UTAH DEPARTMENT OF HEALTH

Streptococcus pneumoniae

Disease Plan

Quick Links

Last updated: October 31, 2017 by Bree Barbeau.

Questions about this disease plan?

Contact the Utah Department of Health Bureau of Epidemiology: 801-538-6191.

✓ CRITICAL CLINICIAN INFORMATION

Clinical Evidence

Signs/Symptoms

- **Pneumococcal pneumonia** – Abrupt onset of chills and fever, chest pain, cough, rusty sputum, difficulty breathing, rapid breathing, hypoxia, malaise, and weakness
- **Pneumococcal bacteremia and sepsis** – fever, chills, low alertness
- **Pneumococcal meningitis** – Headache, stiff neck, fever, lethargy, vomiting, seizures, and coma

Period of Communicability

- The period of communicability for pneumococcal disease is unknown, but presumably transmission can occur as long as the organism appears in respiratory secretions.
- Remains communicable presumably until discharges of mouth and nose no longer contain infectious numbers of pneumococci, which usually occurs within 24 hours of initiation of effective antibiotic therapy

Incubation Period

- Typically 1-3 days, but varies depending on type of infection

Mode of Transmission

- Respiratory droplet contact from person-to-person

Laboratory Testing

Type of Lab Test/Timing of Specimen Collection

- Culture or PCR

Type of Specimens

Specimens from normally-sterile sites:

- Blood or serum
- Cerebrospinal fluid
- Joint or other internal body fluids such as pleural or pericardial fluids (but not urine)
- Bone or other tissue if collected sterilely
- Abscesses if collected via aspiration (but not by a swab)

Treatment Recommendations

Type of Treatment

- Treated with antibiotics such as penicillin, amoxicillin, cephalosporins, quinolones, or vancomycin (testing for resistance to these treatments should be done prior to administration)

Prophylaxis

- Pre-exposure: available vaccines include the pneumococcal conjugate vaccine (PCV13 or Prevnar 13) and the pneumococcal polysaccharide vaccine (PPV23 or Pneumovax)
- Post-exposure: prophylactic antibiotics are not routinely recommended for contacts. Daily antimicrobial prophylaxis is recommended for children with functional or anatomic asplenia, regardless of their immunization status.

Contact Management

Isolation of Case

- Standard precautions are recommended

Quarantine of Contacts

- None

Infection Control Procedures

- Standard body substance precautions

✓ WHY IS *STREPTOCOCCUS PNEUMONIAE* IMPORTANT TO PUBLIC HEALTH?

The World Health Organization (WHO) estimates that *Streptococcus pneumoniae* kills close to half a million children under five years old worldwide every year, with most of these deaths occurring in developing countries. A large reduction in invasive pneumococcal disease and pneumonia has been seen in countries that have introduced pneumococcal conjugate vaccines (PCV). PCV is in the routine immunization schedule in the United States (U.S.) and Canada where it has been shown to be highly effective. More countries in the Americas have introduced PCV into their routine immunization schedules in recent years; however, a few countries have yet to introduce it. Despite the extensive study of this pathogen and the availability of a vaccine covering 23 different serotypes, *S. pneumoniae* remains a major invasive pathogen of children and older adults and is a principal cause of otitis media, community-acquired pneumonia, bacteremia, and meningitis. The introduction of PCV13 in 2010 into the routine childhood immunization schedule expanded protection against invasive disease in children. Today, surveillance for invasive *S. pneumoniae* among children less than five years of age is particularly important for identifying populations that may not be receiving vaccination, and for monitoring the incidence of disease caused by non-vaccine serotypes (replacement disease). Surveillance for invasive *S. pneumoniae* disease in persons equal or greater than five years of age is useful to monitor the impact of PCV vaccination, the indirect effects of PCV13, and replacement disease.

