Pertussis (*Bordetella pertussis)*
(Whooping Cough)

REPORTING INFORMATION

- **Class B:** Report by the close of the next business day after the case or suspected case presents and/or a positive laboratory result to the local public health department where the patient resides. If patient residence is unknown, report to the local public health department in which the reporting health care provider or laboratory is located.
- Reporting Form(s) and/or Mechanism: Ohio Confidential Reportable Disease Form (HEA 3334), Positive Laboratory Findings for Reportable Disease Form (HEA 3333), the local health department via the Ohio Disease Reporting System (ODRS), or telephone.
- CDC Pertussis Surveillance Worksheet is available for use to assist in local health department disease investigation and contact tracing activities. Information collected from the form should be entered into ODRS and not sent to the Ohio Department of Health (ODH), unless otherwise requested.

AGENT

Bordetella pertussis, a Gram-negative coccobacillus; a pertussis-like syndrome can also be caused by *B. parapertussis*; parapertussis is not reportable in Ohio.

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: paroxysms of coughing, or inspiratory "whoop," or post-tussive vomiting, or apnea (with or without cyanosis) (FOR INFANTS <1 YEAR ONLY).

Laboratory Criteria for Diagnosis

- Isolation of *Bordetella pertussis* from a clinical specimen, *or*
- Positive polymerase chain reaction [PCR] for *B. pertussis*.

Case Classification

Suspect*: A case not fully meeting the clinical criteria (e.g. cough illness ≥14 days) and/or is not laboratory confirmed by culture or PCR (e.g. positive DFA and/or IgM but no positive culture or PCR).

Probable: A case that meets the clinical case definition, is not laboratory confirmed, and is not epidemiologically linked to a laboratory-confirmed case of pertussis; *or* (FOR INFANTS <1 YEAR ONLY) a case of acute cough illness of any duration with at least one of the following symptoms: paroxysms of coughing, inspiratory "whoop", post-tussive vomiting, or apnea (with or without cyanosis) and is laboratory confirmed by PCR or epidemiologically linked to a case confirmed by either culture or PCR.

Confirmed: A case of acute cough illness of any duration with a positive culture for *B. pertussis*; *or* a case that meets the clinical criteria and is laboratory confirmed by either culture or PCR; *or* a case that meets the clinical definition and is epidemiologically linked directly to a case confirmed by either culture or PCR.

Not a Case: This status will not generally be used when reporting a case, but may be used to reclassify a report if investigation revealed that it was not a case.

Comment
An institutional outbreak of pertussis is defined as two or more cases clustered in time and space where transmission is suspected to have occurred in that setting. An outbreak is community-related when the number of reported cases is higher than what is expected on the basis of previous reports during a non-epidemic period for a given population in a defined time. Two or more large outbreaks within the same community setting at the same time should be combined to one outbreak. Household outbreaks are defined as three or more cases in two or more households.

The clinical case definition is appropriate for endemic or sporadic cases. In outbreak settings, one or more cases should be confirmed to be pertussis by positive culture results. Active surveillance should be maintained for 42 days after cough onset of most recent case in the outbreak.

The outbreak definition should be used for epidemiologic investigation and not for implementing control measures.

Because some studies have documented that *direct fluorescent antibody [DFA] testing of nasopharyngeal secretions has low sensitivity and variable specificity, it should be not 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 are reported nationally.

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).

* This case classification can be used for initial reporting purposes to ODH as CDC has not developed a classification.

SIGNS AND SYMPTOMS
The clinical course is divided into three stages: catarrhal, paroxysmal, and convalescent. The catarrhal stage has a gradual onset and initially resembles the common cold (i.e. coryza, sneezing, low grade fever, mild cough); this stage lasts from one to two weeks. Usually, whooping cough is not suspected until the cough gradually becomes more severe and paroxysms occur. These are characterized by repeated violent coughs without intervening inhalation, followed by a gasp for air that produces a characteristic high-pitched whoop. The patient becomes red or cyanotic, the eyes bulge, and the tongue protrudes. Thick mucus is dislodged and vomiting often follows. There is no fever and the patient appears normal between attacks.

The paroxysmal stage generally lasts from four to six weeks but might last as long as 10 weeks. Paroxysmal attacks occur more frequently at night. Adults, infants less than six months of age, and partially immunized persons may lack the whoop and have few paroxysms. In infants, the cough may be minimal or absent, and apnea may be the only symptom. In convalescence the whoop and vomiting stop and the cough becomes less paroxysmal, disappearing over two to three weeks. Some patients have recurrent bouts of all symptoms, including whoop, during viral upper respiratory infections for many months after pertussis.

