Pertussis (Whooping Cough)

Disease Plan

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Last updated: June 4, 2018 by Bree Barbeau

Questions about this disease plan?

Contact the Utah Department of Health Bureau of Epidemiology: 801-538-6191.
**PERTUSSIS CRITICAL CLINICIAN INFORMATION**

### Clinical Evidence

#### Signs/Symptoms
- Non-specific respiratory symptoms; worsening cough, lasting at least two weeks
- Paroxysmal coughing
- High-pitched inspiratory whoop
- Apnea with or without cyanosis
- Post-tussive vomiting

#### Period of Communicability
- During catarrhal stage (defined on page 4) and the first two weeks after cough onset
- Not infectious after five days of appropriate antibiotic treatment

#### Incubation Period
- Average 7-10 days; range of 4-21 days

#### Mode of Transmission
- Respiratory droplets
- Contact with infected fomites

### Laboratory Testing

<table>
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<tr>
<th>Type of Lab Test</th>
<th>Also Known As</th>
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<td>IgM, IgG, IgA, Antibodies</td>
<td>Serum</td>
<td>Useful <strong>ONLY</strong> when cough has persisted for &gt;3 weeks</td>
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### Treatment Recommendations

#### Type of Treatment
- Azithromycin (Recommended)
  - Infants <6 months: 10mg/kg per day for 5 days
  - Infants and children ≥6 months: 10mg/kg (maximum: 500 mg) on day one, followed by 5 mg/kg per day (maximum: 250 mg) on days 2-5
  - Adults: 500 mg on day 1, followed by 250 mg per day on days 2-5 (Z Pak)
- Clarithromycin
  - Infants <1 month: not recommended.
  - Infants and children >1 month: 15 mg/kg per day (maximum: 1 g per day) in 2 divided doses each day for 7 days
  - Adults: 1 g per day in two divided doses for 7 days
- Erythromycin
  - Infants <1 month: not preferred because of risk for infantile hypertrophic pyloric stenosis (IHPS). If azithromycin is unavailable and erythromycin is used, the dose is 40-50 mg/kg per day in 4 divided doses. These infants should be monitored for IHPS.
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- Infants >1 month and older children: 40-50 mg/kg per day (maximum: 2 g per day) in 4 divided doses for 14 days
- Adults: 2 g per day in 4 divided doses for 14 days

**TMP-SMX (Bactrim, Sulfatrim, Septra)**
- Adolescents and Adults: one double strength tablet twice daily for 14 days) is an acceptable alternative.
- Infants and Children: is an alternative for children >2 months who have a contraindication to or cannot tolerate macrolide agents.
- TMP-SMX should not be used in infants <2 months of age because of the potential risk of kernicterus related to bilirubin displacement.

For more treatment information, visit [http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5414a1.htm](http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5414a1.htm).

**Time Period to Treat**
- Preferable to collect laboratory specimens prior to treatment.
- Before paroxysmal coughing begins, if possible (earlier treatment may lessen the severity of disease/transmission risk).
- Infants <1 year and pregnant women are recommended to be treated up to six weeks after cough onset.
- Likely not effective after three weeks of illness.

**Post-exposure Prophylaxis**
- All household and close contacts should receive prophylaxis regardless of age and vaccination status, particularly persons with high risk of developing severe pertussis, and those who will have close contact with those at high risk of developing severe pertussis.
- Initiating >3 weeks after exposure is likely not beneficial for contacts; however, it may be considered beneficial for high-risk infants or pregnant women up to six weeks after exposure.

**Case and Contact Management**
To provide future protection, contacts’ immunization history should be assessed and brought up to date according to current ACIP guidance, as needed.

**Isolation of Case**
- Patients with pertussis may not return to work, school, or childcare settings until after five days of appropriate antibiotic therapy.
- Patients with pertussis who were not treated with appropriate antibiotic therapy may not return to work, school, or childcare settings for 21 days after cough onset.

**Quarantine of Contacts**
- While quarantine is not typically indicated for asymptomatic contacts of a pertussis case, high-risk contacts (infants <12 months of age, pregnant women, etc.) and susceptible unimmunized or under-immunized contacts may be recommended for quarantine at the discretion of the Local Health Authority.

**Infection Control Procedures**
- Healthcare settings should follow droplet precautions for cases until completion of appropriate antibiotic therapy, or, if not treated, until 21 days after the onset of cough.
- *B. pertussis* may survive for 3-5 days on inanimate dry surfaces; five days on clothes, two days on paper, and six days on glass, so appropriate cleaning is critical.
- *B. pertussis* has been shown to be sensitive to glutaraldehyde; most vegetative bacteria are susceptible to low concentrations of chlorine, such as Clorox, or Purex (<1ppm), 70% ethanol, or phenolics such as Pine-Sol, Lysol, Triclosan (0.001% to 0.2%).
WHY IS PERTUSSIS IMPORTANT TO PUBLIC HEALTH?

Pertussis, a respiratory illness commonly known as whooping cough, is a very contagious disease caused by a type of bacteria called *Bordetella pertussis*. These bacteria attach to the cilia (tiny, hair-like extensions) that line part of the upper respiratory system. The bacteria release toxins (poisons), which damage the cilia and cause airways to swell. Pertussis is the most poorly controlled bacterial vaccine-preventable disease in the U.S., with peaks in disease occurring every 3-5 years. Although routine childhood vaccination has resulted in substantial reductions in disease, the number of reported pertussis cases has been steadily increasing since the 1980s. Notable peaks in disease occurred in 2004 (25,827 cases, 27 deaths), 2010 (27,550 cases, 27 deaths), and most recently in 2012 when more than 41,000 cases and 18 deaths were reported, the largest number of cases in the U.S. since 1959. Furthermore, the epidemiologic features of pertussis have changed in recent years with an increasing burden of disease among fully-vaccinated children and adolescents.

