

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Diphtheria is an acute bacterial disease caused by *Corynebacterium diphtheriae*.

B. Description of Illness

- **General facts:** Diphtheria is an acute bacterial disease primarily involving the tonsils, pharynx, larynx, nose, occasionally other mucus membranes or skin, and sometimes conjunctivae or vagina. Diphtheria was one of the most common causes of death among children in the pre-vaccine era. Since the introduction of the vaccine, diphtheria has been well controlled in the United States. Approximately 5% of people who develop diphtheria die from the disease, and many more suffer permanent damage.
- **Occurrence:** Diphtheria occurs worldwide, but clinical cases are more prevalent in temperate zones. In the United States during the pretoxoid era, the highest incidence was in the Southeast during the winter. More recently, highest incidence rates have been in states with significant populations of Native Americans. No geographic concentration of cases is currently observed in the United States. The diphtheria vaccine offers the greatest protection against this disease. The fully immunized person who is exposed can become a carrier of infection, may only develop a mild case, or may not get sick at all. But if not fully vaccinated, the risk of getting severely ill is 30 times higher.
- **Incubation period:** Usually about 2 – 5 days (range 1 – 10 days).
- **Common symptoms:** There are 2 types of diphtheria causing different symptoms:
 - **Cutaneous diphtheria** – Usually mild, typically consisting of non-distinctive sores or shallow ulcers and only rarely involves toxic complications.
 - **Respiratory diphtheria** – May include nasal, pharyngeal, tonsillar, and laryngeal. Generally presents as a sore throat with low-grade fever; a characteristic grayish membrane is found on the tonsils, pharynx, or nose. This membrane may cause an upper airway obstruction, and neck swelling is usually present in severe disease. The bacteria can release a toxin that spreads through the bloodstream and may cause muscle paralysis, heart and kidney failure, and death. Respiratory diphtheria usually lasts several days; complications can persist for months.
- **Treatment:** Persons with suspected diphtheria should be given antibiotics and antitoxin in adequate dosage and placed in isolation after a provisional clinical diagnosis is made, and appropriate cultures are obtained. Respiratory support and airway maintenance should be administered as needed. Antibiotic treatment is with erythromycin orally or by injection (40 mg/kg/day; maximum, 2 gm/day) for 14 days, or procaine penicillin G daily, intramuscularly (300,000 U/day for those weighing 10 kg or less and 600,000 U/day for those weighing more than 10 kg) for 14 days. The disease is usually not contagious 48 hours after antibiotics are instituted. Elimination of the organism should be documented by 2 consecutive negative cultures after therapy is completed.
- **Preventive Measures:** For close contacts, especially household contacts, a diphtheria booster, appropriate for age, should be given. Contacts should also receive antibiotics – benzathine penicillin G (600,000 units for persons younger than 6 years

old and 1,200,000 units for those 6 years old and older) or a 7 to 10-day course of oral erythromycin, (40 mg/kg/day for children and 1 g/day for adults). For compliance reasons, if surveillance of contacts cannot be maintained, they should receive benzathine penicillin G. Identified carriers in the community should also receive antibiotics. Maintain close surveillance and begin antitoxin at the first signs of illness.

C. Reservoirs

Humans, which are the only known source of infection, are usually asymptomatic. In outbreaks, high percentages of children are found to be transient carriers.

D. Modes of Transmission

Transmission is most often person-to-person spread via the respiratory tract. Rarely, transmission may occur from skin lesions or articles soiled with discharges from lesions of infected persons (fomites). Raw milk has served as a vehicle.

E. Period of Communicability

Transmission can occur as long as the organisms are present in discharge and lesions. Although it can vary, organisms usually persist for less than 2 weeks and seldom more than 4 weeks. The rare chronic carrier may shed organisms for 6 months or more. The disease is usually not contagious 48 hours after antibiotics are instituted.

2) ACTIONS REQUIRED/CONTROL MEASURES

A. Reporting Requirements

Diphtheria is physician reportable by telephone immediately on the day of recognition or strong suspicion to both the Connecticut Department of Public Health (DPH) and the local health department (LHD). A mailed report is also required within 12 hours. The director of any clinical laboratory must also report laboratory evidence of diphtheria to both the DPH and the LHD.

Additional requirements: Isolates must be submitted to the DPH State Laboratory for confirmation. See current lists of physician Reportable Diseases (Attachment A and Laboratory Reportable Significant Findings (Attachment C).

B. Case Classification

- **Laboratory criteria for diagnosis:**

- Isolation of *Corynebacterium diphtheriae* from the nose or throat; **OR**
- Histopathologic diagnosis of diphtheria

- **Probable Case**

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 Case**

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

- Isolation of *Corynebacterium diphtheriae* from the nose or throat; **OR**
- Histopathologic diagnosis of diphtheria; **OR**
- Epidemiologic linkage to a laboratory-confirmed case of diphtheria.

- **Comment:** Cutaneous diphtheria should not be reported. Respiratory disease caused by nontoxigenic *C. diphtheriae* should be reported as diphtheria.

C. Case Investigation

- **DPH Responsibility:** The DPH Immunization Program ensures that the appropriate diagnostic work has been completed and works in collaboration with LHD to ensure that contacts of each case-patient have been identified, and appropriate recommendations (e.g., vaccination, exclusion) have been made.
- **LHD Responsibility:** The LHD is involved with case investigations and control measures under DPH guidance as necessary.

D. Control Measures

The DPH immunization Program should be contacted (860-509-7929) for guidance on measures and further action, if necessary.

Fact Sheet

What causes diphtheria?

Diphtheria is caused by a bacterium, *Corynebacterium diphtheriae*. The actual disease is caused when the bacteria release a toxin, or poison, into a person's body.

How does diphtheria spread?

Diphtheria bacteria live in the mouth, throat, and nose of an infected person and can be passed to others by coughing or sneezing. Occasionally, transmission occurs from skin sores or through articles soiled with oozing from sores of infected people.

How long does it take to show signs of diphtheria after being exposed?

The incubation period is short: 2–5 days, with a range of 1–10 days.

What are the symptoms of diphtheria?

Early symptoms of diphtheria may mimic a cold with a sore throat, mild fever, and chills. Usually, the disease causes a thick coating at the back of the throat, which can make it difficult to breathe or swallow. Other body sites besides the throat can also be affected, including the nose, larynx, eye, vagina, and skin.

How serious is diphtheria?

Diphtheria is a serious disease: 5%–10% of all people with diphtheria die. Up to 20% of cases lead to death in certain age groups of individuals (e.g., children younger than age 5 years and adults older than age 40 years).

What are possible complications from diphtheria?

Most complications of diphtheria are due to the release of the toxin, or poison. The most common complications are inflammation of the heart leading to abnormal heart rhythms, and inflammation of the nerves which may cause temporary paralysis of some muscles. If the paralysis affects the diaphragm (the major muscle for breathing), the patient may develop pneumonia or respiratory failure. The thick membrane coating at the back of the throat may cause serious breathing problems, including suffocation.

How do I know if someone has diphtheria?

The diagnosis of diphtheria can only be confirmed after a physician takes a small sample of infected material from the patient's throat (or other site) and has the sample tested in a laboratory. But because this disease progresses quickly, treatment usually should begin based on the health professional's assessment of the patient.

Is there a treatment for diphtheria?

Diphtheria is treated with both antibiotics and with diphtheria antitoxin. Diphtheria antitoxin is produced in horses and was first used in the United States in 1891. Antitoxin does not get rid of toxin that is already attached to the body's tissues, but will neutralize any circulating poison and will prevent the disease from getting worse. The patient should be tested for sensitivity to this antitoxin before it is given.

How common is diphtheria in the United States?

Diphtheria was once a greatly feared illness in the United States. In the 1920s, there were between 100,000 and 200,000 cases of diphtheria each year with 13,000–15,000 deaths. Because of widespread immunization and better living conditions, diphtheria is now rare in the United States (during 1998–2009, seven cases of respiratory diphtheria were reported to CDC).

Recent surveys have found that immunity decreases with age, and only 30% of U.S. adults age 60–69 years are vaccinated against diphtheria. This is a concern because the disease continues to occur in other parts of the world. For example, after the breakup of the former Soviet Union, their vaccination rates fell, and large outbreaks of diphtheria began in 1990 in the Newly

Independent States. From 1990 to 1998, more than 150,000 people got sick from diphtheria and more than 5,000 people died. This situation, and other outbreaks around the world, illustrates what can happen when vaccination levels fall. Outbreaks in other countries also increase the risk of diphtheria importation into the United States.

Can you get diphtheria more than once?

Yes. Even individuals recovering from diphtheria should be immunized against the disease as soon as possible.

When did vaccine first become available for diphtheria, tetanus, and pertussis?

The first inactivated toxin, or toxoid, against diphtheria was developed around 1921, but it was not widely used until the 1930s. In 1924, the first tetanus toxoid (inactivated toxin) was produced and was used successfully to prevent tetanus in the armed services during World War II. The first pertussis vaccine was developed in the 1930s and was in widespread use by the mid-1940s, when pertussis vaccine was combined with diphtheria and tetanus toxoids to make the combination DTP vaccine. A series of 4 doses of whole-cell DTP vaccine was quite (70–90%) effective in preventing serious pertussis disease; however, up to half of the children who received the vaccine developed local reactions such as redness, swelling, and pain at the injection site. In 1991, concerns about safety led to the development of more purified (acellular) pertussis vaccines that are associated with fewer side effects. These acellular pertussis vaccines have replaced the whole cell DTP vaccines in the U.S.

In 2005, two new vaccine products were licensed for use in adolescents and adults that combine the tetanus and diphtheria toxoids with acellular pertussis (Tdap) vaccine. These vaccines are the first acellular pertussis-containing vaccines that make it possible to vaccinate adolescents and adults against pertussis.

How are vaccines made that prevent diphtheria, tetanus and pertussis?

These vaccines are made by chemically treating the diphtheria, tetanus, and pertussis toxins to render them nontoxic yet still capable of eliciting an immune response in the vaccinated person. They are known as “inactivated” vaccines because they do not contain live bacteria and cannot replicate themselves, which is why multiple doses are needed to produce immunity.

What’s the difference between all the vaccines containing diphtheria and tetanus toxoids and pertussis vaccine?

It’s like alphabet soup! Here is a listing of the various products:

- DTaP: Diphtheria and tetanus toxoids and acellular pertussis vaccine; given to infants and children ages 6 weeks through 6 years. In addition, three childhood combination vaccines include DTaP as a component.
- DT: Diphtheria and tetanus toxoids, without the pertussis component; given to infants and children ages 6 weeks through 6 years who have a contraindication to the pertussis component.
- Tdap: Tetanus and diphtheria toxoids with acellular pertussis vaccine; given to adolescents and adults, usually as a single dose; the exception is pregnant women who should receive Tdap during each pregnancy.
- Td: Tetanus and diphtheria toxoids; given to children and adults ages 7 years and older. Note the small “d” which indicates a much smaller quantity of diphtheria toxoid than in the pediatric DTaP formulation.

How are these vaccines given?

The DTaP and DT preparations are all given as an injection in the anterolateral thigh muscle (for infants and young toddlers) or in the deltoid muscle (for older children and adults). Tdap and Td are given in the deltoid muscle for children and adults age 7 years and older.

Who should get these vaccines?

All children, beginning at age 2 months, and adults need protection against these three diseases—diphtheria, tetanus, and pertussis (whooping cough). Routine booster doses are also needed throughout life.

How many doses of vaccine are needed?

The usual schedule for infants is a series of four doses of DTaP given at 2, 4, 6, and 15–18 months of age. A fifth shot, or booster dose, is recommended between age 4 and 6 years, unless the fourth dose was given late (after the fourth birthday).

For people who were never vaccinated or who may have started but not completed a series of shots, a 3-dose series of Td should be given with 1 to 2 months between dose #1 and #2, and 6 to 12 months between dose #2 and #3. One of the doses, preferably the first, should also contain the pertussis component in the form of Tdap.

Because immunity to diphtheria and tetanus wanes with time, boosters of Td are needed every ten years.

When adolescents and adults are scheduled for their routine tetanus and diphtheria booster, should they get vaccinated with Td or Tdap?

Immunization experts recommend that the first dose of Tdap be given to all adolescents at age 11–12 years as a booster during the routine adolescent immunization visit if the adolescent has finished the childhood DTaP schedule and has not already received a dose of Td or Tdap. If a child age 7–10 years did not complete a primary series in childhood, a dose of Tdap may be given earlier as part of the catch-up vaccinations.

All adults should receive a single dose of Tdap as soon as feasible. Then, subsequent booster doses of Td should be given every ten years. Pregnant teens and women should receive Tdap during each pregnancy. Adolescents and adults who have recently received Td vaccine can be given Tdap without any waiting period.

If someone experiences a deep or puncture wound, or a wound contaminated with dirt, an additional booster dose may be given if the last dose was more than five years ago. This could be a dose of Td or Tdap, depending on the person's vaccination history. It is important to keep an up-to-date record of all immunizations so that repeat doses don't become necessary. Although it is vital to be adequately protected, receiving more doses than recommended can lead to increased local reactions, such as painful swelling of the arm.

Who recommends the use of these vaccines?

The Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics (AAP), the American Academy of Family Physicians (AAFP), and the American College of Physicians (ACP) all recommend this vaccine.

What side effects have been reported with these vaccines?

Local reactions, such as fever, redness and swelling at the injection site, and soreness and tenderness where the shot was given, are not uncommon in children and adults. These minor local and systemic adverse reactions are much less common with acellular DTaP vaccine; however, a determination of more rare adverse effects can only be made when additional data are available following extended use of DTaP.

Side effects following Td or Tdap in older children and adults include redness and swelling at the injection site (following Td) and generalized body aches, and tiredness (following Tdap). Older children and adults who received more than the recommended doses of Td/Tdap vaccine can experience increased local reactions, such as painful swelling of the arm. This is due to the high levels of tetanus antibody in their blood.

How effective are these vaccines?

After a properly spaced primary series of DTaP or Td/ Tdap, approximately 95% of people will have protective levels of diphtheria antitoxin and 100% will have protective levels of tetanus antitoxin in their blood. However, antitoxin levels decrease with time so routine boosters with tetanus and diphtheria toxoids are recommended every 10 years. Estimates of acellular pertussis vaccine efficacy range from 80% to 85%—a level believed to be far more efficacious than the previously-used whole cell pertussis vaccine.

Can a pregnant woman receive Tdap vaccine?

Yes. All pregnant women should receive Tdap during each pregnancy, preferably between 27 and 36 weeks' gestation. Because infants are not adequately protected against pertussis until they have received at least 3 doses of DTaP, it is especially important that all contacts (family members, caregivers) of infants younger than age 12 months are vaccinated with Tdap. If a new mother hasn't been vaccinated with Tdap, she should receive it before hospital discharge, even if she is breastfeeding.

Who should not receive these vaccines?

Generally, any person who has had a serious allergic reaction to a vaccine component or a prior dose of the vaccine should not receive another dose of the same vaccine. People who had a serious allergic reaction to a previous dose of DTaP or Tdap vaccine should not receive another dose.

Certain rare adverse events following pertussis vaccination usually serve as a precaution against receiving further doses. Such events include a temperature of 105°F or higher within two days, collapse or shock-like state within two days, persistent crying for more than three hours within two days, or convulsions within three days. Even if one of these precautions exists, there may be occasions when the benefit of immunization outweighs the risk (for example, during a community-wide outbreak of pertussis). A person who developed one of these adverse events after pediatric DTaP vaccine may receive Tdap as an adolescent or adult.

A person with a recognized, possible, or potential neurologic condition should delay receiving DTaP or Tdap vaccine until the condition is evaluated, treated, and/or stabilized. Although DTaP vaccine does not cause neurological disorders, receiving the vaccine can cause an already-present underlying condition to show itself.

Can the vaccine cause the disease?

No.

Immunization Action Coalition

Technically reviewed by the Centers for Disease Control and Prevention, July 2013.

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Haemophilus influenzae invasive disease is caused by the bacterium *Haemophilus influenzae*. *H. influenzae* may be either encapsulated (typeable) or unencapsulated (nontypeable). The encapsulated strains are further classified into serotypes a through f, based on the antigenic characteristics of their polysaccharide capsules. *H. influenzae* serotype b (Hib) is the most pathogenic.

B. Description of Illness

- **General facts:** Before the introduction of effective vaccines, Hib accounted for 95% of all strains that caused invasive disease and was the most common cause of bacterial meningitis in children in the United States. Invasive Hib disease now occurs primarily in under immunized children and among infants too young to have completed the primary immunization series. The epidemiology of invasive *Haemophilus influenzae* disease in the United States has shifted in the post-Hib vaccination era. Nontypable *Haemophilus influenzae* now causes the majority of invasive disease in all age groups, with the greatest burden of disease among the youngest and oldest age groups.
- **Occurrence:** Due to routine use of the Hib conjugate vaccine since 1990, the incidence of Hib disease in infants and young children has decreased by 99% to less than 1 case per 100,000 in children less than 5 years of age. In developing countries, where routine vaccination with Hib vaccine is not widely available, Hib remains a major cause of lower respiratory tract infections in infants and children. From 1999 through 2008, the annual incidence of invasive nontypable *Haemophilus influenzae* disease was 1.7 cases per 100,000 in children younger than 5 years of age and 4 cases per 100,000 in adults ≥65 years of age.
- **Incubation period:** Unknown, probably short 2 – 4 days. Most individuals who acquire Hib infections are asymptotically colonized.
- **Common symptoms:** The most common types of invasive disease are pneumonia, occult febrile bacteremia, meningitis, epiglottitis, septic arthritis, cellulitis, otitis media, purulent pericarditis, and other less common infections such as endocarditis and osteomyelitis. Invasive *Haemophilus influenzae* is associated with severe outcomes, especially in older adults; among ≥65 year-olds the overall case fatality ratio (CFR) is estimated to be 19.5% and increases with age, ranging from 10.2% to 27.5%.
- **Treatment:** Hib disease is treated with antibiotics for 10 – 14 days. Most cases require hospitalization. Even with antibiotic treatment, about 5% of all children with Hib meningitis die from the disease.

C. Reservoirs

Humans are the only known reservoir.

D. Modes of Transmission

Transmission occurs from person to person by respiratory droplets or direct contact with nasopharyngeal secretions of a carrier or an infected person. It is not highly infectious.

E. Period of Communicability

H. influenzae may be transmitted as long as it is present in throat or nasal discharge,

which may be for a prolonged period. Communicability ends within 24 – 48 hours of effective antibiotic therapy. The contagious potential of invasive *H. influenzae* disease is considered to be limited. However, certain circumstances, particularly close contact with a case (e.g., in a household, daycare center, or institutional setting), can lead to outbreaks of Hib or direct secondary transmission of the disease. Asymptomatic carriage is known to occur.

2) ACTIONS REQUIRED/CONTROL MEASURES

A. Reporting Requirements

Invasive *H. influenzae* infection is physician reportable by mail within 12 hours of recognition or strong suspicion to both the Connecticut Department of Public Health (DPH) and the local health department (LHD). The director of any clinical laboratory must also report laboratory evidence of invasive *H. influenzae* infection to both the DPH and LHD.

Additional requirements: All isolates yielding *H. influenzae* from invasive sterile sites must be submitted to the DPH State Laboratory for confirmation. See current list of Physician Reportable Diseases (Attachment A) and Laboratory Report of Significant Findings (Attachment C).

B. Case Definition

- **Clinical description:** Invasive disease caused by *H. influenzae* may produce any of several clinical syndromes, including meningitis, bacteremia, epiglottitis, or pneumonia.
- **Probable Case:** A meningitis case with detection of *H. influenzae* type b antigen in CSF.
- **Confirmed Case:**
 - Isolation of *H. influenzae* from a normally sterile site (e.g., blood or cerebrospinal fluid, or less commonly, joint, pleural, or pericardial fluid); OR
 - Detection of *H. influenzae* in a specimen obtained from a normally sterile body site using a validated PCR (polymerase chain reaction) assay.

C. Case Investigation

- **DPH Responsibility:** The DPH Epidemiology and Emerging Infections Program obtains additional case data by completing a detailed report through medical chart review. Information is forwarded to the Centers for Disease Control and Prevention. The DPH is available to the LHD for assistance, consultation, guidance, and to ensure that appropriate investigative and control actions are being taken.
- **LHD Responsibility:** For invasive Hib disease, contact case to identify close contacts (see Control Measures) and ensure they are provided antibiotic prophylaxis. Provide educational materials describing the nature of disease and preventive measures. No follow-up is required for other serotypes.

D. Control Measures

- **Household contacts:** Chemoprophylaxis is recommended for all household contacts of Hib cases in the following circumstances:
 - Household with at least 1 contact younger than 4 years of age who is unimmunized or incompletely immunized;
 - Household with a child younger than 12 months of age who has not received the primary series;

- Household with a contact who is an immunocompromised child, regardless of that child's Hib immunization status.
- **Daycare contacts:** Chemoprophylaxis is recommended for nursery school and daycare center contacts when 2 or more cases of Hib invasive disease have occurred within 60 days.
- **Index case:** If the Hib index case is younger than 2 years of age or member of a household with a susceptible contact and treated with a regimen other than cefotaxime or ceftriaxone, chemoprophylaxis usually is provided just before discharge from hospital.

Fact Sheet

What causes Hib disease?

Hib disease is caused by a bacterium, *Haemophilus influenzae* type b. There are six different types of these bacteria (a through f). Type b organisms account for 95% of all strains that cause invasive disease, and this is the type against which the Hib vaccine protects.

How does Hib disease spread?

Hib disease is spread person-to-person by direct contact or through respiratory droplets. Usually the organisms remain in the nose and throat, but occasionally the bacteria spread to the lungs or bloodstream and cause a serious infection in the individual.

How long does it take to show signs of Hib disease after being exposed?

The incubation period of Hib disease is not certain, but could be as short as a few days.

What are the symptoms of Hib disease?

A person with invasive Hib disease can have different symptoms depending on what body systems are affected. (See next question.)

How serious is Hib disease?

Hib disease can be very serious. The most common type of invasive Hib disease is meningitis, an infection of the membranes covering the brain (50%–65% of cases). Symptoms of Hib meningitis include fever, decreased mental status, and stiff neck. The mortality rate is 2%–5%. In addition, 15%–30% of survivors suffer some permanent neurologic damage, including blindness, deafness, and mental retardation.

Another 17% of invasive Hib cases results in epiglottitis, an infection and swelling in the throat that can lead to life-threatening airway blockage. Other forms of invasive Hib disease include joint infection (8%), skin infection (6%), pneumonia (15%), and bone infection (2%).

Two tragic incidents showing the seriousness of Hib were reported from both Minnesota and Pennsylvania in early 2009. Minnesota reported a total of five cases of invasive Hib disease in children younger than 5 years from 2008, the largest number since 1992. Three of the children had not been vaccinated because of parent/guardian deferral or refusal. One of these children died. In Pennsylvania, seven cases were reported for the six-month period from October 2008–March 2009. Only one child had received any vaccine (1 dose) and 3 of the children died.

How do I know if my child has Hib disease?

The diagnosis of Hib disease is usually made based on one or more laboratory tests using a sample of infected body fluid, such as blood or spinal fluid.

Is there a treatment for Hib disease?

Hib disease is treated with antibiotics. Most people with Hib disease require hospitalization. Even with antibiotic treatment, 3%–6% of all children with Hib meningitis die from the disease.

How common is Hib disease in the United States?

Before the introduction of a Hib vaccine, *H. influenzae* type b (Hib) was the leading cause of bacterial meningitis among children younger than age five years in the United States. Every year about 20,000 children younger than age five years got severe Hib disease and about 1,000 children died. More than half of children who developed severe Hib disease were younger than age 12 months.

From 1996 through 2000, an average of 68 reported cases of Hib disease occurred in children younger than age 5 years each year. By 2008, this number had dropped to just 30 cases and, although some of the 163 cases with unknown serotype could have been due to Hib, the significant decline in incidence (>99%) since the pre-vaccine era is truly remarkable.

Can you get Hib disease more than once?

Yes. A child with Hib disease may not develop protective levels of antibodies. Children younger than age 24 months who have recovered from invasive Hib disease should be considered unprotected and receive the Hib vaccine as soon as possible.

When did Hib vaccine become available?

The first Hib vaccine was licensed in the United States in 1985; however, it was not very effective in children age 18 months and younger. The first improved Hib vaccine, a conjugate vaccine, was licensed in December 1987.

What type of vaccine is it?

The Hib conjugate vaccine is an inactivated vaccine. It is made by chemically bonding a polysaccharide (sugar) to a protein. This long chain of sugar molecules makes up the surface capsule of the bacterium.

How is this vaccine given?

The Hib vaccine is given as an injection into the anterolateral thigh muscle (in infants and toddlers) or in the deltoid muscle of older children.

Is there more than one brand of Hib vaccine?

There are several formulations of Hib vaccine, including several that are combined with other vaccines. The number of doses needed depends on the brand of vaccine given.

All conjugate Hib vaccines may be given interchangeably if the original brand is unknown or unavailable.

Who should get this vaccine?

All infants should receive doses of Hib vaccine as part of their routine immunization (unless they have a medical reason not to) beginning at 2 months of age. The 3 or 4 dose series of Hib vaccine should be completed by 15 months of age. However, unvaccinated children 15 through 59 months of age should receive 1 dose of Hib vaccine. As Hib disease is rare in children older than age five years, Hib vaccine is not routinely recommended for healthy people age five years or older.

Is Hib vaccine recommended for anyone age five years or older?

