Coughing Up Answers: A Community’s Response to Pertussis

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Pertussis is a highly contagious but vaccine-preventable disease. In spite of relatively high immunization rates, the number of cases continues to rise. A recent outbreak of pertussis in Alamance County, North Carolina, led to changes in response efforts and improved communication among partners, but it also left public health workers with many unanswered questions.

Pertussis, or whooping cough, was first recognized in France in 1414, and the first epidemic was recorded in Paris in 1578, but the organism responsible for infection, *Bordetella pertussis*, was not isolated until 1900 [1]. Known for the fits of coughing it causes and for the distinctive whooping sound patients make between coughs, pertussis remains one of the leading causes of deaths from vaccine-preventable disease worldwide, resulting in an estimated 300,000 deaths per year [2]. Until the late 20th century, pertussis was one of the most common childhood diseases in the United States.

Pertussis is typically described as having 3 stages [3]. The first stage is characterized by cold-like symptoms such as a runny nose, low-grade fever, and a mild cough; this stage may last up to 2 weeks. The next stage involves numerous coughing fits, and patients typically make a whooping sound between coughs—hence the common name “whooping cough.” This second stage typically lasts 1–6 weeks but may last as long as 10 weeks. Coughing decreases during the final stage, but coughing fits may still occur; this convalescence stage may last a couple of weeks [3].

Antibiotic treatment is standard for pertussis infection, and early treatment is important for decreasing the severity of illness and for preventing the spread of disease. However, antibiotic treatment after 3 weeks of illness is unlikely to be effective; by that time, bacteria have left the body, although symptoms may still be present. Antibiotics may also be given to individuals who have been in contact with an infected individual in order to prevent further spread of the disease [4].

At its peak in the 1930s, pertussis affected approximately 265,000 individuals per year and killed thousands of American children every year. Use of vaccine began in the mid-1940s and eventually became widespread, after which the number of cases of pertussis declined dramatically, reaching an all-time low in the late 1970s [5]. Since the 1980s, the number of pertussis cases has gradually increased, however, with outbreaks occurring approximately every 3–5 years [5]. Alamance County experienced such an outbreak beginning in the winter of 2011.

In December 2011, a child attending a local Alamance County school was diagnosed with pertussis. Upon investigation of the child’s contacts, many other children were found to be exhibiting symptoms of pertussis. Initially, staff members of the Alamance County Health Department followed existing guidelines from the Centers for Disease Control and Prevention (CDC), which stated that antibiotic prophylaxis should be administered to all close contacts of each case—that is, household contacts and others who had spent at least 15 minutes within 3 feet of the infected child [6]. Additionally, if 2 or more cases were found in the same classroom or on the same school bus, then all the children in that class or on that bus were considered contacts and received prophylaxis. Following these guidelines was a daunting task, and hundreds of courses of prophylactic antibiotics were administered in the first few weeks of the outbreak.

After weeks of administering prophylactic antibiotics, the health department saw that this strategy was having little effect in containing the spread of the disease, so they asked state partners and the CDC to review the response approach. After consultation with these groups, the health department moved from a strategy of providing prophylaxis for all close contacts to a more targeted strategy that focused on providing protection for contacts who had the highest risk of morbidity if they were to become infected with pertussis. These high-risk individuals included close contacts with a weakened immune system or chronic lung disease, pregnant women at more than 20 weeks of gestation, and infants younger than 12 months of age [6]. At the same time, the health department redoubled efforts to administer booster doses of the combination vaccine containing tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap) to
all individuals meeting CDC criteria for vaccination.

From November 2011 through October 2012, 173 cases of pertussis were identified in Alamance County (Table 1). The number of cases began to return to baseline in August 2012 and has remained at or below baseline since that time. The number of cases peaked between December 2011 and February 2012, with the highest number of cases diagnosed in December (n = 42). The median age of infected individuals was 8 years, but infected individuals ranged in age from less than 12 months to 87 years. Of note, more than 17% of infected individuals were 18 years of age or older.

In approximately 88% of the laboratory-confirmed cases of pertussis and in 76% of probable cases, the patient was up-to-date on pertussis vaccine. In the cases involving school-age children, almost all (98%) of the patients were up-to-date on pertussis vaccine. In 2 cases, the patient was too young to have received the vaccine. No pertussis-related deaths occurred during this outbreak.

