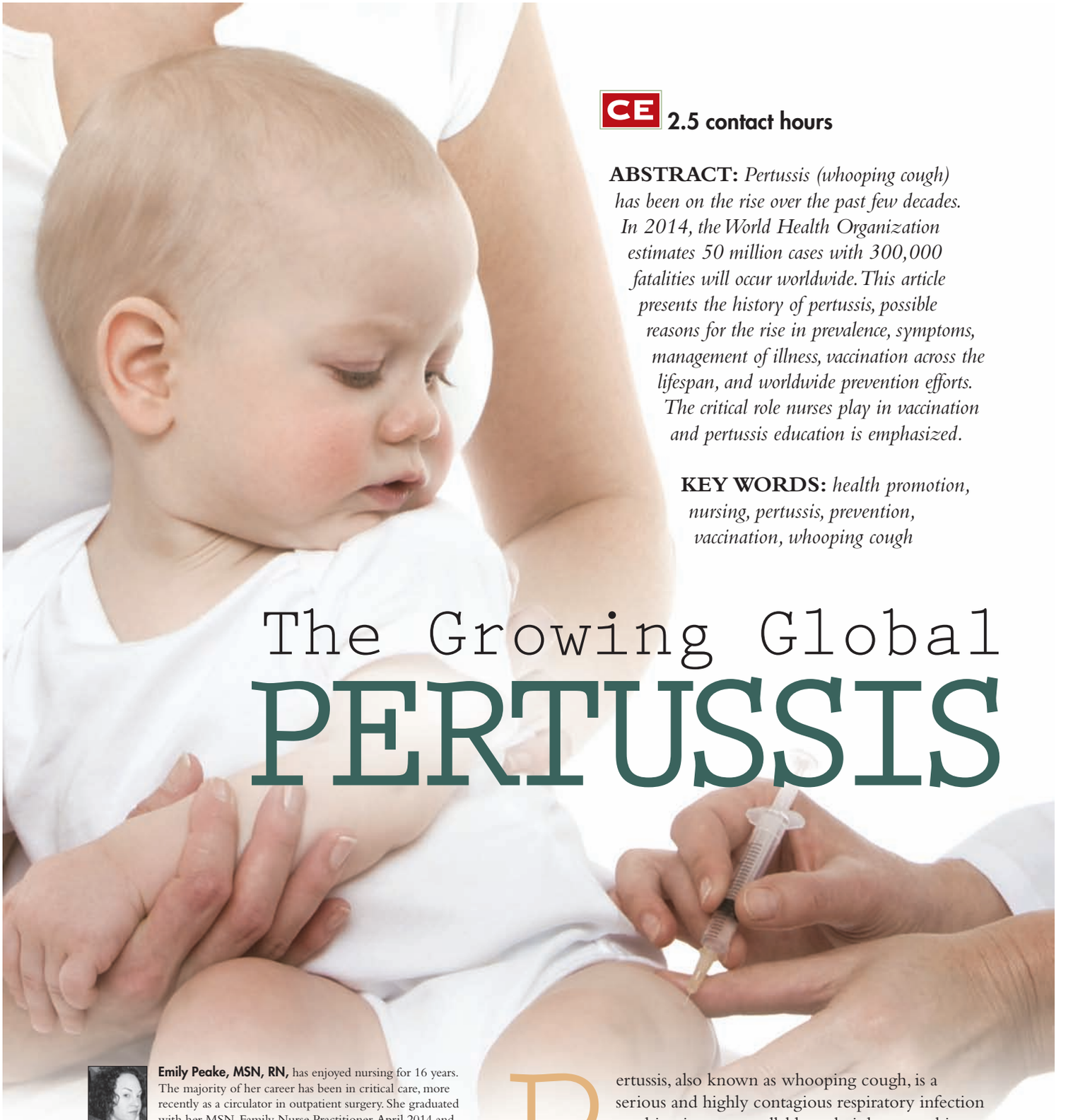

CE 2.5 contact hours

ABSTRACT: *Pertussis (whooping cough) has been on the rise over the past few decades. In 2014, the World Health Organization estimates 50 million cases with 300,000 fatalities will occur worldwide. This article presents the history of pertussis, possible reasons for the rise in prevalence, symptoms, management of illness, vaccination across the lifespan, and worldwide prevention efforts. The critical role nurses play in vaccination and pertussis education is emphasized.*

KEY WORDS: *health promotion, nursing, pertussis, prevention, vaccination, whooping cough*

The Growing Global PERTUSSIS

Emily Peake, MSN, RN, has enjoyed nursing for 16 years. The majority of her career has been in critical care, more recently as a circulator in outpatient surgery. She graduated with her MSN, Family Nurse Practitioner, April 2014 and looks forward to pursuing new endeavors.