Older children and adults who are at increased risk for invasive Hib disease should be vaccinated. High-risk children include those with asplenia (such as sickle cell disease, or having the spleen surgically removed) and HIV infection. A previously unvaccinated child with one of these high-risk conditions should be given one dose of any licensed Hib vaccine. Previously unvaccinated adults age 19 years and older with asplenia are at increased risk of Hib disease and should receive 1 dose of Hib vaccine. Recipients of hematopoietic stem cell (bone marrow) transplant of all ages should be revaccinated regardless of their previous Hib vaccination history. Note: People older than age 59 months with immunoglobulin or complement component deficiency and chemotherapy are not addressed in the 2014 CDC recommendations.

How many doses of Hib vaccine are required for the childhood series?

Children who begin their vaccination series in infancy need three to four doses, depending on the brand of Hib vaccine used. Children should get Hib vaccine at age two months, four months, six months (depending on the brand of vaccine), and 12–15 months of age. Hib vaccine should never be given to a child younger than six weeks of age, as this might reduce his/her ability to respond to subsequent doses.

My 18-month-old toddler has never received Hib vaccine. Does she still need to get the series?

All unvaccinated children ages 15 through 59 months should receive one dose of Hib vaccine.

Will receiving the Hib shot protect my baby from ever getting meningitis?

No. Meningitis can also be caused by other viruses and bacteria. Hib vaccine will only protect against meningitis caused by Hib.

Who recommends this vaccine?

The Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics (AAP), and the American Academy of Family Physicians (AAFP) all recommend this vaccine.

How safe is this vaccine?

Adverse events following receipt of Hib conjugate vaccine are uncommon. The most common reactions are local reactions at the injection site, such as warmth, redness, and swelling, occurring in 5%–30% of recipients. Up to one out of 20 children may develop a fever over 101°F.

How effective is this vaccine?

All the Hib vaccines licensed for use are good at producing immunity to invasive Hib disease. More than 95% of infants will be protected after two or three doses.

Who should NOT receive Hib disease vaccine?

Anyone who has ever had a life-threatening allergic reaction to a previous dose of Hib vaccine or to an ingredient in the vaccine (such as latex, which is present in the vial stopper of some brands of Hib vaccine) should not get another dose.

Children younger than six weeks of age should not get Hib vaccine because a dose given at this time may reduce the infant's response to subsequent doses.

People with a moderate or severe acute illness should postpone receiving the vaccine until their condition has improved.

Can the vaccine cause Hib disease?

No. Only the entire Hib bacterium can cause Hib disease. Hib vaccine is a fractional vaccine, containing only part of the Hib microbe.

Immunization Action Coalition

Technically reviewed by the Centers for Disease Control and Prevention, April 2015.

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Hepatitis B virus (HBV) is a DNA virus. There are four major subtypes.

B. Description of Illness

- **General facts:** HBV can cause severe illness and chronic infection with potentially serious consequences including cirrhosis, liver failure, and hepatocellular carcinoma. Individuals may be symptomatic or asymptomatic. After acute infection, the risk of developing chronic infection varies with age: 90% of infants infected at birth, 20-50% of children infected at 1-5 years of age, and about 1-10% in older children and adults.
- **Occurrence:** It is estimated that 17,000 Connecticut residents are chronically infected. In the United States, it is estimated that 1.25 million individuals are infected with HBV, of whom 20-30% acquired their infection in childhood. HBV is endemic in some countries.
- **Incubation period:** Ranges from 60-50 days, with an average of 90 days.
- **Common symptoms:** Fatigue, abdominal pain, loss of appetite, nausea, and joint pain. Jaundice or dark urine may also be observed. It is estimated that 30 - 50% of persons have signs or symptoms during initial infection. Signs and symptoms are less common in children than adults.
- **Treatment:** No specific therapy for acute HBV infection is available. Medications for treatment of chronic HBV are available. Treatment outcome is highly variable depending on viral strain and patient factors. Patients should be referred to specialized care for evaluation of treatment options.

C. Reservoirs

Humans are the only known reservoir for HBV.

D. Modes of Transmission

- Person-to-person via blood or body fluids (e.g., wound exudates, semen, cervical secretions). Blood and serum contain the highest concentrations of virus. Common modes of transmission include sharing contaminated needles or “works” (equipment or materials used in preparing drugs for injection), sex with an infected person, contact with blood or open sores of infected person, and mother-to-child.
- Occupational exposure to blood has historically been a risk factor, but HBV vaccination has reduced that risk. The virus can exist in the environment for at least 7 days but is inactivated by common disinfectants. Environmental contamination can be a source of infection.
- Hepatitis B is not transmitted through food or water, sharing eating utensils, breastfeeding, hugging, kissing, hand holding, coughing, or sneezing. There is no exclusion of food handlers.

E. Period of Communicability

Hepatitis B surface antigen (HBsAg) is a protein found on the surface of the virus. All HBsAg positive (HBsAg+) persons should be considered infectious. Antigen can be detected in blood from 1 - 9 weeks after infection, with an average of 4 weeks. Acutely

infected persons can transmit HBV many weeks before the onset of symptoms. Infectiousness of chronic carriers can vary, with hepatitis B e antigen positive (HBeAg+) persons being highly infectious.

2) ACTIONS REQUIRED/CONTROL MEASURES

A. Reporting Requirements

Acute HBV infection is physician reportable by mail within 12 hours of recognition or strong suspicion to both the Connecticut Department of Public Health (DPH) and the local health department (LHD). The director of any clinical laboratory must also report laboratory evidence of HBV infection to both the DPH and LHD.

- HBsAg+ and IgM anti-HBc+ are laboratory reportable.
- Acute infection (per the CDC case definition) and HBsAg+ in a pregnant woman is physician reportable.

B. Case Definition

• Acute Case

- Clinical Description: an acute illness with a discrete onset of any sign or symptom* consistent with acute viral hepatitis (e.g., fever, headache, malaise, anorexia, nausea, vomiting, diarrhea, and abdominal pain), and either a) jaundice, or b) elevated serum alanine aminotransferase (ALT) levels >100 IU/L.
- Laboratory Criteria for Diagnosis
 - HBsAg positive, **AND**
 - Immunoglobulin M (IgM) antibody to hepatitis B core antigen (IgM anti-HBc) positive (if done)

*A documented negative hepatitis B surface antigen (HBsAg) laboratory test result within 6 months prior to a positive test (either HBsAg, hepatitis B "e" antigen (HBeAg), or hepatitis B virus nucleic acid testing (HBV NAT) including genotype) result does not require an acute clinical presentation to meet the surveillance case definition.

• Chronic Case

- Clinical Description: no symptoms are required. Persons with chronic hepatitis B virus (HBV) infection may have no evidence of liver disease or may have a spectrum of disease ranging from chronic hepatitis to cirrhosis or liver cancer.
- Laboratory Criteria for Diagnosis
 - Immunoglobulin M (IgM) antibodies to hepatitis B core antigen (IgM anti-HBc) negative **AND** a positive result on one of the following tests: hepatitis B surface antigen (HBsAg), hepatitis B e antigen (HBeAg), or nucleic acid test for hepatitis B virus DNA (including qualitative, quantitative and genotype testing), **OR**
 - HBsAg positive or nucleic acid test for HBV DNA positive (including qualitative, quantitative and genotype testing) or HBeAg positive two times at least 6 months apart (Any combination of these tests performed 6 months apart is acceptable).
- Probable
 - A person with a single HBsAg positive or HBV DNA positive (including qualitative, quantitative and genotype testing) or HBeAg positive lab result and does not meet the case definition for acute hepatitis B.

- **Confirmed**
 - A person who meets either of the above laboratory criteria for diagnosis.

Comments: multiple laboratory tests indicative of chronic HBV infection may be performed simultaneously on the same patient specimen as part of a "hepatitis panel." Testing performed in this manner may lead to seemingly discordant results, e.g., HBsAg-negative AND HBV DNA-positive. For the purposes of this case definition, any positive result among the three laboratory tests mentioned above is acceptable, regardless of other testing results. Negative HBeAg results and HBV DNA levels below positive cutoff level do not confirm the absence of HBV infection.

C. Case Investigation

- **DPH Responsibility:**
 - DPH maintains a statewide HBV registry of laboratory reports (positive IgM and HBsAg results). The DPH database registers acute cases of HBV. DPH does not monitor changes in patient residence from one local health jurisdiction to another.
 - DPH conducts statewide follow-up on all new HBsAg+ and IgM anti-HBc+ reports with the ordering physician. The purpose of follow-up is to ascertain acute versus chronic case status, reasons for testing, risk factors, and pregnancy status.
 - DPH investigates all cases that meet the acute HBV case definition with the attending physicians to determine if the patients are aware of their diagnoses. DPH will interview all cases to provide education and determine risk factors.
 - DPH conducts statewide follow-up for all pregnant women reported with HBsAg+ and their newborns to assure that perinatal prevention recommendations are followed. To report a case, contact DPH at (860) 509-7900.
- **Local Health Department Responsibility:**
 - Control measures as described below.
 - Staff conducting follow-up should be familiar with CDC HBV recommendations.

D. Control Measures

The DPH immunization Program should be contacted (860-509-7929) for guidance on measures and further action, if necessary. Working in conjunction with DPH, the following HBV control measures are recommended:

- Follow-up activities: LHDs should provide services that include the following:
 - **Education:** Inform patients about the implications of HBV infection (avoidance of alcohol and the need to discuss medications (even over-the-counter medications) with their physician). LHDs should maintain a list of locally available medical care providers where patients can receive ongoing evaluation, additional testing, and vaccination for contacts.
 - **Prevention counseling:** Caution about not sharing needles, limiting blood exposure to household contacts, and use of condoms to reduce the risk of sexual transmission. Offer to send a fact sheet (available from DPH). Needle, sex, and/or household contacts may need to be tested for HBV and vaccinated as necessary.

- Additional testing: Persons in risk groups for HIV or HCV should be referred for testing, if not already done.
- Vaccination:
 - Sex partners of persons with HBV should be tested, and if susceptible should be vaccinated against HBV. Household members of persons with chronic HBV should also be tested and vaccinated if applicable.
 - Recommendations for post-exposure use of vaccine/HBIG are provided in MMWR 55 (RR-16), Dec 2006.
 - HAV vaccination is recommended for chronically infected persons who have been diagnosed with chronic liver disease

Fact Sheet

What causes hepatitis B?

Hepatitis B is a liver disease caused by the hepatitis B virus.

How does hepatitis B virus spread?

The virus is found in the blood or certain body fluids and is spread when blood or body fluid from an infected person enters the body of a person who is not infected. This can occur in a variety of ways including:

- Unprotected sexual contact
- Sharing drugs, needles, or “works” when using drugs
- Poor infection control practices in medical settings, particularly with equipment to test blood sugar
- Needle sticks or sharps exposures on the job
- From mother to baby during birth
- Contact with wounds or skin sores
- When an infected person bites another person
- Pre-chewing food for babies
- Sharing personal-care items, such as razors or toothbrushes

Hepatitis B virus particles can be found on objects, even in the absence of visible blood. The virus can remain infectious and capable of spreading infection for at least seven days outside the human body.

Hepatitis B is not spread through food or water, sharing eating utensils, hugging, kissing, coughing, and sneezing or by casual contact, such as in an office or factory setting.

What are the symptoms of hepatitis B?

About 7 out of 10 adults who become infected with hepatitis B develop symptoms. Children under age 5 years rarely have symptoms. When people have symptoms, they usually appear between 60 and 150 days after onset of infection. People who have symptoms generally feel quite ill and might need to be hospitalized.

Symptoms of hepatitis B might include the following:

- Yellowing of skin and whites of eyes
- Dark-colored urine
- Loss of appetite or nausea
- Bloated and tender belly
- Extreme tiredness
- Fever
- Pain in joints

Do people fully recover?

Most people who get infected as adults will fully recover. However, about 2 of 100 adults, 30 of 100 children age 1–5 years, and up to 90 of 100 infants will remain infectious and carry hepatitis B virus in their bodies for life. This is called chronic (life-long) infection. People with chronic

hepatitis B virus infection should not be excluded from work, school, play, childcare, or other settings.

The majority of people with chronic hepatitis B infection feel healthy and do not develop serious problems related to the infection; however, about 25% will develop cirrhosis (scarring of the liver), liver failure, and liver cancer later in life.

How serious is infection with hepatitis B?

Hepatitis B can be very serious. Infection with this virus can cause chronic infection that can lead to cirrhosis and liver cancer. Many people in the United States die every year from hepatitis B-related liver disease. Fortunately, there is a vaccine to prevent acute (recently acquired) hepatitis B.

How common is hepatitis B in the United States?

About 3,000 to 4,000 cases of acute hepatitis B are reported annually to the Centers for Disease Control and Prevention; however, the number of new infections is estimated to be much higher.

Since the introduction of routine vaccination against hepatitis B virus infection, there has been a significant decline in U.S. cases among children and adolescents, the group with the largest increase in hepatitis B vaccination coverage.

However, chronic hepatitis B virus infection remains a major problem. An estimated 800,000 to 1.4 million people are chronically infected with hepatitis B in the United States. Many people chronically infected with hepatitis B virus do not know they are infected. Most cases of chronic hepatitis B virus infection in the United States are found in immigrants or refugees from Asia, Africa, the Pacific Islands, and Eastern Europe. Worldwide, more than 350 million people are chronically infected with hepatitis B virus and more than 1 million of these people die each year from cirrhosis leading to liver failure or liver cancer.

How do people know if they have hepatitis B infection?

Only blood tests can tell whether or not a person is currently infected and whether or not a person has been infected in the past. If the blood tests indicate a person has been infected in the past, testing will also determine whether the person has developed protective antibodies to the virus or whether they still have virus in their blood and could have chronic hepatitis B virus infection.

Who should be tested?

People who are recommended to have screening blood tests to determine if they are infected with hepatitis B virus are:

- All pregnant women
- People born in regions of the world with medium to high rates of hepatitis B (see a map of these countries at <http://wwwnc.cdc.gov/travel/yellowbook/2016/infectious-diseases-related-to-travel/hepatitis-b>)
- U.S.-born people not vaccinated as infants whose parents were born in these same regions
- Infants born to HBV-infected mothers
- Household, needle-sharing, or sex contacts of HBV-infected people
- Men who have sex with men
- Injection drug users
- Patients with elevated liver enzymes of an unknown cause
- Hemodialysis patients
- People needing immunosuppressive therapy or chemotherapy

- People infected with HIV
- Donors of blood, plasma, organs, tissues, or semen

Is there a medication to treat hepatitis B?

There are several FDA-approved medications that might help a person who has chronic hepatitis B virus infection. These medications don't usually get rid of the virus, but they might decrease the chance of the infected person developing severe liver disease. Not every infected person is a candidate for these medications. Researchers continue to seek additional treatments for hepatitis B. There is no treatment (other than supportive care) for people with acute hepatitis B.

What should you do if you have been exposed to hepatitis B virus?

If you think you've been exposed to the virus, contact your doctor or clinic without delay. If you have not been vaccinated, it is recommended that you receive treatment with hepatitis B immune globulin, often called HBIG, a blood product containing protective hepatitis B virus antibodies. You should also get the first dose of hepatitis B vaccine as soon as possible, preferably at the same time as the HBIG is given. Following this, you will need to complete the full hepatitis B vaccine series.

Can you get hepatitis B more than once?

No.

When did hepatitis B vaccine become available?

The first hepatitis B vaccine became commercially available in the United States in 1982. In 1986, a hepatitis B vaccine produced by recombinant DNA technology was licensed, and a second recombinant-type hepatitis B vaccine was licensed in 1989. The two recombinant DNA vaccines (Recombivax HB and Engerix-B) are the only hepatitis B vaccine preparations currently used in the United States. (There are additional products licensed in the United States that contain these vaccines in combination with other vaccines.)

Who should get this vaccine?

Hepatitis B vaccine, usually a three-dose series, is recommended for all children 0 through 18 years of age. It is recommended for infants beginning at birth in the hospital. All older children who did not get all the recommended doses of hepatitis B vaccine as an infant should complete their vaccine series as soon as possible. Most states require hepatitis B vaccine for school entry. Adolescents who are just starting their series will need two or three doses, depending on their age and the brand of vaccine used. Adults at increased risk of acquiring hepatitis B infection should also be vaccinated. In addition, the vaccine can be given to any person who desires protection from hepatitis B.

Who is at increased risk of hepatitis B infection?

Any adult who wishes to be protected from hepatitis B infection should be vaccinated (without having to acknowledge a specific risk factor or reason). Those who are at increased risk of infection include:

- Healthcare workers and public safety workers with reasonably anticipated risk for exposure to blood or blood-contaminated body fluids
- People with diabetes
- Men who have sex with men
- People with HIV infection
- Sexually active people who are not in long-term, mutually monogamous relationships
- People seeking evaluation or treatment for a sexually transmitted disease

- Current or recent injection drug users
- Inmates of long-term correctional facilities
- People with end-stage kidney disease, including pre-dialysis, hemodialysis, peritoneal dialysis, and home dialysis patients
- People with chronic liver disease
- Staff and residents of institutions or group homes for the developmentally challenged
- Household members and sex partners of people with chronic hepatitis B virus infection
- Susceptible (non-infected and non-vaccinated) people from United States populations known to previously or currently have high rates of childhood hepatitis B infection, including Alaska Natives, Pacific Islanders, and immigrants or refugees from countries with intermediate or high rates of chronic hepatitis B virus infection; (see a map of these countries at <http://wwwnc.cdc.gov/travel/yellowbook/2016/infectious-diseases-related-to-travel/hepatitis-b>)
- Travelers to regions with high or intermediate rates of hepatitis B virus infection; (see a map of these countries at <http://wwwnc.cdc.gov/travel/yellowbook/2016/infectious-diseases-related-to-travel/hepatitis-b>).

Who recommends this vaccine?

The Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics (AAP), the American Academy of Family Physicians (AAFP), the American College of Physicians (ACP), and American College of Obstetricians and Gynecologists (ACOG) recommend this vaccine.

Is hepatitis B vaccine safe?

Yes. Hepatitis B vaccines have been demonstrated to be safe when administered to infants, children, adolescents, and adults. Since 1982, more than an estimated 70 million adolescents and adults and more than 50 million infants and children have received at least one dose of hepatitis B vaccine in the United States. The majority of children who receive this vaccine have no side effects. Serious reactions are rare.

What side effects have been reported with this vaccine?

Of those children experiencing a side effect, most will have only a very mild reaction, such as soreness at the injection site (fewer than one out of three children) or low-grade fever. Adults are slightly more likely to experience such mild symptoms. Serious allergic reactions following hepatitis B vaccination are rare.

How effective is this vaccine?

After three properly administered doses of vaccine, at least 9 of 10 healthy young adults and more than 9 of 10 infants, children, and adolescents develop protective antibodies and subsequent immunity to hepatitis B virus infection.

Why is this vaccine recommended for all babies when most of them won't be exposed to hepatitis B virus for many years, if then?

There are four reasons for recommending that all infants receive hepatitis B vaccine, starting at birth. First, people have a very high risk for developing chronic hepatitis B virus infection if they become infected at birth or during childhood, with an increased risk of dying prematurely from liver cancer or cirrhosis.

Second, hepatitis B infection in infants and young children usually produces no symptoms, so these individuals can spread the infection to others without knowing it.

Third, most early childhood spread of hepatitis B occurs in households where a person has chronic hepatitis B virus infection, but the spread of the virus has also been recognized in daycare centers and schools.

Fourth, long-term protection following infant vaccination is expected to last for decades and will ultimately protect against acquiring infection at any age.

Should I be tested before I get the vaccine to see if I'm already infected or immune?

Blood testing before vaccination is not recommended for the routine vaccination of infants, children, and adolescents. However, children born in countries where hepatitis B is moderate or highly endemic (see a map of these countries at <http://wwwnc.cdc.gov/travel/yellowbook/2016/infectious-diseases-related-to-travel/hepatitis-b>) should be tested to be sure they are not already infected. Testing can be done at the same visit when the first dose of hepatitis B vaccine is given. Vaccinating a person already immune to or infected with this virus will not help or harm the person. The main reason for testing people at increased risk for hepatitis B is to determine if they are infected in order to refer them for medical care.

Should I get my blood tested after getting the vaccine series to make sure it worked?

Testing after vaccination is not recommended routinely. Testing after vaccination is recommended only for people whose medical care depends on knowledge of their response to the vaccine. This includes infants born to hepatitis B-infected mothers; health care and public safety workers at reasonable risk of exposure to blood on the job; immunocompromised people (e.g., people with AIDS or on hemodialysis); and sex and needle-sharing partners of people with chronic hepatitis B virus infection.

Who should NOT receive hepatitis B vaccine?

People who had a serious allergic reaction to one dose of hepatitis B vaccine should not have another dose of hepatitis B vaccine. People with a history of hypersensitivity to yeast should not receive this vaccine. People with a moderate or severe acute illness should postpone receiving the vaccine until their condition is improved.

Can I get this vaccine when I am pregnant?

Yes.

I'm an adult who wants hepatitis B vaccination. How can I pay for the shots?

If you have insurance, the cost of hepatitis B vaccination might be covered. If not, these shots are often available at low cost through special programs or from health departments. Call your local health department for details.

Will hepatitis B vaccination protect me from hepatitis A or hepatitis C?

No. Hepatitis A and hepatitis C are different diseases caused by different viruses. There is a vaccine to prevent hepatitis A, but there is no vaccine for hepatitis C.

Immunization Action Coalition

Technically reviewed by the Centers for Disease Control and Prevention, August 2013.

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Three types of influenza virus are recognized: A, B, and C. Type A includes three subtypes (H1N1, H2N2, and H3N2) that have been associated with widespread epidemics and pandemics; type B has been infrequently associated with regional and widespread epidemics; type C has been associated with sporadic cases and minor localized outbreaks.

B. Description of Illness

- **General facts:** Influenza derives its importance from the rapidity with which epidemics evolve, the widespread morbidity, and the seriousness of complications, notably viral and bacterial pneumonias. During major epidemics, severe illness and death occur, primarily among the elderly and those debilitated by chronic cardiac, pulmonary, renal or metabolic disease, anemia or immunosuppression.
- **Occurrence:** Influenza occurs as pandemics, epidemics, localized outbreaks, and as sporadic cases. Epidemics of influenza occur in the United States almost every year (seasonal influenza); they may be caused by type A viruses, occasionally by influenza B viruses or by both.
- **Incubation period:** The typical incubation period ranges from 1 – 4 days (average 2 days) although some strains may have longer incubation periods.
- **Common symptoms:** An acute viral disease of the respiratory tract characterized by abrupt onset of fever, headache, myalgia, prostration, coryza, sore throat and cough. Cough is often severe and protracted, but other manifestations are usually self-limited, with recovery in 2 – 7 days. Additional symptoms may include runny nose, headache, a burning sensation in the chest, and eye pain and sensitivity to light. Someone who has been previously exposed to similar virus strains (through natural infection or immunization) is less likely to develop serious clinical illness.
- **Treatment:** There are several antiviral agents approved for preventing or treating influenza in some patients. Their use is generally limited to situations where an outbreak is underway and immediate protection of vulnerable, unvaccinated persons is critical (e.g., nursing home residents) or in persons who are expected to have an inadequate antibody response to the vaccine (e.g., persons with HIV) or who could not otherwise be vaccinated (e.g., persons with severe egg allergies).

C. Reservoirs

Humans are the primary reservoir for human infections; however, reservoirs such as swine and birds are likely sources of new human subtypes thought to emerge through genetic reassortment.

D. Modes of Transmission

Airborne transmission predominates among crowded populations in enclosed spaces; transmission may also occur by direct contact, since the influenza virus may persist for hours, particularly in cold and in low humidity.

E. Period of Communicability

The period of communicability ranges 1 – 2 days before the onset of symptoms to 4 – 5 days after onset. Children may be able to transmit the virus for 7 days or longer following onset of symptoms.

2) ACTIONS REQUIRED/CONTROL MEASURES

A. Reporting Requirements

Influenza-associated deaths and hospitalizations are physician reportable by mail to both the Connecticut Department of Public Health (DPH) and the local health department (LHD). The director of any clinical laboratory must also report laboratory evidence of influenza infection in all persons to both the DPH and LHD. See current lists of physician Reportable Diseases (Attachment A) and Laboratory Reportable Significant Findings (Attachment C).

B. Case Definition

Influenza-associated mortality

- Clinical Description: an influenza-associated death is defined for surveillance purposes as a death resulting from a clinically compatible illness that was confirmed to be influenza by an appropriate laboratory or rapid diagnostic test. There should be no period of complete recovery between the illness and death. Influenza-associated deaths in all persons should be reported.

A death should not be reported if:

1. There is no laboratory confirmation of influenza virus infection.
2. The influenza illness is followed by full recovery to baseline health status prior to death.

- Laboratory Criteria for Diagnosis

Laboratory testing for influenza virus infection may be done on pre- or post-mortem clinical specimens, and include identification of influenza A or B virus infections by a positive result by at least one of the following:

- Influenza virus isolation in tissue cell culture from respiratory specimens;
- Reverse-transcriptase polymerase chain reaction (RT-PCR) testing of respiratory specimens;
- Immunofluorescent antibody staining (direct or indirect) of respiratory specimens;
- Rapid influenza diagnostic testing of respiratory specimens;
- Immunohistochemical (IHC) staining for influenza viral antigens in respiratory tract tissue from autopsy specimens;
- Four-fold rise in influenza hemagglutination inhibition (HI) antibody titer in paired acute and convalescent sera*.

- Confirmed Case

- A death meeting the clinical definition that is laboratory confirmed.
- Laboratory or rapid diagnostic test confirmation is required as part of the case definition; therefore, all reported deaths will be classified as confirmed.

