



Surveillance of Vaccine-Preventable Diseases (VPDs): Update 2017

Bacterial VPDs

December 5, 2017

Objectives

- Identify 3 main levels of the national surveillance system for VPDs
- Describe the concept of surveillance indicators
- Discuss the importance of surveillance and case identification
- Describe appropriate mechanisms for surveillance
- Describe the appropriate application of case definitions, clinical descriptions, and case classifications
- List the most appropriate laboratory tests for surveillance, and
- List epidemiologically important data to collect for surveillance.

Outline

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

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*

Meningococcal Disease

- Serious and potentially life-threatening infection caused by *Neisseria meningitidis*
- Twelve serogroups based on capsular polysaccharide
 - Serogroups A, B, C, W, X, and Y primary causes of disease worldwide
 - Serogroups B, C, and Y cause most disease in the United States
- Transmitted through direct contact with respiratory secretions from a person with invasive disease, or an asymptomatic carrier
- Signs and symptoms include:
 - Fever, neck stiffness, confusion, nausea, vomiting, lethargy, and/or petechial or purpuric rash
- Can progress rapidly and result in death

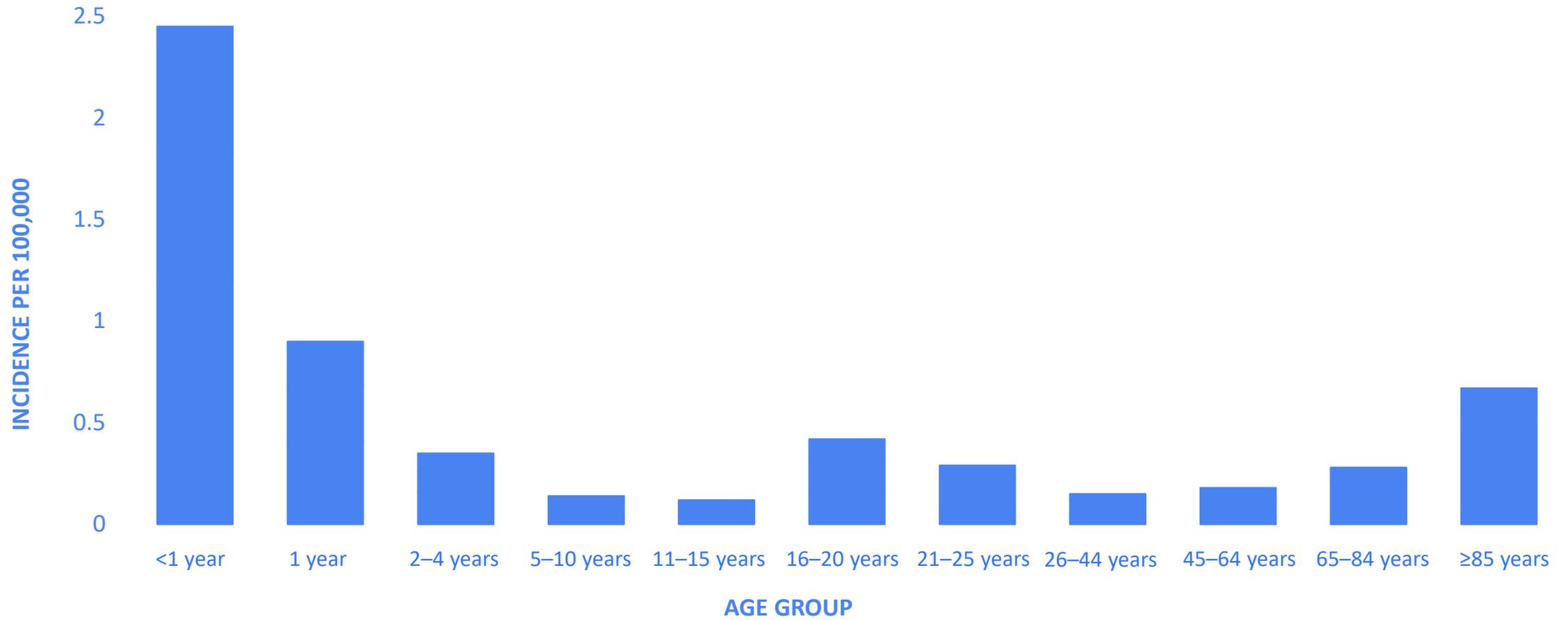
Meningococcal Disease

- Clinical presentations:
 - Meningitis, bloodstream infection, pneumonia
- Key risk factors include host, pathogen, and environmental factors, such as:
 - Medical conditions (e.g., asplenia, complement component deficiencies, HIV)
 - Crowded living conditions
 - Active and passive smoking
 - Recent upper respiratory tract infections
 - Age

Burden of Meningococcal Disease in the U.S.

- Steadily declining since 1990s
- ~350–550 cases of meningococcal disease annually in the U.S.
- Case-fatality ratio 10%–15%
- Sequelae in 10%–20% of survivors
- Highest incidence of disease among children <1 year of age
- Disease is seasonal, with cases peaking in late winter and early spring

Meningococcal Disease Incidence by Age Group, United States, 2006–2015



Source: CDC National Notifiable Diseases Surveillance System.

Meningococcal Conjugate (MenACWY) Vaccines Available in the U.S., 2017

Vaccine	Manufacturer	Type	Serogroups	Ages
Menactra®	Sanofi Pasteur	Conjugate– Diphtheria toxoid	A, C, W, Y	9 months– 55 years
Menveo®	GlaxoSmithKline	Conjugate– CRM ₁₉₇	A, C, W, Y	2 months– 55 years

MenACWY Vaccines

- Routine vaccination of all adolescents 11 through 18 years of age
 - First dose at age 11 or 12 years
 - Booster dose at age 16 years
- Routine vaccination of certain people ≥ 2 months of age at increased risk, including:
 - Anatomic or functional asplenia
 - Complement component deficiencies
 - HIV infection
 - Microbiologists
 - Military recruits
 - College freshmen living in residence halls
 - Travelers
- Also used in outbreak response

Serogroup B Meningococcal (MenB) Vaccines Available in the U.S., 2017

Vaccine	Manufacturer	Schedule	Serogroup	Ages
Bexsero [®]	GlaxoSmithKline	2 doses (0, ≥1 mo)	B	10–25 years
Trumenba [®]	Pfizer	2 doses (0, 6 mo) or 3 doses (0, 1–2 mo, 6 mo)*	B	10–25 years

*For persons at increased risk for meningococcal disease and for use during serogroup B meningococcal disease outbreaks, 3 doses of MenB-FHbp (Trumenba) should be administered to provide earlier protection and maximize short-term immunogenicity.