Lisa K. McGuire, MSN, MBA-HCM, RN, is Clinical Research Coordinator at Miami Valley Hospital, Dayton, Ohio. She also is Adjunct Professor of Nursing at Miami University, in Ohio. She completed her MSN in April 2014 and looks forward to working as a Family Nurse Practitioner.

The authors declare no conflict of interest.

Accepted by peer review 12/4/2013.

ACKNOWLEDGEMENT: Suzanne Burke and Julie Payne, as students in the Family Nurse Practitioner program at Indiana Wesleyan University School of Nursing, Marion, Indiana, contributed to earlier versions of this article.

DOI:10.1097/CNJ.0000000000000073

Pertussis, also known as whooping cough, is a serious and highly contagious respiratory infection resulting in uncontrollable and violent coughing that makes breathing difficult. As the person, especially a baby or young child, tries to take a breath in between coughs, a "whooping" sound is made. Primarily caused by the *Bordetella pertussis* bacteria, pertussis also is caused by *Bordetella parapertussis* in young children and *Bordetella holmesii* in adolescents and adults (Cherry, 2013). Pertussis infection is particularly dangerous in babies under 1 year, where most whooping cough deaths occur. Worldwide, pertussis is one of the leading causes of vaccine-preventable deaths (World Health Organization [WHO], 2014).

PROBLEM

By Emily Peake and Lisa K. McGuire

In recent years pertussis infections have been on the rise, especially in older children, adolescents, and adults. In the United States, from 1980 to 1990 an average of 2,900 cases of pertussis per year were reported. This jumped to 25,827 cases in 2004 and 27,550 in 2010 with 27 related deaths occurring primarily in babies less than 3 months old (Centers for Disease Control and Prevention [CDC], 2012). In 2012, the CDC (2013a) indicated that 48,000 cases of whooping cough were reported with 20 deaths. Worldwide an estimated 16 million cases of whooping cough were reported in 2008 with 195,000 deaths occurring mostly in children in developing countries (WHO, 2010). Currently, WHO (2014) estimates an annual rate of 50 million cases of pertussis worldwide with 300,000 fatalities.

This article presents a brief history of pertussis, possible reasons for the increase in cases, symptoms, management of illness, prevention through vaccination across the lifespan, and worldwide prevention efforts. The critical role nurses play in preventing whooping cough and improving vaccination through education is emphasized. Table 1 summarizes nursing interventions to decrease pertussis.

PERTUSSIS: A LOOK BACK

Pertussis, first recognized in the Middle Ages, was described as "the kink," a Scottish term meaning fit or paroxysm. The first documented epidemic occurred in the 16th century in 1578 in Paris, France (Baker & Katz, 2004; Cherry, 1996).

The primary cause of pertussis, *B. pertussis*, was discovered in 1906 by Belgium scientists Jules Bordet and Octave Gengou. In the 1930s, a vaccine using diphtheria, tetanus, and killed whole-cell *B. pertussis* organisms was developed (DTwP). Although effective, DTwP contains endotoxin and can have unpleasant side effects such as pain and swelling at the injection site along with fever and malaise. In the 1970s and 1980s, an acellular vaccine (DTaP) was developed with no endotoxin and few side effects, but a smaller number of antigens in comparison with DTwP vaccines. Whole-cell DTwP was used in the United States until DTaP vaccines were put into universal use in the 1990s (Baker & Katz, 2004; Cherry, 2013).

Prior to pertussis vaccination more than 200,000 cases were reported annually in the United States with 5,000 to 10,000 deaths per year. When DTwP vaccination began in the 1940s, a 157-fold decrease in pertussis infections occurred (CDC, 2013a; Cherry, 2013). Continued large-scale DTwP vaccinations during the 1950s and 1960s led to a dramatic reduction (>90%) in incidence and mortality in the industrialized world (WHO, 2010).

PERTUSSIS TODAY

Today, the WHO (2014) lists pertussis as a major cause of death in infants worldwide. Ninety-five percent of cases occur in developing countries and pertussis continues to be a public health concern even in countries with high vaccination coverage. Reported pertussis cases have been gradually increasing worldwide since the 1980s (CDC, 2012; Cherry, 2013). Although the causes for this increase are not entirely clear, several reasons have been suggested.