✓ DISEASE AND EPIDEMIOLOGY

Clinical Description

S. pneumoniae is the most common cause of bacterial pneumonia, hospitalized pneumonia, and community-acquired pneumonia in the U.S. *S. pneumoniae* bacteria can cause many other types of illnesses, some of these illnesses being life-threatening. *S. pneumoniae* can also cause non-invasive illness (such as sinusitis or acute otitis media), as well as invasive illness (such as pneumonia or meningitis). Only invasive illness is reportable to public health.

The clinical manifestations of invasive pneumococcal infection depend on the primary site of infection and the presence or absence of bacteremia. Typically, invasive disease presents as a disease of abrupt onset with fever, chills, and cough. Classically there is a single rigor, but repeated shaking chills are also common. Other common symptoms include pleuritic chest pain, cough productive of mucopurulent, rusty, sputum; dyspnea, tachypnea, hypoxia, tachycardia, malaise, and weakness. Nausea, vomiting, and headaches occur less frequently. People over 50 years of age may present with confusion or delirium. Common complications associated with invasive disease are sepsis, empyema, and necrotizing pneumonia. *S. pneumoniae* is the leading cause of bacterial meningitis among children younger than five years of age.

Causative Agent

Invasive pneumococcal disease (IPD) is caused by the bacterial pathogen *Streptococcus pneumoniae*. They are lancet-shaped, gram-positive diplococci that often asymptomatically colonize the human nasopharynx. Of the 92 capsular serotypes that have been identified, 23 serotypes are responsible for most invasive disease. Serotypes 1, 5, 6B, 14, 19F, and 23F cause most invasive childhood pneumococcal infections worldwide. Some of these, and other serotypes, cause most disease in adults. Increasing antibiotic resistance in this organism is an important public health problem.

Differential Diagnosis

S. *pneumoniae* usually causes pneumonia, sepsis, or meningitis. The differential diagnosis depends upon the age of the patient, but usually includes ruling out other bacterial and viral causes of disease. Definitive diagnosis is established by isolation of pneumococci from blood, cerebrospinal fluid or, less commonly, pleural fluid.

Laboratory Identification

If IPD, like meningitis or bloodstream infections, is suspected, samples of cerebrospinal fluid or blood are collected and sent to a laboratory for testing. If pneumococcus bacteria are present with invasive disease, they can be grown (cultured). Growing the bacteria in a laboratory is important for:

- Confirming the presence of bacteria
- Identifying the specific type of bacteria that is causing the infection
- Deciding which antibiotic will work best

S. pneumoniae is easily cultured and the capability for culture is widely available in clinical laboratories. *S. pneumoniae* can be identified via culture or urinary antigen, however, the case definition for IPD is limited to culture isolates from normally-sterile sites. This is interpreted as:

- Blood or serum
- Cerebrospinal fluid
- Joint or other internal body fluids such as pleural or pericardial fluids (but not urine)
- Bone or other tissue if collected sterilely
- Abscesses if collected via aspiration (but not by a swab)

The use of culture-independent diagnostic tests (CIDTs) (e.g. PCR, and other antigen-based tests) as stand-alone tests for the direct detection of *S. pneumoniae* from clinical specimens is increasing. Data regarding their performance indicate variability in the sensitivity, specificity, and positive predictive value depending on the manufacturer and validations methods used. It is therefore useful to collect information on the laboratory conducting the testing, and the type and manufacturer of the CIDT used to diagnose each IPD case. Culture confirmation of CIDT-positive specimens is still the ideal method of confirming a case of IPD.

Utah Public Health Laboratory (UPHL): *S. pneumoniae* is not required to be submitted to UPHL for validation. UPHL cannot perform isolate serotyping.

Treatment

Pneumococcal disease is treated with antibiotics. However, many types of pneumococcal bacteria have become resistant to some of the antibiotics used to treat these infections. In the past, penicillins were very effective for treatment of pneumococcal infections. However, today, pneumococcal bacteria are resistant to one or more antibiotics in 3 of 10 cases. Antibiotic susceptibility testing can demonstrate which antibiotics will be most successful at treating a bacterial infection.