DISEASE AND EPIDEMIOLOGY

Clinical Description

Pertussis is a highly contagious toxin-mediated bacterial disease that interferes with the body’s ability to clear pulmonary secretions. Pertussis can be categorized into 3 stages.

- **Catarrhal stage**: characterized by non-specific respiratory symptoms with a worsening cough. It generally lasts 1-2 weeks.
- **Paroxysmal stage**: where most diagnosis occurs. Symptoms include sudden, severe coughing fits (paroxysms). These fits are often followed by a high-pitched whoop when the person breathes in. Persons may become cyanotic due to a lack of oxygen, and may vomit after a coughing fit. Infants and children generally have the most severe symptoms. In children less than 6 months of age, the most common symptom is apnea, and the whoop is often absent. Older children and adults may also lack the whoop, with a prolonged cough as the most common symptom. This paroxysmal stage can last for 1-6 weeks, sometimes lasting as long as 10 weeks.
- **Convalescent stage**: the patient gradually recovers from the disease. The cough becomes less paroxysmal and disappears in 2-3 weeks.

Subsequent respiratory infections may elicit paroxysms for months after the onset of pertussis. Milder disease is often seen in adolescents and adults and those who are partially protected because of vaccination.
Infants younger than 12 months are at the greatest risk of complications from pertussis infection. Bacterial pneumonia is the most common complication and cause of pertussis-associated deaths. The lack of oxygen caused by coughing can produce neurological disorders like seizures and encephalopathy (a dysfunction of the brain). Other complications include otitis media (ear infection), anorexia (loss of appetite), and dehydration. Complications resulting from pressure effects of severe paroxysms include pneumothorax (collection of gas or air in the chest cavity), epistaxis (nosebleed), subdural hematomas (swelling or mass of blood under the outer membrane covering the spinal cord), hernias (protrusion of organ through wall), and rectal prolapse (protrusion of rectal mucosa though the anus). Adolescents and adults may suffer from difficulty sleeping, urinary incontinence, pneumonia, and rib fracture.

**Causative Agent**
Pertussis is caused by *Bordetella pertussis*, a fastidious, gram-negative bacterium.

**Differential Diagnosis**
Typically, viruses cause upper respiratory infections/bronchitis. The frequency of pertussis as a cause of upper respiratory infection with prolonged cough varies, but can range from 5-20%. Other bacterial pathogens causing upper respiratory illnesses include *Bordetella parapertussis*, *Mycoplasma pneumoniae*, *Chlamydia trachomatis*, *Chlamydia pneumoniae*, *Bordetella bronchiseptica* and certain adenoviruses.

**Laboratory Identification**

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<td>IgM, IgG, IgA, Antibodies</td>
<td>Serum</td>
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Laboratory testing of pertussis can guide both clinical and public health responses. Pertussis can be easily missed and confused with other causes of chronic cough, so laboratory testing is useful in appropriate diagnosis. Additionally, laboratory data can significantly contribute to public health’s ability to recognize an outbreak. However, laboratory testing can often be difficult, expensive, and may not be clinically useful. Laboratory testing may not be necessary in settings where the patient has clinically compatible symptoms and has exposure to a confirmed case, or where there is a documented outbreak in the community. Public health’s recommendation for
laboratory testing of individual cases should carefully consider the above circumstances, and should recognize that in certain situations, testing may not be necessary.

**PCR**
Currently, this test is the best option in most clinical circumstances. Specimens may be collected 0-3 weeks following cough onset but may provide accurate results up to four weeks after cough onset. This test provides acceptable sensitivity in children and adults, has a relatively short turnaround time, and is available at most commercial reference laboratories. Nasopharyngeal (NP) swabs and aspirates are the preferred method for specimen collection. PCR results may not be reliable after five days of appropriate antibiotic treatment. After the fourth week of cough, bacterial DNA rapidly diminishes, which increases the risk of false negative results.

PCR allows for confirmation and speciation among *Bordetella* species. Results should be interpreted along with the clinical symptoms and epidemiological information. PCR tests vary in specificity, so obtaining culture confirmation of pertussis for at least one suspicious case is recommended any time there is suspicion of a pertussis outbreak.

**NOTE:** NP swabs have thin wire shafts and are flexible. You cannot collect an NP specimen with a throat swab. Throat swabs and cough plates are not acceptable specimens.

**Culture**
Culture is the gold standard for pertussis diagnosis. However, it is highly specific only in the initial stages of disease (during first two weeks of cough), and the sensitivity varies widely. Additionally, the length of time to obtain results makes it unacceptable for determining patient therapy. NP swabs and aspirates are the preferred method for specimen collection. Pertussis DFA or PCR testing is always recommended in addition to culture. Generally this test may be used when:

- Using an on-site laboratory (transport decreases yield)
- Patients have not started taking antibiotics
- Patients are within two weeks of symptom onset
- Determining possible antibiotic resistance

Since culture is considered the gold standard, it is particularly important to isolate the bacterium and confirm the pertussis diagnosis if an outbreak is suspected. Many other respiratory pathogens have similar clinical symptoms to pertussis and co-infections are common. Culture will help identify strains of *Bordetella pertussis*. Identifying which strains of *Bordetella pertussis* are causing disease is of public health importance. Culture must be taken from NP aspirates collected between 0-2 weeks after symptom onset. PCR should ideally be tested from NP aspirates taken at 0-2 weeks, but may provide accurate results for up to four weeks in infants or unvaccinated persons. For serology, the optimal timing for specimen collection is at 2-8 weeks post-symptom onset, when antibody titers are at their highest; however, serology may be performed on specimens collected up to 12 weeks post-symptom onset.