*Serologic testing for influenza is available in a limited number of laboratories, and should only be considered as evidence of recent infection if a four-fold rise in influenza (HI) antibody titer is demonstrated in paired sera. Single serum samples are not interpretable.

Influenza-Associated Hospitalizations

- Clinical Criteria
 - Hospital admission date 14 days or less after a positive influenza test, **OR**
 - Hospital admission date 3 days or less before a positive influenza test
- Laboratory Criteria for Diagnosis

Evidence of a positive influenza test by at least one of the following methods:

 - Positive viral culture for influenza
 - Positive immunofluorescence antibody staining (Direct [DFA] or indirect [IFA]) for influenza
 - Reverse transcriptase polymerase chain reaction (RT-PCR) positive for influenza
 - Serologic testing positive for influenza
 - A positive, unspecified influenza test noted in the medical chart (e.g., a written note in the admission H&P or discharge summary)
 - A positive commercially available rapid diagnostic test for influenza
- **Confirmed**
 - A case that meets the clinical and laboratory evidence criteria.

C. Case Investigation

- **DPH Responsibility:** The DPH Epidemiology and Emerging Infections Program collects epidemiological, clinical, and laboratory information on all influenza-associated deaths.
- **LHD Responsibility:** The LHD is involved with case investigations and control measures under DPH guidance as necessary.

D. Control Measures

The DPH Epidemiology Program (860-509-7995) or Immunization Program (860-509-7929) should be contacted for guidance on control measures and further action, if necessary.

Fact Sheet

What causes influenza?

Viruses cause influenza. There are two basic types, A and B, which can cause clinical illness in humans. Their genetic material differentiates them. Influenza A can cause moderate to severe illness in all age groups and infects humans and other animals. Influenza B causes milder disease and affects only humans, primarily children.

Subtypes of the type A influenza virus are identified by two antigens (proteins involved in the immune reaction) on the surface of the virus. These antigens can change, or mutate, over time. An antigen “shift” (major change) creates a new influenza virus and an epidemic is likely among the unprotected population. This happened when the novel H1N1 influenza virus appeared in March 2009 and led to a major pandemic, lasting until the summer of 2010.

How does influenza spread?

Influenza is transmitted through the air from the respiratory tract of an infected person. It can also be transmitted by direct contact with respiratory droplets.

How long does it take to develop symptoms of influenza after being exposed?

The incubation period of influenza is usually two days but can range from one to four days.

What are the symptoms of influenza?

Typical influenza disease is characterized by abrupt onset of fever, aching muscles, sore throat, and non-productive cough. Additional symptoms may include runny nose, headache, a burning sensation in the chest, and eye pain and sensitivity to light. Typical influenza disease does not occur in every infected person. Someone who has been previously exposed to similar virus strains (through natural infection or vaccination) is less likely to develop serious clinical illness.

How serious is influenza?

Although many people think of influenza as just a common cold, it is really a specific and serious respiratory infection that can result in hospitalization and death. In the United States, the number of influenza-associated deaths has increased since 1990. This increase is due in part to the substantial increase in the number of people age 65 years or older who are at increased risk for death from influenza complications. The Centers for Disease Control and Prevention (CDC) estimates that from the 1976–77 influenza season to the 2006–07 season, influenza-associated deaths ranged from a low of about 3,000 to a high of about 49,000 each year. It is estimated that approximately 43–89 million people became ill with 2009 pandemic H1N1 in the U.S. from April 2009 to April 2010.

Influenza disease can occur among people of all ages; however, the risks for complications, hospitalizations, and deaths are higher among people age 65 years or older, young children, and people of any age who have certain medical conditions. Pregnancy also increases the risk for serious medical complications from influenza.

During an outbreak in a long-term-care facility, up to 60% of residents may become infected, with up to a 30% fatality rate in the infected people. Risk for influenza-associated death is highest among the oldest of the elderly: people age 85 years and older are 16 times more likely to die from an influenza-associated illness than people age 65–69 years.

Hospitalization from influenza-related complications is also high among children age 24 months and younger—comparable to rates for people age 65 and older. There were 107 laboratory-confirmed influenza-related pediatric deaths reported during the 2013-2014 influenza season. During the H1N1 pandemic (April 2009 through September 2010), 348 influenza-related deaths in children were reported.

What are possible complications from influenza?

The most frequent complication of influenza is bacterial pneumonia. Viral pneumonia is a less common complication but has a high fatality rate. Other complications include inflammation of the heart and worsening of pulmonary diseases (e.g., bronchitis).

Reye's syndrome is a complication that occurs almost exclusively in children—patients suffer from severe vomiting and confusion, which may progress to coma because of swelling of the brain. To decrease the chance of developing Reye's syndrome, infants, children, and teenagers should not be given aspirin for fever reduction or pain relief.

What is the best way to prevent influenza?

The best way to prevent influenza is with annual vaccination.

Is there an alternative to vaccination in preventing influenza?

Vaccination is the principal means of preventing influenza and its complications. Here are some additional steps that may help prevent the spread of respiratory illnesses like influenza:

1. Cover your nose and mouth with your sleeve or a tissue when you cough or sneeze—throw the tissue away after you use it.
2. Wash your hands often with soap and water, especially after you cough or sneeze. If you are not near water, use an alcohol-based hand cleaner.
3. Stay away as much as you can from people who are sick.
4. If you get influenza, stay home from work or school for at least 24 hours after the fever has ended. If you are sick, don't go near other people to avoid infecting them.
5. Try not to touch your eyes, nose, or mouth. Germs often spread this way.

Are any drugs available to prevent or treat influenza?

There are four antiviral agents approved for preventing or treating influenza in selected patients. Only two, oseltamivir and zanamivir, will offer protection against both A and B viruses; the other two, amantadine and rimantadine, protect only against the A viruses. Their use is generally limited to situations where an outbreak is underway and immediate protection of vulnerable, unvaccinated people is critical (e.g., nursing home residents) or in people who are expected to have an inadequate antibody response to the vaccine (e.g., people with cancer or being treated for cancer) or who could not otherwise be vaccinated (e.g., people with severe egg allergies). Antiviral agents are not a substitute for vaccination. Recent evidence indicates that a high proportion of currently circulating influenza A viruses in the United States have developed resistance to amantadine and rimantadine and researchers are watching for additional antiviral resistance to any of these four agents that might develop in the future.

If I contract influenza, what should I do?

Call your healthcare provider to discuss your particular situation. You will need to get plenty of rest and drink a lot of liquids. You can take medications to relieve the symptoms of influenza (but never give aspirin to children or teenagers who have influenza-like symptoms, particularly fever). If you are at high risk of developing complications from influenza, you should consult your healthcare provider immediately if you develop influenza-like symptoms. For purposes of treatment and prevention, antiviral medicines are prioritized for people at high risk for influenza-related complications, such as people 65 years or older, people with chronic medical conditions, pregnant women, and young children.

When is a person with influenza contagious?

A person is most likely to pass on the virus during the period beginning one to two days before the onset of symptoms and ending four to five days after the onset.

Can you get influenza more than once?

Yes. Influenza viruses change frequently and infection with one strain does not provide protection against all strains.

When did influenza vaccine first become available?

The first influenza vaccine in the United States became available in 1945.

What kind of vaccine is it?

The most common influenza vaccine is made from inactivated (killed) viruses. A vaccine containing live viruses that have been weakened (attenuated) is also available. Most influenza vaccine contains 3 strains of influenza virus. For the 2015–2016 influenza season some vaccine will contain 4 strains of influenza virus.

How are the vaccines made?

Every year, researchers and manufacturers develop a vaccine that contains virus strains they believe will be circulating in the upcoming influenza season. Influenza vaccine typically contains both type A and type B viruses.

For the inactivated (injectable) vaccine, the viruses are inactivated (killed), purified, and packaged in vials or syringes. Live virus vaccine is packaged in a special nasal sprayer. About six months are required to produce influenza vaccine each year.

How is the vaccine given?

The inactivated vaccine is generally given as an intramuscular injection; one inactivated vaccine can be given as an intradermal injection with a micro needle into the skin of the arm for persons ages 18 through 64 years. The live attenuated vaccine is sprayed into the nose.

Is the vaccine that contains 4 viruses preferred over the vaccine that contains 3 viruses?

Vaccines that contain four strains of influenza virus may eventually replace 3-virus vaccines. CDC and other groups do not have a preference for use of the 4-virus vaccine over the 3-virus vaccine.

Who should get influenza vaccine?

Annual influenza vaccination is recommended for all people ages 6 months and older who do not have a contraindication to the vaccine.

What are the unique features of giving influenza vaccine to children compared with adults?

Children ages 6 months through 8 years should receive two doses of influenza vaccine the first time they receive this vaccine, separated by at least 4 weeks. Some other children 6 months through 8 years who have previously received influenza vaccine may also be recommended to receive two doses for the coming season. Your doctor or other healthcare professional should be able to tell you if your child needs a second dose.

Beginning in influenza season 2014–2015 the nasal spray influenza vaccine (LAIV) is preferred for healthy children ages 2 through 8 years who do not have a contraindication or precaution to LAIV, a history of egg allergy, or have taken influenza antiviral medication within the previous 48 hours. This preference is because studies have shown LAIV to be more effective than inactivated influenza vaccine in preventing influenza in this age group. However, both LAIV and IIV are safe and effective in this age group. If LAIV is not immediately available, the inactivated vaccine should be used.

Who recommends the influenza vaccine?

The Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics (AAP), the American Academy of Family Physicians (AAFP), the American College of Physicians (ACP), and the American College of Obstetricians and Gynecologists (ACOG) all recommend this vaccine.

How often should this vaccine be given?

Influenza vaccine is given each year because immunity decreases after a year and because each year's vaccine is formulated to prevent only that year's anticipated influenza viruses. An annual vaccination is recommended even if the strains included in the vaccine are not changed from one year to the next (as is the case for the 2014–2015 vaccine).

When should people be vaccinated?

Health experts recommend that patients should be vaccinated as soon as vaccine is available in their clinic, which can be as early as August or September. Vaccination should continue into the winter and spring, even until April or May. Travelers should be aware that the influenza season typically occurs from April to September in the Southern Hemisphere and throughout the year in the tropics. If they missed vaccination in the previous season, they should still be vaccinated before they travel, even if it's in the following spring or summer.

Are there recommendations for the prevention of influenza outbreaks in institutions?

The most important factor in preventing outbreaks is annual vaccination of all occupants of the facility and all people working or volunteering in the facility who share the same air as the high-risk occupants. Groups that should be targeted include physicians, nurses, and all other personnel in hospitals, long-term care facilities, other care facilities, and outpatient settings who have contact with high-risk patients in all age groups.

Should siblings of a person with a chronic illness receive influenza vaccine even though the chronically ill person has been vaccinated?

Yes. Vaccination is recommended for all people ages 6 months and older. This includes all household contacts of people with "high-risk" conditions. Either inactivated or live virus vaccine may be used; it is preferred that the inactivated vaccine be used for household contacts and caregivers of people with severe immunosuppression that must be in protective isolation.

Should siblings of a healthy child who is younger than age 6 months be vaccinated?

Yes, it is especially important that all household contacts of children too young to be vaccinated against influenza (i.e., younger than age 6 months) receive annual influenza vaccination to protect the infant from serious infection. This is very important because these infants are too young to be vaccinated and are most vulnerable to complications from influenza.

Why is a higher dose influenza vaccine (Fluzone High-Dose) available for adults 65 and older?

Aging decreases the body's ability to develop a good immune response after getting influenza vaccine, which places older people at greater risk of severe illness from influenza. A higher dose of antigen in the vaccine gives older people a better immune response and provides better protection against influenza. Data from clinical trials comparing regular Fluzone to Fluzone High-Dose among people age 65 and older indicate that higher antibody levels occur after vaccination with Fluzone High-Dose. Compared to standard Fluzone the high dose formulation reduced laboratory-confirmed influenza by about 24% and reduced the risk of pneumonia and hospitalization.

CDC has stated no preference for using high-dose influenza vaccine or standard-dose influenza vaccine when vaccinating people age 65 and older. CDC stresses that vaccination is the first and most important step in protecting against influenza. But it is reasonable for a person age 65 years or older to receive Fluzone High Dose if it is readily available. However, influenza vaccination should not be deferred if the high dose formulation is not immediately available. Standard dose vaccine should be given.

If a patient is undergoing treatment for cancer, is it safe to vaccinate her or him against influenza?

People with cancer need to be protected from influenza. Cancer patients and survivors are at higher risk for complications from influenza, including hospitalization and death. They can and should receive injectable (inactivated) influenza vaccine (not the nasal spray vaccine) even if they are being treated for cancer. Here is a helpful CDC web page on cancer and influenza for patients: <http://www.cdc.gov/cancer/flu>.

Is it safe for pregnant women to get influenza vaccine?

Yes. In fact, vaccination with the inactivated vaccine is recommended for women who will be pregnant during the influenza season. Pregnant women are at increased risk for serious medical complications from influenza. One recent study found that the risk of influenza-related hospitalization was four times higher in healthy pregnant women in the fourteenth week of pregnancy or later than in non-pregnant women. An increased risk of severe influenza infections was also observed in postpartum women (those who delivered within the previous 2 weeks) during the 2009–2010 H1N1 pandemic. In addition, vaccination of the mother will provide some protection for her newborn infant. The live intranasal vaccine is not licensed for use in pregnant women. However, pregnant women do not need to avoid contact with people recently vaccinated with this vaccine.

Vaccination is especially important for all people who are contacts of infants or children from birth through age 59 months because infants and young children are at higher risk for influenza complications and are more likely to require medical care or hospitalization if infected. Women who are breastfeeding may receive either type of influenza vaccine unless the vaccine is not appropriate because of other medical conditions.

How safe is this vaccine?

Influenza vaccine is very safe. The most common side effects of the injectable (inactivated) influenza vaccine include soreness, redness, or swelling at the site of the injection. These reactions are temporary and occur in 15%–20% of recipients. Less than 1% of vaccine recipients develop symptoms such as fever, chills, and muscle aches for 1 to 2 days following the vaccination. Experiencing these non-specific side effects does not mean that you are getting influenza.

Healthy children ages 2 through 4 years who received the live attenuated virus (nasal spray) vaccine during clinical trials appeared to have an increased chance of wheezing. Consequently, children with a history of recurrent wheezing or have had a wheezing episode within the past 12 months are not recommended to receive the live nasal spray vaccine; instead, they should be given the inactivated (injectable) vaccine. Healthy adults receiving the live influenza vaccine reported symptoms such as cough, runny nose, sore throat, chills, and tiredness at a rate 3%–18% higher than for placebo recipients.

Serious adverse reactions to either vaccine are very rare. Such reactions are most likely the result of an allergy to a vaccine component, such as the egg protein left in the vaccine after growing the virus. In 1976, the swine flu (injectable) vaccine was associated with a severe illness called Guillain-Barré syndrome (GBS), a nerve condition that can result in temporary paralysis. Injectable influenza vaccines since then have not been clearly linked with GBS, because the disease is so rare it is difficult to obtain a precise estimate of any increase in risk. However, as a precaution, any person without a high risk medical condition who previously experienced GBS within 6 weeks of an influenza vaccination should generally not be vaccinated. Instead, their physician may consider using antiviral drugs during the time of potential exposure to influenza.

What can you tell me about the preservative thimerosal that is in some injectable influenza vaccines and the claim that it might be associated with the development of autism?

Thimerosal is a very effective preservative that has been used to prevent bacterial contamination in vaccines for more than 50 years. It is comprised of a type of mercury known as ethylmercury. It is different from methylmercury, which is the form that is in fish and seafood. At very high levels, methylmercury can be toxic to people, especially to the neurological development of infants.

In recent years, several large scientific studies have determined that thimerosal in vaccines does not lead to serious neurologic problems, including autism. However, because we generally try to reduce people's exposure to mercury if at all possible, the vaccine manufacturers have voluntarily changed their production methods to produce vaccines that are now free of thimerosal or have only trace amounts. They have done this because it is possible to do, not because there was any evidence that the thimerosal was harmful.

How effective is influenza vaccine?

Protection from influenza vaccine varies by the similarity of the vaccine strain(s) to the circulating strains, and the age and health of the recipient. Healthy people younger than age 65 years are more likely to have protection from their influenza vaccination than are older, frail individuals. It is important to understand that although the vaccine is not as effective in preventing influenza disease among the elderly, it is effective in preventing complications and death. In general, the immunity following influenza vaccination rarely lasts longer than a year.

When the "match" between vaccine and circulating strains is close, the injectable (inactivated) vaccine prevents influenza in about 50%–70% of healthy people younger than age 65 years. Among elderly nursing home residents, the shot is most effective in preventing severe illness, secondary complications, and deaths related to influenza. In one large study among children ages 15–85 months, the live, attenuated (nasal-spray) influenza vaccine reduced the chance of influenza illness by 92% compared with the placebo.

Can the vaccine cause influenza?

No. Neither the injectable (inactivated) vaccine nor the live attenuated (nasal spray) vaccine can cause influenza. The injectable influenza vaccine contains only killed viruses and cannot cause influenza disease. Fewer than 1% of people who are vaccinated develop influenza-like symptoms, such as mild fever and muscle aches, after vaccination. These side effects are not the same as having the actual disease. The nasal spray influenza vaccine contains live attenuated (weakened) viruses that can produce mild symptoms similar to a cold. While the viruses are able to grow in the nose and throat tissue and produce protective immunity, they are weakened and do not grow effectively in the lung. Consequently, they cannot produce influenza disease.

Protective immunity develops 1 to 2 weeks after vaccination. It is always possible that a recently vaccinated person can be exposed to influenza disease before their antibodies are formed and consequently develop disease. This can result in someone erroneously believing they developed the disease from the vaccination.

Also, to many people "the flu" is any illness with fever and cold symptoms. If they get any viral illness, they may blame it on the influenza vaccination or think they got "the flu" despite being vaccinated. Influenza vaccine only protects against certain influenza viruses, not all viruses.

Who should NOT receive influenza vaccine?

In general, the inactivated (injectable) influenza vaccine can be given to most everyone except children younger than age 6 months, people with a history of a severe allergic reaction to eggs, or to a previous dose of influenza vaccine (see next question). The live, attenuated (nasal spray) influenza vaccine is licensed for use only in healthy, non-pregnant individuals ages 2 through 49 years.

The following people should not be vaccinated with the live, attenuated virus (nasal spray) influenza vaccine; however, most (except infants younger than 6 months) can be vaccinated with the injectable vaccine:

- People younger than age 2 years
- People age 50 years or older
- Immunosuppressed persons
- Children ages 2 through 4 years with a history of recurrent wheezing or who have had a wheezing episode in the last 12 months
- Children 2 through 17 years who are receiving aspirin or aspirin-containing products
- Pregnant women (adolescents or adults)
- People with a history of egg allergy
- People with severe allergic reaction following a previous dose of nasal spray vaccine
- People who have taken influenza antiviral medication within the previous 48 hours

Healthcare workers, household members, and others who have close contact with severely immunocompromised individuals during the periods in which the immunosuppressed person requires care in protective isolation should preferably receive the injectable vaccine over the live (nasal spray) vaccine.

In addition, the following conditions are considered precautions to LAIV:

- Moderate or severe acute illness
- Chronic pulmonary conditions
- Asthma in someone 5 years old or older
- Cardiovascular (except isolated hypertension) conditions
- Renal conditions
- Hepatic conditions
- Neurologic conditions
- Hematologic conditions
- Metabolic conditions (including diabetes mellitus)

As a general rule people with a precaution should not receive LAIV, but there may be situations when the clinician may decide to administer it.

People with a history of Guillain-Barré syndrome should also consult with their physician before receiving this vaccine, so that the potential risks and benefits of influenza immunization can be weighed. People who are moderately or severely ill at the time of their influenza vaccination appointment should usually wait until their symptoms are improved before getting the vaccine.

Some people believe they are allergic to thimerosal, the preservative used in some brands of influenza vaccine supplied in multi-dose vials, because in the past they developed eye irritation after using eye drops containing thimerosal. Past eye irritation is not a valid reason to avoid getting influenza vaccine. Only serious, life-threatening allergies to thimerosal are reasons not to be vaccinated with an influenza vaccine containing thimerosal.

Some brands of influenza vaccine are packaged in vials or syringes that contain natural rubber or latex. People with a severe allergy to latex generally should not receive vaccine packaged in these vials or syringes.

I heard there was a new influenza vaccine that can be given to people with severe egg allergy. Is that true?

In January 2013 the U.S. Food and Drug Administration (FDA) licensed Flublok, the first influenza vaccine available in the United States that is completely egg-free. Unlike current production methods for other influenza vaccines, production of Flublok does not use the whole influenza virus or chicken eggs in its manufacturing process. It is licensed for persons 18 through 49 years of age.

If the severe allergy to eggs is diagnosed as anaphylactic allergy, and the person is age 18 through 49 years, then the provider can consider using Flublok. Flublok is not currently licensed for children younger than 18 years or persons older than 49 years. If Flublok is not available, or the person is younger than 18 years or older than 49 years, inactivated influenza vaccine should be administered by a physician with experience in the recognition and management of severe allergic conditions.

Immunization Action Coalition

Technical content reviewed by the Centers for Disease Control and Prevention, October 2014.

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Measles virus is an RNA virus, classified as a member of the genus *Morbillivirus* in the Paramyxovirus family.

B. Description of Illness

- **General facts:** Measles is a vaccine-preventable disease. The current measles vaccine is incorporated with mumps and rubella vaccine as a combined vaccine called MMR. It is a live attenuated virus vaccine that confers lifelong immunity and is given in 2 doses separated by at least 4 weeks.
- **Occurrence:** Measles occurs throughout the world. However, interruption of indigenous transmission of measles has been achieved in the United States and other parts of the Western hemisphere. In temperate areas, measles disease occurs primarily in the late winter and spring.
- **Incubation period:** Time from exposure to prodrome (first symptoms) averages 10 – 12 days. Time from exposure to rash onset averages 14 days (range 7 – 18 days).
- **Common symptoms:** Measles is an acute, highly communicable viral disease with prodromal fever, conjunctivitis, runny nose, cough, and small spots with white or bluish centers on an erythematous base on the buccal (cheek of mouth) mucosa (Koplik spots). The rash appears as a maculopapular eruption with a characteristic red blotchy rash appearing on the third to seventh day. The rash begins on the face, then becomes generalized, lasts 4 – 7 days, and sometimes ends in brawny (hardening) desquamation (shedding of the epidermis). An abnormal decrease in white blood cells is common. The disease is most severe in infants and adults rather than in children.
- **Treatment:** There is no specific treatment for measles. People with measles need bed rest, fluids, and control of fever. Patients with complications may need treatment specific to their problem.

C. Reservoirs

Humans are the only source of infection.

D. Modes of Transmission

Measles is a highly infectious disease, with >90% secondary attack rates among susceptible persons. Transmission is primarily person-to-person via large respiratory droplets; occurs by airborne, droplet spread, or direct contact with nasal or throat secretions of an infected person when one coughs or sneezes. Measles is less commonly transmitted by articles freshly soiled with nose and throat secretions.

E. Period of Communicability

The measles virus may be transmitted approximately 4 days before rash onset to 4 days after appearance of the rash; transmission is minimal after the second day of the rash.

2) ACTIONS REQUIRED/CONTROL MEASURES

A. Reporting Requirements

Measles is physician reportable by telephone immediately on the day of recognition or strong suspicion to both the Connecticut Department of Public Health (DPH) and the local health department (LHD). A mailed report is also required within 12 hours. The director of any clinical laboratory must also report laboratory evidence of measles to both the DPH and the LHD. See current lists of physician Reportable Diseases (Attachment A) and Laboratory Reportable Significant Findings (Attachment C).

B. Case Definition

- Clinical Description

An acute illness characterized by:

- Generalized, maculopapular rash lasting ≥ 3 days; **and**
- Temperature $\geq 101^{\circ}\text{F}$ or 38.3°C ; **and**
- Cough, coryza, or conjunctivitis.

Case Classification

- **Probable**

- In the absence of a more likely diagnosis, an illness that meets the clinical description with:
- No epidemiologic linkage to a laboratory-confirmed measles case; **and**
- Noncontributory or no measles laboratory testing.

- **Confirmed**

- An acute febrile rash illness[†] with:
- Isolation of measles virus[‡] from a clinical specimen; **or**
- Detection of measles-virus specific nucleic acid[‡] from a clinical specimen using polymerase chain reaction; **or**
- IgG seroconversion[‡] or a significant rise in measles immunoglobulin G antibody[‡] using any evaluated and validated method; **or**
- A positive serologic test for measles immunoglobulin M antibody[§]; **or**
- Direct epidemiologic linkage to a case confirmed by one of the methods above.

[†] Temperature does not need to reach $\geq 101^{\circ}\text{F}/38.3^{\circ}\text{C}$ and rash does not need to last ≥ 3 days.

[‡] Not explained by MMR vaccination during the previous 6-45 days.

[§] Not otherwise ruled out by other confirmatory testing or more specific measles testing in a public health laboratory.

Case Classification Comments

CDC does not request or accept reports of suspect cases so this category is no longer needed for national reporting purposes.

C. Case Investigation

- **DPH Responsibility:** The DPH Immunization Program ensures that the appropriate diagnostic work has been completed and works in collaboration with LHD to ensure that contacts of each case-patient have been identified, and appropriate recommendations (e.g., vaccination, exclusion) have been made.
- **LHD Responsibility:** The LHD is involved with case investigations and control measures under DPH guidance as necessary.

D. Control Measures

The DPH Immunization Program (860-509-7929) should be contacted for guidance on control measures and further action, if necessary.

Fact Sheet

What is measles?

Measles is an acute disease that is caused by a virus.

What causes measles?

Measles is caused by a virus.

How does measles spread?