Since the late 1980s, pertussis diagnoses have increased due to knowledge of the illness from vaccine promotion and popularity of a simple laboratory diagnostic test. Better diagnosis has revealed more pertussis cases, especially in adolescents and adults. In addition, reporting and data collections systems have improved in the last 35 years contributing to more documented cases (Cherry, 2013).

Pertussis immunity wanes over time after vaccination so little protection is available 5 to 10 years after the last dose has been given (CDC, 2012), contributing to increasing pertussis cases. Not completing the

recommended series of five DTaP vaccinations in childhood also decreases immunity. Some suggest universal widespread use of acellular pertussis vaccines has been associated with genetic changes in circulating *B. pertussis* strains due to vaccines containing fewer pertussis antigens (Cherry, 2013). In general, diminished immunity is being caused by ambivalence toward precautionary childhood vaccinations, the lack of well-child visits, and the lack of appropriate boosters. Nurses should educate patients and the public that follow-up booster vaccinations at all ages are critical to maintain immunity to pertussis and other vaccine-preventable diseases (VPDs).

Some suggest that the influx of nonvaccinated immigrants to the United States brings new clusters of pertussis outbreaks every 3 to 5 years. A few years ago the state of California, which receives many Hispanic immigrants, declared a pertussis epidemic due to the largest outbreak in 50 years and urged all residents to obtain vaccinations, especially those of Latino background (Vaughn & Miller, 2011). Nurses in all settings can assist with close observation and immunization of new immigrant families to decrease outbreaks nationwide.

Lack of vaccination may be due to multiple factors including availability, cost, literacy issues, language barriers, and lack of information. Nurses are critical to educating about and assisting patients and the public with obtaining vaccination. However, before individuals can be educated, healthcare practitioners must assess the literacy of their patients. Health literacy is the "degree to which a person can obtain, process, and understand basic health information and services needed to make appropriate health decision" (Joel, 2009, 363.). Health literacy is not only about English or other language proficiency, but about how each individual processes communication with his or her practitioner in terms of interpersonal dynamics and the lens of cultural beliefs and practices. Practitioners must develop forms of information within a cultural context (Joel, 2009). Due diligence in education and the promotion of vaccinations is essential. Divergent cultural perspectives and opinions toward vaccinations indicate the need for continued communication and collaboration between medical and public health officials and the public about appropriate and effective immunization policies (The College of Physician of Philadelphia, 2012).

Fear of vaccination and religious objections may be contributing to increases in pertussis. All 50 U.S. states allow exemption to vaccination for medical reasons and all but two states (Mississippi, West Virginia) allow exemption to vaccination based on religious reasons. Religious objections to vaccines most often are related to use of animal or aborted human tissue in culturing vaccines; however, most major religions allow exemptions for vaccination. Typically a signed affidavit stating how vaccination conflicts with specific religious tenets is required. Some states can legally require vaccination if an epidemic or outbreak occurs (National Vaccine Information Center [NVIC], n.d.). It has been noted that even irreligious parents are using the religious exemption for their children (Leblanc, 2007). Nurses are critical to educating others and providing truthful information about vaccine development and potential side effects.

TABLE 1: Nursing Interventions to Help Decrease the Incidence of Pertussis

- Maintain competency in assessing and improving health literacy
- Maintain up-to-date knowledge of vaccines, administration, and schedules
- Monitor patients for vaccination status
- Provide/update immunization diary, record date and type of immunizations, any reactions
- Identify those most susceptible to not being vaccinated and intervene
- Know side effects of vaccination; be aware of prevalence and educate on treatment of side effects
- Reassure patients of the safety of vaccines; truthfully educate about side effects
- Note patients' medical history and any allergies
- Build trusting relationships; encourage patients to discuss concerns
- Know state laws where you live regarding vaccination and exemptions
- Provide vaccine information statements prepared by the CDC when appropriate
- Minimize localized vaccine reactions by giving DTaP in anterolateral thigh of children < 3 years; vaccinate older children/adults in their nondominant arm
- Encourage widespread distribution of vaccine information (schools, primary care offices, clinics, hospitals, health departments, churches, public places, etc.)
- Educate all on droplet precautions for any respiratory illness
- Participate/volunteer in vaccination programs through health departments, faith communities
- Monitor immigrants for vaccination status
- Keep current with vaccination research to guide patient education
- Support insurance coverage for all vaccines; write your congressman and senator
- Be knowledgeable of programs and policies that provide free or low-cost immunizations
- Support a national registry to track immunization status