**Serology**
Serologic assays can be useful for confirming diagnosis, especially during suspected outbreaks. There are many different serologic tests used in laboratories. Generally, serologic tests are more useful for diagnosis in later phases of the disease.

Serologic diagnosis requires paired acute and convalescent sera, and therefore it is not recommended for diagnosis due to the required wait for convalescent sera. The use of a single serum specimen for diagnostic purposes is not well standardized outside of a research setting. Serology is best used to evaluate a person’s immune response to vaccination. Serological tests should never be used as the sole laboratory method of pertussis diagnosis.

**Figure 1. Pertussis Laboratory Testing Timing**

**Utah Public Health Laboratory (UPHL):** UPHL offers testing of pertussis through the film array multiplex PCR platform. The film array test includes several other tests in addition to pertussis. Only NP swabs sent in viral transport media and kept refrigerated will be accepted for testing of pertussis. Contact UDOH Epidemiology or UPHL to coordinate sample submission.

**Treatment**

Pertussis is generally treated with antibiotics, and early treatment is very important. Treatment may make infection less serious if it is started early, before coughing fits begin. Treatment can also help prevent spread of the disease to close contacts. Treatment after three weeks of illness is unlikely to help, because the bacteria are gone from the body, even though patients will usually still have symptoms. An antibiotic effective against pertussis should be administered to all close contacts of persons with pertussis, regardless of age and vaccination status. There are several antibiotics available to treat pertussis as outlined in the following table:
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<table>
<thead>
<tr>
<th>Drug</th>
<th>Infants &lt;1 month</th>
<th>Children 1-5 months</th>
<th>Children ≥6 months</th>
<th>Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azithromycin</td>
<td>10 mg/kg per day as a single dose daily for 5 days</td>
<td>10 mg/kg per day as a single dose daily for 5 days</td>
<td>10 mg/kg as a single dose on day 1 (maximum 500 mg); then 5 mg/kg per day as a single dose on days 2-5 (maximum 250 mg/day)</td>
<td>500 mg as a single dose on day 1; then 250 mg per day as a single dose on days 2-5</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>40 mg/kg per day in 4 divided doses for 14 days</td>
<td>40 mg/kg per day in 4 divided doses for 14 days</td>
<td>40 mg/kg per day in 4 divided doses for 7-14 days (maximum 1-2 g/day)</td>
<td>2 g per day in 4 divided doses for 7-14 days</td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>Not recommended</td>
<td>15 mg/kg per day in 2 divided doses for 7 days</td>
<td>15 mg/kg per day in 2 divided doses for 7 days (maximum 1 g per day)</td>
<td>1 g per day in 2 divided doses for 7 days</td>
</tr>
<tr>
<td>TMP-SMX</td>
<td>Contraindicated for infants &lt; 2 months; for infants aged ≥ 2 months, 8 mg/kg per day (TMP); 40 mg/kg per day (SMX) in 2 divided doses for 14 days</td>
<td>Contraindicated for infants &lt; 2 months; for infants aged ≥ 2 months, 8 mg/kg per day (TMP); 40 mg/kg per day (SMX) in 2 divided doses for 14 days</td>
<td>8 mg/kg per day (TMP); 40 mg/kg per day (SMX) in 2 divided doses for 14 days</td>
<td>320 mg per day (TMP); 1,600 mg per day (SMX) in 2 divided doses for 14 days</td>
</tr>
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</table>

Azithromycin is most popular because it is given in a short, simple regimen of one dose each day for five days. It is the preferred antimicrobial for use in infants younger than one month of age. Similarly, the regimen of two doses a day for seven days makes clarithromycin another well-accepted choice. Erythromycin, which is given as four doses each day for 14 days, continues to be used, but adherence to the regimen and completion of the course is generally lower than for the other macrolides, and adverse effects occur more frequently.

If resistance to the listed treatment regimens is suspected, CDC recommends treatment with trimethoprim-sulfamethoxazole (TMP-SMX) in a regimen of two doses per day for 14 days. TMP-SMX should not be used to treat infants younger than two months of age.

### Case Fatality

Most fatalities from pertussis occur in infants younger than six months of age, who are too young to have completed the primary series of pertussis vaccines. The case fatality rate for pertussis among infants younger than six months of age is approximately 1%, with the majority of deaths occurring in those younger than two months. In unvaccinated populations, morbidity can be significant, but mortality is rare with appropriate medical care. However, because most reported pertussis cases in infants are hospitalized, complication rates are likely to be representative of more severe illness.
Reservoir
Humans are the only known hosts of *B. pertussis*. Adolescents and adults are an important reservoir for *B. pertussis* and are often the source for infants.

Transmission
Pertussis is transmitted via close contact with aerosolized droplets of respiratory secretions from infected persons. Transmission can also occur through contact with infected fomites. This disease is not thought to have airborne transmission. Pertussis is highly communicable, with secondary attack rates in susceptible household contacts as high as 90%. The majority of infectious patients are symptomatic, however, results of several studies suggest that asymptomatic transmission does occur and might be a contributing factor to the resurgence of pertussis in the U.S. While the contribution of asymptomatic transmission is not well defined, results of a recent study suggest that asymptomatic infection may contribute to about 16% of cases of disease transmission for infants aged <6 months.

