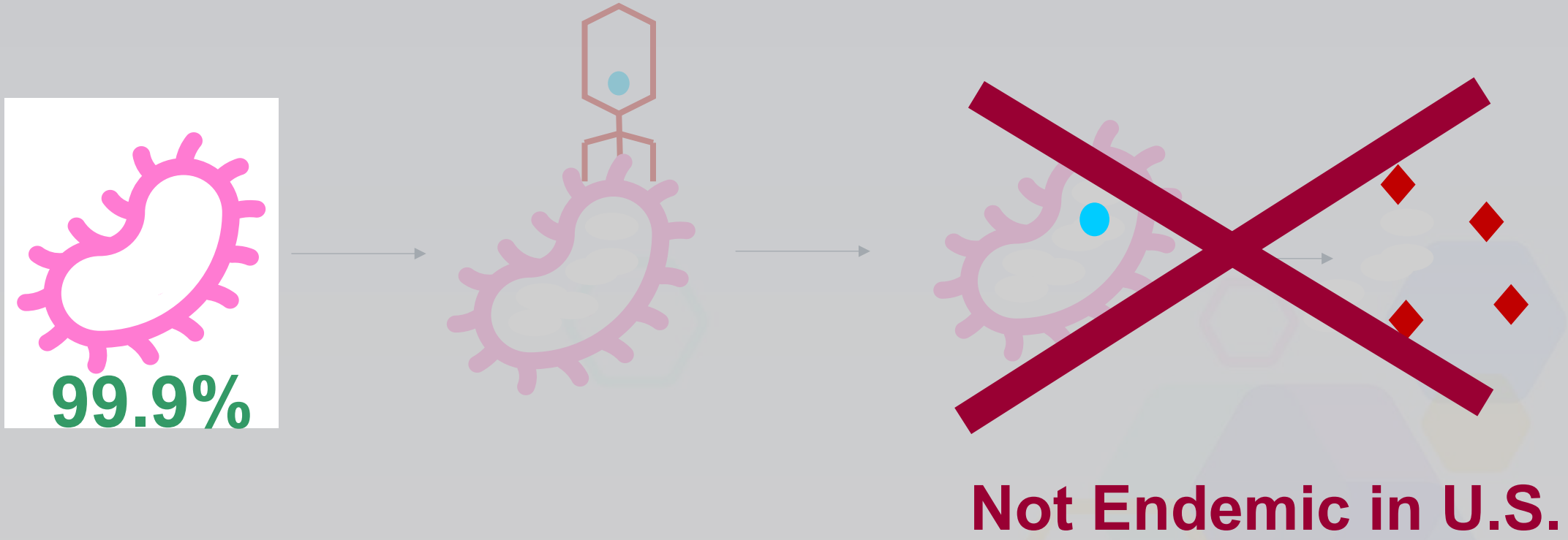


C. diphtheriae–Non-Toxigenic vs. Toxigenic

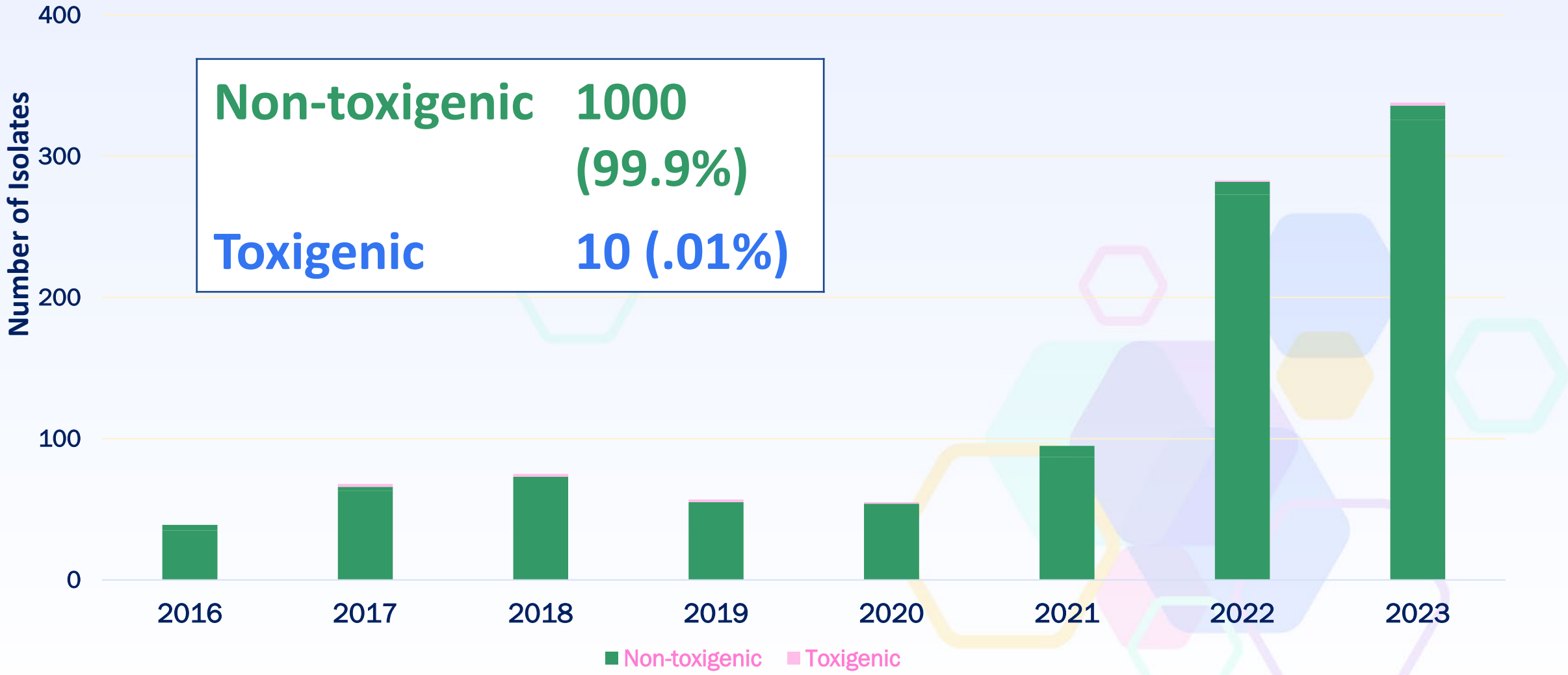


Not Endemic in U.S.

C. diphtheriae–Non-Toxigenic vs. Toxigenic



C. diphtheriae infection is on the rise in the U.S. Diphtheria is not.



Diphtheria Laboratory Confirmation

- Specimens from nose or nasopharynx
  - Swabs from beneath membrane or piece of membrane
- Preliminary tests
  - Gram stain
  - Isolation of *C. diphtheriae* by culture
  - Identification of *C. diphtheria* (e.g., MALDI-TOF)
- Confirmatory tests for diphtheria
  - Testing for presence of toxin by Elek test
- Non-confirmatory test for diphtheria
  - Polymerase chain reaction (PCR) for detection of *tox* gene
  - Does not confirm toxin production or diphtheria
  - Useful for ruling diphtheria out

Suspect Cases and Risk Stratification

1) Clinical findings consistent with toxin mediated disease (e.g., pseudomembrane, bull neck, cardiomyopathy, neuritis)
   - Immediate full case and contact investigation

2) Recent travel to a country with endemic or epidemic diphtheria
   - Consider a full case and contact investigation

Diphtheria Treatment

- Diphtheria antitoxin treatment
  - Should be given early
  - No licensed product available in United States
  - Antitoxin available from CDC through Investigational New Drug (IND) protocol
  - May be requested directly from CDC once healthcare providers have discussed with respective state departments of health

Surveillance Indicators

Critical Data Elements To Collect

- Demographic information
- Clinical data
- Laboratory data
- Vaccination status

National Public Health Surveillance

- Passive reporting
  - Used primarily for monitoring trends in disease occurrence
  - Often incomplete