SYMPTOMS AND TREATMENT

Pertussis symptoms occur because of toxins released by *B. pertussis* that paralyze the cilia of respiratory epithelial cells and cause inflammation. Infection is caused primarily by respiratory contact with airborne droplets from respiratory secretions. The incubation period for pertussis usually is 7 to 10 days (range 4–21 days), but can be as long as 42 days (CDC, 2012). Pertussis infection is divided into three stages.

The first or *catarrhal stage* lasts 1 to 2 weeks and is similar to the common cold with runny nose, low-grade fever, and occasional cough. In the second or *paroxysmal stage* the person has outbursts, or paroxysms, of multiple rapid coughs trying to expel thick mucus from the lungs followed by a high-pitched whoop trying to inhale. Typically, this is when pertussis is suspected. Coughing spells increase for 1 to 2 weeks to about 15 attacks in 24 hours, especially at night, level off for 2 weeks, then start to decrease. Babies and young children can become cyanotic when coughing, often vomiting after a coughing spell; however, infants may not whoop due to exhaustion. Interestingly, people do not appear to be ill between coughing episodes. Supportive therapies attempt to reduce the number of paroxysms (cough suppressants);

improve oxygenation (supplemental O_2, breathing treatments, mechanical ventilation); and support nutrition, hydration, and rest (CDC, 2012, 2013b).

The final *convalescent stage* is gradual as paroxysms become less and eventually disappear. Paroxysms often recur with subsequent respiratory infections for many months after pertussis. Pertussis is typically milder in adolescents and adults, who often are the source of infection for children (CDC, 2012). Individuals are contagious from the beginning of the catarrhal stage through the third week after onset of paroxysms, or until they have been on antibiotics for 5 days (CDC, 2013b).

The most common complication and cause of death in pertussis is secondary pneumonia, especially in infants. Seizures and encephalopathy can occur from hypoxia with coughing or even from pertussis toxins. Other complications include otitis media, sleep loss, weight loss, urinary incontinence, dehydration, pneumothorax, rib fractures, epistaxis (nosebleed), subdural hematomas, hernias, and rectal prolapse (CDC, 2012).

Diagnosis of pertussis can be made with a *polymerase chain reaction* (PCR) swab of the nasal cavity. The PCR test can be completed rapidly and has excellent sensitivity; however, results should always be analyzed in light of clinical symptoms and epidemiological information (CDC, 2011). Pertussis cases should be reported immediately to local health departments.

The traditional treatment for pertussis is antibiotics, most often erythromycin, which removes *B. pertussis* from secretions and may modify the course of illness if started early (CDC, 2011, 2012). Antibiotics are not effective late in the course of the illness except to deal with complications. The CDC recommends antibiotic treatment for everyone in close proximity to the one with pertussis illness regardless of age or vaccination status.

Because pertussis often is not diagnosed until someone has had the illness for several weeks, nurses should educate others about following airborne or droplet precautions any time someone has a respiratory illness. Droplets from sneezing and coughing can travel 3 feet or more, so encourage covering the nose and mouth using the sleeve/arm or wearing a mask. Instruct people to use frequent correct hand washing, use separate towels and dishes for those who are ill, and frequently disinfect surfaces where the sick person has had contact.

VACCINATION FOR PERTUSSIS

Immunization for pertussis utilizes evidence-based practice of appropriate immunization for children and adults. The CDC maintains an Advisory Committee on Immunization Practices (ACIP) made up of healthcare experts who make recommendations on all vaccines, including pertussis. "DTaP" is used in children 7 and under and contains diphtheria, tetanus, and acellular pertussis antigens. "Tdap," first licensed for adolescents and adults in 2005, is used in children 11 and older and contains tetanus and reduced amounts of diphtheria and acellular pertussis antigens. Recommended pertussis immunization schedules and vaccine information for various age groups are provided in Table 2. It should be noted that none of the DTaP or Tdap vaccines contain the preservative thimerosal, a mercury-containing organic compound possibly associated with neurotoxicity (CDC, 2012).

