Coping With a Pertussis Outbreak in Alamance County, North Carolina

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At its peak prevalence in the United States in the 1930s, pertussis (whooping cough) affected as many as 265,000 people per year, killing thousands of infants [1]. With the introduction of a combination vaccine for diphtheria, pertussis, and tetanus (DPT) in the mid 1940s, the number of annual cases gradually decreased, until fewer than 2,000 were being recorded in the 1970s [1]. Since that time, though, the incidence of pertussis has been on the rise, and more than 30,000 cases were reported during the first 9 months of 2012 [2].

Why the resurgence? DPT vaccine, which contains whole-cell pertussis, is very effective but also has an unacceptable side-effect profile. A newer vaccine, DTaP, which has an acellular pertussis component, began gradually replacing the whole-cell vaccine in the 1990s. Although DTaP has fewer side effects than DPT, the immunity it confers is less durable. The acellular vaccine initially provides 98% protection against disease when it is administered to children 4–5 years of age in a 5-dose series, but protection wanes to 71% over the next 5 years [3]. As a result, children 7–10 years of age become susceptible to pertussis, which is also present in the adult population where it often goes undiagnosed. Communities are therefore at increased risk for outbreaks.

Alamance County, North Carolina, experienced such an outbreak recently. In December 2011, a child attending elementary school was diagnosed with pertussis, and investigation of the child’s contacts (schoolmates, fellow school-bus riders, and family members) soon identified many children who had pertussis-like symptoms. Health department nurses spent hundreds of hours talking with families to clarify which children and adults met the case definition for pertussis. Laboratory testing with culture and/or polymerase chain reaction technology was used whenever possible to confirm diagnoses. Contacts in additional schools were identified, and additional unrelated (not epidemiologically linked) cases of pertussis in the community were found by health care providers. A total of 166 cases were diagnosed between December 2011 and August 2012, most of them children in the Alamance-Burlington school system. A total of 24 schools were affected. Inadequate vaccination rates are often blamed for such outbreaks, so it is notable that school records showed that 100% of students in the Alamance-Burlington school system had been appropriately vaccinated. Furthermore, among children with proven disease, 100% of those 3–12 years of age were up to date on their vaccinations, as were 93% of those 13–17 years of age.

Initial responses to the outbreak followed Centers for Disease Control and Prevention (CDC) guidelines [4], which call for administration of prophylaxis to all close contacts of each case—that is, household contacts and those who had spent at least 15 minutes within 3 feet of the ill individual. Furthermore, when 2 or more cases of pertussis were identified in a classroom or on a school bus, all of the children in that classroom or on that bus were considered close contacts. Hundreds of courses of prophylactic antibiotics were prescribed during the first weeks of the outbreak.

Our public health partners in the Immunization Branch and the Communicable Disease Branch of the North Carolina Department of Health and Human Services worked closely with us throughout this effort. We were becoming frustrated with the burdensome strategy for containment, administration of HPV4 to males followed in 2010, a full routine recommendation for its use among males at age 11–12 years did not occur until 2011. In 2010, a bivalent human papilloma virus (HPV2) vaccine was also approved for use in females. Both vaccines are administered in 3 doses over a period of 6 months.

The 2 HPV vaccines differ both in composition and in indications for use. HPV4 contains purified virus-like particles from the major capsid protein of HPV types 6, 11, 16, and 18, whereas HPV2 contains virus-like particles from the major capsid protein of HPV types 16 and 18. Both HPV4 and HPV2 are indicated for the prevention of cervical cancer and precancerous cervical lesions in women. HPV4 is also indicated for prevention of genital warts, anal cancers, and precancerous anal lesions in both males and females. To be most effective, HPV vaccine should be administered prior to acquisition of infection. Because a significant proportion of adolescents will become sexually active during their mid to late teens and the potential risk for HPV exposure is high, the best time to initiate the vaccine series is during the preteen years. Preteen vaccination also assures the best chance for vaccine series completion in order to achieve optimal protection from infection prior to virus exposure [1, 2].