MenB Vaccines

- Adolescents and young adults 16 through 23 years of age may be vaccinated with MenB vaccines to provide short-term protection against most strains of serogroup B meningococcal disease
- Routine vaccination of certain people ≥ 10 years of age at increased risk, including:
 - Individuals with anatomic or functional asplenia
 - Individuals with complement component deficiencies
 - Microbiologists
- Also used in outbreak response

Meningococcal Disease Surveillance in the U.S.

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

Case Definition for National Reporting of Meningococcal Disease

- Confirmed Case:
 - Isolation of *N. meningitidis*
 - From a normally sterile body site (e.g., blood or cerebrospinal fluid (CSF), or less commonly, synovial, pleural, or 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 or 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

Enhancing Meningococcal Disease Surveillance

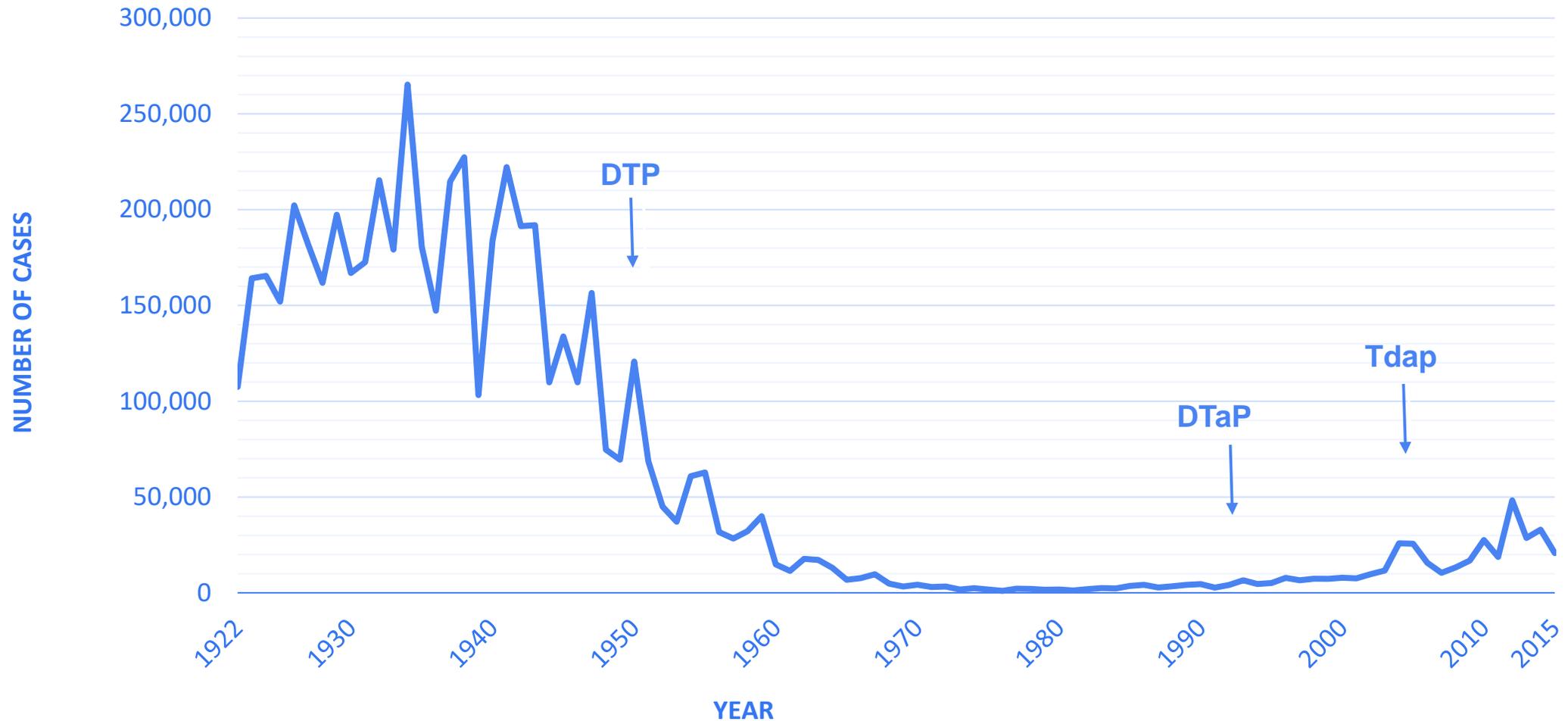
- Enhanced Meningococcal Disease Surveillance implemented in 2015
- Part of the Epidemiology and Laboratory Capacity (ELC) Vaccine-Preventable Diseases (VPD) Surveillance Project
- Goals:
 - Collect data on key variables at CDC for monitoring meningococcal disease epidemiology and informing vaccine policy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

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

Pertussis—United States, 1922–2015



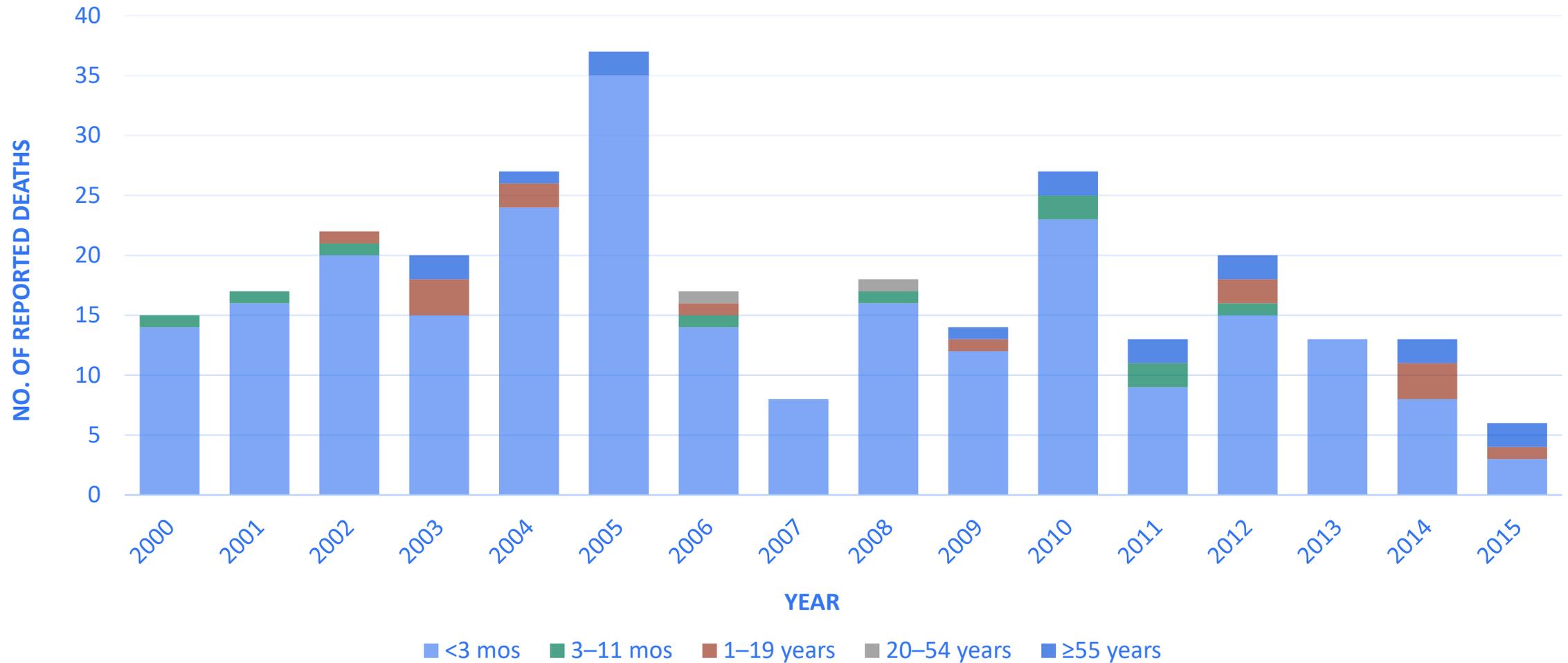
Source: CDC National Notifiable Disease Surveillance System.