Measles is spread from person to person through the air by infectious droplets; it is highly contagious.

How long does it take to show signs of measles after being exposed?

It takes an average of 10–12 days from exposure to the first symptom, which is usually fever. The measles rash doesn't usually appear until approximately 14 days after exposure, 2–3 days after the fever begins.

What are the symptoms of measles?

Symptoms include fever, runny nose, cough, loss of appetite, "pink eye," and a rash. The rash usually lasts 5–6 days and begins at the hairline, moves to the face and upper neck, and proceeds down the body.

How serious is measles?

Measles can be a serious disease, with 30% of reported cases experiencing one or more complications. Death from measles occurs in 2 to 3 per 1,000 reported cases in the United States. Complications from measles are more common among very young children (younger than five years) and adults (older than 20 years).

What are possible complications from measles?

Diarrhea is the most common complication of measles (occurring in 8% of cases), especially in young children. Ear infections occur in 7% of reported cases. Pneumonia, occurring in 6% of reported cases, accounts for 60% of measles-related deaths. Approximately one out of one thousand cases will develop acute encephalitis, an inflammation of the brain. This serious complication can lead to permanent brain damage.

Measles during pregnancy increases the risk of premature labor, miscarriage, and low-birth-weight infants, although birth defects have not been linked to measles exposure.

Measles can be especially severe in persons with compromised immune systems. Measles is more severe in malnourished children, particularly those with vitamin A deficiency. In developing countries, the fatality rate may be as high as 25%.

How is measles diagnosed?

Measles is diagnosed by a combination of the patient's symptoms and by laboratory tests.

Is there a treatment for measles?

There is no specific treatment for measles. People with measles need bed rest, fluids, and control of fever. Patients with complications may need treatment specific to their problem.

How long is a person with measles contagious?

Measles is highly contagious and can be transmitted from four days before the rash becomes visible to four days after the rash appears.

What should be done if someone is exposed to measles?

Notification of the exposure should be communicated to a doctor. If the person has not been vaccinated, measles vaccine may prevent disease if given within 72 hours of exposure. Immune globulin (a blood product containing antibodies to the measles virus) may prevent or lessen the severity of measles if given within six days of exposure.

How common is measles in the United States?

Before the vaccine was licensed in 1963, there were an estimated 3–4 million cases each year. In the years following 1963, the number of measles cases dropped dramatically with only 1,497 cases in 1983, the lowest annual total reported up to that time. By 2004, only 37 cases were reported – a record low. However, new cases continued to be reported, primarily in populations that have refused vaccination for religious or personal belief reasons. From 2001 through 2011, an average of 63 measles cases (range, 37 to 220) and four outbreaks were reported each year in the United States. Of the 911 cases, a total of 372 (41%) were imported from outside the U.S. and an additional 432 (47%) were associated with importations. Hospitalization was reported for 225 (25%) cases. Two deaths were reported. Most cases occur among people who declined vaccination because of a religious, or personal objection.

The U.S. experienced a record number of measles cases during 2014, with 644 cases reported from 27 states. This is the greatest number of cases since measles elimination was documented in the U.S. in 2000. In 2015, the U.S. is currently experiencing a large, multi-state outbreak of measles linked to an amusement park; for up-to-date case counts and outbreak information (updated on Mondays), visit CDC's Measles Cases and Outbreaks web page at <http://www.cdc.gov/measles/cases-outbreaks.html>.

Can someone get measles more than once?

No.

When did vaccines for measles, mumps, and rubella become available?

The first measles vaccines (an inactivated and a live virus product) became available in 1963, both of which were largely replaced by a further attenuated live virus vaccine that was licensed in 1968. The mumps vaccine first became available in 1967, followed by the rubella vaccine in 1969. These three vaccines were combined in 1971 to form the measles-mumps-rubella (MMR) vaccine. A vaccine that combines both MMR and varicella (chickenpox) vaccines, known as MMRV, became available in 2005. Single antigen measles, mumps, and rubella vaccines are no longer available in the U.S.

What kind of vaccine is it?

MMR vaccine contains live, attenuated (or weakened) strains of the measles, mumps, and rubella viruses.

How is this vaccine given?

This vaccine is a shot given subcutaneously (in the fatty layer of tissue under the skin).

Who should get this vaccine?

All children, adolescents, and adults born in 1957 or later without a valid contraindication should have documentation of vaccination or other evidence of immunity. Additionally, some healthcare personnel who were born before 1957 may also need proof of vaccination or other evidence of immunity.

What kind of “evidence of immunity” can substitute for MMR vaccination?

Evidence of immunity can be shown by having laboratory evidence of immunity to measles, mumps, and/or rubella or laboratory confirmation of disease. However, if a person doesn't have evidence of immunity to all three diseases (e.g., measles, mumps, and rubella), they would still need to get vaccinated with MMR since the vaccine is not available as a single antigen product in the U.S.

At what age should the first dose of MMR be given?

The first dose of MMR should be given on or after the child's first birthday; the recommended age range is from 12–15 months. A dose given before 12 months of age will not be counted, so the child's medical appointment should be scheduled with this in mind.

When should children get the second MMR shot?

The second dose is usually given when the child is 4–6 years old, or before he or she enters kindergarten or first grade. However, the second dose can be given earlier as long as there has been an interval of at least 28 days since the first dose.

How effective is this vaccine?

The first dose of MMR produces immunity to measles and rubella in 90% to 95% of recipients. The second dose of MMR is intended to produce immunity in those who did not respond to the first dose, but a very small percentage of people may not be protected even after a second dose.

Which adolescents and adults should receive the MMR vaccine?

All unvaccinated adolescents without a valid contraindication to the vaccine should have documentation of two doses of MMR. All adults born in or after 1957 should also have documentation of vaccination or other evidence of immunity.

Adults born before 1957 are likely to have had measles and/or mumps disease as a child and are generally (but not always) considered not to need vaccination.

Which adults need two doses of MMR vaccine?

Certain adults are at higher risk of exposure to measles, mumps, and/or rubella and may need a second dose of MMR unless they have other evidence of immunity; this includes adults who are:

- students in postsecondary educational institutions (for measles and mumps)
- healthcare personnel (for measles and mumps)
- living in a community experiencing an outbreak or recently exposed to the disease (for measles and mumps)
- planning to travel internationally (for measles and mumps)
- people who received inactivated (killed) measles vaccine or measles vaccine of unknown type during 1963–1967 should be revaccinated with two doses of MMR vaccine.
- people vaccinated before 1979 with either killed mumps vaccine or mumps vaccine of unknown type who are at high risk for mumps infection (e.g., persons who are working in a healthcare facility) should be considered for revaccination with 2 doses of MMR vaccine.

Why do healthcare personnel need vaccination or other evidence of immunity to measles, mumps, and rubella?

People who work in medical facilities are at much higher risk for being exposed to disease than is the general population. Making sure that all employees are immune to these diseases protects both the employee and the patients with whom he or she may have contact. All people working in a healthcare facility in any capacity should have documentation of vaccination or evidence of immunity, including full- or part-time employees, medical or non-medical, paid or volunteer, students, and those with or without direct patient responsibilities.

Facilities should consider vaccinating with MMR vaccine healthcare personnel born before 1957 who lack laboratory evidence of measles, mumps, and rubella immunity or laboratory confirmation of previous disease. These facilities should vaccinate healthcare personnel with MMR during an outbreak of any of the diseases, regardless of birth year.

Who recommends this vaccine?

The Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics (AAP), the American Academy of Family Physicians (AAFP), the American College of Obstetricians and Gynecologists, and the American College of Physicians (ACP) have all recommended this vaccine.

How safe is this vaccine?

Hundreds of millions of doses of measles, mumps, and rubella vaccine prepared either as separate vaccines or as the combined MMR have been given in the United States, and its safety record is excellent.

What side effects have been reported with this vaccine?

Fever is the most common side effect, occurring in 5%–15% of vaccine recipients. About 5% of people develop a mild rash. When they occur, fever and rash usually appear 7–12 days after vaccination. About 25% of adult women receiving MMR vaccine develop temporary joint pain, a symptom related to the rubella component of the combined vaccine. Joint pain only occurs in women who are not immune to rubella at the time of vaccination. MMR vaccine may cause thrombocytopenia (low platelet count) at the rate of about 1 case per 30,000–40,000 vaccinated people. Cases are almost always temporary and not life-threatening. More severe reactions, including allergic reactions, are rare. Other severe problems (e.g., deafness, permanent brain damage) occur so rarely that experts cannot be sure whether they are caused by the vaccine or not.

If a child develops a rash after getting the MMR vaccine, is he contagious?

Transmission of the vaccine viruses does not occur from a vaccinated person, including those who develop a rash. No special precautions (e.g., exclusion from school or work) need be taken.

Who should NOT receive MMR vaccine?

Anyone who had a severe allergic reaction (e.g., generalized hives, swelling of the lips, tongue, or throat, difficulty breathing) following the first dose of MMR should not receive a second dose. Anyone knowing they are allergic to an MMR component (e.g., gelatin, neomycin) should not receive this vaccine.

As with all live virus vaccines, women known to be pregnant should not receive the MMR vaccine, and pregnancy should be avoided for four weeks following vaccination with MMR. Children and other household contacts of pregnant women should be vaccinated according to the recommended schedule. Women who are breast-feeding can be vaccinated.

Severely immunocompromised people should not be given MMR vaccine. This includes people with conditions such as congenital immunodeficiency, AIDS, leukemia, lymphoma, generalized malignancy, and those receiving treatment for cancer with drugs, radiation, or large doses of corticosteroids. Household contacts of immunocompromised people should be vaccinated according to the recommended schedule.

Although people with AIDS or HIV infection with signs of serious immunosuppression should not be given MMR, people with HIV infection who do not have laboratory evidence of severe immunosuppression can and should be vaccinated against measles.

Can individuals with egg allergy receive MMR vaccine?

In the past it was believed that people who were allergic to eggs would be at risk of an allergic reaction from the vaccine because the vaccine is grown in tissue from chick embryos. However, recent studies have shown that this is not the case. MMR may be given to egg-allergic individuals without prior testing or use of special precautions.

Does the MMR vaccine cause autism?

There is no scientific evidence that measles, MMR, or any other vaccine causes autism. The question about a possible link between MMR vaccine and autism has been extensively reviewed by independent groups of experts in the U.S. including the National Academy of Sciences' Institute of Medicine. These reviews have concluded that there is no association between MMR vaccine and autism.

For a summary of the issues on this topic, please read “Do Vaccines Cause Autism?” on the website of the Vaccine Education Center at Children’s Hospital of Philadelphia. This discussion can be accessed at <http://www.chop.edu/service/vaccine-education-center/vaccine-safety/vaccines-and-health-conditions/autism.html>.

“MMR vaccine does not cause autism. Examine the evidence!” lists all the major studies related to this issue with links to journal article abstracts: <http://www.immunize.org/catg.d/p4026.pdf>.

Dr. Ari Brown has written a good piece for parents questioning the safety of vaccines. To access “Clear Answers & Smart Advice about Your Baby’s Shots,” go to: <http://www.immunize.org/catg.d/p2068.pdf>.

For more information, visit CDC’s web page about vaccines and autism at <http://www.cdc.gov/vaccinesafety/Concerns/Autism/Index.html>.

Can the live virus in the vaccine cause measles, mumps, and/or rubella?

Because the measles, mumps, and rubella viruses in the MMR vaccine are weak versions of the disease viruses, they may cause a very mild case of the disease they were designed to prevent; however, it is usually much milder than the natural disease and is referred to as an adverse reaction to the vaccine.

What if a pregnant woman inadvertently got the MMR vaccine?

Women are advised not to receive any live virus vaccine during pregnancy as a safety precaution based on the theoretical possibility of a live vaccine causing disease (e.g., rubella virus leading to congenital rubella syndrome [CRS]).

Because a number of women have inadvertently received this vaccine while pregnant or soon before conception, the Centers for Disease Control and Prevention has collected data about the outcomes of their births. From 1971–1989, no evidence of CRS occurred in the 324 infants born to 321 women who received rubella vaccine while pregnant and continued pregnancy to term. As any risk to the fetus from rubella vaccine appears to be extremely low or zero, individual counseling of women in this situation is recommended, rather than routine termination of pregnancy.

Immunization Action Coalition

Technically reviewed by the Centers for Disease Control and Prevention, April 2015.

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic A

Meningococcal disease is an infection of the tissues that cover the brain and spinal cord. It is caused by a bacterium called *Neisseria meningitidis*. This bacterium has five subtypes: A, B, C, Y, and W-135.

B. Description of Illness

- **General facts:** Invasive infection caused by *N. meningitidis* usually results in meningococemia, meningitis, or both. In the United States, serogroups B, C, and Y each account for approximately 30% of reported cases. With early diagnosis and treatment, the case fatality rate remains at 10% – 15% and 11%-19% of survivors have long term sequelae (e.g., neurologic disability, limb or digit loss, and hearing loss). In the United States, approximately 98% of cases are sporadic but outbreaks do occur. In many parts of the world, it is the leading cause of bacterial meningitis. There are several vaccines against *N. meningitidis* available in the United States: 3 quadrivalent vaccines (Menactra, Menveo, and Menomune), one bivalent vaccine (Menhiberix) and two serogroup B meningococcal vaccines (Bexsero and Trumenba). Connecticut General Statutes Section 10a-155b states that each public or private college or university in this state shall require that each student who resides in on-campus housing be vaccinated against meningitis as a condition of such residence. The provisions of this subsection shall not apply to any such student who (1) presents a certificate from a physician stating that, in the opinion of such physician, such vaccination is medically contraindicated because of the physical condition of such student, or (2) presents a statement that such vaccination would be contrary to the religious beliefs of such student.
- **Occurrence:** The incidence of meningococcal disease is seasonal, usually peaking in late winter to early spring. During 2005-2011, an estimated 800-1,200 cases of meningococcal disease occurred annually in the United States, representing an incidence of 0.3 cases per 100,000 population. Incidence has declined annually since a peak of disease in the late 1990s. Meningococcal disease is most common among very small children and the elderly but occurs commonly in teenagers and young adults and is associated with crowded living conditions (e.g., dormitories, barracks). Community outbreaks have affected school and college-aged persons.
- **Incubation period:** From 2 – 10 days; usually about 3 – 4 days.
- **Common symptoms:** An acute bacterial disease, characterized by sudden onset of high fever, intense headache, nausea and often vomiting, stiff neck and frequently a petechial rash with pink macules or, very rarely, vesicles. Delirium, coma, and seizure may happen as the disease progresses. In newborns and small infants, the hallmarks may be difficult to detect – the infant may appear to be inactive, irritable, vomit, or feed poorly.
- **Treatment:** Meningococcal disease can be treated with antibiotics. It is critical to start treatment early. Even with treatment, approximately 10% – 15% of patients die.

C. Reservoirs

Humans are the only source of infection.

D. Modes of Transmission

Transmission occurs through direct contact with respiratory droplets from the nose and throat of infected people; infection usually only causes a subclinical mucosal infection. Up to 5% – 10% of people may be asymptomatic carriers with nasopharyngeal colonization by *N. meningitidis*. Less than 1% of those colonized will progress to invasive disease. Behaviors that facilitate transmission include coughing and kissing. Fomite transmission is not significant.

The communicability of *N. meningitidis* is generally limited. In studies of households in which a case of meningococcal disease has occurred, only 3% – 4% of households had secondary cases. Most households had only one secondary case. Estimates of the risk of secondary transmission are generally 2 – 4 cases per 1,000 household members at risk. However, this risk is 500–800 times that in the general population.

E. Period of Communicability

The bacteria may be transmitted as long as they are present in nasal and oral secretions. Usually, 24 hours of treatment with an antibiotic to which the bacteria are sensitive decreases their numbers in the nose and mouth. Penicillin will temporarily suppress the organisms, but it does not usually eradicate them from the oronasopharynx.

2) ACTIONS REQUIRED/CONTROL MEASURES

A. Reporting Requirements

Meningococcal disease is physician reportable immediately by telephone on the day of recognition or strong suspicion to both the Connecticut Department of Public Health (DPH) and the local health department (LHD). A mailed report is also required within 12 hours. The director of any clinical laboratory must also report laboratory evidence of invasive meningococcal disease to both the DPH and LHD. **Additional requirements:** All isolates yielding *N. meningitidis* from invasive sterile sites must be submitted to the DPH State Laboratory for confirmation. See current list of Physician Reportable Diseases (Attachment and Laboratory Report of Significant Findings (Attachment C).

B. Case Definition

- **Clinical Description:** Meningococcal disease manifests most commonly as meningitis and/or meningococemia that may progress rapidly to purpura fulminans, shock, and death. Other less common manifestations include pneumonia and septic arthritis.
- **Suspect Case:**
 - Clinical purpura fulminans in the absence of a positive blood culture; OR
 - Gram-negative diplococci, not yet identified, from a normally sterile body site.
- **Probable Case:**
 - Evidence of *N. meningitidis* DNA using a validated polymerase chain reaction (PCR), obtained from a normally sterile site; OR
 - Evidence of *N. meningitidis* antigen by immunohistochemistry (IHC) on formalin- fixed tissue or latex agglutination of CSF.
- **Confirmed Case:**
 - Isolation of *N. meningitidis* from a normally sterile site (e.g., blood or CSF or, less commonly, synovial, pleural, or pericardial fluid) or skin scrapings of purpuric lesions; OR
 - Detection of *N. meningitidis* in a specimen obtained from a normally sterile body site by PCR (polymerase chain reaction) assay.

C. Case Investigation

- **DPH Responsibility:** The DPH Epidemiology and Emerging Infections Program will follow-up with the reporting laboratory and physician (or hospital infection control staff) to confirm the diagnosis. DPH will then notify the LHD of the above findings and provide additional recommendations for follow-up, if needed.

The DPH is available to the LHD for assistance, consultation, guidance, and to ensure that appropriate investigative and control actions are being taken.

- **LHD Responsibility:** Contact case-patient to identify close contacts and ensure they are provided antibiotic prophylaxis (see Control Measures). Provide educational materials describing the nature of disease and preventive measures.

D. Control Measures

- **Close contacts:** Household contacts of all persons with meningococcal disease should receive antibiotic prophylaxis. Prophylaxis is also warranted for people who have been exposed directly to a patient's oral secretions through close social

contact, kissing or sharing food or beverages, as well as childcare and nursery school contacts.

Antimicrobial prophylaxis should be administered as soon as possible (ideally < 24 hours after identification of the index patient). Prophylaxis administered > 14 days after onset of illness in the index patient is probably of limited or no value. Routine prophylaxis is not recommended for healthcare professionals unless they have had intimate exposure, such as occurs with unprotected mouth-to-mouth resuscitation, intubation, or suctioning, before antimicrobial therapy was initiated.

Fact Sheet

What causes meningococcal disease?

Meningococcal disease is caused by the bacterium *Neisseria meningitidis*. This bacterium has at least 13 different subtypes (serogroups). Five of these serogroups, A, B, C, Y, and W, cause almost all invasive disease. The relative importance of these five serogroups depends on geographic location and other factors. In the United States almost all meningococcal disease is caused by serogroups B, C and Y. Each serogroup accounts for about one third of reported cases.

How does meningococcal disease spread?

The disease is spread person-to-person through the exchange of respiratory and throat secretions (e.g., by coughing, kissing, or sharing eating utensils). Meningococcal bacteria can't live for more than a few minutes outside the body, so the disease is not spread as easily as the common cold or influenza.

How long does it take to show signs of meningococcal disease after being exposed?

The incubation period of meningococcal disease is 3 to 4 days, with a range of 2 to 10 days. Meningococcal bacteria can make a person extremely ill by infecting the blood (septicemia) or by infecting the fluid of the spinal cord and around the brain (meningitis). Because this disease progresses quickly, it is important to be diagnosed and start treatment as soon as possible.

What are the symptoms of meningococcal disease?

The most common symptoms are high fever, chills, lethargy, and a rash. If meningitis is present, the symptoms will also include headache and neck stiffness (which may not be present in infants); seizures may also occur. In overwhelming meningococcal infections, shock, coma, and death can follow within several hours, even with appropriate medical treatment.

How serious is meningococcal disease?

Meningococcal disease caused by any serogroup is very serious. About 10 to 15% of people with meningococcal disease die even with appropriate antibiotic treatment. Of those who recover, up to 20% suffer from some serious after-effects, such as permanent hearing loss, limb loss, or brain damage.

How is meningococcal disease diagnosed?

The diagnosis is made by taking samples of blood and spinal fluid from a person who is sick. The spinal fluid is obtained by performing a spinal tap, where a needle is inserted into the lower back. Any bacteria found in the blood or spinal fluid is grown in a medical laboratory and identified.

Meningococcal disease is uncommon in the United States, and the symptoms can be mistaken for other illnesses, which unfortunately can lead to delayed diagnosis and treatment.

Can't meningitis be caused by a virus too?

Yes. The word "meningitis" refers to inflammation of the tissues covering the brain and spinal cord. This inflammation can be caused by viruses and fungi, as well as bacteria. Viral meningitis is the most common type; it has no specific treatment but is usually not as serious as meningitis caused by bacteria.

Is there a treatment for meningococcal disease?

Meningococcal disease can be treated with antibiotics. It is critical to start treatment early.

How common is meningococcal disease in the United States?

Fewer than 700 cases of meningococcal disease were reported each year since 2010 in the United States. An estimated average 80 deaths from meningococcal disease occurred each year in the United States since 2010.

The disease is most common in children younger than 5 years (particularly children younger than age 1 year), people age 16–21 years, and people age 65 years and older.

What people are at special risk for meningococcal disease?

For all meningococcal serogroups risk factors include age, having a damaged or missing spleen, persistent complement component deficiency (an immune system disorder), and occupation as a microbiologist in a laboratory that works with meningococcal isolates.

Certain groups are at increased risk for meningococcal serogroups A, C, Y, and W but not serogroup B. These risk factors include travel to places where meningococcal disease is common (such as certain countries in Africa and in Saudi Arabia), and college freshmen who live in a dormitory (see question below for more on college students). Other risk factors for serogroups A, C, Y and W include having a previous viral infection, living in a crowded household, having an underlying chronic illness, and being exposed to cigarette smoke (either directly or second-hand).

How common is meningococcal disease in the world?

Meningococcal disease occurs throughout the world, but is more common in the area of Africa known as the “meningitis belt.” Serogroup A is responsible for most of the meningococcal disease in sub-Saharan Africa. This serogroup is uncommon in the United States.

Can you get meningitis more than once?

Yes. Meningitis can be caused by different serogroups of the meningococcal bacterium, by other bacteria such as *Streptococcus* and *Haemophilus*, as well as by viruses and fungi. Being vaccinated against *Neisseria meningitidis* or having had the disease will not protect you against meningitis from other bacteria or viruses.

If a child is diagnosed with meningococcal disease, can anything be done to protect the other children with whom he has contact?

Individuals who have been exposed to a person with bacterial meningitis can be protected by being started on a course of antibiotics immediately (ideally within 24 hours of the patient being diagnosed). This is usually recommended for household contacts and children attending the same day care or nursery school. Older children and adults (e.g., who are in the same school or church) aren't usually considered exposed unless they have had very close contact with the infected person (e.g., kissing or sharing a glass).

In addition to the antibiotic treatment, vaccination may be recommended for people 2 months of age and older if the person's infection is caused by meningococcus serogroup A, C, Y, or W-135, which are contained in 3 of the 4 meningococcal vaccines available in the United States.

What meningococcal vaccines are available in the United States?

There are 2 types of meningococcal vaccine available in the United States. Vaccines for meningococcal serogroups A, C, W and Y are composed of polysaccharide (sugar molecules) from the surface of the meningococcal bacteria. Meningococcal vaccines in which the polysaccharide is chemically bonded (“conjugated”) to a protein produce better protection and are more effective in young children than the original polysaccharide vaccine. Vaccines for meningococcal serogroup B (MenB) are composed of proteins also found in the surface of the bacteria. Neither type of vaccine contains live meningococcal bacteria.

Meningococcal polysaccharide or conjugate vaccines provide no protection against serogroup B disease and MenB vaccines provide no protection against serogroup A, C, W or Y disease. For protection against all 5 serogroups of meningococcus it is necessary to receive both vaccines.

How is this vaccine given?

Meningococcal polysaccharide vaccine (MPSV4) is given as an injection into the fatty tissue of the upper arm. Meningococcal conjugate vaccines (MCV4) are given in a leg muscle of a young

child or the deltoid (arm) muscle of an older child or adult. MenB vaccines are given in the deltoid muscle.

Who should get the meningococcal vaccine?

Certain groups should receive both MCV4 and MenB vaccines. Others are recommended to receive MCV4 only. MPSV4 is recommended only for certain people older than 55 years.

MCV4 is recommended for these groups:

- All children and teens, ages 11 through 18 years
- People younger than 22 years of age if they are or will be a first-year college student living in a residential hall
- People age 2 months and older who have a damaged or missing spleen (MenHibrix may be used for children age 6 weeks through 18 months in this group)
- People age 2 months and older who have persistent complement component deficiency (an immune system disorder), or are at risk during an outbreak caused by a vaccine serogroup (MenHibrix may be used for children age 6 weeks through 18 months in these groups)
- People age 2 months and older who reside in or travel to certain countries in sub-Saharan Africa as well as to other countries for which meningococcal vaccine is recommended (e.g., travel to Mecca, Saudi Arabia, for the annual Hajj).
- People working with meningococcus bacteria in laboratories

MenB is recommended for these groups:

- People age 10 years and older who have a damaged or missing spleen
- People age 10 years and older who have persistent complement component deficiency (an immune system disorder), or are at risk during an outbreak caused by a vaccine serogroup
- People working with meningococcus bacteria in laboratories

MenB vaccines are not routinely recommended for all adolescents or college students. However, at their June 2015 meeting ACIP voted to recommend that a MenB vaccine series may be administered to persons 16 through 23 years of age with a preferred age of vaccination of 16 through 18 years. This permissive (Category B) recommendation allows the clinician to make a MenB vaccine recommendation based on the risk and benefit for the individual patient.