In addition to implementing revised guidelines for antibiotic prophylaxis and redoubling immunization efforts, the health department responded to the outbreak by initiating the Incident Command System—which is often used in preparedness work—to organize staff, community partners, and the overall effort. Under unified command, representatives from the health department, the Alamance-Burlington School System administration, the local hospital, and private practices—along with school principals, school nurses, and public information officers—developed initial action plans, set objectives, and assigned tasks. A 3-pronged approach was used to disseminate information to stakeholders: a letter was sent to all parents with children in the local school system; a communicable-disease bulletin was sent to local medical providers to increase their awareness of pertussis in the community; and press releases were prepared for the community at large. As more and more potential contacts were identified, the health department created a 24/7 communicable-disease phone line to answer questions from parents. Restrictions and cost barriers for booster doses of pertussis vaccine (Tdap) were lifted, allowing the health department to administer the vaccine to anyone meeting
<table>
<thead>
<tr>
<th>Case status</th>
<th>No. (%)</th>
<th>Median age (range)</th>
<th>Infants No. (%)</th>
<th>Males No. (%)</th>
<th>Pertussis vaccination status</th>
<th>Up-to-date No. (%)</th>
<th>Not up-to-date No. (%)</th>
<th>Not old enough to receive vaccine* No. (%)</th>
<th>Unknown No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirmed</td>
<td>87 (50)</td>
<td>9 years (3 weeks–87 years)</td>
<td>5 (42)</td>
<td>40 (46)</td>
<td>76 (88)</td>
<td>—</td>
<td>2 (2)</td>
<td>9 (10)</td>
<td></td>
</tr>
<tr>
<td>Probable</td>
<td>86 (50)</td>
<td>8 years (2 weeks–75 years)</td>
<td>7 (58)</td>
<td>35 (41)</td>
<td>65 (76)</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>19 (22)</td>
<td></td>
</tr>
<tr>
<td>Total cases</td>
<td>173 (100)</td>
<td>8 years (2 weeks–87 years)</td>
<td>12 (100)</td>
<td>75 (43)</td>
<td>141 (82)</td>
<td>1 (1)</td>
<td>3 (1)</td>
<td>28 (16)</td>
<td></td>
</tr>
</tbody>
</table>

*Pertussis vaccination begins at 2 months of age.

At onset of illness, 1 case was 3 weeks old and other was 5 weeks old.
CDC criteria, regardless of insurance eligibility or purchase constraints. Mass vaccination clinics were organized, and local health fairs and community events served as venues for administration of the vaccine. The health department also used off-site points of distribution for Tdap so that local providers could administer the vaccine at no cost, and the health department worked closely with staff members at the local hospital to vaccinate all new parents whose babies were delivered at the hospital, in order to create a cocoon of protection around infants who were too young to be eligible for the vaccine.

Although the outbreak dissipated, numerous challenges confronted those who were trying to prevent further disease in the community. Specific to this outbreak, timing was everything. Notification that the disease was present in the school system coincided with winter break and holiday celebrations, making it difficult to reach, isolate, and treat potential cases. In addition, because the local schools were the epicenter of cases, the initial approach of providing prophylaxis to all close contacts created a sizable challenge. The large number of individuals included in the initial approach meant that many public health workers were needed to track, notify, and monitor cases. The cost of prophylaxis for all close contacts was also significant. Hundreds of doses of antibiotics were administered in the initial response, and we still do not know the total cost to the public health system in Alamance County, as it includes not only the cost of the vaccine but also costs associated with staff hours at the health department, manpower hours at local schools, facility time at mass vaccinations, and miscellaneous supplies.

One of the challenges facing medical providers was differentiating pertussis from other respiratory infections during the advent of cold and influenza season. Since pertussis had seldom been seen in Alamance County, the outbreak served as a teaching moment, allowing public health workers to educate private providers about the epidemiology, identification, treatment, and containment of pertussis. Additionally, it provided an opportunity to collaborate in addressing a communitywide outbreak of vaccine-preventable communicable disease. The health department continually kept providers updated with the latest information by forwarding correspondences from the North Carolina Division of Public Health and the CDC regarding differentiation of pertussis from other respiratory infections and effective control measures. This was especially true when the outbreak response changed.

As a more complete picture of this outbreak developed, larger and more global challenges also emerged. As we have noted, the vast majority of individuals diagnosed with pertussis during this outbreak had been properly immunized, which raised questions regarding the efficacy of the acellular vaccine and the potential need for additional booster doses of pertussis vaccine in elementary school-aged children and in adults. Currently, the CDC recommends that children get 5 doses of the combination vaccine against diphtheria, tetanus, and pertussis (DTaP), to be administered at the ages of 2 months, 4 months, 6 months, 15–18 months, and 4–6 years (prior to entry into kindergarten); doses of the booster (Tdap) should then be administered at age 11–12 years and again at age 19 years, especially if individuals have close contact with infants [7]. The combined vaccine (DTaP) used to protect against pertussis was changed in the 1990s, with the whole-cell pertussis component being replaced by an acellular pertussis component. Recent research suggests that the acellular combined vaccine may not provide the same level of protection as the previously used whole-cell combined vaccine, leaving individuals with varying immune responses or waning immunity [8, 9]. The booster vaccine (Tdap) also contains an acellular pertussis component. Although the local health department is not charged with addressing these larger issues, staff members do have questions regarding the potential for waning immunity when the acellular vaccine is administered. That said, booster doses of Tdap vaccine at ages 11–12 and 19 years remain the best defense against widespread pertussis.

Although pertussis is a vaccine-preventable disease and there is evidence of a relatively high rate of immunization in North Carolina, pertussis continues to endure as an epidemic disease. Early identification of pertussis is especially important in treating infants and those living in households with infants. One of the most effective ways of protecting infants is to introduce vaccine at 2 months of age and to comply with the vaccination schedule recommended by the CDC’s Advisory Committee on Immunization Practices. It is also important to ensure that adults who have close contact with vulnerable infants and children are properly immunized against pertussis.

The pertussis outbreak in Alamance County led to changes in how public health workers respond to an outbreak in classroom and school situations; these changes were implemented following consultation with the CDC. The health department continues to educate caregivers, school staff, and the community at large about the importance of immunization for children and adults in order to prevent disease. Hopefully other communities and counties in the state will study the pertussis outbreak in Alamance County and reassess their own needs with regard to pertussis vaccine for their residents in order to better prevent future outbreaks. NCMJ


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References