

Epidemiology Update

Pertussis

Pertussis Key Findings

- ◆ During 2005-2009, 18.6% of the Minnesota pertussis cases occurred in Hennepin County residents.
- ◆ Pertussis was most frequently reported in school-age children: 5-9 years (20.2%), 10-14 years (26.9%) and 15-19 years (17.9%).
- ◆ 55.9% of cases were reported in females and 44.1% in males.
- ◆ Transmission occurred in school (15.9%), home (17.7%) and unknown settings (60.3%).
- ◆ Azithromycin was used most frequently to treat case patients and as prophylaxis for household contacts, persons with face-to-face contact with the case patient, and for others depending on contact and/or activities.
- ◆ 32.7% of cases in children 7 months through 5 years of age had not received 3 doses of pertussis vaccine. These cases were considered vaccine-preventable.

Introduction

This *Epidemiology Update* on pertussis (whooping cough) highlights the cyclic occurrence of the disease and outlines the appropriate exclusion, recommendations for treatment of cases and prophylaxis of contacts.

This issue of *Epidemiology Update* is one in a series of reports from Hennepin County Human Services and Public Health Department – Epidemiology available at:

www.hennepin.us/EpiUpdates

Background

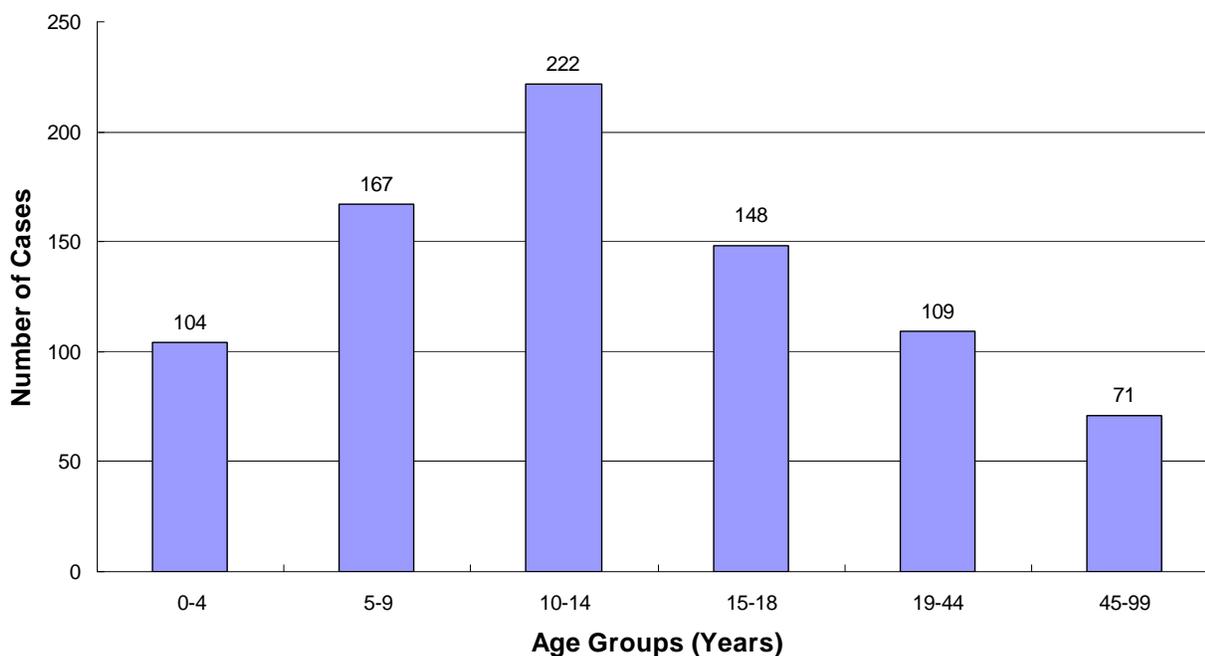
Pertussis, a toxin-mediated disease, is caused by the bacterium *Bordetella pertussis*. The bacteria attach to respiratory cells, produce toxins, and cause inflammation.

