

Pertussis Vaccination of Health Care Workers

*ACOEM Medical Center Occupational Health Section Task Force on
Pertussis Vaccination of Health Care Workers*

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Infection with *Bordetella pertussis*, the cause of whooping cough, is common in the adult and adolescent population because immunity from prior illness or childhood vaccination is not lifelong. As many as 800,000 to 3.3 million cases of pertussis may occur annually in the United States. Because pertussis causes cough for prolonged periods of time, and the organism spreads readily from person to person, adults may spread it unwittingly to vulnerable infants or others who are either unprotected or not fully protected by acellular pertussis vaccine.

Health care environments have been the setting for a number of pertussis outbreaks. Health care workers are at risk for occupational infections with pertussis and at risk for inadvertently transmitting pertussis to vulnerable patients, particularly the very young. An acellular pertussis vaccine (Tdap) was approved in 2005 by the US Food and Drug Administration for adults and adolescents, and recommendations from the US Centers for Disease Control and Prevention's Advisory Committee on Immunization Practices (ACIP) call for its administration to the general population and, as soon as feasible, to health care personnel who work in hospitals or ambulatory care settings and have direct patient contact.

The American College of Occupational and Environmental Medicine (ACOEM) continues its support of that recommendation. The College's position is based on current knowledge of the epidemiology of pertussis, its transmission characteristics, documented risk in patient care settings, and efficacy of the Tdap vaccine.

EPIDEMIOLOGY OF PERTUSSIS

The number of reported pertussis cases has generally risen in recent years. A low of 1010 cases was reported in 1976, compared with 27,550 cases in 2010. Age group distribution also has changed, with adolescents and adults comprising an increasing proportion of the total. The rise in reported

illness is likely due to the increased use of diagnostic testing to detect pertussis in adults and may also reflect an increased disease frequency.

However, reported cases represent only the tip of the iceberg. A trial of acellular pertussis vaccine evaluated the incidence of pertussis in a control population by testing for *B. pertussis* infection whenever prolonged cough occurred. Incidence of infection ranged from 370 to 450 cases per 100,000 person years. Extrapolating that rate to the total US population suggests that there are nearly 1 million pertussis cases per year among those aged 15 to 65 years in the United States.¹ A number of other studies have yielded similar results, with estimates ranging from 800,000 to 3.3 million cases per year in the United States.²

Estimates vary regarding how frequently pertussis is the causal agent when a person suffers prolonged cough. Among studies done when no known pertussis outbreak was occurring, an estimated 12% to 50% of chronic cough illnesses were associated with pertussis infection. When only the most specific diagnostic criteria were used in nonoutbreak settings, a median 13% of chronic cough illnesses were due to pertussis.²

CLINICAL CHARACTERISTICS AND DISEASE TRANSMISSION

Pertussis is often unrecognized among adolescents and adults and is highly contagious for several weeks, with 80% of susceptible household contacts becoming infected. This large case reservoir represents a substantial threat to those unprotected or incompletely protected by vaccine with infants less than 6 months of age being the most vulnerable population. From 2004 to 2011, a total of 159 deaths from pertussis were reported in the US, and children younger than 3 months of age accounted for 141 (89%) of those deaths.³ Similar to the experience with transmission of the common cold, pertussis is most contagious during its early catarrhal stage, when infected persons experience only rhinorrhea, sneezing, low-grade fever, and mild occasional cough. It is not until the paroxysmal stage, characterized by coughing fits and prolonged inspiratory phase, that

pertussis is likely to be clinically suspected and diagnosed. Nearly 80% of adults with confirmed pertussis have an illness involving a cough of at least 3 weeks' duration, and 27% have cough lasting longer than 90 days.⁴

THE HEALTH CARE SETTING

In health care settings, where despite recommendations to the contrary, health care workers frequently remain on the job with respiratory symptoms, the threat of transmission from symptomatic, but undiagnosed, health care workers to vulnerable patients is very real. A number of pertussis outbreaks have occurred in hospitals, resulting in transmission to health care workers, vulnerable infants, and other patients.^{5,6} Those outbreaks also have resulted in labor intensive contact tracing and administration of prophylactic antibiotics to large numbers of exposed individuals.

ADULT ACELLULAR PERTUSSIS VACCINE (TDAP)

In 2005, the Food and Drug Administration approved two acellular pertussis vaccines. The vaccines (referred to as Tdap) contain pertussis antigens in a reduced quantity compared to the pediatric formulation, but amounts of tetanus and diphtheria toxoids that are similar to those in the tetanus/diphtheria booster vaccines currently in use in the adult population. Vaccine efficacy for pertussis ranges from 66% to 92%, and the side-effect profile does not differ significantly from the tetanus and diphtheria booster vaccine.^{1,7,8} Most common side effects are pain, redness, or swelling at the injection site. Other reported symptoms include headache, fatigue, and gastrointestinal symptoms. Serious adverse events have not been attributed to Tdap, and its safety has been established among adults and adolescents by several trials.⁹⁻¹³