Pertussis—United States, 1980–2015



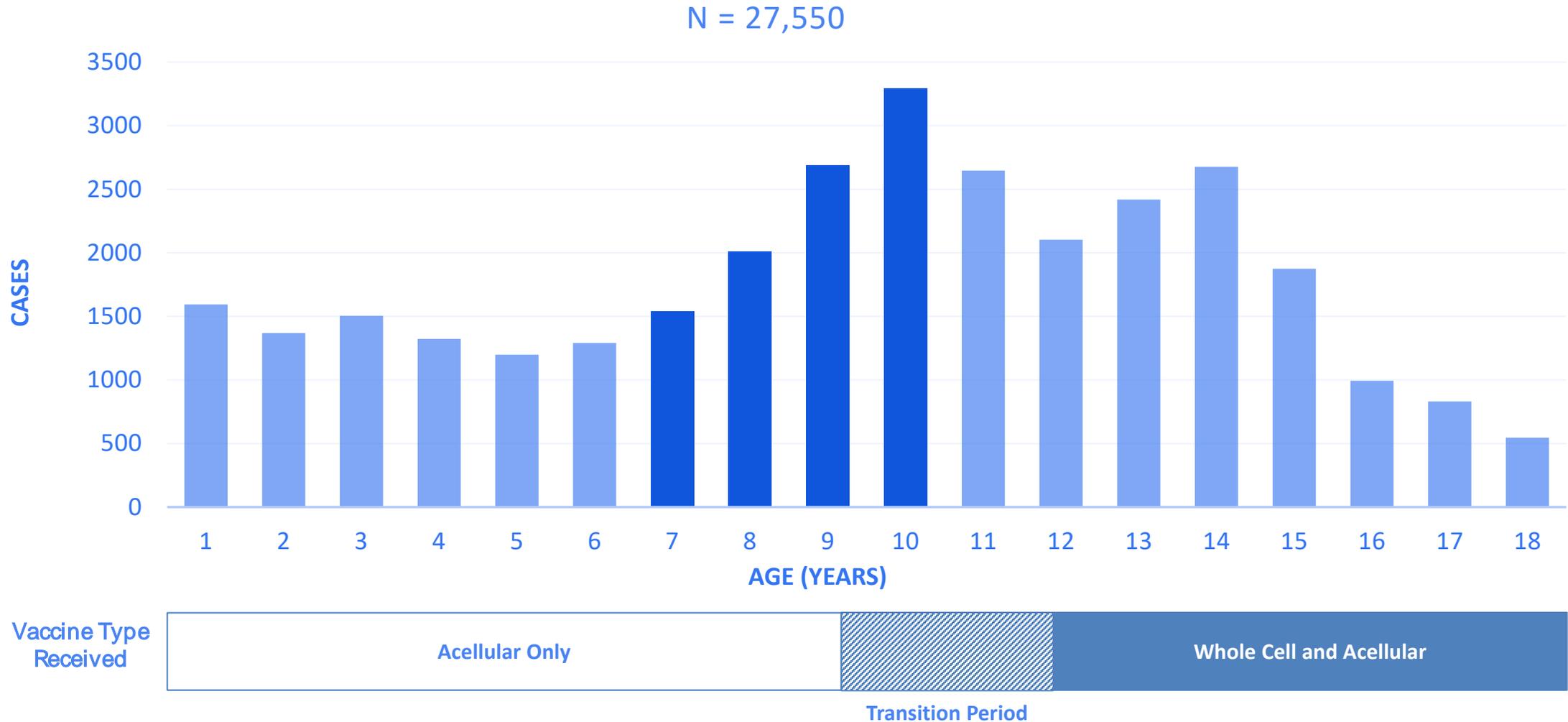
Source: CDC National Notifiable Disease Surveillance System.

Pertussis Deaths by Age Group, 2000–2015



Source: CDC National Notifiable Disease Surveillance System.