Pertussis begins with a runny nose, sneezing, mild cough, and possibly a low-grade fever. After a week or two, a persistent cough develops, which may occur in explosive bursts (paroxysmal coughing), sometimes ending in a high-pitched whoop and vomiting. A whoop may be absent in older children, adults, and infants younger than 6 months. Coughing attacks occur more frequently at night. The coughing attacks usually increase during the first two weeks of illness and then remain the same for two or three more weeks before gradually decreasing. Some people, particularly infants, may develop pneumonia and ear infections. Pertussis can occur in vaccinated children, but the illness is usually milder.

Older children and adults may have a less typical cough; however, it is usually persistent and may lead to vomiting or a whoop. Although the disease may be less severe in adults and older children, they can unknowingly infect infants and preschoolers who are at risk for serious illness.

Graph 1

Hennepin County Pertussis Cases by Age Groups 2005-2009



Pertussis can affect persons of any age. This may be due to waning immunity from either natural infection or vaccine. During 2005-2009 case-patients ranged in age from 16 days to 77 years. Of the 825 cases reported, the majority 540 (65.1%) occurred in children 5 through 18 years of age (school-aged) with the highest percentage in children 10-14 years old (26.9%); 190 (21.8%) occurred in persons 19 years of age and older; 65 (7.9%) occurred in children 7 months through 4 years of age, 39 (4.7%) occurred in infants 0-6 months of age; and 8 (0.5%) occurred in persons of unknown age.

Table 1

Symptoms Reported from Pertussis Case Patients Hennepin County 2005—2009

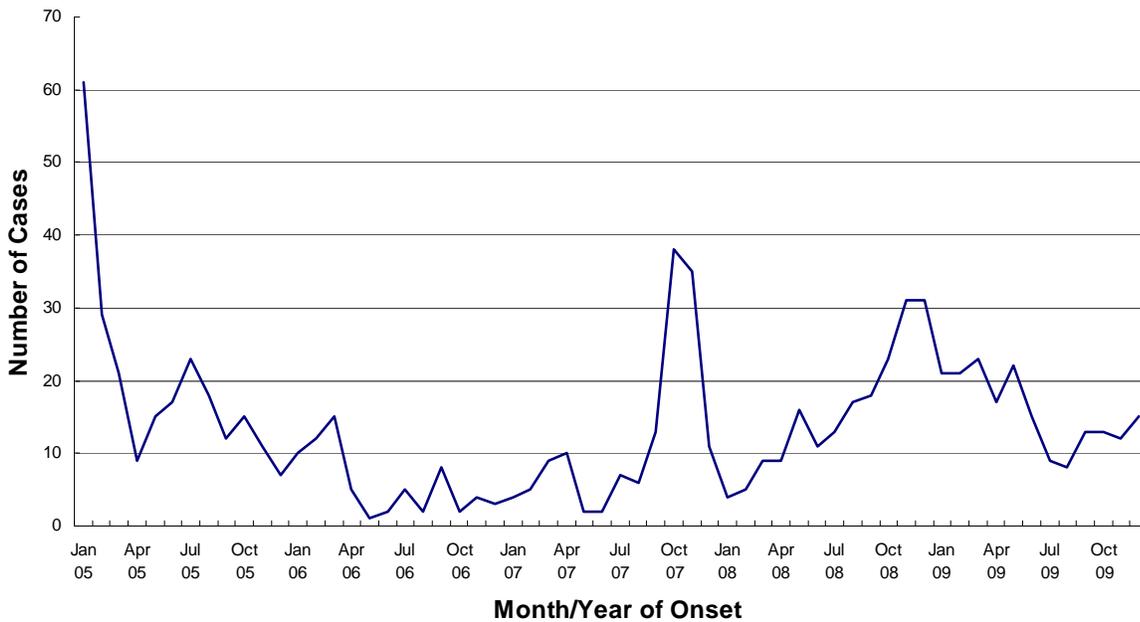
	2005	2006	2007	2008	2009	5 year total	%
Symptoms							
Paroxysmal cough	233	62	138	181	184	798	96.7
Post-tussive vomiting	122	37	49	64	74	346	41.9
Whoop	65	20	34	56	44	219	26.5
Apnea	69	18	25	30	24	166	20.1

Paroxysmal cough was the most frequently reported symptom. Seven hundred ninety eight case-patients (96.7%) reported paroxysmal coughing and 41.9% had post-tussive vomiting. Whoop was reported in 26.5% of the case-patients. Most reports of whoop were self-reported either by the patient or the patient's parent/guardian, not by the healthcare provider. Of the case-patients who had reported whoop, 41.5% were 15 years of age or older, 44.2% were 5-14 years old, 9.7% were 7 months to 4 years old, and 4.6% were 6 months or younger.