Should college students be vaccinated against meningococcal disease?

The MCV4 vaccine is recommended for previously unvaccinated first-year college students, age younger than 22 years, who are or will be living in a residence hall. Some colleges and universities require incoming freshmen and others to be vaccinated with MCV4; some may also require that a dose of MCV4 have been given since the age of 16 years. MCV4 may be available from the college health service.

Although several small MenB outbreaks have occurred on college campuses since 2013, college students in general are not at higher risk of MenB than persons of the same age who are not college students. Consequently, ACIP does not routinely recommend MenB vaccination for college students. However, college students may choose to receive MenB vaccine to reduce their risk should a MenB outbreak occur.

Why doesn't ACIP recommend MenB vaccination for all adolescents or all college students?

Although a person with MenB disease can die or be permanently scarred or disabled, and may incur staggering medical expenses, MenB disease is rare and MenB vaccine is very expensive. A recommendation to vaccinate all adolescents or all college students is not cost-effective.

How many doses of meningococcal vaccine are needed?

For MCV4 vaccines the number of doses recommended depends on the age when the vaccine is given and the presence of certain medical conditions or risk factors. All adolescents should be vaccinated with one dose of MCV4 at ages 11 or 12 years and with a booster dose at age 16 years. All teens who were vaccinated with MCV4 at ages 13 through 15 years need a booster dose at age 16 through 18 years (at least 8 weeks after the first dose). First-year college students younger than 22 years who are living in a residential hall should get an MCV4 booster dose if their previous dose was given before age 16 years. People ages 2 months and older who have certain risk factors such as no spleen or a damaged spleen, or persistent complement component deficiency (an immune system disorder), may need more than one dose. In addition, vaccinated people who remain at risk, such as people without a spleen, microbiologists who work with meningococcus, or those who travel repeatedly to parts of Africa, should receive a booster dose of MCV4 every 5 years.

A series of MenB vaccine is either 2 (for Bexsero) or 3 (for Trumenba) doses. Booster doses of MenB vaccine following the initial series are currently not recommended, including for people with no spleen or persistent complement component deficiency.

How soon after their first MCV4 dose should people who remain at risk for meningococcal disease be vaccinated again?

The time between the primary (initial) dose(s) of MCV4 and the first booster varies. Children who received their primary MCV4 dose(s) before their seventh birthday should get their first booster 3 years after their primary dose(s). Children who received their primary MCV4 dose(s) at or after age 7 years and all adults should get MCV4 boosters 5 years after their primary dose(s).

What are the side effects of this vaccine?

Up to about half of people who get meningococcal vaccines have mild side effects, such as redness or pain where the shot was given. These symptoms usually last for one or two days and are more common after MCV4 than after MPSV4. A small percentage of people who receive the vaccine develop a fever. Severe reactions, such as a serious allergic reaction, are very rare.

More than 60,000 persons have received MenB vaccines during clinical trials or for outbreak control on college campuses. The most common side effect was pain at the injection site, which was reported by about 80% of recipients. The Vaccine Adverse Event Reporting System (VAERS) and other vaccine safety systems will carefully monitor MenB vaccine safety as they do for other U.S.-licensed vaccines.

How effective is this vaccine?

The MPSV4 vaccine is 85 percent to 100 percent effective at preventing infection from the subtypes of meningococcus found in the vaccine. Based on results of laboratory studies, MCV4 is believed to be at least as effective as MPSV4.

Because of the low incidence of serogroup B meningococcal disease, MenB vaccine efficacy estimates were based on demonstration of an immune response after vaccination. From 63% to 88% of recipients of a full series of MenB vaccine develop a protective level of antibody against representative strains of serogroup B meningococcus.

Who should not receive meningococcal vaccine?

These groups should not receive either type of meningococcal vaccine:

- People who have had a serious allergic reaction to a previous dose of either meningococcal vaccine or to one of the vaccine components. The packaging of some meningococcal vaccines may contain latex. Information on the contents of each vaccine is included with each vaccine.
- People who are moderately or severely ill.

Can a pregnant woman get meningococcal vaccine?

Studies of vaccination with MPSV4 during pregnancy have not documented adverse effects among either pregnant women or newborns. Post-licensure safety data suggest no concerns with the safety of MCV4 during pregnancy. Pregnancy is not considered to be a contraindication to either MPSV4 or MCV4. Although experience with MenB vaccines is limited they have not been shown to be detrimental to a pregnant woman or fetus.

Can the vaccine cause meningococcal disease?

No. Only the *Neisseria meningitidis* bacterium can cause meningococcal disease. Meningococcal vaccines contain only the sugar capsule or capsule protein of the microbe.

Immunization Action Coalition

Technically reviewed by the Centers for Disease Control and Prevention, August 2015.

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Mumps is a viral illness caused by a paramyxovirus of the genus *Rubulavirus*.

B. Description of Illness

- **General facts:** Mumps is a vaccine-preventable disease. The current mumps vaccine is incorporated with measles and rubella vaccine as a combined vaccine called MMR. Currently, two doses of MMR are necessary to confer lifelong immunity. Mumps vaccine is routinely used in only 38% of countries or areas in the world, and importation of mumps into the United States is now increasingly recognized.
- **Occurrence:** The incidence of mumps in the United States has declined since introduction of the live attenuated vaccine in 1967 from 152,209 cases in 1968 to 258 cases in 2004. In 2006 a multistate mumps outbreak resulted in more than 6,000 reported cases. Eight states in the Midwest reported the majority of cases. The outbreak peaked in mid-April. The median age of persons reported with mumps was 22 years. Many cases occurred among college students, many of who had received 1 or 2 doses of MMR vaccine. The incidence of mumps peaks in the winter through spring.
- **Incubation period:** The average incubation period is about 14 – 18 days (range 14 – 25 days).
- **Common symptoms:** A systemic disease characterized by swelling of one or more of the salivary glands, usually the parotid glands. Additional symptoms include fever, muscle aches, loss of appetite, and headache. Complications include aseptic meningitis, inflammation of the testicles or ovaries, inflammation of the pancreas, and deafness (usually permanent).
- **Treatment:** There is no specific treatment for mumps. People with mumps need bed rest, fluids, and control of fever.

C. Reservoirs

Humans are the only source of infection.

D. Modes of Transmission

Mumps is about as contagious as influenza and rubella, but less so than measles or chickenpox. It is spread primarily by airborne transmission or by droplet spread and by direct contact with the saliva of an infected person.

E. Period of Communicability

The virus has been isolated from saliva from 6 – 7 days prior to swelling of the glands to 9 days after the swelling. Maximum infectiousness occurs about 2 days before onset of parotitis and 5 days afterwards. Approximately one third of cases do not have clinically apparent salivary gland swelling. Inapparent infections can be communicable.

2) ACTIONS REQUIRED/CONTROL MEASURES

A. Reporting Requirements

Mumps is physician reportable by mail within 12 hours of recognition or strong suspicion to both the Connecticut Department of Public Health (DPH) and the local health department (LHD). The director of any clinical laboratory must also report laboratory evidence of mumps to both the DPH and the LHD. See current lists of physician Reportable Diseases (Attachment A) and Laboratory Reportable Significant Findings (Attachment C).

B. Case Classification

- **Suspected**
 - Parotitis, acute salivary gland swelling, orchitis, or oophoritis unexplained by another more likely diagnosis, **OR**
 - A positive lab result with no mumps clinical symptoms (with or without epidemiological-linkage to a confirmed or probable case).
- **Probable**
 - Acute parotitis or other salivary gland swelling lasting at least 2 days, or orchitis or oophoritis unexplained by another more likely diagnosis, in:
 - A person with a positive test for serum anti-mumps immunoglobulin M (IgM) antibody, **OR**
 - A person with epidemiologic linkage to another probable or confirmed case or linkage to a group/community defined by public health during an outbreak of mumps.
- **Confirmed**
 - A positive mumps laboratory confirmation for mumps virus with reverse transcription polymerase chain reaction (RT-PCR) or culture in a patient with an acute illness characterized by any of the following:
 - Acute parotitis or other salivary gland swelling, lasting at least 2 days
 - Aseptic meningitis
 - Encephalitis
 - Hearing loss
 - Orchitis
 - Oophoritis
 - Mastitis
 - Pancreatitis

C. Case Investigation

- **DPH Responsibility:** The DPH Immunization Program ensures that the appropriate diagnostic work has been completed and works in collaboration with LHD to ensure that contacts of each case-patient have been identified, and appropriate recommendations (e.g., vaccination, exclusion) have been made.

- **LHD Responsibility:** The LHD is involved with case investigations and control measures under DPH guidance as necessary.

D. Control Measures

The DPH Immunization Program (860-509-7929) should be contacted for guidance on control measures and further action, if necessary.

Fact Sheet

What causes mumps?

Mumps is caused by a virus.

How does mumps spread?

Mumps spreads from person to person via droplets of saliva or mucus from the mouth, nose, or throat of an infected person, usually when the person coughs, sneezes, or talks. The virus may also be spread indirectly when someone with mumps touches items or surfaces without washing their hands and then someone else touches the same surface and rubs their mouth or nose. Mumps is less contagious than measles or chickenpox.

How long does it take to show signs of mumps after being exposed?

The incubation period of mumps is usually 16–18 days, but can range from 12–25 days.

What are the symptoms of mumps?

Individuals with mumps usually first feel sick with nonspecific symptoms like headache, loss of appetite, and low-grade fever. The most well-known sign of mumps is parotitis, the swelling of the salivary glands, or parotid glands, below the ear. Parotitis occurs only in 31% to 65% of individuals infected with mumps. From 15% to 27% of people with mumps have no signs or symptoms of illness; others may have respiratory symptoms or only nonspecific symptoms such as headache, loss of appetite, and low-grade fever.

How serious is mumps?

In children, mumps is usually a mild disease. Adults may have more serious disease and more complications.

What are possible complications from mumps?

Before a vaccine was available mumps accounted for about 10% of viral meningitis reported in the United States. This complication is now rare. Up to 10% of postpubertal males experience orchitis (testicular inflammation) as a complication of mumps. This may involve pain, swelling, nausea, vomiting, and fever, with tenderness of the area possibly lasting for weeks. Approximately half of patients with orchitis have some degree of testicular atrophy, but sterility is rare.

Inflammation of the ovaries (oophoritis) and/or breasts (mastitis) can occur in females who have reached puberty. An increase in spontaneous abortion (miscarriage) has been found among women who developed mumps during the first trimester of pregnancy in some studies but not in others; however, there is no evidence that mumps causes birth defects. Deafness, in one or both ears, can occur in approximately one per 20,000 reported cases of mumps.

Is there a treatment for mumps?

There is no cure for mumps, only supportive treatment (bed rest, fluids, and fever reduction).

How is mumps diagnosed?

Mumps is diagnosed by a combination of symptoms and physical signs and laboratory confirmation of the virus, as not all cases develop characteristic parotitis and not all cases of parotitis are caused by mumps.

How long is a person with mumps contagious?

People with mumps are usually considered most infectious from a few days before until 5 days after the onset of parotitis. Therefore, CDC recommends isolating mumps patients for 5 days after their glands begin to swell.

What should be done if someone is exposed to mumps?

If the exposed person has not been vaccinated against mumps, receiving the vaccine after exposure to the virus will not help prevent disease if the person has already been infected. However, if they did not become infected after this particular exposure, the vaccine may help protect him or her against future infection with mumps virus.

How common is mumps in the United States?

Due to good immunization coverage, mumps is now rare in the United States. An estimated 212,000 cases occurred in 1964, while only 229 cases were reported in 2012. Large outbreaks of mumps occurred in the United States in 2006 and 2009–10 with more than 6,000 and 3,000 cases, respectively, reported in those years.

Can someone get mumps more than once?

People who have had mumps are usually protected for life against another mumps infection. However, second occurrences of mumps do rarely occur.

When did vaccines for measles, mumps, and rubella become available?

The first measles vaccines (an inactivated and a live virus product) became available in 1963, both of which were largely replaced by a further attenuated live virus vaccine that was licensed in 1968. The mumps vaccine first became available in 1967, followed by the rubella vaccine in 1969. These three vaccines were combined in 1971 to form the measles-mumps-rubella (MMR) vaccine. A vaccine that combines both MMR and varicella (chickenpox) vaccines, known as MMRV, became available in 2005. Single antigen measles, mumps, and rubella vaccines are no longer available in the United States.

What kind of vaccine is it?

MMR vaccine contains live, attenuated (or weakened) strains of the measles, mumps, and rubella viruses.

How is this vaccine given?

This vaccine is a shot given subcutaneously (in the fatty layer of tissue under the skin).

Who should get this vaccine?

All children, adolescents, and adults born in 1957 or later without a valid contraindication should have documentation of vaccination or other evidence of immunity. Additionally, some healthcare personnel who were born before 1957 may also need proof of vaccination or other evidence of immunity.

What kind of “evidence of immunity” can substitute for MMR vaccination?

Evidence of immunity can be shown by having laboratory evidence of immunity to measles, mumps, and/or rubella or laboratory confirmation of disease. However, if a person doesn't have evidence of immunity to all three diseases (e.g., measles, mumps, and rubella), they would still need to get vaccinated with MMR since the vaccine is not available as a single antigen product in the U.S.

At what age should the first dose of MMR be given?

The first dose of MMR should be given on or after the child's first birthday; the recommended age range is from 12–15 months. A dose given before 12 months of age will not be counted, so the child's medical appointment should be scheduled with this in mind.

When should children get the second MMR shot?

The second dose is usually given when the child is 4–6 years old, or before he or she enters kindergarten or first grade. However, the second dose can be given earlier as long as there has

been an interval of at least 28 days since the first dose.

How effective is this vaccine?

Post-licensure studies have demonstrated one dose of MMR vaccine is 78% (range, 45%-97%) effective for prevention of mumps. The second dose of MMR is intended to produce immunity in those who did not respond to the first dose, but a very small percentage of people may not be protected even after a second dose.

Which adolescents and adults should receive the MMR vaccine?

All unvaccinated adolescents without a valid contraindication to the vaccine should have documentation of two doses of MMR. All adults born in or after 1957 should also have documentation of vaccination or other evidence of immunity.

Adults born before 1957 are likely to have had measles and/or mumps disease as a child and are generally (but not always) considered not to need vaccination.

Which adults need two doses of MMR vaccine?

Certain adults are at higher risk of exposure to measles, mumps, and/or rubella and may need a second dose of MMR unless they have other evidence of immunity; this includes adults who are:

- students in postsecondary educational institutions (for measles and mumps)
- healthcare personnel (for measles and mumps)
- living in a community experiencing an outbreak or recently exposed to the disease (for measles and mumps)
- planning to travel internationally (for measles and mumps)
- people who received inactivated (killed) measles vaccine or measles vaccine of unknown type during 1963-1967 should be revaccinated with two doses of MMR vaccine.
- people vaccinated before 1979 with either killed mumps vaccine or mumps vaccine of unknown type who are at high risk for mumps infection (e.g., people who are working in a healthcare facility) should be considered for revaccination with 2 doses of MMR vaccine.

Why do healthcare personnel need vaccination or other evidence of immunity to measles, mumps, and rubella?

People who work in medical facilities are at much higher risk for being exposed to disease than is the general population. Making sure that all employees are immune to these diseases protects both the employee and the patients with whom he or she may have contact. All people working in a healthcare facility in any capacity should have documentation of vaccination or evidence of immunity, including full- or part-time employees, medical or non-medical, paid or volunteer, students, and those with or without direct patient responsibilities.

Facilities should consider vaccinating with MMR vaccine healthcare personnel born before 1957 who lack laboratory evidence of measles, mumps, and rubella immunity or laboratory confirmation of previous disease. These facilities should vaccinate healthcare personnel with MMR during an outbreak of any of the diseases, regardless of birth year.

Who recommends this vaccine?

The Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics (AAP), the American Academy of Family Physicians (AAFP), the American College of Obstetricians and Gynecologists, and the American College of Physicians (ACP) have all recommended this vaccine.

How safe is this vaccine?

Hundreds of millions of doses of measles, mumps, and rubella vaccine prepared either as separate vaccines or as the combined MMR have been given in the United States, and its safety record is excellent.

What side effects have been reported with this vaccine?

Fever is the most common side effect, occurring in 5%–15% of vaccine recipients. About 5% of people develop a mild rash. When they occur, fever and rash usually appear 7–12 days after vaccination. About 25% of adult women receiving MMR vaccine develop temporary joint pain, a symptom related to the rubella component of the combined vaccine. Joint pain only occurs in women who are not immune to rubella at the time of vaccination. MMR vaccine may cause thrombocytopenia (low platelet count) at the rate of about 1 case per 30,000–40,000 vaccinated people. Cases are almost always temporary and not life-threatening. More severe reactions, including allergic reactions, are rare. Other severe problems (e.g., deafness, permanent brain damage) occur so rarely that experts cannot be sure whether they are caused by the vaccine or not.

If a child develops a rash after getting the MMR vaccine, is he contagious?

Transmission of the vaccine viruses does not occur from a vaccinated person, including those who develop a rash. No special precautions (e.g., exclusion from school or work) need be taken.

Who should NOT receive MMR vaccine?

Anyone who had a severe allergic reaction (e.g., generalized hives, swelling of the lips, tongue, or throat, difficulty breathing) following the first dose of MMR should not receive a second dose. Anyone knowing they are allergic to an MMR component (e.g., gelatin, neomycin) should not receive this vaccine.

As with all live virus vaccines, women known to be pregnant should not receive the MMR vaccine, and pregnancy should be avoided for four weeks following vaccination with MMR. Children and other household contacts of pregnant women should be vaccinated according to the recommended schedule. Women who are breast-feeding can be vaccinated.

Severely immunocompromised people should not be given MMR vaccine. This includes people with conditions such as congenital immunodeficiency, AIDS, leukemia, lymphoma, generalized malignancy, and those receiving treatment for cancer with drugs, radiation, or large doses of corticosteroids. Household contacts of immunocompromised people should be vaccinated according to the recommended schedule.

Although people with AIDS or HIV infection with signs of serious immunosuppression should not be given MMR, people with HIV infection who do not have laboratory evidence of severe immunosuppression can and should be vaccinated against measles.

Can individuals with egg allergy receive MMR vaccine?

In the past it was believed that people who were allergic to eggs would be at risk of an allergic reaction from the vaccine because the vaccine is grown in tissue from chick embryos. However, recent studies have shown that this is not the case. MMR may be given to egg-allergic individuals without prior testing or use of special precautions.

Does the MMR vaccine cause autism?

There is no scientific evidence that measles, MMR, or any other vaccine causes autism. The question about a possible link between MMR vaccine and autism has been extensively reviewed by independent groups of experts in the U.S. including the National Academy of Sciences' Institute of Medicine. These reviews have concluded that there is no association between MMR vaccine and autism.

For a summary of the issues on this topic, please read “Do Vaccines Cause Autism?” on the website of the Vaccine Education Center at Children’s Hospital of Philadelphia. This discussion can be accessed at <http://www.chop.edu/centers-programs/vaccine-education-center>. “MMR vaccine does not cause autism. Examine the evidence!” lists all the major studies related to this issue with links to journal article abstracts:
<http://www.immunize.org/catg.d/p4026.pdf>.

Dr. Ari Brown has written a good piece for parents questioning the safety of vaccines. To access “Clear Answers & Smart Advice about Your Baby’s Shots,” go to:
<http://www.immunize.org/catg.d/p2068.pdf>.

For more information, visit CDC’s web page about vaccines and autism at
<http://www.cdc.gov/vaccinesafety/Concerns/Autism/Index.html>.

Can the live virus in the vaccine cause measles, mumps, and/or rubella?

Because the measles, mumps, and rubella viruses in the MMR vaccine are weak versions of the disease viruses, they may cause a very mild case of the disease they were designed to prevent; however, it is usually much milder than the natural disease and is referred to as an adverse reaction to the vaccine.

What if a pregnant woman inadvertently got the MMR vaccine?

Women are advised not to receive any live virus vaccine during pregnancy as a safety precaution based on the theoretical possibility of a live vaccine causing disease (e.g., rubella virus leading to congenital rubella syndrome [CRS]).

Because a number of women have inadvertently received this vaccine while pregnant or soon before conception, the Centers for Disease Control and Prevention has collected data about the outcomes of their births. From 1971–1989, no evidence of CRS occurred in the 324 infants born to 321 women who received rubella vaccine while pregnant and continued pregnancy to term. As any risk to the fetus from rubella vaccine appears to be extremely low or zero, individual counseling of women in this situation is recommended, rather than routine termination of pregnancy.

Immunization Action Coalition

Technically reviewed by the Centers for Disease Control and Prevention, March 2014.

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Pertussis, or whooping cough, is an acute bacterial disease of the respiratory tract and is caused by the gram-negative bacillus *Bordetella pertussis*.

B. Description of Illness

- **General facts:** Infants under the age of 12 months have more serious illness from pertussis and they are more likely to have complications and be hospitalized than persons in other age groups. Older patients (adolescents and adults) and those partially protected by the vaccine may get infected with *B. pertussis*, but generally have milder disease.
- **Occurrence:** Since the introduction of the pertussis vaccine in the 1940s, the average incidence of pertussis decreased from 150 per 100,000 persons between 1922 and 1940 to 0.5 per 100,000 in 1976. However, since the 1980s, the incidence of reported pertussis cases has increased. The increase has been primarily among infants less than 4 months and among adolescents and adults. Reasons for the increase in pertussis are not completely clear. Improvements in diagnosis and reporting of pertussis in adolescents and adults appear to be important factors contributing to the overall increase. Outbreaks are being recognized in high schools and middle schools more frequently.
- **Incubation period:** Usually from 7 – 10 days (range 6 – 21 days).
- **Common symptoms:** Pertussis begins with mild upper respiratory tract symptoms. The cough gradually (within 1 – 2 weeks) becomes severe, characterized by bursts of numerous, rapid coughs where one cough follows the next without a break for breath. The cough may be accompanied by a characteristic high-pitched whoop. During such an attack, the patient may become cyanotic (turn blue). Vomiting and exhaustion commonly follow the episode. Fever is absent or gradual. Symptoms wane gradually over weeks to months. Disease in infants younger than 6 months of age is unusual; apnea (cessation of breathing) is a common manifestation, and whoop is absent.
- **Treatment:** Antibiotics are somewhat helpful in treating pertussis. The drug of choice is usually erythromycin. This antibiotic should be given for 14 days to all household and other close contacts of the patient to minimize transmission, regardless of age and vaccination status. Patients also need supportive therapy such as bed rest, fluids, and control of fever.

C. Reservoirs

Humans are the only known source of infection. Older siblings, including adolescents, and adults may be an important source of *B. pertussis* for infants and young children.

D. Modes of Transmission

Transmission occurs primarily by direct contact with discharges from respiratory mucous membranes of infected persons by the airborne route, probably by droplets. Up to 80% of non-immune household contacts may acquire the disease.

E. Period of Communicability

Pertussis is highly communicable in the early stage of illness. For control purposes, the period of communicability extends from the initial mild respiratory symptoms to 3 weeks after onset of cough in patients not treated with antibiotics. When treated with appropriate antibiotics, the period of infectiousness is usually 5 days or less after onset of therapy.

2) ACTIONS REQUIRED/CONTROL MEASURES

A. Reporting

Pertussis is physician reportable by telephone immediately on the day of recognition or strong suspicion to both the Connecticut Department of Public Health (DPH) and the local health department (LHD). A mailed report is also required within 12 hours. The director of any clinical laboratory must also report laboratory evidence of pertussis to both the DPH and the LHD. **Additional requirements:** Isolates must be submitted to the DPH State Laboratory for confirmation. See current lists of physician Reportable Diseases (Attachment A and Laboratory Reportable Significant Findings (Attachment C).

B. Case Definition

- **Clinical criteria:**

In the absence of a more likely diagnosis, a cough illness lasting ≥ 2 weeks, with at least one of the following signs or symptoms:

- Paroxysms of coughing; **OR**
- Inspiratory whoop; **OR**
- Post-tussive vomiting; **OR**
- Apnea (with or without cyanosis) (FOR INFANTS AGED < 1 YEAR ONLY)

- **Laboratory Criteria for Diagnosis**

- Isolation of *B. pertussis* from a clinical specimen
- Positive PCR for pertussis

- **Epidemiologic Linkage**

- Contact with a laboratory-confirmed case of pertussis*.

Case Classification

- **Probable**

In the absence of a more likely diagnosis, a cough illness lasting ≥ 2 weeks, with at least one of the following signs or symptoms:

- Paroxysms of coughing; or inspiratory "whoop"; **or**
- Post-tussive vomiting; **or**
- Apnea (with or without cyanosis) (FOR INFANTS AGED < 1 YEAR ONLY)

And

- Absence of laboratory confirmation;

And

- No epidemiologic linkage to a laboratory-confirmed case of pertussis.

OR, FOR INFANTS AGED < 1 YEAR ONLY:

- Acute cough illness of any duration, with at least one of the following signs or symptoms:
 - Paroxysms of coughing; **or**

- Inspiratory "whoop"; **or**
- Post-tussive vomiting; **or**
- Apnea (with or without cyanosis)

And

- Polymerase chain reaction (PCR) positive for pertussis.