Initial antibiotic treatment for invasive pneumococcal infections typically includes 'broad-spectrum' antibiotics until results of antibiotic susceptibility testing are available. Broad-spectrum antibiotics work against a wide range of bacteria. Once the susceptibilities of a bacteria are known, a more targeted (or 'narrow spectrum') antibiotic may be selected. Penicillin/amoxicillin, cephalosporins, quinolones, and/or vancomycin are typical treatment regimens depending upon resistance and presentation.

With success of the pneumococcal conjugate vaccine, we see much less antibiotic-resistant pneumococcal infections. In addition to the vaccine, appropriate use of antibiotics may also slow or reverse drug-resistant pneumococcal infections.

Case Fatality

Approximately 20% of all patients with IPD die of their illness, but case-fatality rates for the elderly and patients with underlying illnesses can be as high as 60%, even with antimicrobial therapy.

Reservoir

Humans are the only known reservoir. Between 5-90% of healthy persons are colonized with at least one strain of *S. pneumoniae* in their upper respiratory tract. Among school-aged children, 20-60% may be colonized. Only 5-10% of adults without children are colonized, although on military installations, as many as 50-60% of service personnel may be colonized. Close living conditions, such as medical wards, prisons, dorms, and military barracks has been found to be associated with increased colonization with *S. pneumoniae*. The duration of carriage varies and is generally longer in children than adults.

Transmission

S. pneumoniae is spread from person to person by respiratory droplets. Person-to-person transmission is common, but illness among casual contacts and attendants is infrequent. Invasive disease arises in colonized individuals related mostly to host factors.

Susceptibility

Anyone can get pneumococcal disease, but some people are at greater risk for disease than others. Being a certain age or having some medical conditions can put you at increased risk for pneumococcal disease. Children under the age of two years and adults over the age of 65 years have the highest rates of invasive disease.

Incubation Period

The incubation period is thought to be from 1-3 days, but is difficult to establish due to routine colonization.

Period of Communicability

The infectious period is generally unknown. Because organisms are transmitted but disease does not usually result, isolation of colonized or infected people is not necessary. The disease remains communicable presumably until discharges of mouth and nose no longer contain infectious numbers of pneumococci, which usually occurs within 24 hours of initiation of effective antibiotic therapy.

Epidemiology

Incidence

Streptococcus pneumoniae is a leading cause of serious illness among children worldwide. Before universal infant immunization with pneumococcal conjugate vaccine in the U.S., *S. pneumoniae* caused approximately 17,000 cases of invasive disease each year among children younger than five years of age, including 700 cases of meningitis and 200 deaths. It was the most frequent cause of bacteremia, bacterial pneumonia, bacterial meningitis, sinusitis, and acute otitis media. From 1998 to 2007 (after PCV7 was introduced in 2000), the incidence of invasive pneumococcal infections due to vaccine serotypes decreased by 99%, and the incidence of all IPD decreased by 76% in children younger than five years. Further reductions in disease in children of all ages, also associated with herd protection, have been demonstrated since the introduction of PCV13.

Of the approximately four million cases of pneumonia each year in the U.S., *S. pneumoniae* is the most common agent leading to hospitalization in all age groups. For many decades, bacteremic pneumococcal pneumonia has accounted for 9 -18 cases per 100,000 adults/year. Nationally, incidence in healthy young adults is 3.8/100,000, whereas incidence in those under two years or greater than 64 years of age is ten times higher. *S. pneumoniae* rates have been decreasing in Utah since 2010.

Although *S. pneumoniae* is the most common cause of community-acquired pneumonia (CAP), many studies have reported isolation of the organism in only 5-18% of cases. The rate of isolation increases when more invasive methods are used for obtaining specimens, such as trans-tracheal aspiration, which eliminates contaminating oropharyngeal flora. It is currently believed that many culture-negative cases of CAP are caused by pneumococcus. The following observations support this belief:

- The sputum culture is negative in about 50% of patients with concurrent pneumococcal bacteremia.
- A discriminant functional analysis, in which cases of unknown etiology were evaluated according to the clinical characteristics of *S. pneumoniae*, *Mycoplasma pneumoniae*, or other organisms, predicted that the majority of cases were due to pneumococcus.
- A majority of cases of unknown etiology respond to treatment with penicillin.
- Studies using trans-tracheal aspiration show high yields of *S. pneumoniae*.
- *S. pneumoniae* accounts for 66% of bacteremic pneumonias

Cases are underestimated because:

- The case definition does not include individuals diagnosed via sputum cultures, and
- Many people receive antibiotics prior to specimen collection.