Are vaccinations, including DTaP and Tdap, safe? In 1990, the Centers for Disease Control and Prevention began the Vaccine Adverse Event Reporting System (VAERS, n.d.-a), a surveillance system to record adverse events to vaccine administration. Around 11,000 adverse event reports for all ages and all vaccines are made to VAERS annually where 10% to 15% of reported events entail hospitalization, permanent disability, or are considered life-threatening, and about 2% involve deaths. Reporting is not mandatory but based on decisions by healthcare providers or the public to report, and reports are accepted by VAERS whether or not the vaccination is shown to have caused the adverse event. The majority of reported events involve localized reactions to vaccinations (Braun, 2014). A recent study supports that DTaP vaccine should be given in the anterolateral thigh in children younger than 3 years to decrease severe local reactions (Jackson et al., 2013).

Tdap dose during each pregnancy, preferably at 27-36 weeks gestation to transfer antibodies to the newborn.

Although the number of minimal adverse events may be higher due to underreporting, are 11,000 reported vaccine events significant? More than 10 million vaccines are administered each year to children less than 1-year old (VAERS, n.d.-b) so even if the 11,000 events occurred only in young children, these events would represent only a small fraction of children being vaccinated and the majority of the events would be local reactions. Regarding serious reactions, babies are at the highest risk for high fevers, seizures, and sudden infant death syndrome (SIDS); thus, these events can occur whether related to vaccination or not. However, severe allergic reaction (anaphylaxis) following vaccination with DTaP, or encephalopathy within 7 days, are contraindications for further vaccination. Caution should be used in continuing DTaP vaccinations if a child develops a "temperature of 105°F (40.5°C) or higher within 48 hours that is not due to another identifiable cause; collapse or shock-like state (hypotonic hyporesponsive episode) within 48 hours; persistent, inconsolable crying lasting 3 hours or longer, occurring within 48 hours; and convulsions with or without fever occurring within 3 days" (CDC, 2012, p. 227). Tdap

TABLE 2: Pertussis Vaccine Recommendations Across the Lifespan (CDC, 2012; 2013c)

Recommended Vaccination Schedule	Approved Vaccines	How Supplied
Birth to 6 years		
Administer at: • 2 months • 4 months • 6 months • 15 to 18 months • 4 to 6 years (5 vaccinations total)	• DtaP • Combination vaccines	• **Infanrix** (three pertussis antigens) • **Tripedia** (two pertussis antigens) • **Daptacel** (five pertussis antigens) • **Pediarix** Five components (Infanrix, Hepatitis B, inactivated polio vaccine [IPV]) Approved for three doses only, 6 weeks to 6 years • **Pentacel** (lyophilized Hib [ActHIB] reconstituted with DTaP-IPV solution) Licensed only for doses 1–4 of DTaP at 6 weeks to 4 years at designated intervals • **Kinrix** (DTaP with IPV) Licensed only for fifth dose of DTaP and fourth dose of IPV ages 4–6 years and previously dosed with Infanrix
7 to 10 years		
• Single dose Tdap for those not fully vaccinated (have *not* received five DtaP or four doses of DtaP if fourth dose administered on/after fourth birthday) • If additional doses of tetanus and diphtheria toxoid vaccines needed, age 7 to 10 should be vaccinated per catch-up schedule[b], with Tdap as first dose.	Tdap[a]	• **Boostrix** (three pertussis antigens; approved for 10 years and older) • **Adacel** (5 pertussis antigens; approved for 11-64 yrs.)
11 to 18 years		
• Single dose, preferred administration at 11–12 years. • If adolescent not fully vaccinated as a child (5 DTaP doses), check catch-up schedule[b]. • If 13–18 years and missed Tdap at 11–12 years, administer at next patient encounter or sooner, especially if close contact with infants.	Tdap[a]	• **Boostrix** • **Adacel**
19 to 64 years		
• Any adult who has not received a dose of Tdap should get one as soon as feasible. • If Tdap indicated, Tdap booster dose can replace a 10-year Td booster dose. • Can administer Tdap regardless of interval since prior Td dose; shorter intervals between Tdap/Td may increase risk of mild local reactogenicity.	Tdap[a]	• **Boostrix** • **Adacel**
65 and older		
• Boostrix should be used; however either vaccine is considered valid.	Tdap[a]	• **Boostrix** recommended • **Adacel** can be used if needed
Pregnant Women		
• Dose during each pregnancy, preferably at 27–36 weeks gestation to transfer antibodies to newborn and make mother less likely to transmit pertussis to infant at delivery. • All family members/caregivers should be up-to-date before coming into close contact with infant. • Tdap recommended in immediate postpartum period (before discharge) for mothers who have never received Tdap or vaccination status is unknown.	Tdap[a]	• **Boostrix** • **Adacel**
Healthcare Personnel		
• Single dose recommended for those who have not received Tdap as adult and have patient contact. • Priority for vaccinating those who have direct contact with babies < 12 months. • Administer Tdap regardless of interval since Td.	Tdap[a]	• **Boostrix** • **Adacel**