OR, FOR INFANTS AGED <1 YEAR ONLY:

- Acute cough illness of any duration, with at least one of the following signs or symptoms:

- Paroxysms of coughing; **or**
- Inspiratory "whoop"; **or**
- Post-tussive vomiting; **or**
- Apnea (with or without cyanosis)

And

- Contact with a laboratory-confirmed case of pertussis.

• Confirmed

Acute cough illness of any duration, with isolation of *B. pertussis* from a clinical specimen.

OR

Cough illness lasting ≥ 2 weeks, with at least one of the following signs or symptoms:

- Paroxysms of coughing; **or**
- inspiratory "whoop"; **or**
- Post-tussive vomiting; **or**
- Apnea (with or without cyanosis) (FOR INFANTS AGED <1 YEAR ONLY)

And

- Polymerase chain reaction (PCR) positive for pertussis.

OR

Cough illness lasting ≥ 2 weeks, with at least one of the following signs or symptoms:

- Paroxysms of coughing; **or**
- inspiratory "whoop"; **or**
- Post-tussive vomiting; **or**
- Apnea (with or without cyanosis) (FOR INFANTS AGED <1 YEAR ONLY)

And

- Contact with a laboratory-confirmed case of pertussis*.

Case Classification Comments

*Note: An illness meeting the clinical case definition should be classified as "probable" rather than "confirmed" if it occurs in a patient who has contact with an infant aged <1

year who is Polymerase Chain Reaction (PCR) positive for pertussis and has ≥ 1 sign or symptom and cough duration < 14 days (classified as "probable" case).

C. Case Investigation

- **DPH Responsibility:** The DPH Immunization Program ensures that the appropriate diagnostic work has been completed and works in collaboration with LHD to ensure that contacts of each case-patient have been identified, and appropriate recommendations (e.g., vaccination, exclusion) have been made.
- **LHD Responsibility:** The LHD is involved with case investigation and control measures under DPH guidance as necessary.

D. Control Measures

The DPH Immunization Program (860-509-7929) should be contacted for guidance on control measures and further action, if necessary.

Fact Sheet

What causes pertussis?

Pertussis, commonly known as whooping cough, is caused by a bacterium, *Bordetella pertussis*.

How does pertussis spread?

Pertussis is spread through the air by infectious droplets and is highly contagious.

How long does it take to show signs of pertussis after being exposed?

The incubation period of pertussis is commonly 7 to 10 days, with a range of 4–21 days.

What are the symptoms of pertussis?

Pertussis disease can be divided into three stages:

Catarrhal stage: can last 1–2 weeks and includes a runny nose, sneezing, low-grade fever, and a mild cough (all similar symptoms to the common cold).

Paroxysmal stage: usually lasts 1–6 weeks, but can persist for up to 10 weeks. The characteristic symptom is a burst, or paroxysm, of numerous, rapid coughs. At the end of the cough paroxysm, the patient can suffer from a long inhaling effort that is characterized by a high-pitched whoop (hence the name, "whooping cough"). Infants and young children often appear very ill and distressed, and may turn blue and vomit. "Whooping" does not necessarily have to accompany the cough.

Convalescent stage: usually lasts 2–6 weeks, but may last for months. Although the cough usually disappears after 2–3 weeks, paroxysms may recur whenever the patient suffers any subsequent respiratory infection. The disease is usually milder in adolescents and adults, consisting of a persistent cough similar to that found in other upper respiratory infections. However, these individuals are still able to transmit the disease to others, including unimmunized or incompletely immunized infants.

How serious is pertussis?

Pertussis can be a very serious disease, especially for infants. Infants (6 months of age and younger) are the children most likely to die from this disease. Rates of hospitalization and complications increase with decreasing age. The breathing difficulties associated with this disease can be very distressing and frightening for the patient and his or her family.

Although adults are less likely than infants to become seriously ill with pertussis, most make repeated visits for medical care and miss work, especially when pertussis is not initially considered as a reason for their long-term cough. In addition, adults with pertussis infection have been shown to be a frequent source of infection to infants with whom they have close contact.

What are possible complications from pertussis?

Younger patients have a greater chance of complications from pertussis than older patients. The most common complication is secondary bacterial infection, which is the cause of most pertussis-related deaths. Pneumonia occurs in one out of 20 cases; this percentage is higher for infants younger than age 6 months.

Infants are also more likely to suffer from such neurologic complications such as seizures and encephalopathy, probably due to the reduction of oxygen supply to the brain. Other less serious complications include ear infection, loss of appetite, and dehydration.

Adults with pertussis can have complications such as pneumonia (up to 5% of cases) and rib fracture from coughing (up to 4% of cases). Other reported side effects include (among others), loss of consciousness, female urinary incontinence, hernias, angina, and weight loss.

How do I know if my child has pertussis?

The diagnosis of pertussis is usually made based on its characteristic history and physical examination. A laboratory test may be done, which involves taking a specimen from the back of the patient's throat (through the nose).

Is there a treatment for pertussis?

Antibiotics are necessary in treating pertussis cases. The drug of choice is usually a form of erythromycin that is also given to all household and other close contacts of the patient to minimize transmission, regardless of age and vaccination status. Patients also need supportive therapy such as bed rest, fluids, and control of fever.

All close contacts younger than seven years of age should complete their DTaP vaccine series if they have not already done so. If they have completed their primary four dose series, but have not had a dose from age 4 to 6 years, they should be given a booster dose if it has been at least 6 months since the last dose. People age 10 years and older should receive a dose of Tdap if they haven't received it already.

How long is a person with pertussis contagious?

People with pertussis are most infectious during the catarrhal period and during the first two weeks after onset of the cough (approximately 21 days).

How common is pertussis in the United States?

Before a vaccine against pertussis was available, pertussis (whooping cough) was a major cause of childhood illness and death in the United States. From 1940–1945, over one million cases of pertussis were reported. With the introduction of a vaccine in the late 1940s, the number of reported pertussis cases in the U.S. declined from approximately 200,000 a year in the pre-vaccine era to a low of 1,010 cases in 1976.

Since the 1980s, the number of cases of pertussis has increased, especially among babies younger than 6 months and teenagers. In recent years, several states have reported a significant increase in cases, with outbreaks of pertussis reaching epidemic levels in some states. Many infants have died from whooping cough during this epidemic.

Can you get pertussis more than once?

Reinfection appears to be uncommon but does occur. With natural infection, immunity to pertussis will likely wane as soon as seven years following disease; reinfection may present as a persistent cough, rather than typical pertussis.

When did vaccine first become available for diphtheria, tetanus, and pertussis?

The first inactivated toxin, or toxoid, against diphtheria was developed around 1921, but it was not widely used until the 1930s. In 1924, the first tetanus toxoid (inactivated toxin) was produced and was used successfully to prevent tetanus in the armed services during World War II. The first pertussis vaccine was developed in the 1930s and was in widespread use by the mid-1940s, when pertussis vaccine was combined with diphtheria and tetanus toxoids to make the combination DTP vaccine. A series of 4 doses of whole-cell DTP vaccine was quite (70–90%) effective in preventing serious pertussis disease; however, up to half of the children who received the vaccine developed local reactions such as redness, swelling, and pain at the injection site. In 1991, concerns about safety led to the development of more purified (acellular) pertussis vaccines that are associated with fewer side effects. These acellular pertussis vaccines have replaced the whole cell DTP vaccines in the U.S.

In 2005, two new vaccine products were licensed for use in adolescents and adults that combine the tetanus and diphtheria toxoids with acellular pertussis (Tdap) vaccine. These vaccines are the

first acellular pertussis-containing vaccines that make it possible to vaccinate adolescents and adults against pertussis.

How are vaccines made that prevent diphtheria, tetanus and pertussis?

These vaccines are made by chemically treating the diphtheria, tetanus, and pertussis toxins to render them nontoxic yet still capable of eliciting an immune response in the vaccinated person. They are known as “inactivated” vaccines because they do not contain live bacteria and cannot replicate themselves, which is why multiple doses are needed to produce immunity.

What’s the difference between all the vaccines containing diphtheria and tetanus toxoids and pertussis vaccine?

It’s like alphabet soup! Here is a listing of the various products:

- DTaP: Diphtheria and tetanus toxoids and acellular pertussis vaccine; given to infants and children ages 6 weeks through 6 years. In addition, three childhood combination vaccines include DTaP as a component.
- DT: Diphtheria and tetanus toxoids, without the pertussis component; given to infants and children ages 6 weeks through 6 years who have a contraindication to the pertussis component.
- Tdap: Tetanus and diphtheria toxoids with acellular pertussis vaccine; given to adolescents and adults, usually as a single dose; the exception is pregnant women who should receive Tdap during each pregnancy.
- Td: Tetanus and diphtheria toxoids; given to children and adults ages 7 years and older. Note the small “d” which indicates a much smaller quantity of diphtheria toxoid than in the pediatric DTaP formulation.

How are these vaccines given?

The DTaP and DT preparations are all given as an injection in the anterolateral thigh muscle (for infants and young toddlers) or in the deltoid muscle (for older children and adults). Tdap and Td are given in the deltoid muscle for children and adults age 7 years and older.

Who should get these vaccines?

All children, beginning at age 2 months, and all adults need protection against these three diseases— diphtheria, tetanus, and pertussis (whooping cough). Routine booster doses are also needed throughout life.

How many doses of vaccine are needed?

The usual schedule for infants is a series of four doses of DTaP given at 2, 4, 6, and 15–18 months of age. A fifth shot, or booster dose, is recommended between age 4 and 6 years, unless the fourth dose was given late (after the fourth birthday).

For people who were never vaccinated or who may have started but not completed a series of shots, a 3-dose series of Td should be given with 1 to 2 months between dose #1 and #2, and 6 to 12 months between dose #2 and #3. One of the doses, preferably the first, should also contain the pertussis component in the form of Tdap.

Because immunity to diphtheria and tetanus wanes with time, boosters of Td are needed every ten years.

When adolescents and adults are scheduled for their routine tetanus and diphtheria booster, should they get vaccinated with Td or Tdap?

Immunization experts recommend that the first dose of Tdap be given to all adolescents at age 11–12 years as a booster during the routine adolescent immunization visit if the adolescent has finished the childhood DTaP schedule and has not already received a dose of Td or Tdap. If a

child age 7–10 years did not complete a primary series in childhood, a dose of Tdap may be given earlier as part of the catch-up vaccinations.

All adults should receive a single dose of Tdap as soon as feasible. Then, subsequent booster doses of Td should be given every ten years. Pregnant teens and women should receive Tdap during each pregnancy. Adolescents and adults who have recently received Td vaccine can be given Tdap without any waiting period.

If someone experiences a deep or puncture wound, or a wound contaminated with dirt, an additional booster dose may be given if the last dose was more than five years ago. This could be a dose of Td or Tdap, depending on the person's vaccination history. It is important to keep an up-to-date record of all immunizations so that repeat doses don't become necessary. Although it is vital to be adequately protected, receiving more doses than recommended can lead to increased local reactions, such as painful swelling of the arm.

Who recommends the use of these vaccines?

The Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics (AAP), the American Academy of Family Physicians (AAFP), and the American College of Physicians (ACP) all recommend this vaccine.

What side effects have been reported with these vaccines?

Local reactions, such as fever, redness and swelling at the injection site, and soreness and tenderness where the shot was given, are not uncommon in children and adults. These minor local and systemic adverse reactions are much less common with acellular DTaP vaccine; however, a determination of more rare adverse effects can only be made when additional data are available following extended use of DTaP.

Side effects following Td or Tdap in older children and adults include redness and swelling at the injection site (following Td) and generalized body aches, and tiredness (following Tdap). Older children and adults who received more than the recommended doses of Td/Tdap vaccine can experience increased local reactions, such as painful swelling of the arm. This is due to the high levels of tetanus antibody in their blood.

How effective are these vaccines?

After a properly spaced primary series of DTaP or Td/ Tdap, approximately 95% of people will have protective levels of diphtheria antitoxin and 100% will have protective levels of tetanus antitoxin in their blood. However, antitoxin levels decrease with time so routine boosters with tetanus and diphtheria toxoids are recommended every 10 years. Estimates of acellular pertussis vaccine efficacy range from 80% to 85%—a level believed to be far more efficacious than the previously-used whole cell pertussis vaccine.

Can a pregnant woman receive Tdap vaccine?

Yes. All pregnant women should receive Tdap during each pregnancy, preferably between 27 and 36 weeks' gestation. Because infants are not adequately protected against pertussis until they have received at least 3 doses of DTaP, it is especially important that all contacts (family members, caregivers) of infants younger than age 12 months are vaccinated with Tdap. If a new mother hasn't been vaccinated with Tdap, she should receive it before hospital discharge, even if she is breastfeeding.

Who should not receive these vaccines?

Generally, any person who has had a serious allergic reaction to a vaccine component or a prior dose of the vaccine should not receive another dose of the same vaccine. People who had a serious allergic reaction to a previous dose of DTaP or Tdap vaccine should not receive another dose.

Certain rare adverse events following pertussis vaccination usually serve as a precaution against receiving further doses. Such events include a temperature of 105°F or higher within two days, collapse or shock-like state within two days, persistent crying for more than three hours within two days, or convulsions within three days. Even if one of these precautions exists, there may be occasions when the benefit of immunization outweighs the risk (for example, during a community-wide outbreak of pertussis). A person who developed one of these adverse events after pediatric DTaP vaccine may receive Tdap as an adolescent or adult.

A person with a recognized, possible, or potential neurologic condition should delay receiving DTaP or Tdap vaccine until the condition is evaluated, treated, and/or stabilized. Although DTaP vaccine does not cause neurological disorders, receiving the vaccine can cause an already-present underlying condition to show itself.

Can the vaccine cause the disease?

No.

Immunization Action Coalition

Technically reviewed by the Centers for Disease Control and Prevention, July 2013.

• THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Pneumococcal disease is caused by the bacterium *Streptococcus pneumoniae*. There are more than 90 serotypes. While most types can cause disease, the 11 most common serotypes cause at least 75% of invasive disease.

B. Description of Illness

- **General facts:** Pneumococcal disease is a vaccine-preventable disease. Following the introduction of the 7-valent pneumococcal conjugate vaccine (PCV7) in 2000, dramatic declines in invasive pneumococcal disease were reported among children less than 5 years old. Rates of PCV7-type invasive pneumococcal disease among children in this age group dropped from around 80 cases per 100,000 population to less than 1 case per 100,000 by 2007 and continue to be low. The use of PCV7 also reduced the burden of invasive pneumococcal disease among older children and adults through reduced transmission of vaccine serotype pneumococci (herd protection). With the introduction of the 13-valent pneumococcal conjugate vaccine (PCV13) in 2010, cases of invasive disease due to the additional serotypes covered by PCV13 but not by PCV7 also decreased substantially.
- **Occurrence:** Until 2000, *S. pneumoniae* infections caused 100,000 – 135,000 hospitalizations for pneumonia, 6 million cases of otitis media, and 60,000 cases of invasive disease, including 3,300 cases of meningitis. Incidence from sterile-site infections showed geographic variation from 21 – 33 cases per 100,000 population. These figures decreased substantially following the introduction of the conjugate vaccine in children in 2000. Pneumococcal infections are most prevalent during winter months; most common in infants, young children, and the elderly; and more common in black individuals and some American Indian populations than in other racial and ethnic groups.
- **Incubation period:** The incubation period can vary by type of infection and can be as short as 1 – 3 days.
- **Common symptoms:** There are three major conditions caused by invasive pneumococcal disease: pneumonia, bacteremia, and meningitis. They are all caused by infection with the same bacteria, but have different symptoms.
- **Treatment:** Penicillin is the drug of choice for treatment of pneumococcal disease; however, resistance to penicillin and other antibiotics has been on the rise. Studies indicate that in some areas of the United States up to 40% of pneumococci are resistant to common antibiotics. Treating patients infected with resistant organisms requires expensive alternative antimicrobial agents and may result in prolonged hospital stays. The increased difficulty of treating serious bacterial infection makes prevention through vaccination even more important.

C. Reservoirs

S. pneumoniae is a human pathogen. The reservoir for pneumococci is presumably the nasopharynx of asymptomatic human carriers. There is no animal or insect vector.

D. Modes of Transmission

Transmission of *S. pneumoniae* occurs as the result of direct person-to-person contact via respiratory droplets and autoinoculation in persons carrying the bacteria in their upper respiratory tract. The pneumococcal serotypes most often responsible for causing infection

are those most frequently found in carriers. The spread of the organism within a family or household is influenced by such factors as crowding, season, and the presence of upper respiratory infections or pneumococcal disease such as pneumonia or otitis media. The spread of pneumococcal disease is usually associated with increased carriage rates. However, high carriage rates do not appear to increase the risk of disease transmission in households.

E. Period of Communicability

The exact period of communicability is unknown. It appears transmission can occur as long as the organism remains in respiratory secretions. Treatment with an appropriate antibiotic renders an individual non-infectious within 24 – 48 hours.

- **ACTIONS REQUIRED/CONTROL MEASURES**

- A. Reporting Requirements**

Invasive pneumococcal disease is physician reportable by mail within 12 hours of recognition or strong suspicion to both the Connecticut Department of Public Health (DPH) and the local health department (LHD). The director of any clinical laboratory must also report laboratory evidence of invasive pneumococcal disease to both the DPH and LHD.

Additional requirements: All isolates yielding *S. pneumoniae* from invasive sterile sites must be submitted to the DPH State Laboratory for confirmation. See current list of Physician Reportable Diseases (Attachment A) and Laboratory Report of Significant Findings (Attachment C).

- B. Case Definition**

- **Clinical Description:** Invasive pneumococcal disease may produce any of several clinical syndromes, including meningitis, bacteremia, and pneumonia.
 - **Laboratory criteria for diagnosis:** Isolation of *S. pneumoniae* from a normally sterile site (e.g., blood, cerebrospinal fluid, joint fluid, pleural fluid, peritoneal fluid, etc.).
 - **Confirmed Case:** A clinically compatible case that is laboratory confirmed.

- C. Case Investigation**

- **DPH Responsibility:** The DPH Epidemiology Program obtains additional case data by completing a detailed report form through medical chart review. Information is forwarded to the Centers for Disease Control and Prevention.
 - **LHD Responsibility:** No action required.

- D. Control Measures**

No specific control measures are recommended.

Fact Sheet

What causes pneumococcal disease?

Pneumococcal disease is caused by the bacterium *Streptococcus pneumoniae*, also called pneumococcus. There are more than 90 subtypes. Most subtypes can cause disease, but only a few produce the majority of invasive pneumococcal infections. The 10 most common subtypes cause 62% of invasive disease worldwide.

How does pneumococcal disease spread?

The disease is spread from person to person by droplets in the air. The pneumococci bacteria are common inhabitants of the human respiratory tract. They may be isolated from the nasal passages and throat of 5%–70% of normal, healthy adults, depending on the population and setting.

What diseases can pneumococci bacteria cause?

There are three major conditions caused by pneumococci: pneumonia, bacteremia, and meningitis. They are all caused by infection with the same bacteria, but have different symptoms.

Pneumococcal pneumonia (lung disease) is the most common disease caused by pneumococcal bacteria. The incubation period is short (1–3 days). Symptoms include abrupt onset of fever, shaking chills or rigors, chest pain, cough, shortness of breath, rapid breathing and heart rate, and weakness. As many as 400,000 hospitalizations from pneumococcal pneumonia are estimated to occur annually in the United States. Pneumococci account for about 30% of adult community-acquired pneumonia. Complications of pneumococcal pneumonia include empyema (infection of the pleural space), pericarditis (inflammation of the sac surrounding the heart), and respiratory failure. The fatality rate is 5%–7% and may be higher than 50% among elderly people. About 12,000 cases of pneumococcal bacteremia (blood infection) occur each year in the United States. Pneumococcal bacteremia occurs in about 25%–30% of patients with pneumococcal pneumonia. Bacteremia is the most common clinical presentation among children age two years and younger, accounting for 40% of invasive disease in this group. The overall case-fatality rate for bacteremia is about 15% but may be as high as 60% among elderly people. Patients with asplenia who develop bacteremia may experience a severe illness.

Pneumococci cause 50% of all cases of bacterial meningitis (infection of the covering of the brain or spinal cord) in the United States. There are an estimated 3,000 cases of pneumococcal meningitis each year. Symptoms may include headache, tiredness, vomiting, irritability, fever, seizures, and coma. The case-fatality rate of pneumococcal meningitis is 10% but may be higher among elderly people. Permanent neurologic damage is common among survivors. People with a cochlear implant appear to be at increased risk of pneumococcal meningitis. With the decline of invasive Hib disease, pneumococci has become the leading cause of bacterial meningitis among children younger than 5 years of age in the United States.

Pneumococci are also a common cause of acute otitis media (middle ear infection). By age 12 months, more than 60% of children have had at least one episode of acute otitis media. Approximately 28%–55% of such ear infections are caused by *S. pneumoniae*. In the United States, there were 5 million cases of otitis media each year in children younger than age five years prior to the use of the pneumococcal conjugate vaccine. Middle ear infections are the most frequent reason for pediatric office visits in the United States, resulting in more than 20 million visits annually. Complications of pneumococcal otitis media may include infection of the mastoid bone of the skull and meningitis.

How serious is pneumococcal disease?

Pneumococcal disease is a serious disease that causes much sickness and death. An estimated 31,600 cases and 3,300 deaths from invasive pneumococcal diseases (bacteremia and

meningitis) are estimated to have occurred in the United States in 2012. Many of these cases occurred in adults for whom pneumococcal polysaccharide vaccine was recommended. Young children and the elderly (individuals younger than age five years as well as those older than age 65 years) have the highest incidence of serious disease.

Case-fatality rates are highest for meningitis and bacteremia, and the highest mortality occurs among the elderly and patients who have underlying medical conditions. Despite appropriate antimicrobial therapy and intensive medical care, the overall case-fatality rate for pneumococcal bacteremia is about 15% among adults. Among elderly patients, this rate may be as high as 60%.

Before the routine use of a vaccine for children in the United States, pneumococcal disease was a significant problem in children younger than age five years. Each year it was responsible for causing 700 cases of meningitis, 13,000 blood infections, five million ear infections, and 200 deaths.

Is there a treatment for pneumococcal disease?

Penicillin is the drug of choice for treatment of pneumococcal disease; however, resistance to penicillin and other antibiotics has been on the rise. In 2011, an estimated 31% of pneumococcal bacteria were resistant to one or more antibiotics. How common drug resistance is depends on what part of the country you live in. Treating patients infected with resistant organisms requires expensive alternative antimicrobial agents and may result in prolonged hospital stays. The increased difficulty of treating this serious bacterial infection makes prevention through vaccination even more important.

How long is a person with pneumococcal disease contagious?

The exact period of communicability is not known. It appears that transmission can occur as long as the organism remains in respiratory secretions.

Can you get pneumococcal disease more than once?

Yes. There are more than 90 known subtypes of pneumococcus bacteria, with 23 subtypes included in the current pneumococcal polysaccharide (adult) vaccine and 13 subtypes included in the current conjugate (child) vaccine. Having been infected with one type does not always make the patient immune to other types. Even if an individual has had one or more episodes of invasive pneumococcal disease, he or she needs to be vaccinated.

When did pneumococcal vaccine become available?

There are two types of pneumococcal vaccine — pneumococcal polysaccharide vaccine and pneumococcal conjugate vaccine.

The first pneumococcal polysaccharide vaccine, containing 14 serotypes, was licensed in the United States in 1977. In 1983, an improved pneumococcal polysaccharide vaccine (Pneumovax, Merck) was licensed, containing purified polysaccharide from 23 types of pneumococcal bacteria. This pneumococcal polysaccharide vaccine is commonly known as PPSV23. The PPSV23 vaccine is licensed for routine use in adults 65 years and older and people with certain risk factors who are age 2 through 64 years.

The first pneumococcal conjugate vaccine, PCV7 (Prevnar 7, Pfizer), was licensed in 2000. In 2010, an improved pneumococcal conjugate vaccine (PCV13; Prevnar 13, Pfizer) was licensed and replaced PCV7 for use in the routine vaccination of children. PCV13 offers additional protection against the types of pneumococcal bacteria that cause the majority of invasive pneumococcal disease in the United States. PCV13 is recommended for use in preventing pneumococcal disease in all infants and young children, beginning as young as 6 weeks. In 2014, ACIP decided PCV13 is also recommended for all adults age 65 years or older, as well as in certain adults ages 19 through 64 years at increased risk of invasive pneumococcal disease.

Following the introduction of PCV7 for children in 2000, the incidence of pneumococcal disease decreased significantly. At the time of its introduction, about 80% of disease was caused by the 7 serotypes contained in the vaccine. After the vaccine was introduced, there was a rapid reduction in disease caused by those serotypes and a rise of serotypes not covered in the vaccine. There also has been a substantial decline in the rate of invasive pneumococcal disease caused by the seven serotypes in unvaccinated adults, probably due to a reduction in transmission from vaccinated children to their family members and other close contacts.

What kind of vaccines are they?

Both pneumococcal vaccines are made from inactivated (killed) bacteria. The pneumococcal polysaccharide vaccine (PPSV23) contains long chains of polysaccharide (sugar) molecules that make up the surface capsule of the bacteria. Generally speaking, pure polysaccharide vaccines do not work well in children younger than 2 years, induce only short-term immunity, and multiple doses do not provide a “boost” to immunity.

The pneumococcal conjugate vaccine includes purified capsular polysaccharides from the bacteria that are “conjugated” (or joined) to a protein (a harmless variety of diphtheria toxin). The resultant conjugate vaccine is able to produce an immune response in infants and antibody booster response to multiple doses of vaccine.

How is this vaccine given?

The polysaccharide vaccine (PPSV23) can be given as a shot in either the muscle or the fatty tissue of the arm or leg. The conjugate vaccine (PCV13) is given as a shot in the muscle.