DIAGNOSIS

Culture

Culture is considered the gold standard laboratory test and is the most specific of the laboratory tests for pertussis. Cultures should be collected from a nasopharyngeal (NP) specimen during the first two weeks of cough. Cultures are less likely to be positive if the patient has received prior antibiotic therapy, if the specimen collection is beyond the first two weeks of cough, or the patient has been vaccinated.

Polymerase Chain Reaction (PCR)

PCR should be tested from NP swabs during the first three weeks following cough onset. After the fourth week of cough, the amount of bacterial DNA rapidly diminishes which increases the risk of obtaining false-negative results. False-negative results may also occur if PCR testing is performed after antibiotic therapy. PCR testing after 5 days of antibiotic use is unlikely to be of benefit and is generally not recommended.

Serology

Serologic testing is performed by commercial labs in the United States. There are many different serologic tests used with unproven or unknown clinical accuracy.

Note 1:

Early signs and symptoms of pertussis are often non-specific, making it difficult to determine clinically who has pertussis in the earliest stages. However, only patients with signs and symptoms consistent with pertussis should be tested by PCR to confirm the diagnosis. Testing asymptomatic persons should be avoided as it increases the likelihood of obtaining false-positive results. Asymptomatic close contacts of confirmed cases should not be tested, and testing of contacts should not be used for post-exposure prophylaxis decisions.

Note 2:

Efforts should be made to avoid contamination of clinical specimens from pertussis DNA. Some pertussis vaccines have been found to contain PCR-detectable *B. pertussis* DNA. Environmental sampling has identified *B. pertussis* DNA from those vaccines in clinical environments. While the presence of this DNA in the vaccines does not impact the safety or immunogenicity of these vaccines, accidental transfer of the DNA from environmental surfaces to a clinical specimen can result in specimen contamination and false-positive results. If health care professionals adhere to good practices, there is no need to switch vaccines.

Preparation and administration of vaccines in areas separate from pertussis specimen collection areas may reduce the opportunity for cross-contamination of clinical specimens. Care should be taken when preparing and administering pertussis vaccines to avoid contamination of surfaces with vaccine. For more information, please review Best Practices for Health Care Professionals on the use of Polymerase Chain Reaction (PCR) for Diagnosing Pertussis found at: https://www.cdc.gov/pertussis/clinical/downloads/diagnosis-pcr-bestpractices.pdf.

Please notify the ODH Bureau of Infectious Diseases VPD Epidemiology Program at (614) 995-5599 before shipping a specimen to the Ohio Department of Health Laboratory.

EPIDEMIOLOGY

Source

Humans are the only reservoir.

Occurrence
The disease is common to children worldwide. Since the 1940's, there has been a marked decline in the United States and other countries where immunization levels are high. The disease might be more common in adults than previously thought, but it is often not considered in the differential diagnosis.

Transmission
Through direct contact with discharges from an infected person, usually by the airborne route. Communicability is greatest in the catarrhal stage and the first two weeks after cough onset (i.e. approximately 21 days).

Period of Communicability
Communicability gradually decreases and becomes negligible for ordinary nonfamilial contacts in about three weeks, despite spasmodic cough with whoop. For control purposes communicability extends from seven days after exposure to three weeks after the paroxysmal stage in patients not treated with effective antibiotics. In treated patients, infectiousness extends for five days after onset of therapy.

Incubation Period
The incubation period is usually 7 to 10 days, with a range of 4 to 21 days.

PUBLIC HEALTH MANAGEMENT

Case

Treatment

Spread of pertussis can be limited by decreasing infectivity of the patient and by protecting close contacts of that patient. Antimicrobials given in the catarrhal stage may ameliorate the disease. After paroxysms are established, however, antimicrobials have no discernible effect on the course of the illness and are given primarily to limit the spread of the organisms to others. The macrolide agents azithromycin, erythromycin and clarithromycin are preferred for treatment of pertussis in persons aged ≥1 month (see table for dosing recommendations). For infants <1 month azithromycin is preferred, erythromycin and clarithromycin are not recommended. For persons ≥2 months old who cannot tolerate macrolides, an alternative agent is trimethroprim-sulfamethoxazole [TMP-SMX]. The choice of antibiotic for treatment or prophylaxis should take into account effectiveness, safety, tolerability, ease of adherence to the regimen prescribed and cost.

Isolation

The Ohio Administrative Code (OAC 3701-3-13, (R)) states that "a person with pertussis who is not treated with effective antimicrobial therapy, shall be isolated, including exclusion from school or child care center, until three weeks after the onset of paroxysms. If effective antimicrobial therapy is given, the person shall be isolated for five days after initiation of antimicrobial therapy".

Contacts

Prophylaxis

The primary objective of postexposure antimicrobial prophylaxis (PEP) is to prevent death and serious complications from pertussis in individuals at increased risk of severe disease. CDC supports **targeting postexposure antibiotic use to persons at high risk of developing severe pertussis and to persons who will have close contact with those at high risk of developing severe pertussis**. For more information, please visit CDC's Postexposure Antimicrobial Prophylaxis for pertussis website at: http://www.cdc.gov/pertussis/outbreaks/PEP.html.