Risk

At risk populations include certain racial/ethnic groups (such as African/American and American Indian), alcohol abuse (past or present), smoking (active or passive), COPD, pregnancy, chronic heart, lung, liver, or renal disease, immunocompromised health status, incarceration, homelessness, and crack cocaine use. People infected with influenza are at increased risk as well.

✓ PUBLIC HEALTH CONTROL MEASURES

Public Health Responsibility

- Investigate all suspect cases of disease, and fill out and submit appropriate disease investigation forms.
- Determine whether the organism is non-susceptible to antibiotics; if so, define which antibiotics and whether susceptible (S), intermediate (I), or resistant (R).
- Determine vaccination status of children under the age of five years.
- Provide education to the general public, clinicians, and first responders regarding disease transmission and prevention.
- Identify clusters or outbreaks of this disease.

Prevention

Vaccine is the only preventive measure. Proper hand hygiene and cough etiquette can also prevent spread of infection.

Chemoprophylaxis

Since it is uncommon for people to develop an infection after being exposed to someone with a pneumococcal infection, prophylactic antibiotics are not recommended for contacts of patients with such infections. Daily antimicrobial prophylaxis is recommended for children with functional or anatomic asplenia, regardless of their immunization status, for prevention of pneumococcal disease.

Vaccine

Because there are more than 90 known pneumococcal serotypes (strains or types) that cause disease, a previous pneumococcal infection is not necessarily protective from future infection. Therefore, pneumococcal vaccines are still recommended for children and adults who have had pneumococcal disease in the past.

There are two types of pneumococcal vaccines are approved for use in the United States:

Pneumococcal polysaccharide vaccine

- Also called PPSV23, Pneumovax, or Pnu-Immun.
- Has been used in adults for decades, but not in infants or toddlers under age two years, since polysaccharide antigens are poorly immunogenic in such individuals.
- Recommended for a number of groups:
    - Routine immunization of all children 2–23 months of age.
    - Children 24–59 months of age with the following high-risk medical conditions:
        - Sickle cell disease;
        - Functional or anatomic asplenia;
        - HIV infection;
        - Immunosuppression caused by illness, treatment, or medication; and
        - Certain chronic medical diseases (e.g., cardiopulmonary disease, cochlear implants, CSF fluid leaks, renal failure, nephrotic syndrome, diabetes, liver disease).
    - PCV13 should be considered for all children 24–59 months of age, with prioritization given to:
        - All children 24–35 months of age;
        - All children 36–59 months of age who are African American, Alaskan Native or Native American; and
        - All children attending out-of-home childcare (≥4 hours per week with ≥2 unrelated children)

Pneumococcal conjugate vaccine

- PCV, initially marketed as a 7-valent vaccine, PCV7 (Prevnar or Prevnar 7)**, n**ow replaced by PCV13 (Prevnar 13).
- Because of its excellent immunogenicity in infants and toddlers, PCV7 was adopted for universal use in this age group beginning in 2000. Since 2010, PCV13 has been recommended for infants and children in its place.
- Starting in 2012, PCV13 began to be recommended for use in selected high-risk adults.
- In 2014, PCV13 began to be recommended for all adults ≥65 years of age.
- Recommended for both immunocompetent and immunocompromised individuals:
    - Immunocompetent
        - All persons 65 years of age and older
        - Persons 2–64 years of age with:
            - Cardiovascular disease
            - Pulmonary disease (excluding asthma)
            - Diabetes
            - Alcoholism or chronic liver disease
            - CSF leaks
            - Sickle cell disease
            - Cochlear implants
        - Persons 2–64 years of age:
            - Living in long-term care facilities
            - Who are Native American