Who should get the pneumococcal polysaccharide vaccine (PPSV23)?

- All adults age 65 years or older
- Anyone age two years or older who has a long-term health problem such as cardiovascular disease, sickle cell anemia, alcoholism, lung disease, diabetes, cirrhosis, or leaks of cerebrospinal fluid
- Anyone who has or is getting a cochlear implant (a surgically implanted device that provides a sense of sound to a person who is profoundly deaf or severely hard of hearing)
- Anyone age two years or older who has a disease or condition that lowers the body’s resistance to infection, such as Hodgkin’s disease, kidney failure, nephrotic syndrome, lymphoma, leukemia, multiple myeloma, HIV infection or AIDS, damaged spleen or no spleen, or organ transplant
- Anyone age two years or older who is taking any drug or treatment that lowers the body’s resistance to infection, such as long-term steroids, certain cancer drugs, or radiation therapy
- Adults ages 19 through 64 years who have asthma
- Adults ages 19 through 64 years who smoke cigarettes
- In special situations, public health authorities may recommend the use of PPSV23 after PCV13 for Alaska Native or American Indian children ages 24 through 59 months who are living in areas in which risk of invasive pneumococcal disease is increased.
- In special situations, public health authorities may recommend PPSV23 for Alaska Natives and American Indians ages 50 through 64 years who are living in areas in which the risk of invasive pneumococcal disease is increased.

Who should get the pneumococcal conjugate vaccine (PCV13)?

All infants beginning at two months of age should receive a four-dose series of vaccine; catch-up vaccination is recommended for children younger than age 5 years who did not receive vaccine on schedule. In addition, all healthy children younger than 5 years who have completed an age-appropriate schedule of vaccination with the earlier PCV7 vaccine are recommended to receive

one additional dose of PCV13 as are children with specific medical conditions who haven't yet reached their 6th birthday.

One dose of PCV13 vaccine should be administered to adults age 65 years or older. One dose of PCV13 should also be given to persons ages 19 through 64 years who have not previously received PCV13 and who are at the highest risk of serious pneumococcal disease. This includes adults with functional or anatomic asplenia, those with chronic renal failure or nephrotic syndrome, a cerebrospinal fluid leak, cochlear implant, and those who are immunocompromised (including HIV infection), on immunosuppressive therapy, or have received an organ or bone marrow transplant.

What is the schedule for the routine doses of PCV13 for children?

All infants and toddlers should get four doses of PCV13 vaccine, usually given at ages two, four, six, and 12 through 15 months.

Can older children be given PCV13?

Yes. Children ages 6 through 18 years who are at increased risk for pneumococcal disease because of sickle cell disease, HIV infection, or other immunocompromising condition; have a cochlear implant; or have a cerebrospinal fluid leak should be vaccinated. These children may get a single dose of PCV13 regardless of their history with PCV7 or PPSV23.

What if my three-year-old child never got his PCV13 shots?

The number of doses a child needs to complete the series depends on his or her current age. Older children need fewer doses. For example, a healthy unvaccinated child age 24 through 59 months needs a single dose of PCV13. Your healthcare provider can tell you how many doses are needed to complete the series at a certain age. PCV13 is not routinely recommended for individuals who are age five years or older but is recommended for certain older children and adults who have a medical condition that increases their risk of pneumococcal disease.

You can find more information about pneumococcal vaccination schedules for children at <http://www.immunize.org/catg.d/p2016.pdf>.

Do some children need to get both PCV13 and PPSV23?

Yes, children at high risk of invasive pneumococcal disease should receive PCV13 and then also receive PPSV23 when age two years or older. PPSV23 is not given routinely to healthy children.

If influenza vaccine is recommended for healthcare personnel to protect high-risk patients from getting influenza, why isn't pneumococcal vaccine also recommended?

Influenza virus is easily spread from healthcare personnel to their patients, and infection usually leads to clinical illness. Pneumococcus is probably not spread from healthcare personnel to their patients as easily as is influenza, and transmission of pneumococcus does not necessarily lead to clinical illness. Host factors (such as age and underlying illness) are more important in the development of invasive pneumococcal disease than just having the bacteria in one's nose or throat.

My elderly neighbor got a second pneumococcal shot. I thought just one was required.

All adults should receive a dose of PCV13 and PPSV23 at age 65 years. The PCV13 should be given first followed by the PPSV23 6–12 months later. Adults should receive only one dose of PCV13. Most people who receive PPSV23 need only one dose. However an additional dose of PPSV23 (at least 5 years after the first dose) is recommended for people at highest risk of serious infection. For example, people who received a first dose of PPSV23 when they were younger than age 65 years should receive a second dose at age 65 years if at least five years have elapsed since the previous dose.

Likewise, people age two years through 64 years who are at high risk for pneumococcal disease due to certain long-term health problems, in particular immunosuppression, HIV infection, and not having a functional spleen (or having no spleen) should get a second dose five years after the first dose, and then a third and final dose once they are age 65 years. A maximum of three lifetime doses of PPSV23 are currently recommended.

If I have already received at dose of PPSV23 at age 65 years should I still receive PCV13?

Yes. People who have previously received PPSV23 but have not received PCV13 should receive one dose of PCV13 at least 12 months after the most recent PPSV23 dose. Likewise, people age two years through 64 years who are at high risk for pneumococcal disease due to certain long-term health problems, in particular immunosuppression, HIV infection, and not having a functional spleen (or having no spleen) should get a second dose of PPSV23 five years after the first dose, and then a third and final dose once they are age 65 years. A maximum of three lifetime doses of PPSV23 are currently recommended.

Who recommends pneumococcal vaccines?

The Centers for Disease Control and Prevention, the American Academy of Pediatrics, and the American Academy of Family Physicians recommend routine vaccination with PCV13 vaccine. The Centers for Disease Control and Prevention, the American Academy of Pediatrics, the American College of Obstetricians and Gynecologists, the American Academy of Family Physicians, and the American College of Physicians all recommend the PPSV23 vaccine.

Can pregnant women get this vaccine?

Pregnancy is not a contraindication to either PCV13 or PPSV23.

How safe are the pneumococcal vaccines?

PPSV23 and PCV13 are both very safe vaccines. For PPSV23, about 30%–50% of the people who get the vaccine have very mild side effects, such as redness or pain where the shot was given. Fewer than 1% of recipients develop a fever, muscle aches, or more severe local reactions. Serious allergic reactions have been reported very rarely. For PCV13 about 1 out of 3 children have swelling where the shot was given, about 1 of 3 have a mild fever, about 1 in 20 have a higher fever (over 102°F), and about 8 out of 10 become fussy or irritable. About half of the children were drowsy after the shot or had a temporary loss of appetite. No serious reactions have been associated with either PPSV23 or PCV13.

How effective is pneumococcal polysaccharide vaccine (PPSV23)?

Overall, PPSV23 is 50%–80% effective in preventing invasive disease. Older adults (that is older than age 65 years) and people with significant underlying illnesses do not respond as well, but vaccination with PPSV23 is still recommended because they are at high risk of developing severe pneumococcal disease.

Who should NOT receive pneumococcal vaccine?

For both PPSV23 and PCV13, people who had a severe allergic reaction to one dose should not receive another (such reactions are rare). People who have a moderate or severe acute illness should wait until their condition improves to be vaccinated.

Can the vaccine cause pneumococcal disease?

No. Both PPSV23 and PCV13 are inactivated vaccines containing only a portion of the bacteria. The vaccines cannot cause pneumococcal disease.

Immunization Action Coalition

Technically reviewed by the Centers for Disease Control and Prevention, October 2014

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Poliomyelitis is a highly contagious disease caused by three serotypes of poliovirus that can cause paralysis: types 1, 2, and 3. Type 1 is isolated from paralytic cases most often, type 3 less so, and circulation of wild poliovirus type 2 has been interrupted since 1999. Type 1 most frequently causes epidemics. Most vaccine-associated cases are due to type 2 or 3.

B. Description of Illness

- **General facts:** Poliomyelitis is a vaccine-preventable disease nearing worldwide eradication. The last case of indigenously acquired poliomyelitis occurred in the United States in 1979 and in the Western Hemisphere in 1991.
- **Occurrence:** In the United States, all cases since 1979 have been vaccine-associated paralytic poliomyelitis (VAPP), which is attributable to the oral poliovirus (OPV) vaccine. An average of 8 VAPP cases occurred in the United States between 1980 and 1996. In 2000, the United States instituted an all-inactivated poliovirus (IPV) vaccine schedule, ending the occurrence of VAPP in this country.
- **Incubation period:** Commonly 6 – 20 days (range of 3 to possibly 35 days).
- **Common symptoms:** Approximately 95% of poliovirus infections are asymptomatic; 4% – 8% of infected individuals have symptoms of a minor, non-specific nature, such as sore throat and fever, nausea, vomiting, malaise and headache. About 1% – 2% of infected individuals develop non-paralytic aseptic meningitis, with temporary stiffness of the neck, back, and/or legs. Less than 2% of all polio infections result in the classic “flaccid paralysis,” where the patient is left with permanent weakness or paralysis of the legs, arms, or both. Adults who contracted paralytic poliomyelitis during childhood may develop postpolio syndrome 30 – 40 years later. Postpolio syndrome is characterized by slow onset of muscle pain and exacerbation of weakness.
- **Treatment:** There is no treatment for polio. Persons infected with polio need supportive therapy, such as bed rest and fluids. Standard precautions should be taken to avoid passing on the virus through any contamination from the patient's stool.

C. Reservoirs

Humans are the only source of infection.

D. Modes of Transmission

Poliovirus is spread person to person, primarily through the fecal-oral route. However, it may also spread through oral and nasal secretions. In rare instances, milk, foodstuffs, and other materials contaminated with feces have been incriminated as vehicles.

E. Period of Communicability

Communicability of poliovirus is greatest shortly before and after onset of clinical illness when the virus is present in the throat and excreted in high concentration in feces. The virus persists in the throat for approximately 1 week after the onset of illness and is excreted in feces for several weeks. Patients are potentially contagious for as long as fecal excretion persists.

2) ACTIONS REQUIRED/CONTROL MEASURES

A. Reporting Requirements

Poliomyelitis is physician reportable by telephone immediately on the day of recognition or strong suspicion to both the Connecticut Department of Public Health (DPH) and the local health department (LHD). A mailed report is also required within 12 hours. The director of any clinical laboratory must also report laboratory evidence of poliomyelitis to both the DPH and the LHD. See current lists of physician Reportable Diseases (Attachment A) and Laboratory Reportable Significant Findings (Attachment C).

B. Case Definition

Poliomyelitis, Paralytic:

Case Classification

- **Probable**
 - Acute onset of a flaccid paralysis of one or more limbs with decreased or absent tendon reflexes in the affected limbs, without other apparent cause, and without sensory or cognitive loss.
- **Confirmed**
 - Acute onset of a flaccid paralysis of one or more limbs with decreased or absent tendon reflexes in the affected limbs, without other apparent cause, and without sensory or cognitive loss; AND in which the patient has:
 - A neurologic deficit 60 days after onset of initial symptoms; OR
 - Died; OR
 - Unknown follow-up status.
- **Comments:** All suspected cases of paralytic poliomyelitis are reviewed by a panel of expert consultants before final classification occurs. Confirmed cases are then further classified based on epidemiologic and laboratory criteria.

Poliovirus infection, nonparalytic:

- **Confirmed**

Any person without symptoms of paralytic poliomyelitis in whom a poliovirus isolate was identified in an appropriate clinical specimen, with confirmatory typing and sequencing performed by the CDC Poliovirus Laboratory, as needed.

C. Case Investigation

- **DPH Responsibility:** The DPH Immunization Program ensures that the appropriate diagnostic work has been completed and works in collaboration with LHD to ensure that contacts of each case-patient have been identified, and appropriate recommendations (e.g., vaccination, exclusion) have been made.
- **LHD Responsibility:** The LHD is involved with case investigations and control measures under DPH guidance as necessary.

D. Control Measures

The DPH Immunization program (860-509-7929) should be contacted for guidance on control measures and further action, if necessary.

Fact Sheet

What causes polio?

Polio is caused by a virus.

How does polio spread?

Polio is usually spread via the fecal-oral route (i.e., the virus is transmitted from the stool of an infected person to the mouth of another person from contaminated hands or such objects as eating utensils). Some cases may be spread directly via an oral to oral route.

How long does it take to show signs of polio after being exposed?

The incubation period for polio is commonly 6–20 days, with a range of 3–35 days.

What are the symptoms of polio?

Surprisingly, 95% of all individuals infected with polio have no apparent symptoms. Another 4%–8% of infected individuals have symptoms of a minor, non-specific nature, such as sore throat and fever, nausea, vomiting, and other common symptoms of any viral illness. About 1%–2% of infected individuals develop non-paralytic aseptic (viral) meningitis, with temporary stiffness of the neck, back, and/or legs. Less than 1% of all polio infections result in the classic “flaccid paralysis,” where the patient is left with permanent weakness or paralysis of legs, arms, or both.

How serious is polio?

Although most cases of polio are mild, the 1% of cases resulting in flaccid paralysis has made polio a feared disease for hundreds of years. Of people with paralytic polio, about 2%–5% of children die and up to 15%–30% of adults die.

Are there any long-term concerns for persons who contracted paralytic polio in childhood?

About 25%–40% of people who suffered from paralytic polio as children develop new symptoms in adulthood (usually after an interval of 30–40 years). This problem is called post-polio syndrome (PPS) and symptoms can include new muscle pain, weakness, or paralysis. PPS is not infectious. For more information or for support for people with post-polio syndrome, go to <http://www.post-polio.org>.

How is polio diagnosed?

If a person is suspected of being infected, a sample from their stool or throat should be tested for the poliomyelitis virus.

How long is a person with polio contagious?

Patients infected with the polio virus can pass the virus on for 7–10 days before the onset of disease. In addition, they can continue to shed the virus in their stool for 3–6 weeks.

Is there a treatment for polio?

There is no “cure” for polio. People infected with polio need supportive therapy, such as bed rest and fluids. Standard precautions should be taken to avoid passing on the virus through any contamination from the patient’s stool.

How common is polio in the U.S.?

Before a polio vaccine was developed, polio epidemics were common in the United States. For example, in the immediate pre-vaccine era (i.e., early 1950s), between 13,000 and 20,000 paralytic cases were reported each year. After the development of the inactivated (Salk) injectable vaccine in 1955 and the live (Sabin) oral vaccine in 1961, the number of polio cases

dropped dramatically. In 1960, there were 2,525 paralytic cases reported, but by 1965 this number had fallen to 61.

Due to a concentrated effort to eradicate polio from the world, there have been no cases of “wild” (i.e., natural) polio acquired in the United States since 1979, and no cases of wild polio acquired in the entire Western Hemisphere since 1991.

How common is polio in the world?

In 1988, the World Health Organization (WHO) adopted the goal of global polio eradication. Although the initial target date of 2000 was not met, substantial progress has been made. In 1988, there were estimated to be 350,000 reported cases of polio in the world; in 2001, just 483 cases were reported. Unfortunately, rumors about the safety of polio vaccine in 2003, and subsequent refusal of vaccine by many parents in Nigeria, led to an increase in cases and spread of the virus to nearby countries that had previously been polio free. In 2003, there were 784 reported cases; in 2004, there were 1,255 reported cases.

Wild polio currently exists only in a few countries in Asia and Africa. In 2014, only 359 cases of polio were reported from nine countries, according to the Global Polio Eradication Initiative. About 95% of all cases were reported from Pakistan, Afghanistan, or Nigeria. Many organizations have been working hard toward eradicating polio including the World Health Organization, the United Nations Children’s Fund (UNICEF), the Centers for Disease Control and Prevention (CDC), Rotary International, the Bill and Melinda Gates Foundation, and many other international and national groups. Strategies include house-to-house vaccination and National Immunization Days, where even warring factions have called temporary cease fires to allow children to be vaccinated.

When did the polio vaccine first become available?

The first polio vaccine was an inactivated, or killed, vaccine (IPV) developed by Dr. Jonas Salk and licensed in 1955.

What are the polio vaccines that have followed the first Salk vaccine?

In 1961, a live attenuated (e.g., weakened) vaccine was developed by Dr. Albert Sabin. This vaccine was given as an oral preparation instead of as a shot. By 1963, this oral vaccine had been improved to include protection against three strains of polio and was licensed as “trivalent oral poliovirus vaccine” (OPV). OPV was the vaccine of choice for the United States and most other countries of the world from 1963 until changes in U.S. policy in the 1990s.

In 1988, an enhanced-potency IPV formulation became available and by 1997 had become part of the routine schedule for infants and children, given in a sequential combination with OPV. In 2000, an all-IPV vaccine schedule was adopted in the United States. IPV is also available in combination with other vaccines (e.g., DTaP-HepB-IPV, DTaP-IPV/Hib, or DTaP-IPV).

How is the vaccine administered?

IPV is given as a shot in the arm or leg. OPV is given as an oral liquid. OPV is no longer used in the United States, but is still given in other parts of the world where polio is common.

Why was the U.S. polio immunization recommendation changed from OPV to IPV?

The change to an all-IPV schedule in the United States occurred because the few cases of polio that were occurring (8–10 per year) were caused by the OPV vaccine itself and not the wild virus. The change to IPV protects individuals against paralytic polio, while eliminating the small chance (about once in every 2.4 million doses) of actually contracting polio from the live oral vaccine. OPV is better at stopping the spread of the virus to others, but now that wild (natural) polio has been eliminated from the Western Hemisphere, this advantage is no longer a consideration in the United States. IPV has been used exclusively in the United States since 2000. However, in other countries where wild polio is still a threat, OPV is still used.

Who should get this vaccine?

All infants should get this vaccine unless they have a medical reason not to. A primary series of IPV consists of three properly spaced doses, usually given at two months, four months, and 6–18 months. A booster dose is given at 4–6 years (before or at school entry), unless the primary series was given so late that the third dose was given on or after the fourth birthday.

Does my child need additional doses of polio vaccine if he received a combination of OPV and IPV?

No, four doses of any combination of IPV or OPV, properly spaced, is considered a complete poliovirus vaccination series.

Why should I vaccinate my child against polio if this disease has been eliminated from the Western Hemisphere since 1991?

Polio still exists in parts of Africa and Asia and can easily be imported. When the effort to eliminate polio from the world is successful, polio vaccine will become part of history. But we are not to that point yet.

Should adults get vaccinated against polio?

In the United States, routine vaccination of people 18 years of age and older against polio is not recommended because most adults are already immune and also have little risk of being exposed to wild polio virus. Vaccination is recommended, however, for certain adults who are at increased risk of infection, including travelers to areas where polio is common, laboratory workers who handle specimens that might contain polioviruses, and healthcare workers in close contact with patients who might be excreting wild polioviruses in their stool (e.g., those caring for recent immigrants from central Africa or parts of Asia).

If an adult is at increased risk of exposure and has never been vaccinated against polio, he or she should receive three doses of IPV, the first two doses given 1–2 months apart, and the third 6–12 months after the second. If time will not allow the completion of this schedule, a more accelerated schedule is possible (e.g., each dose separated four weeks from the previous dose).

If an adult at risk previously received only one or two doses of polio vaccine (either OPV or IPV), he or she should receive the remaining dose(s) of IPV, regardless of the interval since the last dose.

If an adult at increased risk previously completed a primary course of polio vaccine (three or more doses of either OPV or IPV), he or she may be given another dose of IPV to ensure protection. Only one “booster” dose of polio vaccine in a person’s lifetime is recommended. It is not necessary to receive a booster dose each time a person travels to an area where polio may still occur.

Who recommends this vaccine?

The Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics (AAP), and the American Academy of Family Physicians (AAFP) have all recommended that children receive this vaccine.

How safe is this vaccine?

The IPV vaccine is very safe; no serious adverse reactions to IPV have been documented.

What side effects have been reported with this vaccine?

Possible side effects include minor local reactions at the site of injection (e.g., pain, redness).

How effective is this vaccine?

IPV is very effective in preventing polio, but only when all recommended doses are completed. A single dose of IPV produces little or no immunity, but 99% of recipients are immune after three doses.

Who should not receive the polio vaccine?

- Anyone who has ever had a life-threatening allergic reaction to neomycin, streptomycin, or polymyxin B should not get the IPV shot because it contains trace amounts of these antibiotics.
- Anyone who has had a severe allergic reaction to a dose of polio vaccine should not get another one.
- Anyone who is moderately or severely ill at the time the shot is scheduled should usually wait until they recover to get vaccination.

Can the IPV vaccine cause polio?

No, the inactivated polio vaccine (IPV) cannot cause paralytic polio because it contains killed virus only.

Immunization Action Coalition

Technically reviewed by the Centers for Disease Control and Prevention, April 2015.

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Tetanus is an acute, often fatal, disease caused by an exotoxin produced by *Clostridium tetani*. *C. tetani* is an anaerobic, spore forming bacterium. The spores enter the body through breaks in the skin and germinate under low oxygen conditions; the exotoxin is produced as the bacteria multiply.

B. Description of Illness

- **General facts:** Tetanus is characterized by generalized rigidity and convulsive spasms of skeletal muscles. The muscle stiffness usually involves the jaw (lockjaw) and neck and then becomes generalized. *C. tetani* spores are widely distributed in soil and in the intestine and feces of horses, sheep, cattle, dogs, cats, rats, guinea pigs, and chickens. Manure-treated soil may contain large numbers of spores. In agricultural areas, a significant number of human adults may harbor the organism. The spores can also be found on skin surfaces and in contaminated heroin. Laboratory confirmation for tetanus is of little help as the organisms are rarely recovered from the site of infection, and usually there is no detectable antibody response.
- **Occurrence:** Tetanus occurs worldwide and is more frequently seen in warmer climates and months, partly because of the frequency of contaminated wounds. In the United States, the reported morbidity and mortality due to tetanus have declined dramatically since the mid-to late 1940s, when tetanus toxoid became available. Tetanus is sporadic and relatively uncommon in the United States and most industrial countries, mostly because of widespread use of tetanus toxoid as part of routine immunizations and improved wound management. During the period 1996 – 2000, a total of 202 cases were reported in the United States: 72 (36%) were aged ≥ 60 years, 116 (57%) were aged 20- 59 years, and 14 (7%) were aged < 20 years, including 2 cases of neonatal tetanus.
- **Incubation period:** The incubation period ranges from 3 – 21 days (average 8 days). In neonates the incubation period is usually 5 – 14 days. Shorter incubation periods are associated with more heavily contaminated wounds, more severe disease, and a worse prognosis.
- **Common symptoms:** The most common type (about 80%) of reported tetanus is generalized tetanus. The disease usually presents with a descending pattern. The first sign is trismus or lockjaw, followed by stiffness of the neck, difficulty in swallowing, and rigidity of abdominal muscles. Other symptoms include elevated temperature, sweating, elevated blood pressure, and episodic rapid heart rate. Spasms may occur frequently and last for several minutes. Spasms continue for 3 – 4 weeks. Complete recovery may take months.
- **Treatment:** Human tetanus immune globulin (TIG) is recommended for treatment in a single dose of 3000 to 6000 U for children and adults. The optimum therapeutic dose has not been established, and doses as small as 500 U have been effective and cause less discomfort to the patient. TIG can only help remove unbound tetanus toxin. It cannot affect toxin bound to nerve endings.

C. Reservoirs

C. tetani are found in the intestines of horses and other animals, including humans, in which the organism is a harmless normal inhabitant. Soil or fomites contaminated with

animal and human feces can act as a reservoir. Tetanus spores are a normal inhabitant of the environment and can contaminate wounds of all types.

D. Modes of Transmission

Transmission is primarily by contaminated wounds. The wound may be major or minor. In recent years, however, a higher proportion of cases had minor wounds, probably because severe wounds are more likely to be properly managed. Tetanus may follow elective surgery, burns, deep puncture wounds, crush wounds, otitis media (ear infections), dental infection, animal bites, abortion, and pregnancy.

E. Period of Communicability

Tetanus is not contagious from person to person. It is the only vaccine-preventable disease that is infectious but not contagious.

2) ACTIONS REQUIRED/CONTROL MEASURES

A. Reporting Requirements

Tetanus is physician reportable by mail within 12 hours of recognition or strong suspicion to both the Connecticut Department of Public Health (DPH) and the local health department (LHD). See current list of physician Reportable Diseases (Attachment A).

B. Case Classification

- **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
- **Comments:** There is no definition for "confirmed" tetanus.

C. Case Investigation

- **DPH Responsibility:** The DPH Immunization Program is responsible for obtaining additional case data for tetanus, which is reportable to the Centers for Disease Control and Prevention (CDC). The additional information is usually obtained by either calling the reporting source or mailing a more detailed report form.
- **LHD Responsibility:** The assistance of the LHD is usually not required, unless there is an urgent need to simultaneously initiate control measures. The Immunization Program will contact the LHD if there is a need for the LHD to become involved.

D. Control Measures

The DPH Immunization program (860-509-7929) should be contacted for guidance on control measures and further action, if necessary.

Fact Sheet

What causes tetanus?

Tetanus is caused by a toxin (poison) produced by the bacterium *Clostridium tetani*. The *C. tetani* bacteria cannot grow in the presence of oxygen. They produce spores that are very difficult to kill as they are resistant to heat and many chemical agents.

How does tetanus spread?

C. tetani spores can be found in the soil and in the intestines and feces of many household and farm animals and humans. The bacteria usually enter the human body through a puncture (in the presence of anaerobic [low oxygen] conditions, the spores will germinate).

Tetanus is not spread from person to person.

How long does it take to show signs of tetanus after being exposed?