Twenty-two (2.7%) of the case-patients were hospitalized; 16 (72.7%) of hospitalized case-patients were 6 months of age or younger. The days of hospitalization ranged from 1–41 days with a mean of 8.6 days. The other hospitalizations were in adults over age 40 years with a range of 1–9 days with a mean of 3.6 days.

Pneumonia was diagnosed in 22 (2.7%) case-patients of which 4 (18.2%) occurred in children 6 months of age or younger. Three of the case-patients with pneumonia were hospitalized; two of these were infants less than 6 months of age.

Graph 2 **Hennepin County Pertussis Cases**
Month and Year of Onset
2005-2009



Pertussis tends to be a cyclic disease with peaks every 3-5 years. Graph 2 shows the number of cases by onset of illness over the five year time span. In 2004 there were 354 cases with a large peak of cases in November and December which carried over into the first quarter of 2005. The number of cases decreased in 2006 and the first three quarters of 2007. An increase in the number of cases started in the fall of 2007 and again for the school year 2008-2009. The increase in cases was associated with several school outbreaks.

Reservoir

Humans are believed to be the only hosts for pertussis. Adolescents and adults are an important reservoir for *B. pertussis* and are often the source of infection for infants.

Transmission

Spread occurs when a person with pertussis coughs or sneezes tiny droplets with pertussis bacteria into the air and another person breathes them in.

Case-patient data was analyzed for sources of transmission; 146 (17.7%) case-patients acquired their disease from a household member; 131 (15.9%) from school; 497 (60.3%) were unknown or not documented. Other places where disease was acquired included childcare, work, church, college, doctor’s office, and international travel.

Incubation Period

The incubation period ranges from 4 to 21 days, and is usually 7 to 10 days, from the time a person is exposed until symptoms start.

Infectious Period

Persons are contagious at the beginning of early cold-like symptoms, before a persistent cough and explosive bursts of coughing start. Persons remain contagious until three weeks after first cold-like symptoms begin. Those treated with antibiotics are contagious until 5 days of treatment are completed.

Diagnosis

Pertussis may present as a nonspecific cough in adolescents and adults, often resulting in several trips to the healthcare provider's office before diagnosis. Consider pertussis in patients (including adults) coughing more than 7 days or even less if a patient (or parent/guardian) presents with a letter from public health stating an exposure to a probable or lab-confirmed case has occurred.

Using data from 2006-2009, 328 case patients visited a healthcare provider. Of those, 238 (72.6%) were diagnosed on their first visit; 59 (18%) made two visits, 24 (7.3%) made three to four visits, and 7 (2.1%) made five to six visits.

Testing

Test symptomatic patients only. Collect a nasopharyngeal (NP) swab, not a throat swab. Use an NP swab applicator (Dacron or rayon) with a flexible wire. Gently let the swab move slowly along the floor of the nasal cavity to the posterior wall of the pharynx. Hold it in place for 10 seconds or until a paroxysmal cough is elicited or ask the patient to cough. Immediately place swab in appropriate transport medium.

NOTE: DO NOT use calcium alginate swabs to collect NP swabs for PCR.

Recommended lab tests are:

Culture and PCR (DNA by polymerase chain reaction).

Culture: is considered the gold standard laboratory test and is the most specific of the lab tests for pertussis. Specimen collection, transportation, and isolation techniques may affect the yield of culture. A culture needs to be done during the first three weeks of cough. Otherwise, isolation of the organism decreases if the patient has:

- Received prior antibiotics effective against *B. pertussis*
- Specimen collected beyond first two weeks of cough
- Been vaccinated

It may take from 10-14 days to get culture results.