a At this time, Tdap is only recommended for a single does across all age groups.
b Catch-up schedule available at http://www.cdc.gov/vaccines/schedules

vaccination is contraindicated if prior severe allergic reaction has occurred to DTaP or a vaccine component, or a history of encephalopathy developed within 7 days of receiving a pertussis vaccine (CDC, 2012).

Practitioners must build a trusting relationship with patients and reinforce the need for vaccinations through face-to-face contact, engaging parents to discuss concerns, and provide evidence-based research to guide recommendations and reassure patients of the safety of vaccines (Smith et al., 2011). Waiting rooms in primary care providers' offices are excellent places to acquaint patients with health information. Studies indicate that continuous

audiovisual messages in clinic waiting rooms showing educational material increases awareness (Eubelen et al., 2011). Short video clips with children portraying pertussis in the clinic waiting rooms with a message regarding the vaccination requirement will have an impact. This type of message was associated with an increase in the number of prescriptions for vaccinations; the audiovisual messages attracted patient's attention and encouraged them to ask questions, therefore, encouraging patients to be active players in their healthcare (Eubelen et al., 2011). Primary care providers' offices that utilize call logs and strict record keeping can improve compliance and ensure timely immunization coverage (Vaughn & Miller, 2011). Stockwell et al. (2012) concluded in a study that text messages to parents and caregivers of children reminding about immunizations is an effective communication and reminder system.

PERTUSSIS WORLDWIDE

Developing nations have the most underserved and sickest populations, and inadequate numbers of healthcare providers. The skills needed by nurses in third world nations are an intimate knowledge of the community's needs and the ability to obtain and organize resources to meet needs on a continuing basis. The healthcare practitioner must gain the trust of each community, understand the beliefs and concerns of the people, and be able to communicate complex ideas and concepts simply and clearly.

The CDC's Global Immunization Division (GID), Global Alliance for Vaccines and Immunizations (GAVI), World Health Organization (WHO), United Nations International Children's Emergency Fund (UNICEF), World Bank, and the United Nations Foundation (UNF) are involved with vaccination against deadly diseases and work closely with a variety of partners in more than 60 countries to vaccinate children against contagious and potentially serious VPDs. These efforts reduce the risk for VPDs spreading to other countries and, ultimately, protect all from sickness and death (CDC, 2011). Funding for GID has been provided by the U.S. Congress since 1991. Bolstering routine immunizations and increasing the use of new vaccines to protect against pneumonia, diarrhea, and meningitis could prevent approximately 2 million child deaths annually.

Infection is caused primarily by respiratory contact with airborne droplets from respiratory secretions.

The CDC has made immunization a global health priority as vaccines prevent diseases, save lives, and are cost-effective (CDC, 2011).

Potential strategies to protect babies worldwide are: (a) selective immunization of close family members of neonates and (b) universal adolescent, maternal, and neonate immunization. Household contacts are most often the source of pertussis exposure for young infants (Campbell et al., 2012). Studies also have shown that pregnant women have a good immune response to the vaccine, thus, providing protection to neonates (Campbell et al., 2012). Nurses should play an important role in educating mothers-to-be on the benefits of vaccination.

Protecting newborns from VPDs requires an organized, accessible, and well-functioning immunization program as a key component of a country's public health program. When strong routine immunization programs combine with effective disease surveillance programs, the results are fewer deaths and less disease from VPDs. Effective routine immunization programs maintain high vaccine coverage, decrease waste and shortages of vaccines, allow earlier detection of disease outbreaks, and lessen the need to rely on resource-intensive special vaccination campaigns (CDC, 2011).

The pertussis vaccine has been part of WHO's Expanded Programme on Immunization (EPI) since its inception in 1974, and in 1982, about 82% of infants worldwide received three doses of the vaccine. A serological study from the United States showed that 21% of adults with prolonged cough (>2 weeks) had pertussis. Another study found that when pertussis occurs in infants, 76% to 83% of the time family members, primarily parents, are the source of the disease (WHO, 2010). Thus, WHO has placed a worldwide priority on achieving ≥90% coverage with three doses of high-quality pertussis vaccines in infants, particularly in developing countries.

