School-Associated Pertussis Outbreak—Yavapai County, Arizona, September 2002–February 2003

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2 figures, 1 table omitted

On September 21, 2002, a pertussis case (confirmed by isolation of Bordetella pertussis) was reported to the Yavapai County Health Department (YCHD). The patient was a child aged 13 years in the 8th grade at a middle school in Yavapai County; the child had attended school during the illness. A case consistent with the clinical definition of pertussis had been reported in another student in the same classroom 2 weeks earlier. On September 22, a second culture-confirmed case was reported from the same classroom. Subsequent investigation identified five additional persons (two students in the same classroom, two 8th-grade teachers, and one parent of an ill student) with prolonged cough illnesses. In comparison, during the previous 10 years, an average of four pertussis cases were reported annually from this county. On September 26, YCHD, in conjunction with the Arizona Department of Health Services (ADHS) and school officials, notified the community of the pertussis outbreak in the middle school and initiated control measures. This report summarizes the epidemiology of the outbreak and the control measures used to contain it. Health-care providers should consider pertussis in persons of any age with acute cough illnesses and consider obtaining nasopharyngeal (NP) specimens for B. pertussis culture.

A probable case of pertussis was defined as an acute cough illness lasting ≥14 days. In a person with ≥1 day of cough, cases were confirmed by isolation of B. pertussis from an NP specimen. In persons with cough of ≥14 days, cases were confirmed by either (1) a positive polymerase chain reaction (PCR) test result for B. pertussis DNA from an NP specimen or (2) epidemiologic linkage to a person with a laboratory-confirmed case. Epidemiologic linkage was defined as close contact with a person with laboratory-confirmed pertussis or attendance at the same school as a person with a laboratory-confirmed case.

Public health and school officials implemented an aggressive control strategy requiring the exclusion of any coughing student or staff member from the school through the fifth day of treatment with an antibiotic recommended for pertussis. Parents of excluded students were given letters advising them to contact their health-care providers for medical examination, to contact YCHD to have an NP specimen collected for culture, and to stay at home and away from others (particularly infants and young children) through the fifth day of treatment. Health-care providers were alerted to the pertussis outbreak through an existing e-mail and facsimile network and were urged to send patients with suspected pertussis to YCHD for NP specimen collection. To attempt isolation of B. pertussis, YCHD forwarded all NP specimens collected to Arizona’s Bureau of State Laboratory Services (BSLS). If identified at another laboratory, B. pertussis isolates were forwarded to BSLS in accordance with Arizona administrative code. All B. pertussis isolates were forwarded to CDC for pulsed-field gel electrophoresis (PFGE) profiling. A sample of NP specimens collected by YCHD was forwarded from BSLS to CDC for PCR testing. PCR testing targeted genes coding for an insertion element (IS481) and for pertussis toxin subunit 1 (ptxS1).

On October 24, YCHD and ADHS recommended initiation of an accelerated pertussis vaccination schedule for infants because of the increasing number of pertussis cases identified throughout six communities in Yavapai County. On the accelerated schedule, the first 3 doses of the diphtheria and tetanus toxoids and acellular pertussis (DTaP) vaccine are administered at ages 6, 10, and 14 weeks rather than at the usual recommended ages of 2, 4, and 6 months. Other vaccinations recommended according to the childhood immunization schedule also were administered on the accelerated schedule.

A total of 485 pertussis cases were reported from six communities (2000 population: 83,550 in the county (580.5 per 100,000 population): 218 confirmed cases (16 by isolation of B. pertussis and 202 by epidemiologic linkage) and 267 probable cases (Figures 1 and 2). Of the 485 cases, 203 (42%) were associated with schools; 113 (56%) were in students, eight (4%) were in school staff, and 82 (40%) were in family members (including the nine infants with cases confirmed by epidemiologic linkage) or close contacts of ill students or staff members. Cases were identified in an elementary school, a middle school, and a high school (Table). The highest attack rate was among students in the 8th grade of the middle school; of 198 students in this grade, 20 (10%) were confirmed to have pertussis. Males accounted for 193 (54%) of 357 persons aged 0–19 years and 24 (19%) of 128 persons aged ≥20 years. The median age of persons with pertussis was 13 years (range: 0–83 years). Among the 29 infants aged <1 year, 20 (69%) had onset before October 24, when the accelerated schedule was recommended; of the nine cases that occurred after October 24, one infant was too young to be vaccinated, seven were aged ≥14 weeks and were ineligible for the accelerated schedule, and one was eligible but did not receive vaccine according to the accelerated schedule. DTaP vaccination data were available for 24 (83%) infants; three (13%) infants were not vaccinated; eight (33%) received 1 DTaP vaccination; five
(21%) received 2 DTaP vaccinations; and eight (33%) received 3 DTaP vaccinations. Although 15 (52%) of the 29 infants were aged <6 months, no infants were hospitalized for pertussis.