PCR: has increased sensitivity and faster reporting. Like culture, PCR is also affected by inappropriately obtained NP swabs. PCR is less affected by prior antibiotic therapy, since the organism does not need to be viable to be detected. However, with a negative test the healthcare provider would need to rely on their clinical judgment.

It is recommended that both culture and PCR be done when possible.

DFA: may be useful as a rapid screening test for pertussis. DFA has a low sensitivity and should not be relied upon as a confirmatory lab test.

Serology: could be useful for adults and adolescents who present late in the course of illness, when both culture and PCR are likely to be negative. However, there is no FDA-approved diagnostic test. The currently available serologic tests measure antibodies that could result from either recent or remote infection or recent or remote vaccination. At this time, serologic test results should not be relied upon as a confirmatory lab test.

Test Results

PCR

- Positive PCR is confirmatory with clinical presentation.
- Negative PCR requires clinical judgment in relation to timing of the test and specimen collection technique.

Culture

- Positive culture confirms the diagnosis of pertussis.
- Negative culture does not rule out pertussis.

Six hundred seventy (81.2%) case-patients had one or more laboratory tests done. Of the 800 tests that were done, the type of test was as follows: 626 (78.2%) PCR, 129 (16.1%) cultures, 27 (3.4%) were DFA, and 18 (2.2%) serology.

The percent positive for the laboratory tests were as follows: PCR: 550/626 (87.8%); cultures: 81/129 (62.8%); and DFA 16/27 (59.2%). There were 18 serologies done with 15 reported as positive. Only one of the 15 had another lab test but the PCR was negative. Eleven (73.3%) of the 15 serologies were from adults who had been coughing for one to two months at the time of the test.

Treatment

Antibiotics are recommended for both treatment of pertussis cases and prophylaxis of case contacts. Treatment is most effective if started within the first week of cough. Antibiotics shorten the time a person with pertussis can give it to others, but because pertussis is toxin-mediated, symptoms do not necessarily resolve with treatment. Treatment initiated 21 days after cough onset will not be useful because no viable organisms will be present.

Close contacts should be treated with antibiotics to prevent infection. Prophylaxis should be initiated as soon as possible after contact with an infectious case. In the mid-2000s, azithromycin (zithromax) was recommended as the drug of choice for treatment of pertussis. Previously, erythromycin had been the drug of choice. However, erythromycin had side effects (e.g. skin rashes and gastrointestinal symptoms) and a much longer course of treatment (10-14 days) whereas a course of azithromycin is only 5 days and with fewer reported side effects.

Graph 3

Hennepin County First Antibiotic Prescribed for Pertussis Case-Patients 2005-2009