The ACIP recommends administration of Tdap to the general population and especially to pregnant women.^{14,15} In addition, ACIP recommends that the vaccine be given as soon as feasible to health care workers employed in hospitals and ambulatory settings who have direct patient contact. Targeted groups include—but are

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not limited to—physicians, other primary care providers, nurses, aides, respiratory therapists, radiology technicians, students (medical, nursing, and other), dentists, social workers, chaplains, volunteers, and dietary and clerical workers. The recommendation for administration in health care settings is based on heightened transmission risk in health care settings, the need to protect vulnerable patients, particularly infants, from pertussis, and the desire to minimize transmission risk to health care workers. The recommendation assigns the highest priority to health care workers who have contact with infants younger than 12 months and encourages health care institutions to utilize methods shown to maximize vaccination rates, namely education about the benefits of vaccination, convenient access, and the provision of Tdap to health care workers at no charge.

A recent study demonstrated that Tdap vaccination of health care workers does not obviate the need for postexposure antibiotic prophylaxis.¹⁶ Based on 86 Tdap-vaccinated subjects who were exposed to pertussis over a 30-month period, 98% of those who received antibiotic prophylaxis did not develop pertussis. Among those who received no antibiotic prophylaxis, 86% did not contract illness. However, it should be noted that of the seven subjects who met criteria for pertussis infection (positive nasopharyngeal culture or polymerase chain reaction, twofold rise in IgG titers, or single IgG titer 94 or greater), none developed a cough illness. Based on the study outcome, ACIP recommends antibiotic postexposure prophylaxis for exposed health care workers likely to secondarily expose high-risk patients (eg, neonates, pregnant women). Health care workers without high-risk patient contact are recommended to receive either antibiotic prophylaxis or daily symptom monitoring for 21 days, with antibiotic treatment only if symptoms of pertussis develop.¹⁷

ACOEM POSITION

As the largest professional organization concerned with the prevention and management of occupational exposures, injuries, and illnesses, ACOEM endorses the ACIP recommendation that Tdap be administered as soon as feasible to health care workers with direct patient contact as a vital step to protect both health care workers and patients. While initial costs to administer Tdap to large numbers of health care workers are high, annual expenses to administer vaccine will also decrease after the first year. Although licensed for a single dose, it is anticipated that for continued protection from pertussis, additional doses will be required periodically, possibly up to every 10 years. With wider vaccination coverage, the general population will gradu-

ally contain a larger proportion of vaccinated individuals.

Occupational medicine physicians in hospital settings bring vital experience in the management of vaccine campaigns to this important public health issue. It is expected that initial Tdap administration will be most successfully accomplished by using techniques already shown to be successful in influenza vaccination campaigns, and many occupational medicine physicians may choose to fold Tdap administration into those campaigns. Some may favor a tiered approach, vaccinating first those with direct infant contact. In many hospitals, occupational medicine physicians, in cooperation with colleagues in infection control, will need to present the case to hospital administrators that expenditures for Tdap administration are justified by patient safety and health care worker protection.

When pertussis exposures occur among vaccinated staff, medical center-based occupational medicine physicians need to identify which exposed personnel might have contact with high-risk patients, such as hospitalized neonates and pregnant women, ensuring that those exposed personnel receive antibiotic prophylaxis. Health care workers without high-risk patient contact may receive antibiotic prophylaxis or undergo symptom monitoring for 21 days. Strategies for such monitoring range from daily clinic visits to the establishment of a symptom and body temperature log, with instructions for exposed personnel to contact the Occupational Medicine Department if symptoms or elevated temperature occurs. Symptom-monitoring programs rely on effective methods of educating exposed personnel regarding symptoms of early pertussis, which do not differ from those of commonly circulating upper respiratory tract infections.

Based on 2011 data, Tdap vaccination coverage among health care workers is 37%.¹⁸ Pertussis is a disease that kills otherwise-healthy infants in the United States. Until its epidemiology is fundamentally altered by eliminating the large reservoir of adult and adolescent cases, infants will continue to die from it. Because the most vulnerable of the very young are often treated in hospitals, administration of Tdap vaccine as soon as feasible to health care workers will reduce the likelihood of devastating outcomes among such patients. It will also provide vital protection to millions of US health care workers at enhanced exposure risk from pertussis. ACOEM fully supports pertussis vaccination of health care workers with direct patient contact and urges physicians in its membership who oversee occupational health programs in medical centers to assign high priority to vaccinating health care workers as soon as feasible.