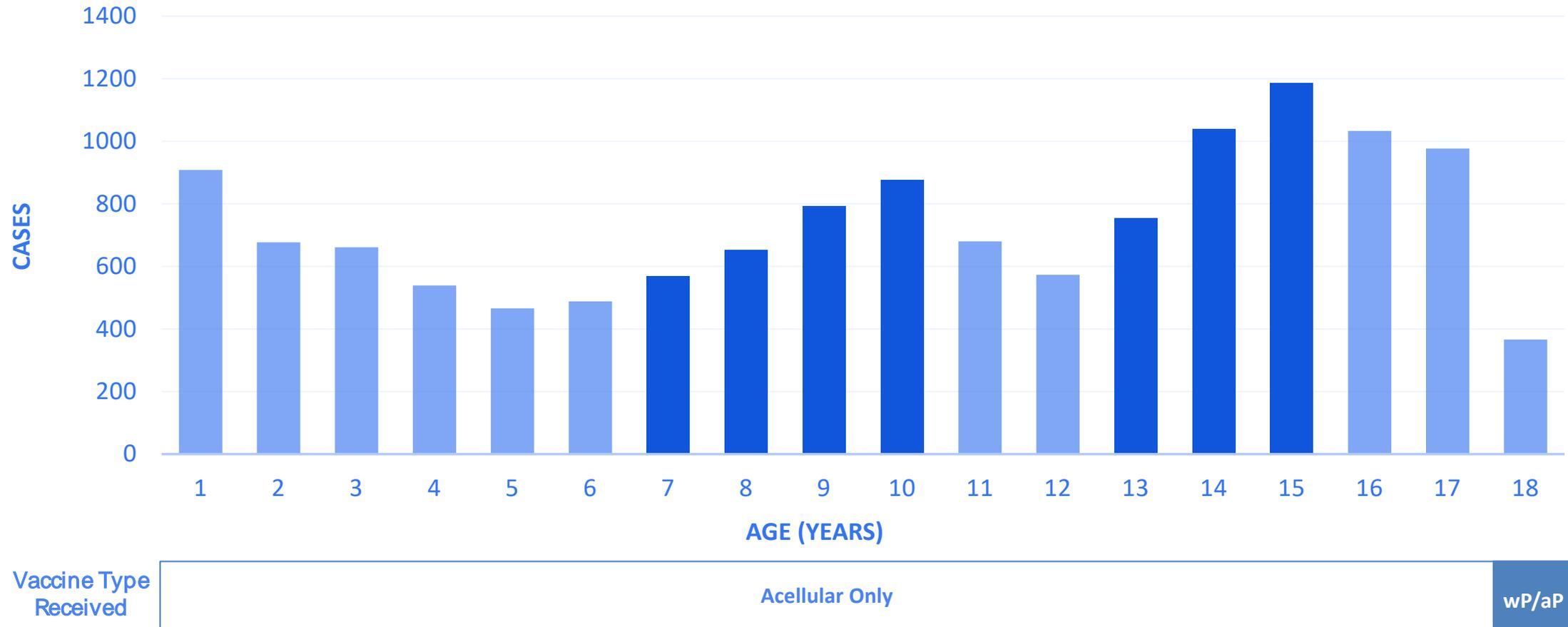
Pertussis Cases by Age—United States, 2010



Source: CDC National Notifiable Disease Surveillance System.

Pertussis Cases by Age—United States, 2015

N = 20,762



Source: CDC National Notifiable Disease 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)

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

Pertussis Vaccine Recommendations in the U.S.

- DTaP vaccine series for all children 2 months through 6 years of age
 - First dose may be administered as early as 6 weeks of age
- Single dose of Tdap for:
 - All adolescents, preferably 11–12 years of age
 - All adults who have not previously received a dose of Tdap
- Tdap for all pregnant women during every pregnancy, preferably between 27 and 36 weeks of gestation
- Collection of vaccine history for all cases is important
 - Encourage providers to remind adults to keep vaccination records
 - Record vaccine manufacturer, type of vaccine, and lot number

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

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
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Birth Date <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Month Day Year	Age <input type="text"/> <input type="text"/> Unk= 999	Age Type <input type="checkbox"/> 0 = 0-120 years <input type="checkbox"/> 1 = 0-11 months <input type="checkbox"/> 2 = 0-52 weeks <input type="checkbox"/> 3 = 0-28 days <input type="checkbox"/> 9 = Age Unknown	Race <input type="checkbox"/> N = Native Amer./Alaskan Native <input type="checkbox"/> A = Asian/Pacific Islander <input type="checkbox"/> B = African American W = White O = Other U = Unknown	Ethnicity <input type="checkbox"/> H = Hispanic <input type="checkbox"/> N = Not Hispanic <input type="checkbox"/> U = Unknown	Sex <input type="checkbox"/> M = Male <input type="checkbox"/> F = Female <input type="checkbox"/> U = Unknown
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Event Date <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Month Day Year	Event Type <input type="checkbox"/> 1 = Onset Date <input type="checkbox"/> 2 = Diagnosis Date <input type="checkbox"/> 3 = Lab Test Done <input type="checkbox"/> 4 = Reported to County <input type="checkbox"/> 5 = Reported to State or MMWR Report Date <input type="checkbox"/> 9 = Unknown	Outbreak Associated <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 999 = Unknown	Reported <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Month Day Year	Report Status <input type="checkbox"/> 1 = Confirmed <input type="checkbox"/> 2 = Probable <input type="checkbox"/> 3 = Suspect <input type="checkbox"/> 9 = Unknown
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CLINICAL DATA	Any Cough? Cough Onset <input type="checkbox"/> Y = Yes <input type="checkbox"/> N = No <input type="checkbox"/> U = Unknown <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Month Day Year	Paroxysmal Cough? <input type="checkbox"/> Y = Yes <input type="checkbox"/> N = No <input type="checkbox"/> U = Unknown	Whoop? <input type="checkbox"/> Y = Yes <input type="checkbox"/> N = No <input type="checkbox"/> U = Unknown	COMPLICATIONS	Chest X-ray for Pneumonia <input type="checkbox"/> P = Positive <input type="checkbox"/> N = Negative <input type="checkbox"/> U = Unknown X = Not Done U = Unknown	Seizures Due to Pertussis <input type="checkbox"/> Y = Yes <input type="checkbox"/> N = No <input type="checkbox"/> U = Unknown
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Posttussive Vomiting? <input type="checkbox"/> Y = Yes <input type="checkbox"/> N = No <input type="checkbox"/> U = Unknown	Apnea? <input type="checkbox"/> Y = Yes <input type="checkbox"/> N = No <input type="checkbox"/> U = Unknown	Final Interview Date <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Month Day Year	Acute Encephalopathy Due to Pertussis <input type="checkbox"/> Y = Yes <input type="checkbox"/> N = No <input type="checkbox"/> U = Unknown
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Cough at Final Interview? <input type="checkbox"/> Y = Yes <input type="checkbox"/> N = No <input type="checkbox"/> U = Unknown	Duration of Cough at Final Interview <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Days 0-150 999 = Unknown	Hospitalized? <input type="checkbox"/> Y = Yes <input type="checkbox"/> N = No <input type="checkbox"/> U = Unknown	Days Hospitalized? <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 0-998 999 = Unknown	Died? <input type="checkbox"/> Y = Yes <input type="checkbox"/> N = No <input type="checkbox"/> U = Unknown
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TREATMENT	Were Antibiotics Given? <input type="checkbox"/> Y = Yes <input type="checkbox"/> N = No <input type="checkbox"/> U = Unknown <input type="checkbox"/> 1 = Erythromycin (incl. pediazole, ilosone) <input type="checkbox"/> 2 = Cotrimoxazole (bactrim/sepra) <input type="checkbox"/> 3 = Clarithromycin/azithromycin <input type="checkbox"/> 4 = Tetracycline/Doxycycline <input type="checkbox"/> 5 = Amoxicillin/Penicillin/Ampicillin/Augmentin/Cector/Cefixime <input type="checkbox"/> 6 = Other <input type="checkbox"/> 9 = Unknown	LABORATORY	Was Laboratory Testing for Pertussis Done? <input type="checkbox"/> Y = Yes <input type="checkbox"/> N = No <input type="checkbox"/> U = Unknown
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Date Started First Antibiotic <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Month Day Year	Days First Antibiotic Actually Taken <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 0-998 999 = Unknown	<table border="1"> <thead> <tr> <th rowspan="2">Result</th> <th colspan="3">Date Specimen Taken</th> </tr> <tr> <th>Month</th> <th>Day</th> <th>Year</th> </tr> </thead> <tbody> <tr> <td>Culture</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>DFA</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>Serology 1</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>Serology 2</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td>PCR</td> <td><input type="text"/></td> <td><input type="text"/></td> <td><input type="text"/></td> </tr> </tbody> </table>	Result	Date Specimen Taken			Month	Day	Year	Culture	<input type="text"/>	<input type="text"/>	<input type="text"/>	DFA	<input type="text"/>	<input type="text"/>	<input type="text"/>	Serology 1	<input type="text"/>	<input type="text"/>	<input type="text"/>	Serology 2	<input type="text"/>	<input type="text"/>	<input type="text"/>	PCR	<input type="text"/>	<input type="text"/>	<input type="text"/>
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Serology 2	<input type="text"/>	<input type="text"/>	<input type="text"/>																										
PCR	<input type="text"/>	<input type="text"/>	<input type="text"/>																										