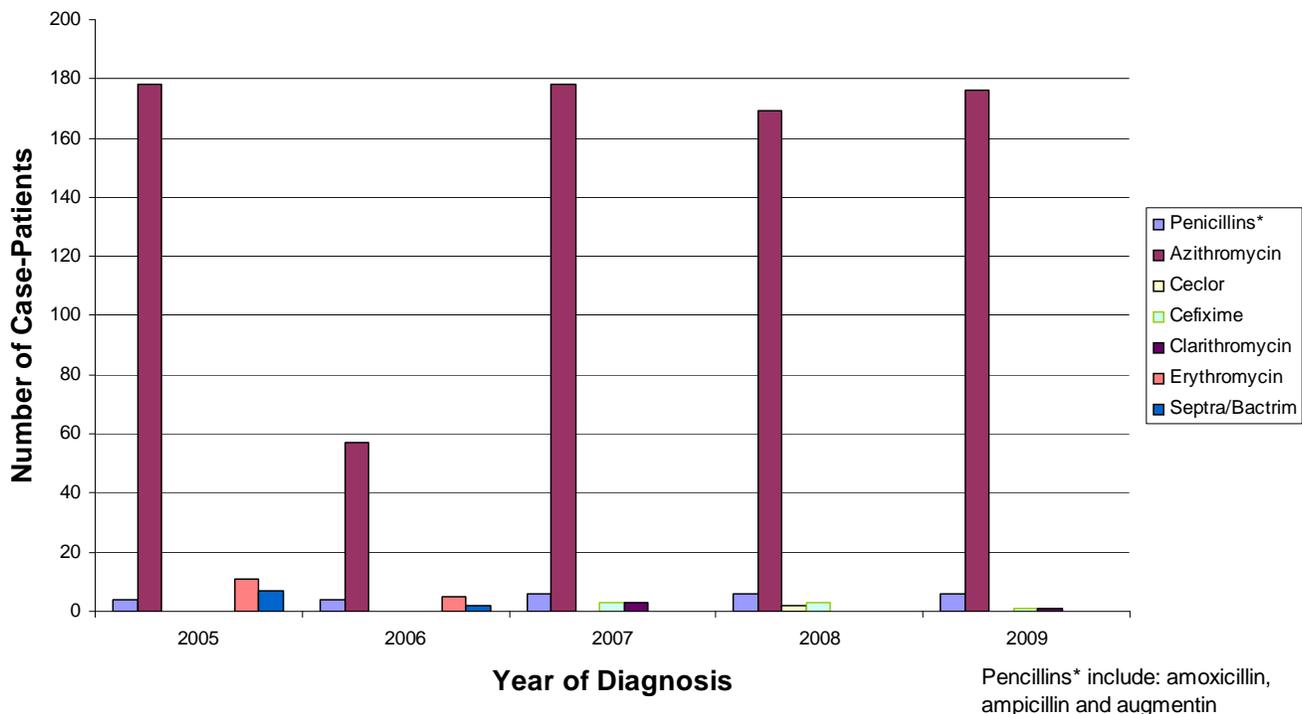


Table 2.

Antibiotic Treatment and Prophylaxis

DRUG	INFANT (<u><</u> 6 months of age)	CHILD (<u>≥</u> 6 months of age)	ADULT
Azithromycin ^{1,4} (3-day course not yet approved for treatment of pertussis)	1-5 months: 10 mg/kg/day orally daily for 5 days <1 month of age: same as above and is the preferred choice for infants <1 month	10 mg/kg/day orally on the first day (maximum 500 mg), 5 mg/kg once daily on days 2-5 (maximum 250 mg/day)	500 mg orally on the first day, 250 mg once daily on days 2-5
Clarithromycin ^{2,4} Not recommended for use in pregnant women	Not recommended for use in infants < 6 months of age; see child dose for infants <u>≥</u> 6 months of age	15 mg/kg/day orally divided into 2 doses/day for 7 days (maximum 1 g/day)	500 mg twice daily for 7 days
Erythromycin ^{1,3,4}	Estolate preparation preferred if available 1-5 months: 40-50 mg/kg/day orally divided into 4 doses/day for 14 days (maximum 2 g/day) <1 month of age: same as above, but should only be used as an alternate drug. Drug use is associated with elevated risk of IHPS	40-50 mg/kg/day orally divided into 4 doses/day for 14 days (maximum 2 g/day)	2 g/day orally divided into 4 doses/day for 14 days
Trimethoprim-Sulfamethoxazole ^{2,4} For those not able to tolerate macrolides Not recommended for use in pregnant or nursing women	Not recommended for use in children < 2 months of age; see child dose for infants <u>≥</u> 2 months of age	8 mg TMP/40 mg SMX/kg/day orally divided into 2 doses/day for 14 days (maximum 320mg TMP/1600mg SMX/ day)	320 mg TMP/ 1600 mg SMX per day orally divided into 2 doses/day for 14 days

¹ FDA Pregnancy Category B drug

² FDA Pregnancy Category C drug

³ Some authorities prefer the estolate preparation for children but recommend avoiding its use in adults and pregnant woman

⁴ Source: Centers for Disease Control and Prevention (CDC): Recommendations for Pertussis Treatment and Prophylaxis—January 2005. www.cdc.gov/vaccines/pubs/pertussis-guide/guide.htm

Vaccination

Vaccination of susceptible individuals is the most important preventive strategy against pertussis. Five doses of diphtheria and tetanus toxoid and acellular pertussis (DTaP) are recommended for children at 2, 4, 6, 15–18 months and 4–6 years of age. Studies have shown that protection from the pertussis vaccine (DTP/DTaP) decreases from 3 to 5 years after the last vaccination.