Of 1,047 NP samples sent to BSLS, CDC tested 569 (54%) by PCR. Of these 569 samples, 11 (2%) had positive PCR results for *B. pertussis* DNA, 462 (81%) had negative results, and 96 (17%) could not be tested because of improper specimen processing or were indeterminate because of contamination. Of the 11 persons with positive PCR results, 10 (91%) also had *B. pertussis* isolated at BSLS. The one case with a positive PCR result and a negative culture result was in a person in close contact with a person from whom *B. pertussis* was isolated.

All 16 *B. pertussis* isolates were profiled genetically by PFGE, and four profiles were identified: profile 10 (63%), profile 160 (25%), profile 13 (6%), and profile 55 (6%). Profile 10 was identified in *B. pertussis* isolates from epidemiologically linked patients attending the middle and high school. Seven of the eight isolates from middle school students were profile 10; seven of these students were linked epidemiologically and had cough onset within 1 month of each other. The eighth student had onset of pertussis 3 months later, and the isolate was PFGE profile 55.

The outbreak peaked in mid-October and lasted 6 months. The last culture-positive case occurred in a person who had cough onset on January 10, 2003.

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CDC Editorial Note: Middle and high school–associated pertussis outbreaks are recognized increasingly and reported to state health departments, but few outbreak investigation results are published. The Yavapai outbreak shared features of many of these outbreaks, including a substantial number of cases among older children and adolescents (i.e., persons aged 10-19 years) and subsequent spread to the community, with cases among infants aged <1 year. In the United States, cases in older children and adolescents are reported most commonly in the fall, when students return to school. Because of waning immunity, older children and adolescents can become susceptible to pertussis 5-15 years after the last DTaP dose. In 2002, pertussis cases in persons aged 10-19 years constituted 29% (7.0 per 100,000 population) of 9,771 nationally reported cases (CDC, unpublished data, 2003). In the six affected communities in Yavapai County, the incidence of confirmed and probable pertussis among older children and adolescents was 1,348 per 100,000 population.

Attack rates among children in the three schools differed by school and grade. The outbreak was recognized first among students in the 8th grade of the middle school, which had higher attack rates than either the elementary or the high school. Although control measures implemented when the outbreak was identified appear to have contributed to lower attack rates in the elementary and high schools, differences in susceptibility, efficiency of transmission, or mixing patterns also might have been factors. The coverage level for ≥4 DTaP doses among children entering elementary school was >90% (ADHS, unpublished data, 2003); these children probably had immunity from recent DTaP vaccination. Although high school students can be susceptible to pertussis, and high attack rates have been documented, immunity boosted by exposure to *B. pertussis* before this outbreak might account for the low attack rate at this school.

In this outbreak, CDC's PCR testing was as specific as *B. pertussis* isolation but not more sensitive in confirming *B. pertussis* infection. The concordance of results was high and probably reflects the use of two sets of primers and a stringent quality-assurance program that detected false-positive results. In other pertussis outbreaks in which different PCR primers and protocols were used, cases with PCR-positive but culture-negative results were identified. Although they are widely used in the United States, PCR assays have not been standardized, and their predictive value for pertussis is unknown. Exclusive use of nonstandardized PCR assays can result in either underestimation or overestimation of pertussis.

As in other school outbreaks, a single PFGE profile predominated among the middle school isolates, including student-to-student spread. Community-wide outbreaks have been associated with an increase in *B. pertussis* infections with PFGE profiles that predominated before the epidemic. Although minimal data are available on the profiles of strains circulating in Yavapai County before the outbreak, outbreak PFGE profiles 10 and 13 were identified among 169 sporadic isolates recovered in Arizona during 1999-2003 (CDC, unpublished data, 2003).