- Important for diseases with few remaining cases to have very complete data

Surveillance Indicators

- Developed to assess:
  - Quality of national surveillance
  - Ability of our surveillance system to identify all cases
  - Investigative effort and the completeness of epidemiologically important surveillance data

Surveillance Indicators for Measles, Mumps, and Rubella

- Shared indicators:
  - Completeness of data
  - Timeliness of reporting
  - Proportion of cases that are laboratory confirmed
  - Proportion of cases that have an imported source
- Rubella-specific indicator:
  - Proportion of cases among women of child-bearing age with known pregnancy status
- Measles-specific indicator:
  - Proportion of cases for which a clinical specimen is submitted for virus isolation

Surveillance Indicators for *Haemophilus influenzae*

- Timeliness and completeness of case information for children younger than 5 years of age
  - Vaccination history
  - Serotype
- Incidence of non-type b disease among children younger than 5 years of age

Surveillance Indicators for Pertussis

- Timeliness and completeness of epidemiologic data, especially vaccination history for children younger than 7 years of age
- Proportion of clinically compatible cases that have laboratory testing

Surveillance Indicators for Varicella

- Completeness of epidemiologic data, especially vaccine history and proportion of cases with laboratory testing
- Proportion of cases related to outbreaks

Surveillance Indicators for Meningococcal Disease

- Completeness of epidemiologic data, especially vaccination history and clinical outcome
- Proportion of cases that have serogroup testing

Surveillance Indicators for Invasive Pneumococcal Disease

- Completeness of epidemiologic data, especially vaccination history and isolate serotyping