IMPROVING VACCINATION RATES

Throughout the 1980s, UNICEF worked with the WHO to achieve Universal Childhood Immunization of the six EPI vaccines, which includes pertussis, with the aim of immunizing 80% of all children by 1990. Since then, progress has continued: by 2010, a record 109 million children were vaccinated and global immunization rates were at 85%, the highest level ever. Of the world's 19.3 million children not immunized for pertussis, 13.2 million (or 68%) live in 10 countries. Delivering immunizations also offers an opportunity to deliver other preventative services such as deworming medications, insecticide-treated mosquito nets, and vitamin A supplements. UNICEF works with governments, partners, and communities to "Reach the Unreached," and increase national ownership for immunization (UNICEF, 2012).

Established in 1944, the World Bank is a partner with the GAVI Alliance and is a vital source of financial and

technical assistance to developing countries (The World Bank, 2014). The World Bank's mission is to reduce poverty and support development. The UNF works with the WHO, UNICEF, and other United Nations agencies to develop and expand major initiatives to help families survive and thrive. In 2012, the UNF predicted that over 1.7 million children worldwide would die from diseases that have all but disappeared in the United States because one in five does not have access to life-saving immunizations needed to thrive. The UNF has created the Shot@Life campaign, which educates, connects, and empowers Americans to champion vaccines as one of the most cost-effective ways to save the lives of children in developing countries. By expanding access to vaccines, the UNF potentially saves a child's life every 20 seconds (UNF, 2012). By encouraging Americans to learn about, advocate for, and donate vaccines, the UNFs campaign will decrease vaccine-preventable childhood deaths and give children a shot at a healthy life.

To encourage those in impoverished communities in the United States to seek out vaccinations, partnerships should be formed with service organizations such as the Kiwanis club, local food banks, churches, hospitals, and schools. These groups can help identify those most likely not to be vaccinated and help them find free or low-cost immunizations. Faith community nurses are in an ideal role to create and lead these partnerships. Nurses also can volunteer in vaccination outreach events.

Another creative approach to solving the pertussis problem is to push for universal vaccinations for adolescents and adults (Rittle, 2010). Healthcare practitioners must seek the assistance of the U.S. Congress to pass bills making insurance companies responsible for coverage of vaccinations as "health prevention" incentives. The Tdap is more costly than the older Td booster vaccine, which may be a factor when facilities make decisions about vaccine provision to patients; therefore, a mandatory guideline should be followed by all facilities through a universal vaccination program. For the program to be successful, healthcare providers and the general public must be included in public health education to control the incidence of the disease (Rittle, 2010). Nurses also can push for a national registry to track immunization status across state lines. The media is a good resource to increase awareness and to influence health policy on vaccinations.

Pertussis is a killer of tomorrow's future generations, but prevention through partnerships with the global leaders of health today ensures their tomorrow. A concerted effort begins on both the national and international level. This effort begins with nurses and nurse practitioners and other primary care providers who educate patients and the public. The battle of pertussis is winnable through education, awareness, and vaccination. By using our resources and uniting, a global battle will be waged and won against pertussis and the children of tomorrow can breathe easier for a lifetime.

Web Resources

- CDC—http://www.cdc.gov/vaccines/
- Immunization & Catch-Up Schedules—http://www.cdc.gov/vaccines/schedules
- The Pink Book—http://www.cdc.gov/vaccines/pubs/pinkbook/index.html
- ACIP—http://www.cdc.gov/vaccines/acip
- VAERS—http://vaers.hhs.gov
- UNICEF—http://www.unicef.org/immunization
- UNF Shot@Life—http://shotatlife.org

Baker, J. P., & Katz, S. L. (2004). Childhood vaccine development: An overview. *Pediatric Research, 55*(2), 347–356. doi:10.1203/01.PDR.0000106317.36875.6A

Braun, M. M. (2014). *Vaccine Adverse Event Reporting System (VAERS): Usefulness and limitations*. Institute for Vaccine Safety, Johns Hopkins Bloomberg School of Public Health. Retrieved from http://www.vaccinesafety.edu/VAERS.htm

Campbell, H., Amirthalingam, G., Andrews, N., Fry, N. K., George, R. C., Harrison, T. G., & Miller, E. (2012). Accelerating control of pertussis in England and Wales. *Emerging Infectious Diseases, 18*(1), 38–47.