Other Considerations for Vaccination of Preteens

All 3 routinely recommended preteen vaccinations (MCV4, Tdap, and HPV) can be administered at the same health care visit, thereby decreasing the need for additional visits other than those to complete the 3-dose HPV series and to receive the MCV4 booster at age 16. Preteens should also receive an annual influenza vaccine. Although most preteens can receive the intramuscular inactivated influenza vaccine, an alternative for those without underlying long-term health problems such as asthma is the intranasal administration of live attenuated influenza vaccine. The preteen health care visit also provides an opportunity to assess whether or not preteens are up to date for other immunizations. All preteens should have previously received 2 doses.
which did not appear to be effective, so our state partners soon linked us with pertussis experts at the CDC, who reviewed our approach.

CDC staff informed us that broad-scale prophylaxis for pertussis is ineffective at curbing outbreaks and that they are therefore developing new guidelines. Alamance County implemented this unofficial guidance from the CDC, which focuses on protection of those at highest risk: close contacts to a pertussis case who have a weakened immune system or chronic lung disease, or who live with a woman who is more than 20 weeks pregnant or an infant who is younger than 12 months. This narrowed focus freed our nursing staff to begin the potentially more effective strategy of widespread pertussis vaccination. We administered Tdap vaccine to thousands of people, including parents and staff members of schools and child care centers, and offered vaccination at multiple community events.

Despite its imperfect nature, vaccination is one of our most effective prevention strategies. North Carolina state law requires DTAp vaccination at the ages of 2 months, 4 months, 6 months, and 15-18 months, with a booster dose at age 4-5 years. In addition, administration of Tdap vaccine, which contains a reduced amount of diphtheria toxoid, is now mandated for entrance into the sixth grade and is strongly recommended for every adult.

Immunizing caregivers of infants is especially important. Fewer than 50% of pertussis infections in infants have a known source, but when the source is known, in 80% of cases it is a parent, sibling, or other close family member [3]. Women who are pregnant can be given Tdap vaccine after the 20th week of pregnancy and should receive it immediately after giving birth at the latest. In Alamance County, we partnered with local hospitals and obstetricians to ensure Tdap vaccination of all new mothers, and we also strongly encouraged their family members to be vaccinated.

By October 2012, Alamance County pertussis rates had returned to baseline. We keep our fingers crossed. Our hope is that other North Carolina counties will undertake robust vaccination programs in order to avoid experiencing a similar outbreak. In addition, local health departments and the North Carolina Division of Public Health should continue to work together to determine optimal responses, including use of new strategies based on emerging information about pertussis control.

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References

Teen Vaccination Coverage
In 2011, 77.8% of North Carolina adolescents 13-17 years of age had received Tdap vaccine and 65.9% had received 1 or more doses of MCV4 vaccine as shown in Figure 3 [12]. In addition, 54.4% of females 13-17 years of age had received 1 or more doses of HPV vaccine, but only 32.3% had received the full recommended complement of 3 doses [14]. It is encouraging that state trends in teen vaccine coverage have mirrored national trends by showing steady increases in Tdap and MCV4 coverage over the past 4 years [14-17].

Unfortunately, increases in HPV coverage among adolescent females lag considerably behind those for other teen vaccines. Routine HPV vaccination of males was recommended only recently, so it is too soon to comment on coverage level in that group. National data suggest that younger teens are less likely to have received at least 1 dose of HPV vaccine. These data reflect the reluctance of many parents to vaccinate their preteens. Some parents prefer to defer vaccination based on their assessment of their child’s experience with sexual activity. Likewise, health care providers often reinforce the parents wish to defer vaccination. Providers delay preteen HPV vaccination for a number of different reasons including discomfort discussing sexuality with parents and preteens, a belief that HPV is not a significant health concern for their younger patients, and concern about parental resistance to HPV vaccination [18]. Health care providers should acknowledge the parents’ perspectives but also point out that preventive measures such as the HPV vaccine are best implemented well in advance of any potential infectious exposures.

Improving Delivery of Vaccines to Preteens
Although the barriers to preteen vaccination are many, efforts to mitigate these obstacles are similarly numerous [19]. Preteens present for routine care less frequently than of vaccine(s) for measles, mumps, rubella, and varicella and 3 doses of hepatitis B vaccine [1, 2].

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