The data described in this report are subject to at least two limitations. First, because persons can have cough of ≥14 days from other illnesses, the use of the probable case definition and epidemiologic linkage to confirm cases in Yavapai County might have led to an overestimation of the size of the outbreak. However, although pertussis is challenging to confirm, studies of pertussis incidence have documented that passive reporting underestimates pertussis incidence. The absence of severe illness among infants could have resulted from the lack of specificity of the case definition used; milder illness also is consistent with DTaP vaccine–induced protection. Second, because the epidemic peak coincided with the time that the accelerated DTaP vaccination schedule was recommended, the impact of this recommendation could not be evaluated. Additional studies are needed to evaluate the effectiveness of the accelerated schedule.

Although infants with pertussis can become severely ill and die, no pertussis-associated hospitalizations or deaths were reported during this outbreak.
break. In contrast to disease severity observed commonly among infants, older persons with pertussis often have a mild illness. As a result, older persons might not visit a health-care provider until several weeks after cough onset, when recovery of the fastidious *B. pertussis* bacterium is unlikely and diagnosis might not be confirmed. Recognizing pertussis outbreaks in schools is challenging for several reasons, including (1) patients usually do not seek medical care early, (2) a diagnosis of pertussis might be delayed or not considered, and (3) the sensitivity and specificity of diagnostic tests will be low if NP specimens are not obtained and transported to the laboratory under optimal conditions. Health-care providers should consider pertussis in persons of any age with an acute cough illness and consider obtaining NP specimens for culture. Early recognition, treatment, and chemoprophylaxis can help prevent transmission to others; because of its severity in young unvaccinated infants, preventing pertussis in this population is of greatest importance.\textsuperscript{1,4,5,10}

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**Protocols for Confirmation of Reactive Rapid HIV Tests**

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1 table omitted

ON NOVEMBER 7, 2002, THE FOOD AND Drug Administration (FDA) announced approval of the OraQuick® Rapid HIV-1 Antibody Test (OraSure Technologies, Inc., Bethlehem, Pennsylvania) for use by trained personnel as a point-of-care test to aid in the diagnosis of infection with human immunodeficiency virus type 1 (HIV-1). Subsequently, two other rapid HIV tests have been approved by FDA: the Reveal™ HIV-1 Antibody Test (MedMira Laboratories, Halifax, Nova Scotia) and the Uni-Gold Recombigen™ HIV Test (Trinity Biotech, Wicklow, Ireland).

All reactive rapid HIV test results require confirmatory testing. CDC described protocols for confirming reactive rapid HIV tests based on a consultation convened in January 2003 with expert laboratory scientists, FDA, and the Centers for Medicare and Medicaid Services. These protocols recommend (1) confirmation of all reactive rapid HIV test results with either Western blot (WB) or immunofluorescent assay (IFA), even if an enzyme immunoassay (EIA) screening test is negative, and (2) follow-up testing for persons with negative or indeterminate confirmatory test results, with a blood specimen collected 4 weeks after the initial reactive rapid HIV test result.

In September 2003, CDC initiated postmarketing surveillance in 14 state and local health departments to monitor the performance of the OraQuick® test. Follow-up was attempted for all persons with reactive OraQuick® tests who had either nonreactive EIAs or negative or indeterminate WB or IFA results. For the 21 such persons who were identified through the surveillance system (Table), follow-up testing was initiated at the testing sites’ reference laboratories only as a result of postmarketing surveillance; test results are available for 13 of these persons.

At least five HIV-infected persons were informed incorrectly that their rapid HIV test results were false-positive. Several public health and commercial laboratories contacted during this same period also indicated that they did not perform WB or IFA on OraQuick®-reactive specimens if the laboratory EIA was nonreactive. Additional persons might have received erroneous results from incomplete confirmatory testing.

CDC emphasizes that reactive rapid HIV tests must be confirmed with WB or IFA, even if a subsequent EIA is nonreactive. If such confirmatory testing yields negative or indeterminate results, follow-up testing should be performed on a blood specimen collected 4 weeks after the initial reactive rapid HIV test result.

**REFERENCES**


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