The incubation period varies from 3–21 days, with an average of eight days. The further the injury site is from the central nervous system, the longer the incubation period. The shorter the incubation period, the higher the risk of death.

What are the symptoms of tetanus?

The symptoms of tetanus are caused by the tetanus toxin acting on the central nervous system. In the most common form of tetanus, the first sign is spasm of the jaw muscles, followed by stiffness of the neck, difficulty in swallowing, and stiffness of the abdominal muscles.

Other signs include fever, sweating, elevated blood pressure, and rapid heart rate. Spasms often occur, which may last for several minutes and continue for 3–4 weeks. Complete recovery, if it occurs, may take months.

How serious is tetanus?

Tetanus has a high fatality rate. In recent years, tetanus has been fatal in about 10% of reported cases.

What are possible complications from tetanus?

Laryngospasm (spasm of the vocal cords) is a complication that can lead to interference with breathing. Patients can also break their spine or long bones from convulsions. Other possible complications include hypertension, abnormal heart rhythm, and secondary infections, which are common because of prolonged hospital stays.

Obviously, the high probability of death is a major complication.

How is tetanus diagnosed?

The diagnosis of tetanus is based on the clinical signs and symptoms only. Laboratory diagnosis is not useful as the *C. tetani* bacteria usually cannot be recovered from the wound of an individual who has tetanus, and conversely, can be isolated from the skin of an individual who does not have tetanus.

What kind of injuries might allow tetanus to enter the body?

Tetanus bacilli live in the soil, so the most dangerous kind of injury involves possible contamination with dirt, animal feces, and manure. Although we have traditionally worried about deep puncture wounds, in reality many types of injuries can allow tetanus bacilli to enter the body. In recent years, a higher proportion of cases had minor wounds than had major ones, probably because severe wounds were more likely to be properly managed. People can also get tetanus from splinters, self-piercing, and self-tattooing. Injecting drug users are also at risk for tetanus.

I stepped on a nail in our yard. What should I do?

Any wound that may involve contamination with tetanus bacilli should be attended to as soon as possible. Treatment depends on your vaccination status and the nature of the wound. In all cases, the wound should be cleaned. Seek treatment immediately and bring your immunization record with you.

With wounds that involve the possibility of tetanus contamination, a patient with an unknown or incomplete history of tetanus vaccination needs a tetanus-and diphtheria-containing shot (Td or Tdap) and a dose of tetanus immune globulin (TIG) as soon as possible.

A person with a documented series of three tetanus-and diphtheria-containing shots (Td or Tdap) who has received a booster dose within the last ten years should be protected. However, to ensure adequate protection, a booster dose of vaccine may still be given if it has been more than five years since the last dose and the wound is other than clean and minor.

Is there a treatment for tetanus?

There is no "cure" for tetanus once a person develops symptoms, just supportive treatment and management of complications. The best "treatment" is prevention through immunization.

How common is tetanus in the United States?

Tetanus first became a reportable disease in the late 1940s. At that time, there were 500–600 cases reported per year. After the introduction of the tetanus vaccine in the mid-1940s, reported cases of tetanus dropped steadily.

From 2000 through 2007 an average of 31 cases were reported per year.

Almost all cases of tetanus are in people who have never been vaccinated, or who completed their childhood series, but did not have a booster dose in the preceding 10 years.

What is neonatal tetanus?

Neonatal tetanus is a form of tetanus that occurs in newborn infants, most often through the use of an unsterile cutting instrument on the unhealed umbilical stump. These babies usually have no temporary immunity passed on from their mother because their mother usually hasn't been vaccinated and therefore has no immunity.

Neonatal tetanus is very rare in the United States (only two cases have been reported since 1989), but is common in some developing countries. It caused more than 257,000 deaths worldwide each year in the years 2000 to 2003.

Can you get tetanus more than once?

Yes! Tetanus disease does not result in immunity because so little of the potent toxin is required to cause the disease. People recovering from tetanus should begin or complete the vaccination series.

When did vaccine first become available for diphtheria, tetanus, and pertussis?

The first inactivated toxin, or toxoid, against diphtheria was developed around 1921, but it was not widely used until the 1930s. In 1924, the first tetanus toxoid (inactivated toxin) was produced and was used successfully to prevent tetanus in the armed services during World War II. The first pertussis vaccine was developed in the 1930s and was in widespread use by the mid-1940s, when pertussis vaccine was combined with diphtheria and tetanus toxoids to make the combination DTP vaccine. A series of 4 doses of whole-cell DTP vaccine was quite (70–90%) effective in preventing serious pertussis disease; however, up to half of the children who received the vaccine developed local reactions such as redness, swelling, and pain at the injection site. In 1991, concerns about safety led to the development of more purified (acellular) pertussis vaccines that are associated with fewer side effects. These acellular pertussis vaccines have replaced the whole cell DTP vaccines in the U.S.

In 2005, two new vaccine products were licensed for use in adolescents and adults that combine the tetanus and diphtheria toxoids with acellular pertussis (Tdap) vaccine. These vaccines are the first acellular pertussis-containing vaccines that make it possible to vaccinate adolescents and adults against pertussis.

How are vaccines made that prevent diphtheria, tetanus and pertussis?

These vaccines are made by chemically treating the diphtheria, tetanus, and pertussis toxins to render them nontoxic yet still capable of eliciting an immune response in the vaccinated person. They are known as “inactivated” vaccines because they do not contain live bacteria and cannot replicate themselves, which is why multiple doses are needed to produce immunity.

What’s the difference between all the vaccines containing diphtheria and tetanus toxoids and pertussis vaccine?

It’s like alphabet soup! Here is a listing of the various products:

- DTaP: Diphtheria and tetanus toxoids and acellular pertussis vaccine; given to infants and children ages 6 weeks through 6 years. In addition, three childhood combination vaccines include DTaP as a component.
- DT: Diphtheria and tetanus toxoids, without the pertussis component; given to infants and children ages 6 weeks through 6 years who have a contraindication to the pertussis component.
- Tdap: Tetanus and diphtheria toxoids with acellular pertussis vaccine; given to adolescents and adults, usually as a single dose; the exception is pregnant women who should receive Tdap during each pregnancy.
- Td: Tetanus and diphtheria toxoids; given to children and adults ages 7 years and older. Note the small “d” which indicates a much smaller quantity of diphtheria toxoid than in the pediatric DTaP formulation.

How are these vaccines given?

The DTaP and DT preparations are all given as an injection in the anterolateral thigh muscle (for infants and young toddlers) or in the deltoid muscle (for older children and adults). Tdap and Td are given in the deltoid muscle for children and adults age 7 years and older.

Who should get these vaccines?

All children, beginning at age 2 months, and adults need protection against these three diseases—diphtheria, tetanus, and pertussis (whooping cough). Routine booster doses are also needed throughout life.

How many doses of vaccine are needed?

The usual schedule for infants is a series of four doses of DTaP given at 2, 4, 6, and 15–18 months of age. A fifth shot, or booster dose, is recommended between age 4 and 6 years, unless the fourth dose was given late (after the fourth birthday).

For people who were never vaccinated or who may have started but not completed a series of shots, a 3-dose series of Td should be given with 1 to 2 months between dose #1 and #2, and 6 to 12 months between dose #2 and #3. One of the doses, preferably the first, should also contain the pertussis component in the form of Tdap.

Because immunity to diphtheria and tetanus wanes with time, boosters of Td are needed every ten years.

When adolescents and adults are scheduled for their routine tetanus and diphtheria booster, should they get vaccinated with Td or Tdap?

Immunization experts recommend that the first dose of Tdap be given to all adolescents at age 11–12 years as a booster during the routine adolescent immunization visit if the adolescent has finished the childhood DTaP schedule and has not already received a dose of Td or Tdap. If a child age 7–10 years did not complete a primary series in childhood, a dose of Tdap may be given earlier as part of the catch-up vaccinations.

All adults should receive a single dose of Tdap as soon as feasible. Then, subsequent booster doses of Td should be given every ten years. Pregnant teens and women should receive Tdap during each pregnancy. Adolescents and adults who have recently received Td vaccine can be given Tdap without any waiting period.

If someone experiences a deep or puncture wound, or a wound contaminated with dirt, an additional booster dose may be given if the last dose was more than five years ago. This could be a dose of Td or Tdap, depending on the person's vaccination history. It is important to keep an up-to-date record of all immunizations so that repeat doses don't become necessary. Although it is vital to be adequately protected, receiving more doses than recommended can lead to increased local reactions, such as painful swelling of the arm.

Who recommends the use of these vaccines?

The Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics (AAP), the American Academy of Family Physicians (AAFP), and the American College of Physicians (ACP) all recommend this vaccine.

What side effects have been reported with these vaccines?

Local reactions, such as fever, redness and swelling at the injection site, and soreness and tenderness where the shot was given, are not uncommon in children and adults. These minor local and systemic adverse reactions are much less common with acellular DTaP vaccine; however, a determination of more rare adverse effects can only be made when additional data are available following extended use of DTaP.

Side effects following Td or Tdap in older children and adults include redness and swelling at the injection site (following Td) and generalized body aches, and tiredness (following Tdap). Older children and adults who received more than the recommended doses of Td/Tdap vaccine can experience increased local reactions, such as painful swelling of the arm. This is due to the high levels of tetanus antibody in their blood.

How effective are these vaccines?

After a properly spaced primary series of DTaP or Td/ Tdap, approximately 95% of people will have protective levels of diphtheria antitoxin and 100% will have protective levels of tetanus antitoxin in their blood. However, antitoxin levels decrease with time so routine boosters with tetanus and diphtheria toxoids are recommended every 10 years. Estimates of acellular pertussis vaccine efficacy range from 80% to 85%—a level believed to be far more efficacious than the previously-used whole cell pertussis vaccine.

Can a pregnant woman receive Tdap vaccine?

Yes. All pregnant women should receive Tdap during each pregnancy, preferably between 27 and 36 weeks' gestation. Because infants are not adequately protected against pertussis until they have received at least 3 doses of DTaP, it is especially important that all contacts (family members, caregivers) of infants younger than age 12 months are vaccinated with Tdap. If a new mother hasn't been vaccinated with Tdap, she should receive it before hospital discharge, even if she is breastfeeding.

Who should not receive these vaccines?

Generally, any person who has had a serious allergic reaction to a vaccine component or a prior dose of the vaccine should not receive another dose of the same vaccine. People who had a serious allergic reaction to a previous dose of DTaP or Tdap vaccine should not receive another dose.

Certain rare adverse events following pertussis vaccination usually serve as a precaution against receiving further doses. Such events include a temperature of 105°F or higher within two days, collapse or shock-like state within two days, persistent crying for more than three hours within two days, or convulsions within three days. Even if one of these precautions exists, there may be occasions when the benefit of immunization outweighs the risk (for example, during a community-wide outbreak of pertussis). A person who developed one of these adverse events after pediatric DTaP vaccine may receive Tdap as an adolescent or adult.

A person with a recognized, possible, or potential neurologic condition should delay receiving DTaP or Tdap vaccine until the condition is evaluated, treated, and/or stabilized. Although DTaP vaccine does not cause neurological disorders, receiving the vaccine can cause an already-present underlying condition to show itself.

Can the vaccine cause the disease?

No.

Immunization Action Coalition

Technically reviewed by the Centers for Disease Control and Prevention, July 2013.

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Varicella (chickenpox) is an acute, infectious disease caused by the varicella zoster virus (VZV). The recurrent infection (herpes zoster, also known as shingles) has been recognized since ancient times.

B. Description of Illness

- **General facts:** Varicella (chickenpox) is a febrile rash illness resulting from primary infection with the varicella zoster virus (VZV). Humans are the only source of infection for this virus. Varicella is highly infectious with secondary infection rates in susceptible household contacts from 65% – 86%.
- **Occurrence:** Occurrence is worldwide. In temperate climates, like the United States, 90% of the population has had chickenpox by age 15 and 95% by young adulthood. Chickenpox is more common in children, whereas shingles is more common in adults.
- **Incubation period:** From 10 – 21 days; usually about 14 – 16 days.
- **Common symptoms:** The most common symptoms of chickenpox are rash, fever, cough, headache, and loss of appetite. Generally, the rash develops on the scalp and body, and then spreads to the face, arms, and legs. The rash usually forms 200 – 500 itchy blisters in several successive crops with several stages of maturity present at the same time. Symptoms last about 5 – 10 days. Varicella severity and complications are increased among immunocompromised persons, neonates, children less than 1 year of age, and adults. However, healthy children and adults may also develop serious complications and even die from varicella. Serious complications include secondary bacterial infections (most notably caused by group A streptococcus including cellulitis, necrotizing fasciitis, septicemia, and toxic shock syndrome), pneumonia, encephalitis, cerebellar ataxia, Reye's syndrome, and death. In vaccinated persons who develop varicella more than 42 days after vaccination (breakthrough disease), the disease is almost always mild with fewer than 50 skin lesions and a shorter duration of illness. The rash may also be atypical in appearance (maculopapular with a few or no vesicles).
- **Treatment:** Most cases of chickenpox in otherwise healthy children are treated with bed rest, fluids, and control of fever. Children with chickenpox should **not** receive aspirin because of possible subsequent risk of Reye's syndrome. Acetaminophen may be given for fever control. Chickenpox may be treated with an antiviral drug in serious cases, depending on the patient's age and health, the extent of the infection, and the timing of treatment.

C. Reservoirs

Humans are the only source of infection.

D. Modes of Transmission

Chickenpox is highly contagious and spreads from person to person by direct contact or through the air from an infected person's coughing or sneezing or from aerosolization of virus from skin lesions. The virus can also be spread indirectly through articles freshly soiled

by discharges from vesicles and mucous membranes of infected people. Scabs from varicella lesions are not infectious.

E. Period of Communicability.

As long as 5 days but usually 1 – 2 days before rash onset and continuing until lesions are crusted over (usually about 6 – 8 days). Susceptible individuals should be considered infectious 10 – 21 days following exposure.

2) ACTIONS REQUIRED/CONTROL MEASURES

A. Reporting Requirements

Chickenpox in adults ≥ 18 years and all hospitalized cases are physician reportable immediately by telephone to the Connecticut Department of Public Health (DPH) and the local health department (LHD). Chickenpox in children <18 years old is physician reportable by mail within 12 hours of recognition or strong suspicion to both the DPH and the LHD. The director of any clinical laboratory must also report laboratory evidence of acute chickenpox infection to both the DPH and LHD. See current list of Physician Reportable Diseases (Attachment A) and Laboratory Report of Significant Findings (Attachment C).

In addition to healthcare providers, school and daycare center administrators are requested to report demographics and vaccination status of all cases they hear about using the DPH "Varicella Case Report Form" (Attachment K). A copy of the completed form can be mailed or faxed back to the Immunization Program at 860-509-7945.

B. Clinical Description

An illness with acute onset of diffuse (generalized) maculo-papulovesicular rash without other apparent cause.

• Laboratory Criteria for Diagnosis

- Isolation of varicella virus from a clinical specimen, **OR**
- Varicella antigen detected by direct fluorescent antibody test, **OR**
- Varicella-specific nucleic acid detected by polymerase chain reaction (PCR), **OR**
- Significant rise in serum anti-varicella immunoglobulin G (IgG) antibody level by any standard serologic assay.

Case Classification

• Probable

- An acute illness with
 - Diffuse (generalized) maculo-papulovesicular rash, **AND**
 - Lack of laboratory confirmation, **AND**
 - Lack of epidemiologic linkage to another probable or confirmed case.

• Confirmed

- An acute illness with diffuse (generalized) maculo-papulovesicular rash, **AND**
 - Epidemiologic linkage to another probable or confirmed case, **OR**
 - Laboratory confirmation according to above criteria for diagnosis.

• Comments

Two probable cases that are epidemiologically linked would be considered confirmed, even in the absence of laboratory confirmation.

In vaccinated persons who develop varicella more than 42 days after vaccination

(breakthrough disease), the disease is almost always mild with fewer than 50 skin lesions and shorter duration of illness. The rash may also be atypical in appearance (maculopapular with few or no vesicles).

Laboratory confirmation of cases of varicella is not routinely recommended; laboratory confirmation is recommended for fatal cases and in other special circumstances.

C. Case Investigation

- **DPH Responsibility:** The DPH Immunization Program ensures that the appropriate diagnostic work has been completed and works in collaboration with LHD to ensure that contacts of each case-patient have been identified, and appropriate recommendations (e.g., vaccination, exclusion) have been made.
- **LHD Responsibility:** The LHD is involved with case investigation and control measures under DPH guidance as necessary.

D. Control Measures

The DPH Immunization Program (860-509-7929) should be contacted for guidance on control measures and further action, if necessary.

Fact Sheet

What causes chickenpox?

Chickenpox is caused by a virus, the varicella-zoster virus.

How does chickenpox spread?

Chickenpox spreads from person to person by direct contact or through the air by coughing or sneezing. It is highly contagious. It can also be spread through direct contact with the fluid from a blister of a person infected with chickenpox, or from direct contact with a sore from a person with shingles.

How long does it take to show signs of chickenpox after being exposed?

It takes from 10 to 21 days to develop symptoms after being exposed to a person infected with chickenpox. The usual time period is 14–16 days.

What are the symptoms of chickenpox?

The most common symptoms of chickenpox are rash, fever, coughing, fussiness, headache, and loss of appetite. The rash usually develops on the scalp and body, and then spreads to the face, arms, and legs. The rash usually forms 200–500 itchy blisters in several successive crops. The illness lasts about 5–10 days.

How serious is chickenpox?

Many cases of chickenpox are mild, but deaths from this disease can occur. Before vaccine became available, about 100 people died every year in the United States from chickenpox. Most of these people were previously healthy. Chickenpox also accounted for about 11,000 hospitalizations each year. Even children with average cases of chickenpox are uncomfortable and need to be kept out of daycare or school for a week or more.

What are possible complications from chickenpox?

The most common complication is bacterial infection of the skin or other parts of the body including the bones, lungs, joints, and blood. The virus can also lead to pneumonia or infection of the brain. These complications are rare but serious. Complications are more common in infants, adults, and people with weakened immune systems.

How do I know if my child has chickenpox?

Usually chickenpox can be diagnosed by disease history and appearance alone. Adults who need to know if they've had chickenpox in the past can have this determined by a laboratory test. Chickenpox is much less common now than it was before a vaccine became available, so parents, doctors, and nurses are less familiar with it. It may be necessary to perform laboratory testing for children to confirm chickenpox.

How long is a person with chickenpox contagious?

Patients with chickenpox are contagious for 1–2 days before the rash appears and continue to be contagious through the first 4–5 days or until all the blisters are crusted over.

Is there a treatment for chickenpox?

Most cases of chickenpox in otherwise healthy children are treated with bed rest, fluids, and control of fever. Children with chickenpox should NOT receive aspirin because of possible subsequent risk of Reye's syndrome. Acetaminophen may be given for fever control.

Chickenpox may be treated with an antiviral drug in serious cases, depending on the patient's age and health, the extent of the infection, and the timing of the treatment.

How common is chickenpox in the U.S.?

Because it is so easy to catch chickenpox, almost every adult in the United States has been infected. Until a vaccine became available, there were an estimated four million cases/year. Since the vaccine was licensed in 1995, the number of cases of chickenpox had fallen more than 90%.

Can you get chickenpox more than once?

Most people are immune to chickenpox after having the disease. However, although it is not common, second cases of chickenpox can occur, particularly in immunocompromised people.

If I think my child has been exposed to chickenpox, what should I do?

If the child has had chickenpox or has been vaccinated, nothing needs to be done. It is recommended that a susceptible person (one who has never had chickenpox) receive the chickenpox vaccine as soon as possible after being exposed to the virus. There is evidence that the vaccine may prevent illness or reduce the seriousness of the disease, if given within 3 to 5 days following exposure. Even if the person was not infected with the chickenpox virus from the exposure, receiving the vaccination will prevent future disease.

How are chickenpox and shingles related?

Both chickenpox and shingles are caused by the same virus. After a person has had chickenpox, the virus remains in the body permanently, but silently. About one-third of all people who have been infected with chickenpox later develop the disease known as herpes zoster, or shingles. Symptoms of shingles are pain, itching, blisters, and loss of feeling along a nerve. Most cases occur in people older than 50, and the risk of developing shingles increases with age. In May 2006, the FDA approved a zoster vaccine to prevent shingles. Currently, the zoster vaccine is recommended by CDC's Advisory Committee on Immunization Practices for people age 60 years and older. (See the shingles section for more information about shingles disease and zoster vaccine.)

When did the chickenpox vaccine become available?

The chickenpox (varicella) vaccine was licensed in the United States in 1995. Since that time, the number of hospitalizations and deaths from varicella has declined more than 90%. In 2005, a combination vaccine containing live attenuated measles-mumps-rubella and varicella (MMRV) vaccine was licensed for use in people age 12 months through age 12 years.

What kind of vaccine is it?

The chickenpox vaccine is a live attenuated vaccine. This means the live, disease-producing virus was modified, or weakened, in the laboratory to produce an organism that can grow and produce immunity in the body without causing illness.

How is this vaccine administered?

The chickenpox vaccine is a shot, given in the fatty tissue. It should be given at the same visit as all other recommended vaccines.

Who should get this vaccine?

Chickenpox vaccine is recommended for the following:

- All children younger than age 13 years (one dose at 12–15 months and a second dose at age 4–6 years);
- Everyone age 13 years and older who has never had chickenpox (two doses, given 4–8 weeks apart);

Anyone who is overdue for receiving a dose should get the missed dose at their next visit to their doctor or clinic.

Who recommends this vaccine?

The Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics (AAP), and the American Academy of Family Physicians (AAFP) have all recommended that children receive this vaccine.

Should adults be tested before vaccination to see if they are already immune to chickenpox?

Currently, 90% of adults are immune to chickenpox because of having had the disease as children. If you have a history of chickenpox disease, you don't need testing or vaccination, unless you are working in an environment where your immune status must be documented (such as in a hospital). If you are uncertain of your medical history, blood testing can be done to see if immunization is appropriate.

How safe is chickenpox (varicella) vaccine?

Tens of millions of doses of varicella vaccine have been given in the United States, and studies continue to show that the vaccine is safe. Serious side effects are very rare.

What side effects have been reported with this vaccine?

Possible side effects are generally mild and include redness, stiffness, and soreness at the injection site; such localized reactions occur in 19% of children immunized and 24% of adolescents and adults (slightly more following the second dose). A small percentage of people develop a mild rash, usually around the spot where the shot was given.

In the several years following the licensure of the combined measles-mumps-rubella (MMR) and varicella vaccines in 2005, surveillance of side effects showed that children who got their first dose as the combined product (MMRV) had more fevers and fever-related seizures (about 1 in 1,250) than children who got the first dose as separate shots of MMR and varicella on the same day. Consequently, in May 2010, the CDC recommended that parents and doctors discuss the risks and benefits of both vaccination options and, unless a clear preference is expressed, the shots should be given separately for the first dose in children age 12 through 47 months. The use of the combination vaccine (MMRV) is generally preferred over separate injections for children who are receiving their second dose or their first dose when age 4 through 12 years.

How effective is this vaccine?

Almost all (more than 99%) children develop immunity to the disease after two doses of vaccine. For older children and adults, an average of 78% develop immunity after one dose and 99% develop immunity after the recommended two doses.

Although some vaccinated children (about 2%) will still get chickenpox, they generally will have a much milder form of the disease, with fewer blisters (typically fewer than 50), lower fever, and a more rapid recovery.

The vaccine almost always prevents against severe disease. Getting chickenpox vaccine is much safer than getting chickenpox disease.

Isn't it better for a child to get chickenpox naturally?

Some parents purposely seek to get their children infected with varicella virus, even promoting "chickenpox parties" for this purpose. The belief is that it's better to be infected when young, a time when the infection is ordinarily less severe. Some parents also believe that something "natural" (the disease) is better than something "artificial" (the vaccine), or that immunity derived from the disease will be more permanent than that from the vaccine.

However, when a safe vaccine is available, parents need to weigh the supposed benefits of infection against its potential risks, including severe disease with complications such as infection

with flesh-eating bacteria. No one can predict which child will develop a life-threatening case of chickenpox; in fact, most serious cases occur in previously healthy children.

In addition, in a recent study, 7 out of 10 children said given the choice, they'd rather have the shot than have the natural disease.

Can the vaccine protect you if you've already been exposed to chickenpox?

Yes, it is 70% to 100% effective if given within 72 hours of exposure.

Who should not receive the chickenpox vaccine?

People with weakened immune systems and those with life-threatening allergies to gelatin or the antibiotic neomycin should not receive this vaccine.

People who had a severe allergic reaction to a prior dose of this vaccine should not receive a second dose.

Pregnant women and women attempting to become pregnant should not receive this vaccine, as the possible effects on fetal development are unknown. However, non-pregnant women of childbearing age who have never had the disease may be immunized against chickenpox to avoid contracting the disease while pregnant.

Can the vaccine cause chickenpox?

Because this vaccine is made from a live, but weakened, virus, about 1% of recipients develop a mild form of the disease, consisting of a limited rash, most often with only 5–6 blisters. Usually there is no fever. These people are then safe from the more serious, naturally occurring form of the virus.

Can the varicella vaccine virus be transmitted (caught) from a person who was vaccinated?

Yes; however, transmission of the varicella vaccine virus is extremely rare. It has only been documented in healthy people on five occasions out of more than 55 million doses of vaccine distributed. All five cases resulted in mild disease without complications.

Can the vaccine cause herpes zoster (shingles)?

Yes, this is possible. The risk of zoster following vaccination appears to be less than that following infection with the varicella virus. The majority of cases of shingles following vaccine have been mild and have not been associated with serious complications.

Immunization Action Coalition

Technically reviewed by the Centers for Disease Control and Prevention, July 2013.