- Immunocompromised
  - Persons 2–64 years of age with:
    - Functional or anatomic asplenia
    - Leukemia, lymphoma, Hodgkin's disease, multiple myeloma, generalized malignancy
    - Chronic renal failure or nephrotic syndrome
    - Conditions, such as organ transplants, associated with immunosuppression
    - HIV infection
    - Immunosuppressive therapy, including long-term corticosteroids (equivalent to ≥2 mg/kg/day, or a total of ≥20 mg/day of prednisone, for ≥14 days) and radiation)

PCV13 and PPSV23 protect against 90% of invasive disease. Vaccination also decreases the need for antibiotics, therefore preventing antibiotic resistance. Investigation provides an opportunity to identify contacts with indications for pneumococcal vaccine.

Isolation and Quarantine Requirements

Isolation: Standard precautions are recommended, including for patients with infections caused by drug-resistant *S. pneumoniae*.

Hospital: Standard body substance precautions.

Quarantine: None.

✓ CASE INVESTIGATION

Reporting

Within one week of diagnosis, report any person

- From whom *Streptococcus pneumoniae* is isolated from a normally sterile body site; **or**
- Whose Detection of S. pneumoniae by CIDT identification in a specimen collected from a normally sterile body site

CSTE Reporting Swimlanes (2016)

Criterion	Reporting
Isolation of *S. pneumoniae* from a normally sterile body site	**S**
Detection of *S. pneumoniae* by CIDT identification in a specimen collected from a normally sterile body site	**S**

Notes:
S = These criterion alone are Sufficient to identify a case for reporting.

Case Definition (CSTE 2016)

Case classification:

- Probable: a case that meets the supportive laboratory evidence.
- Confirmed: a case that meets the confirmatory laboratory evidence.

A single case should be defined as a health event with a specimen collection date that occurs more than 30 days from the last known specimen with a positive lab finding.

CSTE Case Classification (2016)

Criterion	Probable	Confirmed
Clinical evidence		
Laboratory evidence		
Detection of *S. pneumoniae* from a normally sterile body site using a CIDT	N	
Isolation of *S. pneumoniae* from a normally sterile body site		N
Epidemiologic evidence		
Criteria to distinguish a new case		
Not counted as a new case if specimen collection occurred within 30 days of the collection date of a prior case	N	N

Notes:
S = This criterion alone is Sufficient to classify a case.
N = All "N" criteria in the same column are Necessary to classify a case. A number following an "N" indicates that this criterion is only required for a specific disease/condition subtype (see below). If the absence of a criterion (i.e., criterion NOT present) is required for the case to meet the classification criteria, list the Absence of criterion as a Necessary component.
O = At least one of these "O" (one or more) criteria in each category (i.e., clinical evidence and laboratory evidence) in the same column—in conjunction with all "N" criteria in the same column—is required to classify a case. (These "O" criteria are alternatives, which mean that a single column will have either no O criteria or multiple O criteria; no column should have only one O.) A number following an "O" indicates that this criterion is only required for a specific disease/condition subtype

Case Investigation Process

As with most respiratory pathogens, rapid, sensitive, and specific diagnostic tests are not available; thus, early in the course of illness, diagnosis of *S. pneumoniae* infection is usually presumptive, and the choice of antimicrobial therapy is nearly always empiric. However, once *S. pneumoniae* is isolated from a normally sterile body site, antimicrobial susceptibility testing may be necessary for patient management. Case investigations are not usually warranted, except in outbreaks or as determined by the state health department. CDC is available during outbreaks to assist with epidemiologic and laboratory investigations.