Susceptibility
Susceptibility is universal in unimmunized persons. Pertussis immunity typically wanes 3-5 years after vaccination or natural infection. Past infection with pertussis, and/or vaccination history, does not confer lifetime immunity.

Incubation Period
The average incubation period for pertussis is 7-10 days, with a range of 4-21 days, and rarely may be as long as 42 days.

Period of Communicability
Patients are most contagious during the catarrhal stage and the first two weeks after cough onset (approximately three weeks from the initial onset of symptoms). Recent studies suggest that patients with asymptomatic infection can transmit pertussis; however, because asymptomatic transmission is not well defined, it is difficult to determine the period of communicability for these patients. Patients are considered non-infectious after five days of appropriate antibiotic therapy.

Epidemiology
Outbreaks of pertussis typically occur every 3-4 years. The highest annual incidence of pertussis occurs among unvaccinated children aged <5 years. Secondary attack rates are approximately 90% among susceptible household contacts. During 2015, 20,762 cases of pertussis were reported to the CDC. This represents a 37% decrease compared to 32,971 cases reported during 2014.

Recently, both national and Utah trends demonstrate an increasing age in pertussis cases. It is unclear whether this is a real trend, or if it is due to increased recognition, diagnosis, and reporting of pertussis in adolescents and adults. It is hypothesized that widespread use of pertussis vaccine in children may be responsible for the shift in reported cases to adolescents/adults. In vaccinated populations, fewer mothers have acquired immunity through natural infection, and they may be less likely to provide passive immunity to an infant through
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transfer of maternal antibody. This leaves children under the age of one year as a significant at-risk population. The greatest burden of disease is in this population, with a Utah incidence rate of 41.5 cases per 100,000 population/year in 2016, compared to the overall statewide incidence rate of 9.1 cases per 100,000 population/year in 2016.

Pertussis rates in Utah were on the rise since 2009 and then show a decline from 2009-2014. In 2015, the number of reported pertussis cases in Utah was 16.6 per 100,000 persons/year, compared to the U.S. rate of 6.5 per 100,000 persons/year.


✔️ PUBLIC HEALTH CONTROL MEASURES

Public Health Responsibility

- Prevent illness in high-risk individuals through disease investigation, administration of vaccine, and antimicrobial prophylaxis.
- Promote vaccination to reduce disease burden in the community.
- Provide education to the general public (regarding disease transmission) and to clinicians (regarding disease diagnosis, reporting, and prevention).
- Monitor disease trends.

Prevention

Vaccines
The primary method of pertussis prevention is vaccination. In the United States, the recommended pertussis vaccine for babies and children is called DTaP. This is a combination vaccine that helps protect against three diseases: diphtheria, tetanus, and pertussis. There is a booster (Tdap) for preteens, teens, and adults that contains protection against these three diseases.

Antibiotics
When a case of pertussis is diagnosed, preventive antibiotics may be recommended to other members in a household to help prevent the spread of disease. Additionally, preventive antibiotics may be recommended to other people outside the household who have been exposed to the case, including:
- People at risk for serious disease.
- People who have routine contact with someone that is considered at high risk of serious disease.

Hygiene
In addition to the prevention recommendations outlined above, CDC recommends the following hygiene practices to help prevent the spread of pertussis:
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- Cover mouth and nose with a tissue when coughing or sneezing.
- Put used tissue in the waste basket.
- Cough or sneeze into an upper sleeve or elbow, not hands, if a tissue is unavailable.
- Wash hands often with soap and water for at least 20 seconds.
- Use an alcohol-based hand rub if soap and water are not available.

Post-exposure Prophylaxis (PEP)

Post-exposure antimicrobial prophylaxis (PEP) may reduce secondary transmission in household and other settings. UDOH recommends focusing efforts to provide PEP for high risk contacts and household contacts within the appropriate time frame.

CDC supports targeting PEP use to people at high risk of developing severe pertussis, as well as people who will have close contact with others at high risk of developing severe pertussis. The following CDC guidelines outline recommendations for the use of PEP among these groups:

- **Household contacts**: PEP should be administered to household contacts of a pertussis case within 21 days (three weeks) of onset of cough in the index case. PEP of all household and close contacts is recommended regardless of their age and vaccination status. Initiating PEP >3 weeks after exposure has limited benefit for the contacts.
- **High-risk contacts**: Provide PEP to high-risk people within 21 days of exposure to an infectious pertussis case-patient. High-risk people are those who personally are at high risk of developing severe illness, or those people who will have close contact with people at high risk of severe illness. High-risk people include:
  - Infants and women in their third trimester of pregnancy – severe and sometimes fatal pertussis-related complications occur in infants aged <12 months, especially among infants aged <4 months. Women in their third trimester of pregnancy may be a source of pertussis to their newborn infant.
  - All people with pre-existing health conditions that may be exacerbated by a pertussis infection (for example, but not limited to, immunocompromised people and those with moderate to severe medically treated asthma).
  - People who themselves have close contact with either infants <12 months, pregnant women or individuals with pre-existing health conditions at risk of severe illness or complications.
  - All people in high-risk settings that include infants aged <12 months or women in the third trimester of pregnancy. These include, but are not limited to neonatal intensive care units, childcare settings, and maternity wards.

A broader use of PEP may be appropriate in limited, closed settings when the number of identified cases is small and when a community-wide outbreak is not ongoing. However, when continued transmission of pertussis is evident, multiple rounds of antibiotics would not be recommended. Rather than repeating a course of antibiotics, you should monitor people exposed to pertussis for onset of pertussis signs and symptoms for 21 days.