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REFERENCES

1. Ward JI, Cherry JD, Chang SJ, et al. Efficacy of an acellular pertussis vaccine among adolescents and adults. *N Engl J Med*. 2005; 353:1555–1563. Available at: www.nejm.org/doi/full/10.1056/NEJMoa050824. Accessed March 5, 2013.
2. Cherry JD. The epidemiology of pertussis: a comparison of the epidemiology of the disease pertussis with the epidemiology of *Bordetella pertussis* infection. *Pediatrics*. 2005;115:1422–1427. Available at: <http://pediatrics.aappublications.org/content/115/5/1422.long>. Accessed March 7, 2013.
3. Centers for Disease Control and Prevention. *Whooping Cough (Pertussis)*. Updated February 2013. Available at: www.cdc.gov/vaccines/vpd-vac/pertussis/downloads/PL-dis-pertussis-color-office.pdf. Accessed July 18, 2013.
4. Hewlett EL, Edwards KM. Clinical practice. Pertussis—not just for kids. *N Engl J Med*. 2005;352:1215–1222.
5. Christie CD, Glover AM, Willke MJ, Marx ML, Reising SF, Hutchinson NM. Containment of pertussis in the regional pediatric hospital during the Greater Cincinnati epidemic of 1993. *Infect Control Hosp Epidemiol*. 1995;16:556–563.
6. Centers for Disease Control and Prevention. Outbreaks of pertussis associated with hospitals—Kentucky, Pennsylvania, and Oregon, 2003. *Morb Mortal Wkly Rep*. 2005;54:67–71. Available at: www.cdc.gov/mmwr/preview/mmwrhtml/mm5403a3.htm. Accessed March 7, 2013.
7. Rank C, Quinn HE, McIntyre PB. Pertussis vaccine effectiveness after mass immunization of high school students in Australia. *Pediatr Infect Dis J*. 2009;28:152–153.

8. Wei SC, Tatti K, Cushing K, et al. Effectiveness of adolescent and adult tetanus, reduced diphtheria, and acellular pertussis vaccine (Tdap) against pertussis. *Clin Infect Dis*. 2010;51:315–321. Available at: <http://cid.oxfordjournals.org/content/51/3/315.long>. Accessed March 5, 2013.
9. Klein NP, Hansen J, Lewis E, et al. Post-marketing safety evaluation of a tetanus toxoid, reduced diphtheria toxoid and 3-component acellular pertussis vaccine administered to a cohort of adolescents in a United States health maintenance organization. *Pediatr Infect Dis J*. 2010;29:613–617.
10. Blatter M, Friedland LR, Weston WM, Li P, Howe B. Immunogenicity and safety of a tetanus toxoid, reduced diphtheria toxoid and three-component acellular pertussis vaccine in adults 19–64 years of age. *Vaccine*. 2009;27:765–772.
11. Pichichero ME, Rennels MB, Edwards KM, et al. Combined tetanus, diphtheria, and 5-component pertussis vaccine for use in adolescents and adults. *JAMA*. 2005;293:3003–3011. Available at: <http://jama.jamanetwork.com/article.aspx?articleid=201126>. Accessed March 7, 2013.
12. Jackson LA, Yu O, Nelson J, et al. Risk of medically attended local reactions following diphtheria toxoid containing vaccines in adolescents and young adults: a Vaccine Safety Datalink study. *Vaccine*. 2009;27:4912–4916.
13. Yih WK, Nordin JD, Kulldorff M, et al. An assessment of the safety of adolescent and adult tetanus-diphtheria-acellular pertussis (Tdap) vaccine, using active surveillance for adverse events in the Vaccine Safety Datalink. *Vaccine*. 2009;27:4257–4262.
14. Centers for Disease Control and Prevention. Updated recommendations for use of tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine (Tdap) in pregnant women—Advisory Committee on Immunization Practices (ACIP), 2012. *Morb Mortal Wkly Rep*. 2013;62:131–135. Available at: www.cdc.gov/mmwr/preview/mmwrhtml/mm6207a4.htm. Accessed March 7, 2013.
15. Centers for Disease Control and Prevention. Updated Recommendations for use of tetanus toxoid, reduced diphtheria toxoid and acellular pertussis (Tdap) vaccine from the Advisory Committee on Immunization Practices, 2010. *Morb Mortal Wkly Rep*. 2011;60:13–15. Available at: www.cdc.gov/mmwr/preview/mmwrhtml/mm6001a4.htm. Accessed March 7, 2013.
16. Goins WP, Edwards KM, Vnencak-Jones CL, et al. A comparison of 2 strategies to prevent infection following pertussis exposure in vaccinated healthcare personnel. *Clin Infect Dis*. 2012;54:938–945. Available at: <http://cid.oxfordjournals.org/content/early/2012/01/09/cid.cir973.full>. Accessed March 6, 2013.
17. Centers for Disease Control and Prevention. Immunization of health-care personnel: recommendations of the Advisory Committee on Immunization Practices (ACIP). *Morb Mortal Wkly Recomm Rep*. 2011;60:1–45. Available at: www.cdc.gov/mmwr/pdf/rr/rr6007.pdf. Accessed March 6, 2013.
18. Centers for Disease Control and Prevention. Noninfluenza vaccination coverage among adults—United States 2011. *Morb Mortal Wkly Rep*. 2013;62:66–72. Available at: www.cdc.gov/mmwr/preview/mmwrhtml/mm6204a2.htm?s_cid=mm6204a2_w. Accessed March 6, 2013.