Second Antibiotic Received <input type="checkbox"/> See Choices for First Antibiotic Given	Date Started Second Antibiotic <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Month Day Year	Days Second Antibiotic Actually Taken <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 0-998 999 = Unknown	RESULT CODES P = Positive E = Pending X = Not Done U = Unknown N = Negative I = Indeterminate S = Parapertussis
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Vaccinated? (Received any doses of diphtheria, tetanus, and/or pertussis-containing vaccines) <input type="checkbox"/> Y = Yes <input type="checkbox"/> N = No <input type="checkbox"/> U = Unknown	Date First Reported to a Health Department <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Month Day Year	Date Case Investigation Started <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Month Day Year
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Vaccination Date <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Month Day Year	Vaccine <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Month Day Year
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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:

www.cdc.gov/pertussis/outbreaks/pep.html

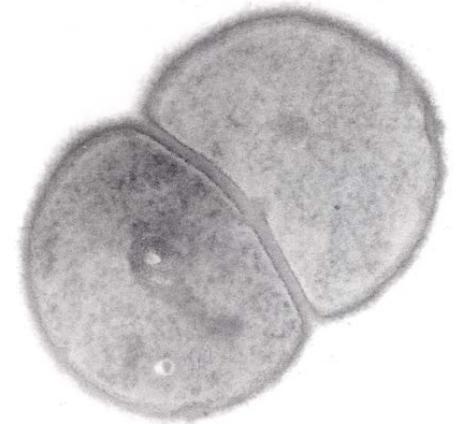
Invasive Pneumococcal Disease

Surveillance Objectives: Pneumococcal Disease

- Measure the burden of invasive pneumococcal disease (IPD) among persons of all ages
- Track emerging antibiotic resistance
- Study the impact of pneumococcal vaccines