**NOTE**: Other contacts can be provided antibiotics at the discretion of the Local Health Authority.
Vaccine
There are several formulations of vaccines used to prevent diphtheria, tetanus, and pertussis. Some are combined with vaccines to prevent other diseases and reduce the total number of shots that someone receives at one office visit. In the U.S., DTaP, Tdap, and Td vaccines are most commonly used. DTaP is given to children younger than seven years of age, and Tdap and Td are given to older children and adults.

DTaP: Diphtheria vaccine is complexed with acellular pertussis and tetanus toxoid, also known as DTaP. Immunization should be initiated in infancy. Children should get five doses of DTaP, one dose at each of the following ages:
- 2 months
- 4 months
- 6 months
- Between 15-18 months
- Between 4-6 years (before starting school).

Td: Td is a tetanus-diphtheria vaccine given to adolescents and adults as a booster shot every 10 years, or after an exposure to tetanus under some circumstances.

Tdap: ACIP recommends a single Tdap dose for persons aged 11-18 years who have completed the recommended childhood diphtheria and tetanus toxoids and pertussis/diphtheria and tetanus toxoids and acellular pertussis (DTP/DTaP) vaccination series and for adults aged 19-64 years. Expectant mothers should receive Tdap during each pregnancy, preferably at 27 through 36 weeks. Tdap should also be given to 7-10 year olds who are not fully immunized against pertussis. Tdap can be given no matter when Td was last received.

In February 2013, ACIP issued the recommendation that pregnant women should be vaccinated with Tdap during every pregnancy, regardless of previous vaccination with Tdap. Tdap may be administered any time during pregnancy, but vaccination during the third trimester would provide the highest concentration of maternal antibodies to be transferred closer to birth. After receipt of Tdap, persons should continue to receive Td every 10 years for routine booster immunization against tetanus and diphtheria. ACIP also recommends that all adolescents and adults who anticipate close contact with an infant <12 months receive a dose of Tdap if they have not previously received one.

For additional information about who should receive the Tdap vaccine and when, go to: http://www.cdc.gov/vaccines/schedules/downloads/adult/adult-schedule.pdf

Vaccine Storage and Handling
DTaP, Td, and Tdap vaccines should be stored at 35-46°F at all times. The vaccines should never be frozen. Vaccines exposed to freezing temperature must not be administered and should be discarded. DTaP, Td, and Tdap should not be used after the expiration date printed on the box or label.
Isolation and Quarantine Requirements

**Isolation:** Cases with pertussis should remain out of school or childcare settings until they have received five days of appropriate antibiotic therapy, or, if not treated, until 21 days after the onset of cough. Voluntary isolation from work and other settings where the case may transmit the disease is desirable.

**Healthcare Settings:** Healthcare worker cases should remain out of work until completion of appropriate antibiotic therapy, or, if not treated, until 21 days after the onset of cough.

**Quarantine:** While quarantine is not typically indicated for asymptomatic contacts of a pertussis case, high-risk contacts (infants <12 months of age, pregnant women, etc.) and susceptible unimmunized or under-immunized contacts may be recommended for quarantine at the discretion of the Local Health Authority.
ATTACHMENT A – Pertussis Vaccine-Exempt Exclusion Algorithm

Are there two or more cases at a school or child care setting that meet the outbreak definition?

No
Not currently an outbreak situation, continue to monitor for any additional cases.

Yes

Child care or High Risk Setting

Are there infants <1 year of age at the facility?

No

School Setting

Are there two or more cases in the same classroom, or are associated with another group that meets the close contact definition? (e.g., same sports team, clubs, band, choir, etc.)

Yes

No

Are the infants and staff responsible for care of the infants isolated from the rest of the children at the facility?

No

Yes

Exclusion of all unimmunized students and staff should be enforced within the child care or other high-risk setting.

Yes

Exclusion of unimmunized students and staff should be enforced within the classroom or other group.

No

No action at this time, unless there is evidence of school wide transmission.

Are there multiple classrooms or groups with cases, with at least one classroom that has 2 or more cases? Continued on next page
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Are there **multiple** classrooms or groups with cases with at least one classroom that has 2 or more cases?

- Yes
- No

No evidence of school wide transmission. Continue to monitor for additional cases.

Is there a high exemption rate in the school/facility?

- <15%
- >15%

How many classrooms are affected?

- >3 or >25% of classrooms (*See classroom definitions)
- <3 or ≤25% of classrooms (*See classroom definitions)

Exclusion of unimmunized students and staff should be enforced throughout the school/facility.

Exclusion of unimmunized students and staff should be "strongly considered" throughout the school/facility.

*Classroom Definitions

<10 classrooms at school: 3+ affected or 25% of classrooms (whichever is greater)

>10 classrooms at school: 25% of classrooms affected

(1) A local or state health department representative may exclude a student who has claimed an exemption or who is conditionally enrolled from school attendance if there is good cause to believe that the student has a vaccine preventable disease and:

(a) has been exposed to a vaccine-preventable disease; or

(b) will be exposed to a vaccine-preventable disease as a result of school attendance.

(2) An excluded student may not attend school until the local health officer is satisfied that a student is no longer at risk of contracting or transmitting a vaccine-preventable disease.

NOTE: Guidance documents specific to school and childcare settings can be found at: http://health.utah.gov/epi/diseases/pertussis/outbreak_recommend.

CASE INVESTIGATION

Reporting

If pertussis is suspected, it should be reported to the local health department or the Utah Department of Health.