Postexposure prophylaxis with an effective antimicrobial agent can be administered to contacts prior to illness onset. The decision to prophylax is made after considering the infectiousness of the patient and the intensity of the exposure, the potential consequences of severe pertussis in the contact, and the possibilities for secondary exposure of persons at high risk from the contact. CDC supports providing PEP to the following:

- Infants and women in their third trimester of pregnancy;
- All persons with pre-existing health conditions that may be exacerbated by a pertussis infection (for example, but not limited to immunocompromised persons and patients with moderate to severe medically treated asthma);
- Contacts who themselves have close contact with either infants under 12 months, pregnant women or individuals with pre-existing health conditions at risk of severe illness or complications;
- All contacts 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.

Prophylaxis of asymptomatic household contacts within 21 days of onset of cough in the index patient is recommended by CDC and can prevent symptomatic infection. Symptomatic (coughing) household members of a pertussis patient should be treated as if they have pertussis. The recommended antimicrobial agents and dosing regimens for postexposure prophylaxis are the same as those for treatment of pertussis (see table). All persons should be watched closely for respiratory symptoms for 14-21 days after last contact.

A broader use of PEP is supported in limited closed settings when the number of identified cases is small and when community-wide outbreaks are 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, contacts should be monitored for onset of signs and symptoms of pertussis for 21 days.

Flight Contact Investigations

CDC recommends contact investigations for pertussis when an individual travelling by airline has been confirmed by either laboratory or physician diagnosis and was infectious during travel (up to 21 days after cough onset if untreated or on antimicrobial therapy for pertussis for less than five days), regardless of the duration of flight. When an individual meets the criteria listed above, please notify the VPD Epidemiology Program at (614) 995-5599 with the flight and seat number. The VPD Epidemiology Program will work with the CDC Quarantine Department to identify and investigate contacts that were seated on either side of the pertussis case.

Vaccine (in addition to antimicrobials)

All close contacts younger than 7 years of age who have not completed the four-dose primary series should complete the series with the minimum intervals. Close contacts who are 4-6 years of age and who have not yet received the second booster (usually the 5th dose of DTaP) should be vaccinated.

The administration of Tdap to persons 10-64 years of age who have been exposed to a person with pertussis is not contraindicated, but the efficacy of postexposure use of Tdap is unknown.

In February 2013, the Advisory Committee on Immunization Practices (ACIP) published updated recommendations for pregnant women, stating that:

- A dose of Tdap should be given to a pregnant woman during each pregnancy, regardless of the patient's previous history of receiving Tdap.
- The optimal timing of this dose is between 27 and 36 weeks of gestation – but it may be given at any time during the pregnancy.
- This dose should be given regardless of the interval since any previous dose of Tdap.
- A woman who did not get a dose of Tdap during her pregnancy, and has never received a dose of Tdap in the past, should get a dose of Tdap immediately post-partum. Women previously vaccinated with Tdap should not get this dose.
- A pregnant woman who is due for a routine 10-year Td booster, or for whom tetanus toxoid is indicated for wound management, should receive Tdap.

Please see the Centers for Disease Control and Prevention (CDC) website for the most current ACIP recommendations:
http://www.cdc.gov/vaccines/hcp/acip-recs/index.html.

Prevention and Control

Immunization with pertussis vaccine is the most important measure for the control of pertussis. Human pertussis immune globulin is no longer available in the United States. Reducing the dose of pertussis vaccine or giving the full dose in multiple small doses may result in an altered immune response and is not recommended. Furthermore, there is no evidence that the frequency of significant vaccine reactions is likely to be reduced by this practice. Interrupting the recommended primary and booster immunization schedule or delaying doses probably does not lead to a reduction in the level of immunity reached on completion of the primary series. Therefore, there is no need to restart a series, regardless of the time elapsed between doses.

Ohio School Requirement: All students entering school should have received a minimum of 4 doses of DTaP with the last dose being received on or after 4 years of age. In addition, in 2011, a progressive requirement was added for seventh graders that they receive a booster Tdap dose. (In 2009, Ohio added a progressive requirement for tetanus vaccination, but both Td and Tdap were allowed. In 2011, the requirement emphasized Tdap.)