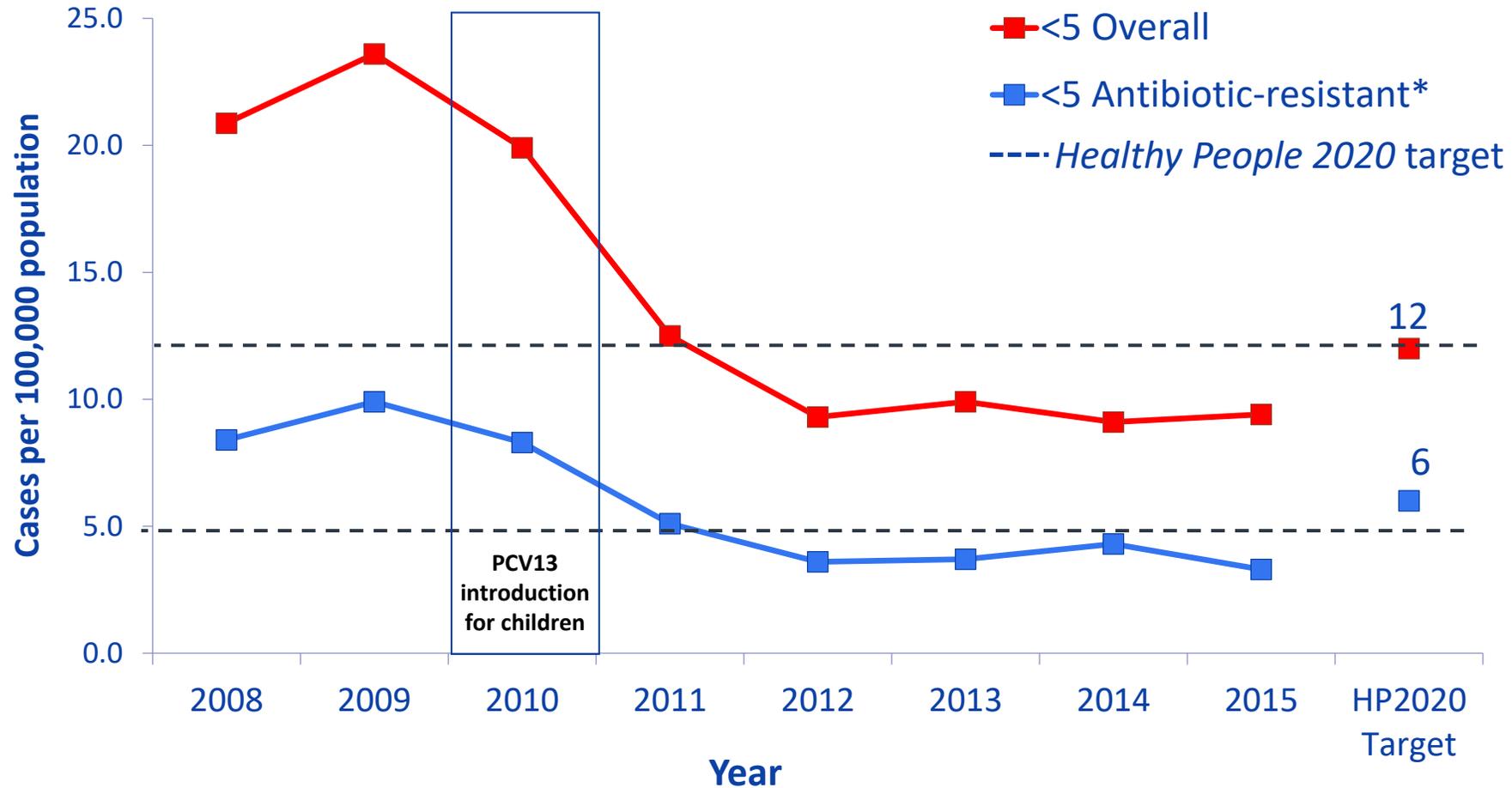
Pneumococcal Disease

- Caused by bacterium *Streptococcus pneumoniae*
- Leading cause of pneumonia, meningitis, and bacteremia worldwide
- Estimated 22,000 deaths and more than 400,000 hospitalizations annually in the United States¹
- Invasive disease risk groups include:
 - Children under 5, adults ≥ 65 , and immunocompromised
- Over 90 serotypes of *S. pneumoniae*
 - Serotypes vary in their ability to cause IPD
 - The majority of invasive disease is caused by only a few serotypes



¹ Huang et al, 2011.

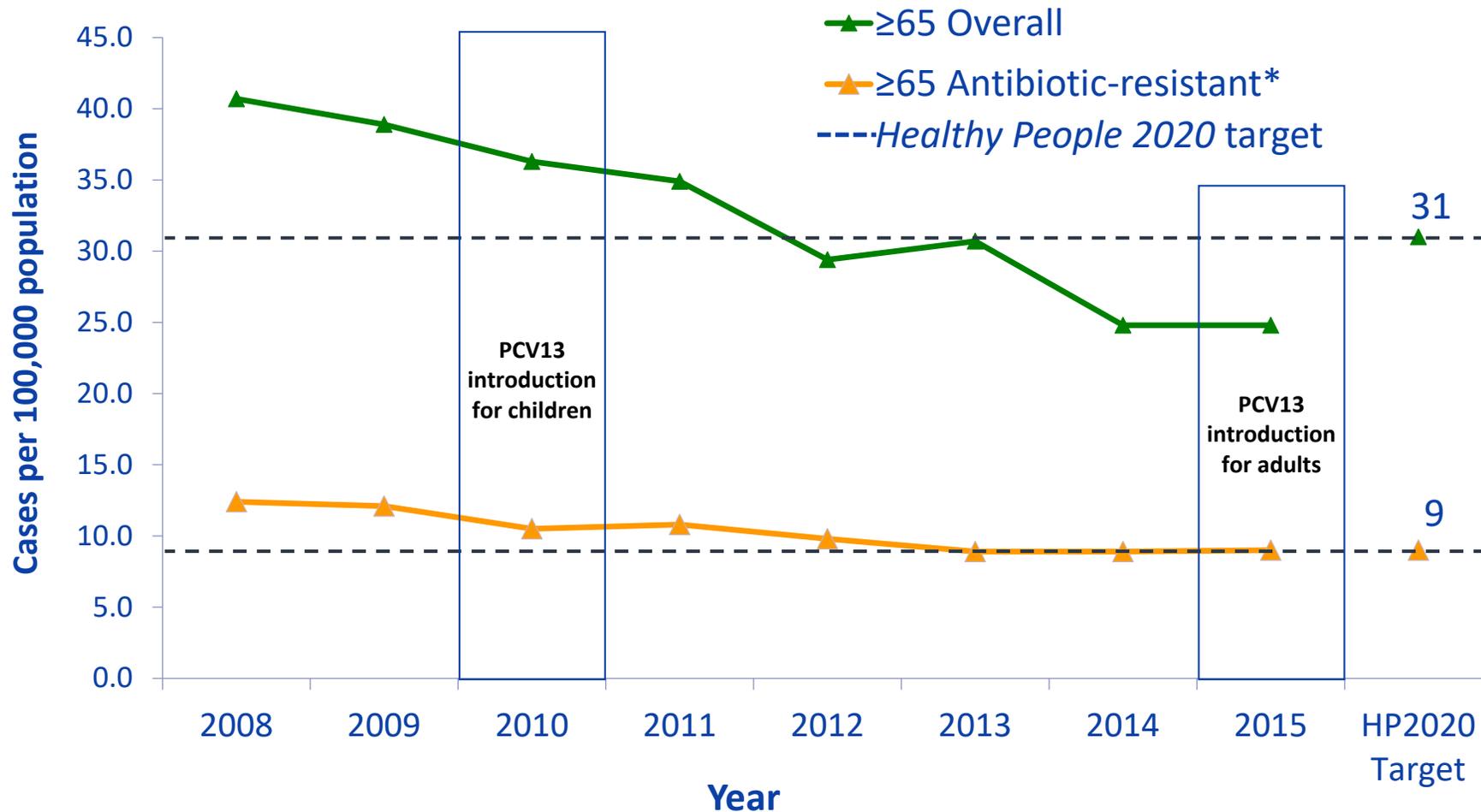
Incidence of IPD in U.S. Children <5 years old, 2008–2015



*Antibiotic-resistant cases are not susceptible to at least one of the following antibiotics: penicillin, amoxicillin, erythromycin, cefotaxime, ceftriaxone, cefuroxime, tetracycline, vancomycin, or levofloxacin.

Source: CDC unpublished data from ABCs.

Incidence of IPD in U.S. Adults ≥65 years old, 2008-2015



*Antibiotic-resistant cases are not susceptible to at least one of the following antibiotics: penicillin, amoxicillin, erythromycin, cefotaxime, ceftriaxone, cefuroxime, tetracycline, vancomycin, or levofloxacin.

Source: CDC unpublished data from ABCs.

Case Definition for National Reporting of IPD: 2017 Update

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

Critical Data for IPD Case Investigation

- Demographic
- Clinical
- Vaccination history
- Risk factors
 - Underlying medical conditions (e.g., asplenia, HIV infection)
 - Out-of-home child care

S. pneumoniae Testing

- Serotyping and susceptibility testing of *S. pneumoniae* isolates are valuable for IPD surveillance
- CDC PCR serotyping protocol
- Two CDC-funded Reference Centers:
 - Wisconsin and Minnesota
 - Serotype IPD isolates, or specimens, using PCR
 - Perform susceptibility testing on isolates
- CDC Streptococcus laboratory
 - Serotyping:
 - Outbreak investigations
 - Individual cases of possible public health importance
 - Susceptibility testing:
 - Isolates with unusual resistance features

APHL/CDC Vaccine Preventable Disease (VPD) Reference Centers

Who are the VPD Reference Centers?