Report any illness to public health authorities that meets any of the following criteria:

1. An acute cough illness of any duration with an inspiratory whoop.
2. Any person with isolation of *B. pertussis* from a clinical specimen or a positive PCR test for pertussis.
3. An acute cough illness of any duration in a person who is a contact of a laboratory-confirmed pertussis case.
4. An acute cough illness of any duration in a person who is a member of a defined risk group during an outbreak.
5. A person whose healthcare record contains a diagnosis of pertussis.
6. A person whose death certificate lists pertussis as a cause of death or a significant condition contributing to death.
Pertussis (Whooping Cough): Utah Public Health Disease Investigation Plan

Reporting Criteria (2014)

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Clinical Evidence</th>
<th>Laboratory Evidence</th>
<th>Epidemiologic Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cough (any duration)</td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cough &gt;2 weeks duration</td>
<td></td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>Inspiratory whoop</td>
<td>N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthcare record contains diagnosis of pertussis</td>
<td></td>
<td></td>
<td>S</td>
</tr>
<tr>
<td>Death certificate lists pertussis as a cause of death or a significant condition contributing to death</td>
<td></td>
<td></td>
<td>S</td>
</tr>
<tr>
<td>Isolation of <em>B. pertussis</em> from a clinical specimen</td>
<td>S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive PCR for pertussis</td>
<td>S</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
*S = This criterion alone is Sufficient to report a case.
N = All "N" criteria in the same column are Necessary to report a case.
O = At least one of these “O” (Optional) criteria in each category (e.g., clinical evidence and laboratory evidence) in the same column—in conjunction with all “N” criteria in the same column—is required to report a case.
* A requisition or order for any of the “S” laboratory tests is sufficient to meet the reporting criteria.

Case Definition

Pertussis (*Bordetella pertussis*) (Whooping Cough) (2014)

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

Epidemiologic Linkage
Contact with a laboratory-confirmed case of pertussis.
Case Classification

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*.

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.

*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 PCR positive for pertussis and has ≥1 sign or symptom and cough duration <14 days (classified as “probable” case). Criteria to distinguish a new case of this disease or condition from reports or notifications which should not be enumerated as a new case for surveillance.

**Case Classification Comment(s)**

The clinical case definition above is appropriate for endemic or sporadic cases. In outbreak settings, a case may be defined as a cough illness lasting at least two weeks (as reported by a health professional). Because direct fluorescent antibody testing of nasopharyngeal secretions has been demonstrated in some studies to have low sensitivity and variable specificity (5, 6), such testing should not be relied on as a criterion for laboratory confirmation. Serologic testing for pertussis is available in some areas but is not standardized and, therefore, should not be relied on as a criterion for laboratory confirmation. Both probable and confirmed cases should be reported nationally.
# Pertussis (Whooping Cough): Utah Public Health Disease Investigation Plan

## Case Classification Criteria (2014)

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Confirmed</th>
<th>Probable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Acute cough illness (any duration)</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Cough &gt;2 weeks duration</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Inspiratory whoop</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Paroxysms of coughing</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Post-tussive vomiting</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Apnea (with or without cyanosis) FOR INFANTS &lt;1 YEAR OF AGE ONLY</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Isolation of <em>B. pertussis</em> from a clinical specimen</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Positive PCR for pertussis</td>
<td>N</td>
<td></td>
</tr>
</tbody>
</table>

### Clinical Evidence

- **Acute cough illness (any duration)**
  - **N**
- **Cough >2 weeks duration**
  - **N**
  - **N**
  - **N**
- **Inspiratory whoop**
  - **O**
  - **O**
  - **O**
  - **O**
- **Paroxysms of coughing**
  - **O**
  - **O**
  - **O**
  - **O**
- **Post-tussive vomiting**
  - **O**
  - **O**
  - **O**
  - **O**
- **Apnea (with or without cyanosis)**
  - **O**
  - **O**
  - **O**
  - **O**
  - **O**

### Laboratory Evidence

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

### Epidemiological Evidence

- **Contact with a laboratory-confirmed infant case (classified as “confirmed”)**
  - **N**
  - **O**
- **Contact with a laboratory-confirmed infant case (classified as “probable”)**
  - **O**
  - **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).
- **A** = This criterion must be absent (i.e., NOT present) for the case to meet the classification criteria.
- **O** = At least one of these “O” (Optional) criteria in each category (e.g., 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 optional criteria are alternatives, which means 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
Cases of pertussis should be managed as follows:

- Encourage appropriate laboratory testing.
- Ensure appropriate antibiotic treatment.
  - Generally recommended for those who are within three weeks (<21 days) of the onset of their illness.
  - Infants <1 year of age, pregnant women, and persons with ongoing, close contact with infants <1 year of age or pregnant women (e.g., childcare workers, pediatricians), should be treated regardless of duration.
- Isolation should be imposed until 21 days after the onset of symptoms, or five days after appropriate antibiotic therapy is begun.
- All case contacts should be identified and appropriately managed (explained in detail below).
- The investigation of cases should not be finalized at the local health department in UT-NEDSS until at least two weeks after the illness onset date to ensure the appropriate case status is assigned, according to the CSTE case definition. In many cases this will require some follow-up after the initial interview, depending on date of onset and when the interview is conducted.
- In the investigation form, there is a question regarding up-to-date vaccination status that is for public health investigators to answer, not the patient/guardian being interviewed. This question should be answered based on the information about vaccine history provided and the age of the patient being interviewed. Per current ACIP recommendations, a case is considered up-to-date under the following circumstances:
  - Infants and children who have received four doses of DTaP, administered at 2, 4, and 6 months, 15 through 18 months, followed by a fifth booster dose given at 4-6 years of age.
  - Adolescents and adults who have received a single dose of Tdap; usually administered at 11-12 years of age.