Centers for Disease Control and Prevention. (2011). *Global vaccines and immunizations.* Retrieved from http://www.cdc.gov/vaccines/programs/global/default.htm

Centers for Disease Control and Prevention. (2012). *Epidemiology and prevention of vaccine-preventable diseases: The pink book: Course textbook* (12th ed. [2nd printing]). Atlanta, GA: CDC.

Centers for Disease Control and Prevention. (2013a). *Childhood Whooping Cough vaccine protects most children for at least 5 years.* Retrieved from http://www.cdc.gov/media/matte/2011/10_whooping_cough.pdf

Centers for Disease Control and Prevention. (2013b). *Pertussis (Whooping Cough): Treatment timing and antimicrobial choice.* Retrieved from http://www.cdc.gov/pertussis/clinical/treatment.html

Centers for Disease Control and Prevention. (2013c). *Pertussis: Summary of vaccine recommendations.* Retrieved from http://www.cdc.gov/vaccines/vpd-vac/pertussis/recs-summary.htm

Cherry, J. D. (1996). Historical review of pertussis and the classical vaccine. *The Journal of Infectious Diseases, 174*(Suppl. 3), S259–S263.

Cherry, J. D. (2013). Pertussis: Challenges today and for the future. *Public Library of Science (PloS) Pathogens, 9*(7), e1003418. doi:10.1371/journal.ppat.1003418. Retrieved from http://www.plospathogens.org/article/info%3Adoi%2F10.1371%2Fjournal.ppat.1003418

Eubelen, C., Brendel, F., Belche, J. L., Freyens, A., Vanbelle, S., & Giet, D. (2011). Effect of an audiovisual message for tetanus booster vaccination broadcast in the waiting room. *BioMedCentral Family Practice, 12*, 104.

Jackson, L. A., Peterson, D., Nelson, J. C., Marcy, S. M., Naleway, A. L., Nordin, J. D., ... Weintraub, E. (2013). Vaccination site and risk of local reactions in children 1 through 6 years of age. *Pediatrics, 131*(2), 283–289. doi:10.1542/peds.2012-2617

Joel, L. A. (2009). *Advanced Practice Nursing: Essentials for role development* (2nd ed.). Philadelphia, PA: F.A. Davis.

Leblanc, S. (2007, October 18). Parents use religion to avoid vaccines. *USA Today.* Retrieved from http://usatoday30.usatoday.com/news/nation/2007-10-17-19819928_x.htm

National Vaccine Information Center. (n.d.). *State law & vaccine requirements.* Retrieved from http://www.nvic.org/Vaccine-Laws/state-vaccine-requirements.aspx

Rittle, C. (2010). Pertussis—The case for universal vaccination. *The Journal for Specialists in Pediatric Nursing, 15*(4), 282–291.

Smith, P. J., Humiston, S. G., Marcuse, E. K., Zhao, Z., Dorell, C. G., Howes, C., & Hibbs, B. (2011). Parental delay or refusal of vaccine doses, childhood vaccination coverage at 24 months of age, and the health belief model. *Public Health Reports, 126*(Suppl. 2), 135–146.

The World Bank. (2014). *What we do.* Retrieved from http://www.worldbank.org/en/about/what-we-do

United Nations Foundation. (2012). *What we do. Shot@life.* Retrieved from http://www.unfoundation.org/what-we-do/campaigns-and-initiatives/shot-at-life/

United Nations International Children's Emergency Fund. (2012). *Immunization.* Retrieved from http://www.unicef.org/immunization/index_2819.html

Vaccine Adverse Event Reporting System. (n.d.-a). *VAERS.* Retrieved from http://vaers.hhs.gov/index

Vaccine Adverse Event Reporting System. (n.d.-b). *VAERS data.* Retrieved from http://vaers.hhs.gov/data/index

Vaughn, J. A., & Miller, R. A. (2011). Update on immunizations in adults. *American Family Physicians, 84*(9), 1015–1020.

World Health Organization. (2010). *Pertussis vaccines: WHO position paper.* Retrieved from http://www.who.int/wer/2010/wer8540.pdf

World Health Organization. (2014). *WHO-recommended surveillance standard of pertussis.* Retrieved from http://www.who.int/immunization/monitoring_surveillance/burden/vpd/surveillance_type/passive/pertussis_standards/en/