The VPD Reference Centers are four public health laboratories that were selected through a competitive process to perform testing for eight VPDs using standardized methods developed by the Centers for Disease Control and Prevention (CDC). The Reference Centers work closely with APHL and CDC to provide quality testing to other public health laboratories and public health departments free of charge. The Reference Centers include:

- California Department of Public Health Laboratory provides measles, mumps, rubella, and varicella-zoster virus real time RT-PCR and genotyping
- Minnesota Public Health Laboratory Division provides measles, mumps, rubella, and varicella-zoster virus real time RT-PCR and genotyping as well as *B. pertussis*, *S. pneumoniae*, *H. influenzae*, *N. meningitidis* detection PCR and molecular serotyping/serogrouping
- New York State Department of Health: Wadsworth Center provides measles, mumps, rubella, and varicella-zoster virus real time RT-PCR and genotyping
- Wisconsin State Laboratory of Hygiene provides measles, mumps, rubella, and varicella-zoster virus real time RT-PCR and genotyping as well as *B. pertussis*, *S. pneumoniae*, *H. influenzae*, *N. meningitidis* detection PCR and molecular serotyping/serogrouping

Submitting sites are assigned to one or two of the VPD Reference Centers depending on the services requested.

Haemophilus influenzae

A decorative horizontal bar at the bottom of the slide, composed of several colored rectangular segments: dark blue, light blue, green, red, grey, and dark blue.

Haemophilus influenzae

- Encapsulated or unencapsulated
- Capsule composed of polysaccharide
 - Six antigenically distinct types designated by the letters a through f
- Unencapsulated strains referred to as nontypeable

Clinical Syndromes

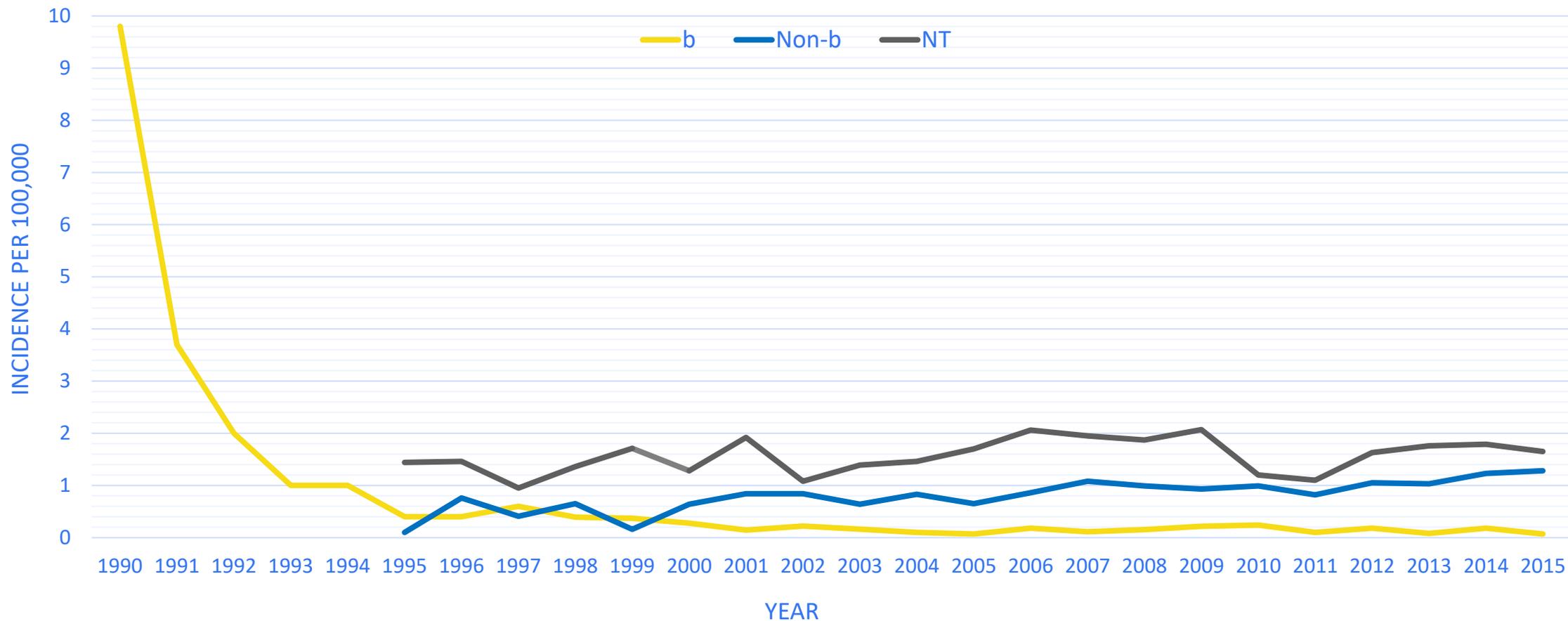
- Invasive disease: bacteremia, meningitis, epiglottitis, cellulitis, infectious arthritis, pneumonia*
- Non-invasive disease: ear infections and bronchitis

* 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

Invasive *H. influenzae* Disease among Children Aged <5 Years—United States, 1990–2015



Source: 1990–1994: https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6301a1.htm?s_cid=rr6301a1_w. Data not available on non-B or nontypeable strains.
1995–2015: Active Bacterial Core Surveillance.

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 on every case
 - Not all PCR assays are capable of detecting or differentiating *H. influenzae* serotypes
 - Laboratories conducting 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 only 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.

H. influenzae Case Investigation: Information to Collect

- Demographic information
- Clinical data
 - Clinical syndrome
 - Dates of hospitalization
 - Date of first positive culture
 - Outcome of the illness
- Results of laboratory testing
 - Serotype
 - Body fluid source
 - Antibiotic susceptibility
- Vaccination status
 - Date
 - Manufacturer
- Risk factors for Hib disease
 - Child care attendance
 - Race and ethnicity