Unvaccinated children are at high risk for pertussis, but fully vaccinated children may also develop the disease. Disease in those previously vaccinated is usually mild. Vaccine efficacy for the currently licensed DTaP vaccine ranges from 80%-85%.³

For years 2006–2009, 52 case-patients were 7 months through 5 years of age. Of these 34 (65.4%) had three or more doses of DTP/DTaP vaccine (primary series) prior to onset of illness; 17 (32.7%) had received fewer than 3 doses and were considered preventable. One child's vaccine history was not available.

In 2005, vaccines containing tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap) were licensed in the United States. These formulations were geared towards adolescents and adults.

Tdap recommendations for:

Adolescents: Routine vaccination at ages 11 or 12. Adolescents aged 13 through 18 should receive a single dose of Tdap, if they have not received a Td (tetanus/diphtheria) booster in the last 5 years.

Adults Ages 19 through 64: One dose of Tdap vaccine is recommended in place of the next

booster of Td. Tdap is recommended for adults having close contact with infants less than 12 months of age, providing the interval of the most recent Td was two years or more.

Of those 20 years or older, 105/112 (93.7%) did not have a record of being vaccinated or did not remember if they had been vaccinated. In 2005 an adult pertussis vaccine was licensed but none of these individuals had received the Tdap vaccine.

Exclusion

Persons with pertussis should be excluded until 5 days after appropriate antibiotic treatment begins. During this time the person with pertussis should NOT participate in any childcare, school, or community activities. If not treated with 5 days of antibiotics, exclusion should be for 21 days after cough onset.

If there is a high index of suspicion that a person has pertussis, exclude until 5 days of antibiotics are completed or until the laboratory test comes back negative.

Reporting

Due to the under-recognition and underreporting of pertussis, along with challenges of laboratory testing, it is crucial to report both cases that are suspect (clinically diagnosed) and laboratory confirmed. Laboratory confirmation of pertussis is highly recommended.

Promptly report the case (suspect or lab-confirmed) to the Minnesota Department of Health at (651) 201-5414 or Hennepin County Human Services and Public Health—Epidemiology at (612) 543-5230.

Surveillance

The national pertussis surveillance system relies on healthcare providers, school health professionals, childcare providers and consultants, and laboratories to report cases of pertussis to state or local public health departments, which then report cases weekly to the National Electronic Transmittal System for Surveillance.

Despite high childhood vaccination coverage levels for pertussis, pertussis remains a cause of substantial morbidity in the United States. The recent rise of pertussis shows the following trends:

- Adolescents and young adults represent an increasing proportion of cases. During 2005-2009 in Minnesota, 62% of the cases were in school-aged children (ages 5–18).
- Infants that get pertussis are usually less than 6 months of age, and have not had the initial three doses of vaccine.
- Studies have shown that infants are often exposed through an older household member.