Outbreaks

An outbreak is defined as more than three or more cases in a closed setting (e.g. hospital, LTCF, military setting, dorm, shelter) within a 14-day period OR three or more cases with direct epidemiological linkage within a 14-day period. In outbreaks in institutions or in other closed

settings, immunization with pneumococcal conjugate or 23-valent polysaccharide vaccine may be carried out, unless it is known that the type causing the disease is not included in the vaccines. Due to theoretical concerns that immunization with PPSV23 may be followed by a period of a few days of increased susceptibility to infection, if PPSV23 is used, or if an outbreak is particularly explosive, antibiotic prophylaxis may also need to be considered.

Identifying Case Contacts

No investigation of case contacts is necessary.

Case Contact Management

No investigation of case contacts is necessary, and therefore, there are no guidelines for case contact management.

✓ REFERENCES

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✓ VERSION CONTROL

Update. Mar 8, 2016: Update to disease plan format.

Update. Mar 8, 2016: Reviewed CTSE (2010) for reporting, case definition, and case classification; no updates needed.

Update. Mar 8, 2016: Updated vaccine information and changed format to make it more understandable.

Update. Mar 22, 2016: Update to clinical description, treatment, susceptibility, period of communicability, reservoir, and chemoprophylaxis.

Update. Mar 22, 2016: Update to isolation and outbreaks. Added case investigation process.

Update. Mar 22, 2016: Update to references.

Update. Mar 22, 2016: Added UT-NEDSS minimum/required fields.

Update. Dec 08, 2016: Verified case definition and references.

Update. Dec 30, 2016: Added new CSTE case definition and swimlanes.

Update. October 2, 2017: Added Critical Clinician Information section.

Update. October 31, 2017: Edited CCI, Clinical Description, Reservoir, and Outbreak sections to reflect comments from Epi Affiliate Group.

✓ UT-NEDSS Minimum/Required Fields by Tab

Demographic

- ☑ Area code
- ☑ Birth gender
- ☑ City
- ☑ County
- ☑ Date of birth
- ☑ Ethnicity
- ☑ Last name
- ☑ First name
- ☑ Middle name
- ☑ Parent/Guardian
- ☑ Phone Number
- ☑ Race
- ☑ State
- ☑ Street
- ☑ Zip code
- ☑ Street number

Clinical

- ☑ Clinician First Name
- ☑ Clinician Last Name
- ☑ Clinician Middle Name
- ☑ Clinician Phone Number
- ☑ Date diagnosed
- ☑ Date of death
- ☑ Diagnostic Facility (DF)
- ☑ Died
- ☑ Disease
- ☑ Health Facility
- ☑ Hospitalized
- ☑ Onset date
- ☑ Did patient receive conjugate pneumococcal vaccine (PCV-7 or PCV-13; e.g., Prevnar 7 or 13)?
- ☑ Is the patient under the age of 5 years?
- ☑ Is child fully vaccinated for their age?
- ☑ Is child partially vaccinated for their age?

Laboratory

- ☑ Collection date
- ☑ Organism
- ☑ Result value
- ☑ Specimen source
- ☑ Lab
- ☑ Lab test date
- ☑ Test result
- ☑ Test status
- ☑ Test type
- ☑ Were antibiotic susceptibility results done?
- ☑ Penicillin:
- ☑ Azithromycin:
- ☑ Cefotaxime
- ☑ Ceftriaxone:
- ☑ Cefuroxime:
- ☑ Clavamox (Amoxicillin/Clavulanic Acid):
- ☑ Clindamycin:
- ☑ Erythromycin:
- ☑ Levofloxacin:
- ☑ Meropenem:
- ☑ Tetracycline:
- ☑ Trimethoprim/Sulfamethoxazole (TMP-SXT):
- ☑ Vancomycin:
- ☑ Was the patient tested for drug susceptibility to drugs not listed above?
- ☑ Specify the drug and susceptibility testing results:
- ☑ Cefepime:
- ☑ Linezolid:

Epidemiological

- ☑ Imported from

Reporting

- ☑ Date first reported to public health

Administrative

- ☑ LHD Case status
- ☑ LHD Date closed
- ☑ LHD Investigation/intervention started
- ☑ Outbreak Name
- ☑ State case status
- ☑ Outbreak Associated