Outbreaks
Depending on the setting, a pertussis outbreak is defined as:

- **Household**: Two or more cases within a 21-day period of each other, AND one of these cases must be laboratory confirmed.
- **School**: Three or more cases identified within a 21-day period AND one of these cases must be laboratory confirmed.
- **Childcare Facility with Infants <1 Year of Age**: one case identified within a 21-day period (laboratory confirmed).
- **Childcare Facility without Infants <1 Year of Age**: Two cases identified within a 21-day period AND one of these cases must be laboratory confirmed.

UDOH, in collaboration with local health departments, has developed outbreak guideline documents for use during an outbreak in schools and childcare settings. These outbreak recommendations were developed to provide statewide consistency in situations involving pertussis outbreaks. The purpose of these guidelines is to provide effective management tools for pertussis outbreak situations. The primary goal of pertussis outbreak control efforts is to decrease morbidity (amount of disease) and mortality (death) among infants (children <1 year of age).
Pertussis (Whooping Cough): Utah Public Health Disease Investigation Plan

A secondary goal is to decrease morbidity among persons of all ages. A unified approach across the state will ensure public health messaging and actions regarding pertussis are clear and consistent to aid in the prevention of pertussis. Outbreak and exclusion guideline documents can be found at http://health.utah.gov/epi/diseases/pertussis/outbreak_recommend.

Identifying Case Contacts
Close contacts are defined as persons who share a confined space (<6 feet) for more than one hour with the patient during the infectious period (defined as a three week period, starting from the onset date for the case). Consider members of the following groups:

- Household and immediate family members (those who spend many hours together or sleep under the same roof)
- Those who have direct contact with respiratory secretions
- Healthcare workers with extensive face-to-face contact with a patient who is coughing
- Core groups of close friends, social contacts, boyfriends, girlfriends
- Students sitting within three feet of the case at school
- Contacts at church activities and employment
- Participants in extracurricular activities (such as fieldtrips)
- Children attending childcare, after-school care, or a playgroup

Household contacts: PEP should be administered to household contacts of a pertussis case within 21 days (three weeks) of onset of cough in the index case. PEP of all household contacts is recommended regardless of age or vaccination status. Initiating PEP >3 weeks after exposure has limited benefit for the contacts.

High-risk Contacts: In addition, a subset of close contacts are considered high-risk contacts because of the severity of disease, or the likelihood of transmitting infection to those at risk of severe disease, and are recommended PEP. Provide PEP to high-risk contacts within 21 days of exposure to an infectious pertussis case. High-risk contacts are those who personally are at high risk of developing severe illness, or those people who will have close contact with people at high risk of severe illness. For the purposes of this guidance, high-risk contacts include:

- **Infants and women in their third trimester of pregnancy:** severe and sometimes fatal pertussis-related complications occur in infants aged <12 months, especially among infants aged <4 months. Women in their third trimester of pregnancy may be a source of pertussis to their newborn infant.
- **All people with pre-existing health conditions** that may be exacerbated by a pertussis infection (for example, but not limited to, immunocompromised people and those with moderate to severe medically treated asthma).
- **People who themselves have close contact with either infants <12 months, pregnant women or individuals with pre-existing health conditions at risk of severe illness or complications.**
- **All people in high-risk settings that include infants aged <12 months or women in the third trimester of pregnancy.** These include, but are not limited to neonatal intensive care units, childcare settings, and maternity wards.

Management of immunocompromised contacts should be made on a case-by-case basis.
Case Contact Management

Asymptomatic Contacts
- Assure that all close contacts and high risk groups (defined in previous section) receive appropriate PEP. For PEP recommendations, refer back to the PEP section of this plan.
- Assess immunization status and provide recommendations for DTaP/Tdap vaccination based on current ACIP recommendations.

Symptomatic Contacts
- Recommend all symptomatic contacts obtain medical evaluation, including confirmatory laboratory testing and appropriate antibiotic therapy if pertussis is identified.
- If symptomatic contacts refuse to obtain medical evaluation, consider providing PEP. For PEP recommendations, refer back to the PEP section of this plan.
- Recommend symptomatic contacts avoid exposure to high-risk groups (defined in previous section).
- For isolation and quarantine recommendations for symptomatic contacts, refer to the Isolation and Quarantine Requirements section of this plan.

Healthcare Contacts
- Respiratory precautions should be taken to prevent unprotected exposure to pertussis.
- PEP is recommended for all healthcare personnel who have unprotected exposure to pertussis and are likely to expose a patient at risk for severe pertussis (e.g. hospitalized neonates and pregnant women).
REFERENCES


CD Summary, Vol 54 (9), Oregon Department of Human Services, 2005.

Pichichero, ME, et.al., Combined Tetanus, Diphtheria, and 5-Component Pertussis Vaccine for use in Adolescents and Adults; JAMA 293 (24), 3003-3011, 2005.


✔ VERSION CONTROL

Update. March 4, 2016: Update to formatting of disease plan.

Update. March 4, 2016: Added reporting narrative and swimlanes.

Update. March 4, 2016: Added importance to public health section.

Update. March 4, 2016: Added treatment section.

Update. March 4, 2016: Added vaccine storage and handling information.

Update. March 4, 2016: Added PFGE to laboratory identification; updates to other laboratory identification methods.

Update. March 4, 2016: Reformatted vaccine information to make it more understandable; added additional information.