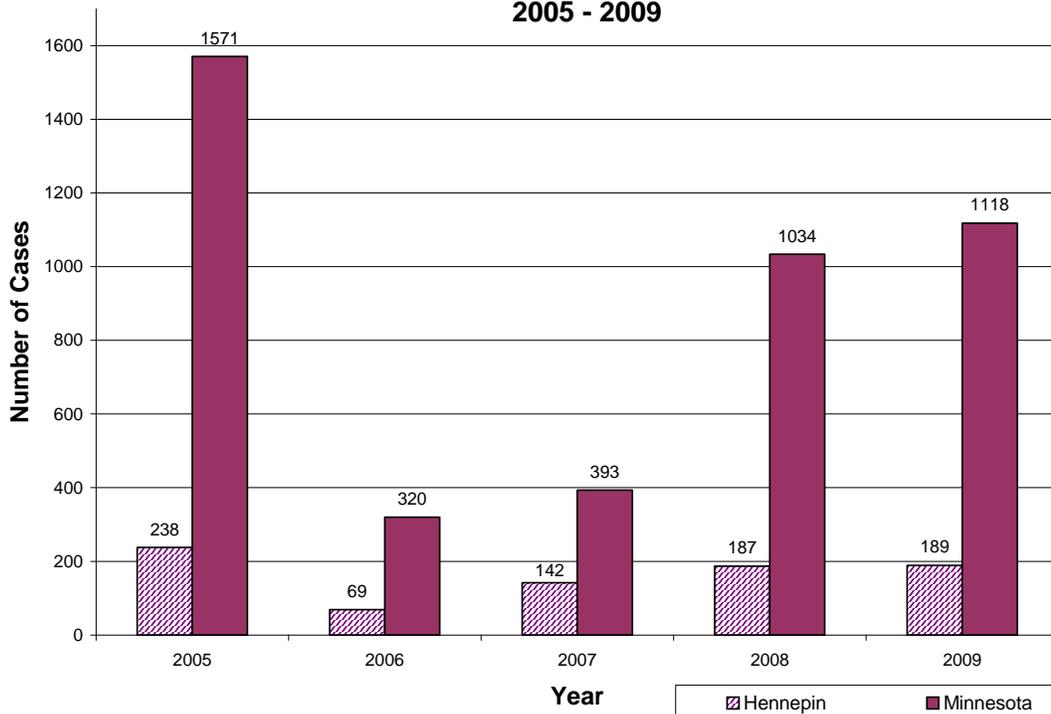
Investigations

Public health investigates reports of suspect and laboratory confirmed cases of pertussis. The purpose of the investigation is two-fold. For the case-patient, public health makes recommendations for exclusion from school, childcare, work, and other activities; provides notification letters for groups where the case had been (classroom, activities such as sports, music, dance, adventure club, after school groups); and identifies source(s) of infection and contacts of the case (who are household members or who would have had close contact). For household or close contacts, public health will often recommend prophylaxis and provide information about pertussis. Examples of these information sheets can be found in *Infectious Diseases in Childcare Settings and Schools* at

www.hennepin.us/daycaremanual

Graph 4

**Pertussis Cases
Hennepin County and Minnesota
2005 - 2009**



During 2005–2009 Hennepin County averaged 18.6% of the pertussis cases in Minnesota with a range from 15.1% to 36.1%.

Points to Remember

- Report **all** cases of pertussis (suspect or lab-confirmed) to the Minnesota Department of Health at (651) 201-5414 or Hennepin County Public Health—Epidemiology at (612) 543-5230.
- Promptly treat case-patient with recommended antibiotics if, at the time of diagnosis, the cough has been present less than 3 weeks.
- Antibiotics are recommended for both treatment of pertussis cases and prophylaxis of asymptomatic close contacts. All household contacts should be prophylaxed. Public health may recommend prophylaxis for childcare contacts and participants of certain activities that are deemed high risk of developing disease.
- Exclude pertussis cases from childcare/school/work/activities until 5 full days of antibiotic treatment are completed, or it has been 21 days since the cough onset if antibiotics are refused.
- Test for pertussis **ONLY** in symptomatic individuals.
- Public health staff will help determine if preventive antibiotics are needed if someone in your childcare or school develops pertussis.
- Communicate with your local public health agency. Public health staff are your partners in preventing pertussis outbreaks.

Points to remember, continued

- Vaccine is recommended for people who are exposed to pertussis and who are not up to date on pertussis vaccinations. They should contact their healthcare provider or public health clinic to be vaccinated.
- Cover your nose and mouth with a tissue when coughing or sneezing, or cough/sneeze into your sleeve. Dispose of used tissues.
- Wash hands thoroughly with soap and warm running water after contact with secretions from the nose or mouth. **Thorough handwashing is the best way to prevent spread of communicable diseases.**
- Clean and sanitize mouthed toys, objects, and surfaces at least daily and when soiled.

www.hennepin.us/daycaremanual

References:

1. Control of Communicable Diseases Manual. American Public Health Association; 2009.
2. Red Book. 2009 Report of the Committee on Infectious Diseases. American Academy of Pediatrics; 2009.
3. Epidemiology and Prevention of Vaccine-Preventable Diseases. Pink Book. Centers for Disease Control and Prevention; 2009.
4. Vaccine Preventable Disease Surveillance Manual. Centers for Disease Control and Prevention; 2008.

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