Recommended antimicrobial treatment and postexposure prophylaxis for pertussis, by age group:

	Primary agents			*Alternate
Age Group	Azithromycin	Erythromycin	Clarithromycin	*TMP-SMX
< 1 month	Recommended agent - 10 mg/kg/day in a single dose for 5 days	Not preferred - Erythromycin is associated with infantile hypertrophic stenosis. Use if azithromycin is unavailable; 40mg/kg/day in 4 divided doses for 14 days	Not recommended (safety data not available)	Contraindicated for infants aged < 2 mos. (risk for kernicterus)

1-5 months	10 mg/kg/day in a single dose for 5 days	40 mg/kg/day in 4 divided doses for 14 days	15 mg/kg/day in 2 divided doses for 7 days	Contraindicated at age < 2 mos. For infants ≥2 mos. TMP 8 mg/kg/day, SMX 40 mg/kg/day in 2 doses for 14 days
Infants ≥6 months and children	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 through 5 (maximum: 250 mg/day)	40 mg/kg/day (maximum: 1-2 g per day) in 4 divided doses for 7-14 days	15 mg/kg/day in 2 divided doses (maximum:1g per day) for 7 days	TMP 8 mg/kg/day, SMX 40mg/kg/day in 2 doses for 14 days
Adolescents and adults	500 mg in a single dose on day 1 then 250 mg as a single dose on days 2-5	2 g per day in 4 divided doses for 7-14 days	1 g per day in 2 divided doses for 7 days	TMP 320 mg per day, SMX 1,600 mg per day in 2 divided doses for 14 days

* Trimethroprim sulfamethoxazole (TMP-SMX) can be used as an alternative agent to macrolides in patients aged ≥2 months that are allergic to macrolides, who cannot tolerate macrolides, or who are infected with a rare macrolide-resistant strain of *Bordetella pertussis*.

American Academy of Pediatrics. Pertussis. In: Kimberlin DW, Brady MT, Jackson MA, Long SS, eds. *Red Book: 2015 Report of the Committee of Infectious Diseases.* 30th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2015: p.611.

What is pertussis?
Pertussis, or whooping cough, is a highly contagious respiratory infection caused by the bacteria *Bordetella pertussis*.

Who gets pertussis?
Pertussis can occur at any age. Although most of the reported cases occur in children under five years, the number of cases in adolescents and adults is increasing, probably due to waning of vaccine immunity. Adolescents and adults and those partially protected by the vaccine may have milder disease which is not diagnosed as pertussis. Pertussis is thought to account for up to 7% of cough illnesses per year in adults.

How is pertussis spread?
Pertussis is primarily spread by direct contact with the discharges from the nose and throat of infected individuals. Frequently, older siblings or other adult household members who may be harboring the bacteria in their nose and throat can bring the disease home and infect an infant in the household.

What are the symptoms of pertussis?
Pertussis begins as a mild upper respiratory infection. Initially, symptoms resemble those of a common cold, including sneezing, runny nose, low-grade fever and a mild cough. Within two weeks, the cough becomes more severe and is characterized by episodes of numerous rapid coughs followed by a crowing or high-pitched whoop. A thick, clear mucous may be discharged with the coughing. These episodes may recur for one to two months, and are more frequent at night. Young infants, adolescents, and adults do not have these typical coughing spells. Older people or partially immunized children may have milder symptoms.

How soon after infection do symptoms appear?
The incubation period is usually 7 to 10 days, with a range of 4 to 21 days.

When and for how long is a person able to spread pertussis?
A person can transmit pertussis from the onset of symptoms to three weeks after the onset of coughing episodes. The period of communicability can be reduced to five days after appropriate antibiotic therapy is begun.

Does past infection with pertussis make a person immune?
One attack usually confers immunity comparable to that provided by vaccine.

What are the complications associated with pertussis?
Young infants are at the greatest risk for complications. Serious complications of pertussis include pneumonia, seizures, encephalopathy (disorders of the brain), and death. Less serious complications include ear infections, loss of appetite, and dehydration.

What is the vaccine for pertussis?
Children should be immunized with the DTaP (diphtheria toxoid in combination with tetanus toxoid and acellular pertussis) vaccine at 2, 4, 6 and 15 to 18 months of age and between 4 and 6 years of age. Older children and adults who have completed the primary series should receive Td (tetanus/diphtheria) boosters every 10 years. It is recommended that for both adolescents (11-18 years of age) and adults <65 years of age, Tdap (tetanus/diphtheria/acellular pertussis) be used for one of those boosters to

provide protection against pertussis. See the Centers for Disease Control and Prevention (CDC) for the most current Advisory Committee on Immunization Practices (ACIP) recommendations on vaccination and control measures found at: http://www.cdc.gov/vaccines/hcp/acip-recs/index.html .

What can be done to prevent the spread of pertussis?
The single most effective control measure is maintaining the highest possible level of immunization in the community. The treatment of cases of pertussis with the appropriate antibiotic is important, as is the treatment of close contacts of cases. In addition, medical professionals should consider the diagnosis of pertussis in adolescents and adults with persistent coughs. People who have or may have pertussis (including those with a persistent cough) should stay away from young children and infants until properly evaluated by a physician.