Update. March 4, 2016: Added healthcare personnel outbreak information.


Update. March 4, 2016: Update to references.

Update. March 8, 2016: Update to epidemiology and Utah trends.

Update. March 8, 2016: Reviewed clinical description; no updates needed.
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Update. March 8, 2016: Reviewed chemoprophylaxis; no update needed.

Update. March 8, 2016: Reviewed CTSE case definition, case classification, and reporting; no updates needed.

Update. March 8, 2016: Update to identifying case contacts; added high-risk contact group.

Update. March 8, 2016: Updated link to outbreak information (UDOH recommendations).

Update. March 8, 2016: Reviewed case contact management; no updates needed.

Update. July 17, 2017. Updated to reflect changes discussed at VPD Disease Plan Workgroup.

Update. October 4, 2017. Updated Critical Clinician Information, Laboratory Identification, Treatment, Case Fatality, Transmission, Susceptibility, Period of Communicability, Epidemiology, Prevention, Post-Exposure Prophylaxis (PEP), Vaccine, Isolation and Quarantine Requirements, Case Investigation Process, Outbreaks, Identifying Case Contacts, Case Contact Management, and References sections to reflect changes discussed at EAG VPD Disease Plan Workgroup.

✅ UT-NEDSS MINIMUM/REQUIRED FIELDS BY TAB

Demographic
- Area code
- Birth gender
- City
- County
- Date of birth
- Ethnicity
- Last name
- Phone number
- Race
- State
- Street
- Zip code

Clinical
- Did cough last at least two weeks?
- Did patient have paroxysmal cough?
- Did patient have inspiratory whoop?
- Did patient have post-tussive vomiting?
- Did patient have apnea?
- Did patient have acute encephalopathy?
- Date of last pertussis-containing vaccine:
- What type of vaccine was administered?
- Date diagnosed
- Date of death
- Date of treatment
- Date treatment stopped
- Died
- Disease
- Onset date

Laboratory
- Organism
- Specimen source
- Test type
- Test result

Epidemiological
- Has the facility staff been alerted to watch for symptoms in contacts for 21 days after the last exposure?
- Attends school
- Name and location of school:
- Has case been excluded from school for the first 5 days of antibiotics or 21 days after cough onset if antibiotics were not taken?
- Has school administration been alerted to watch for symptoms in contacts for 21 days after the last exposure? Seizures
- Did the patient cough at the final interview?
- What are the results of a chest x-ray for pneumonia?
- What is the transmission setting?
- Was there secondary spread?
- Epi-linkage to a confirmed or probable case
- List names:
- Epi-linkage to a laboratory-confirmed case
- List names:
- Did the patient ever receive a diphtheria, tetanus, and/or pertussis-containing vaccine?
- If the subject did not receive at least 3 doses of pertussis-containing vaccine, why not?
- Was patient treated with antimicrobial agents? If so, what was the name of the medication, the date treatment began and ended.
- Date of exposure
- Imported from

Reporting
- Date first reported to public health

Administrative
- Outbreak name
- State case status
- Outbreak associated
**RULES FOR ENTERING LABORATORY TEST RESULTS**

The following rules describe how laboratory results reported to public health should be added to new or existing events in UT-NEDSS. These rules have been developed for the automated processing of electronic laboratory reports, although they apply to manual data entry, as well.

**Test-Specific Rules**

*Test specific rules describe what test type and test result combinations are allowed to create new morbidity events in UT-NEDSS, and what test type and test result combinations are allowed to update existing events (morbidity or contact) in UT-NEDSS.*

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Test Result</th>
<th>Create a New Event</th>
<th>Update an Existing Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antigen by DFA/IF</td>
<td>Positive</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>IgA Antibody</td>
<td>Positive</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Equivocal</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>IgG Antibody</td>
<td>Positive</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td></td>
<td>Negative</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Equivocal</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>IgM Antibody</td>
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<td>Yes</td>
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<td>Negative</td>
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<td>Yes</td>
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<td></td>
<td>Negative</td>
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<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Western (immuno) blot IgA</td>
<td>Positive</td>
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<td>Yes</td>
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<tr>
<td></td>
<td>Negative</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Equivocal</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Western (immuno) blot IgG</td>
<td>Positive</td>
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<td>Yes</td>
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<td>Negative</td>
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<td>Yes</td>
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<td>Western (immuno) blot IgM</td>
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</tr>
<tr>
<td></td>
<td>Equivocal</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Whitelist Rules

Whitelist rules describe how long an existing event can have new laboratory data appended to it. If a laboratory result falls outside the whitelist rules for an existing event, it should not be added to that event, and should be evaluated to determine if a new event (CMR) should be created.

**Pertussis Morbidity Whitelist Rule:** If the specimen collection date of the laboratory result is two years or less after the event date of the morbidity event, the laboratory result should be added to the morbidity event.

**Pertussis Contact Whitelist Rule:** If the specimen collection date of the laboratory result is 60 days or less after the event date of the contact event, the laboratory result should be added to the contact event.

Graylist Rule

We often receive laboratory results through ELR that cannot create cases, but can be useful if a case is created in the future. These laboratory results go to the graylist. The graylist rule describes how long an existing event can have an old laboratory result appended to it.

**Pertussis Graylist Rule:** If the specimen collection date of the laboratory result is 30 days before to seven days after the event date of the morbidity event, the laboratory result should be added to the morbidity event.

**Other Electronic Laboratory Processing Rules**

If an existing event has a state case status of “not a case,” ELR will never add additional test results to that case. New labs will be evaluated to determine if a new CMR should be created.