Resources

Manual for the Surveillance of Vaccine-Preventable Diseases

- Guidelines for those directly involved in the surveillance of VPDs
- Includes chapters for each VPD, surveillance indicators and data analyses, laboratory support for surveillance, and appendices with disease-specific worksheets and instructions
- Available on the CDC website: Manual for the Surveillance of Vaccine-Preventable Diseases for Public Health | Manual for the Surveillance of Vaccine-Preventable Diseases | CDC

VPD Reference Centers

- Four public health laboratories that work with APHL and CDC to provide quality testing to other public health jurisdictions free of charge
- Provide testing for measles, mumps, rubella, varicella zoster virus, *Bordetella pertussis*, *Haemophilus influenzae* and *Neisseria meningitides*

National Notifiable Disease Surveillance System (NNDSS)

- Public health case definitions for all infectious conditions under national public health surveillance: Surveillance Case Definitions for Current and Historical Conditions (cdc.gov)

Resources

- Collecting a nasopharyngeal swab for clinical specimen (video)
  - Pertussis Testing Video: Collecting a Nasopharyngeal Swab Clinical Specimen
- CDC PCR serotyping protocol
  - Streptococcus pneumoniae Detection and Serotyping Using PCR | Strep Lab | CDC

Accreditation Statement

- In support of improving patient care, the Centers for Disease Control and Prevention is jointly accredited by the Accreditation Council for Continuing Medical Education (ACCME), the Accreditation Council for Pharmacy Education (ACPE), and the American Nurses Credentialing Center (ANCC), to provide continuing education for the healthcare team.

CE Accreditation Statements

- CME: The Centers for Disease Control and Prevention designates this activity for a maximum of **1.5** American Medical Association (AMA) Physician's recognition Award (PRA) Category 1 Credits™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.
- CNE: The Centers for Disease Control and Prevention designates this activity for **1.5** nursing contact hours.
- CEU: The Centers for Disease Control and Prevention is authorized by International Accreditors for Continuing Education and Training (IACET) to offer **0.2** CEUs for this program.
- CPH: The Centers for Disease Control and Prevention is a pre-approved provider of Certified in Public Health (CPH) recertification credits and is authorized to offer **2.0** CPH recertification credits for this program.

Instructions for Obtaining Continuing Education (CE) for Web-on-Demand

To receive continuing education credits for this session, activity number [**WD4893-020425**]-[2025 CDC Training for Bacterial Vaccine-Preventable Disease Surveillance]:

1. Pass the post-assessment at 80%.
2. Complete the evaluation.
3. Visit Your Learning to access your certificates and transcript.

Meningococcal Disease

Is decreased vaccination coverage during the pandemic causing the increase in meningococcal disease cases?

Meningococcal Disease

What influences the likelihood of developing meningococcal disease?

Meningococcal Disease

Did the number of meningococcal disease cases increase during 2024?

Meningococcal Disease

What risk factor data is collected through meningococcal disease surveillance?

Pertussis

Based on preliminary data so far, did the number of pertussis cases increase during 2024?

Pertussis

When should pertussis be suspected?

How is it laboratory confirmed?

Pertussis

What demographic and clinical information should be collected for pertussis cases?

Pertussis

Did decreased vaccination coverage during the pandemic cause the increase in pertussis cases?

Diphtheria

When should a case and contact investigation be initiated for suspect diphtheria cases?

Diphtheria

Is testing for the presence of diphtheria toxin via Elek testing the only way to confirm diphtheria?

Diphtheria

Have both *C. diphtheriae* infections and diphtheria increased in the United States?

Diphtheria

Can you clarify the recent trend in the increase in the number of *C. diphtheriae* infections in the United States resulting in a 5-fold increase in *C. diphtheriae* isolates submitted to CDC between 2019 and 2023?

Haemophilus influenzae

Should everyone with *Haemophilus influenzae* be serotyped?

What kind of specimen does that require?

Where do I send the specimen?

Haemophilus influenzae

What is driving the increase in nontypeable *Haemophilus influenzae* cases since 2021?

Haemophilus influenzae

Do *Haemophilus influenzae* type b (or Hib) vaccines provide any cross-protection against other serotypes of non-typeable *Haemophilus influenzae*?

Haemophilus influenzae

How important is it to collect Hib vaccine manufacture and type?

Tetanus

What age group has the highest risk of death related to tetanus?

Tetanus

What laboratory test can be used to diagnose tetanus?

Tetanus

How many tetanus cases have been reported in the United States each year in the last decade?

Invasive Pneumococcal Disease

How many cases of invasive Pneumococcal disease are there in the United States each year?

Invasive Pneumococcal Disease

What are the two surveillance systems for IPD in the United States?

Invasive Pneumococcal Disease

What lab tests are most important and available for IPD surveillance?

U.S. CENTERS FOR DISEASE CONTROL AND PREVENTION

- Centers for Disease Control and Prevention | CDC
- National Center for Immunization and Respiratory Diseases (NCIRD) | NCIRD | CDC