Invasive Hib disease: Control Measures

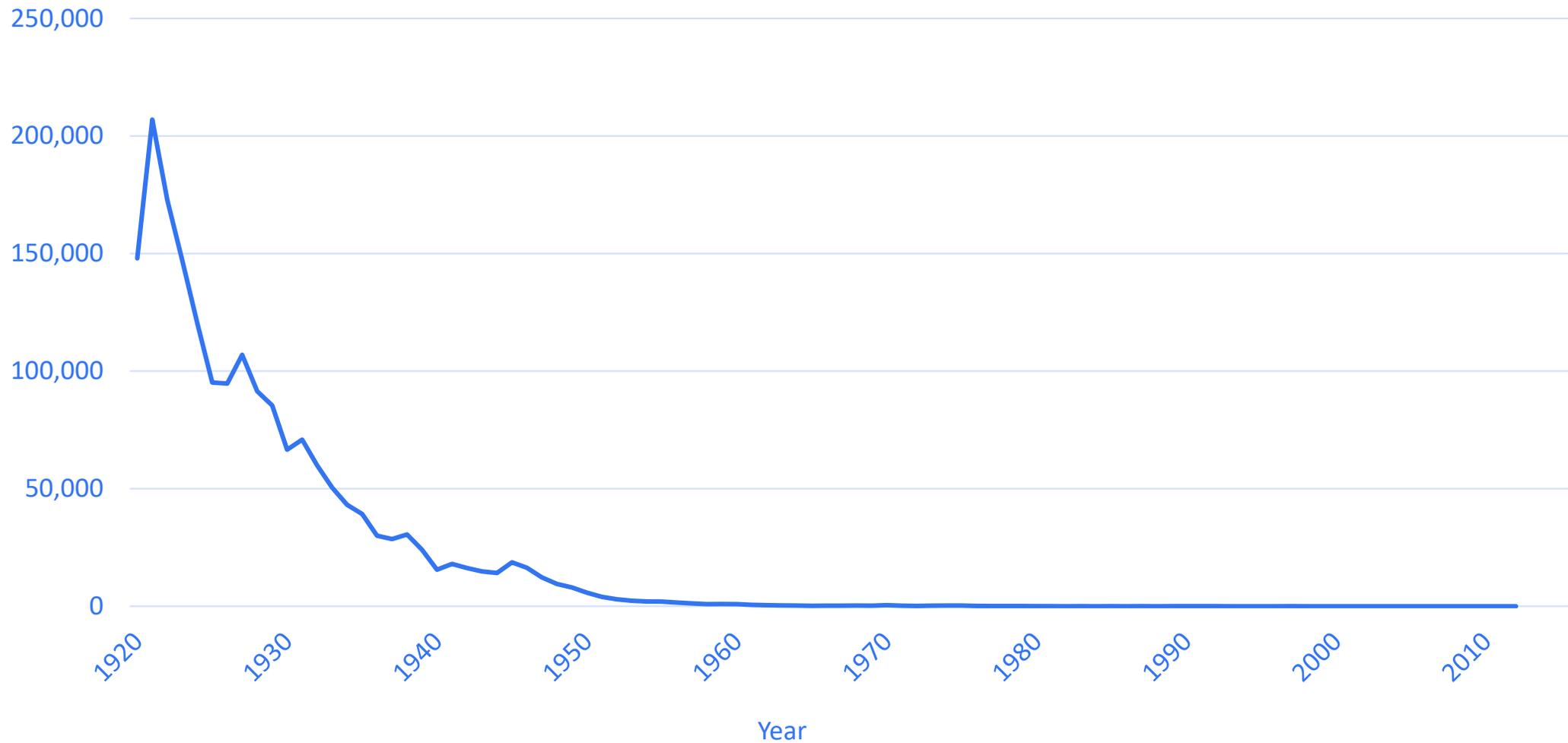
- Rifampin chemoprophylaxis recommended for:
 - All household contacts, if the household has at least one:
 - Un/under-immunized contact aged <4 years
 - Child aged <12 months who has not completed the Hib primary series
 - Immunocompromised child of any age or immunization status
 - Preschool or childcare contacts when two or more cases of invasive Hib disease have occurred within 60 days

Diphtheria

Diphtheria Disease

- *Corynebacterium diphtheriae* – toxigenic
 - Respiratory or cutaneous infections
- Respiratory disease
 - Pseudomembrane over tonsils, larynx, pharynx; severe disease
- Cutaneous disease
 - Non-distinctive shallow ulcers; mild disease
- Humans are only known reservoirs
- Transmitted person-to-person

Reported Diphtheria Cases, 1920–2015, United States



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)
DT	Generic (Sanofi Pasteur)

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

Diphtheria Laboratory Confirmation

- Specimens from nose or nasopharynx
 - Swabs from beneath membrane or piece of membrane
- Confirmatory tests for diphtheria
 - Isolation of *C. diphtheriae* by culture
 - Testing for presence of toxin by Elek test
- Non-confirmatory test for diphtheria
 - Polymerase chain reaction (PCR) for detection of toxin gene
 - Does not confirm production of toxin
 - Useful when patient received antibiotics before swab

Diphtheria Surveillance Case Definition

- **Probable**: In the absence of a more likely diagnosis, an upper respiratory tract illness with 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
- **Confirmed**: An upper respiratory tract illness with an adherent membrane of the nose, pharynx, tonsils, or larynx, AND any of the following:
 - Isolation of *C. diphtheriae* from the nose or throat; OR
 - Histopathologic diagnosis of diphtheria; OR
 - Epidemiologic linkage to a laboratory-confirmed case of diphtheria

Diphtheria Case Investigation

- Case information
 - Demographics and symptoms of illness
 - Vaccine history
 - Travel history
 - Exposure history
 - Identification of close contacts (typically household members)
- Close contacts
 - Screening for respiratory or cutaneous illness
 - If case confirmed to be toxigenic, close contacts should:
 - Complete nasopharyngeal cultures for diphtheria
 - Receive antibiotic prophylaxis
 - Receive necessary diphtheria vaccinations

Diphtheria Treatment

- Diphtheria antitoxin treatment
 - Should be given promptly
 - 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

Monitoring Quality of Surveillance

- Disease-specific approaches
- Quality of immunization program
- Quality of surveillance

Resources

- VPD Surveillance Manual
 - 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: www.cdc.gov/vaccines/pubs/surv-manual/index.html
- VPD Reference Centers
 - Four public health laboratories that work with APHL (aphl.org) and CDC to provide quality testing to other public health jurisdictions free of charge
 - Provide testing for measles, mumps, rubella, varicella-zoster, *B. pertussis*, *S. pneumoniae*, *N. meningitidis*, and *H. influenzae*
- National Notifiable Disease Surveillance System
 - Public health case definitions for all infectious conditions under national public health surveillance: wwwn.cdc.gov/nndss/conditions/

Resources

- Collecting a nasopharyngeal swab/aspirate clinical specimen (video)
 - www.cdc.gov/pertussis/clinical/diagnostic-testing/specimen-collection.html
- CDC PCR serotyping protocol
 - www.cdc.gov/streplab/pcr.html
- CDC serotyping requests for suspected outbreaks and unique resistance patterns
 - www.cdc.gov/streplab/s-pneumoniae-qa.html
 - pneumococcus@cdc.gov

Questions?

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Thank you!