

TEACHING IMMUNIZATION

→ *for Medical Education*

REVISED BY

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PERTUSSIS PREVENTION

Facilitator's Guide



DEPARTMENT OF FAMILY MEDICINE
UNIVERSITY OF PITTSBURGH

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INTRODUCTION

- **MODULE ORGANIZATION**

Multistation clinical teaching scenarios (MCTS) materials were developed to encourage active learning in a small-group setting with a modest amount of faculty time. The MCTS module consists of two booklets.

Facilitator's Guide

This guide includes all contents of the *Small-Group Booklet*, as well as information about the development and history of the module, instructions for the facilitator, and suggested teaching points for each scenario.

Small-Group Booklet

Each small group of 3 to 5 students or residents should receive one *Small-Group Booklet*. Extra copies are available from the Association of Teachers of Preventive Medicine's website: www.atpm.org. The booklet contains a list of the session's objectives, the module pages (each representing a case scenario), related learning aids (e.g. graphs and abstracts), and questions to answer.

- **THE TEACHING IMMUNIZATION FOR MEDICAL EDUCATION (TIME) PROJECT**

The Teaching Immunization for Medical Education (TIME) Project is a collaboration of the Association of Teachers of Preventive Medicine (ATPM) and the Centers for Disease Control and Prevention (CDC).¹ An Advisory Committee of representatives from professional and educational organizations* provides guidance on all activities of the project. A survey to assess the current teaching about immunization in medical schools and residency programs was conducted.^{2,3} In response to deficiencies revealed by the survey, the Advisory Committee envisioned a resource to assist the educator and to provide information to practicing physicians. From a framework of core curriculum objectives, the *TIME Resource* was created to offer a variety of educational modules for integration into existing curricula or for self-study by practicing physicians.

*The organizations include the American Academy of Pediatrics, the American College of Obstetricians and Gynecologists, the American College of Physicians, the American College of Preventive Medicine, the American Medical Association, the American Osteopathic Association, the Association of American Medical Colleges, the Association of Teachers of Preventive Medicine, the Centers for Disease Control and Prevention (CDC), the Interamerican College of Physicians and Surgeons, the National Medical Association, the Society of General Internal Medicine, and the Society of Teachers of Family Medicine.



The *TIME Resource* includes:

- Traditional didactic modules which present review articles for hepatitis B, influenza, and measles. These modules, the results of the medical school and residency surveys, and core curriculum objectives were published as a supplementary issue to the *American Journal of Preventive Medicine*.^{4,7}
- Slide sets to accompany the modules for didactic presentation on influenza, and measles.
- Case-based materials in two formats, developed by a multidisciplinary team and widely field-tested.

Problem-Based Learning (PBL) Approach - intended for medical schools with the time and resources available for PBL and the desire for student-directed learning. PBL approach modules are available for hepatitis B, influenza, measles, and pertussis.^{8,9}

Multistation Clinical Teaching Scenarios (MCTS) - encourages active, small-group learning, uses modest amounts of faculty and learner time, and is objective-driven. MCTS uses a more structured approach than classic PBL. MCTS modules are available for adult vaccination, childhood vaccination, *Haemophilus influenzae* type b, hepatitis B, influenza, measles, and pertussis.^{9,10}

**INFORMATION FOR FACILITATORS**

- **BACKGROUND ON THE MULTISTATION CLINICAL TEACHING SCENARIOS (MCTS) METHOD**

The multistation clinical teaching scenarios were developed to encourage active small-group learning in a clinically relevant context with a modest amount of faculty time. The time commitment of both the facilitator and the student is typically 50 to 90 minutes, depending on the setting and goals. The MCTS teaching method may be readily used in medical pre-clinical and clinical years when students' or residents' time is limited. MCTS is well suited to objective-driven curricula. In the MCTS session, one facilitator can interact with groups ranging from 10 to 30 residents or students. The facilitator needs basic knowledge about the disease and immunization covered but does not need to be a content expert.

MCTS was developed at Harvard University to teach radiology.¹¹ Viewboxes were displayed around a room and small groups of students rotated between viewboxes. At each viewbox, a clinical history was given along with questions (e.g., What is the differential diagnosis?). W. Scott Schroth, MD, modified this approach to teach medical students during a primary care clerkship at George Washington University.¹² Students rotated between stations that consisted of microscopes (e.g., Gram stain and urine specimens), x-rays, and brief histories. After all cases were completed, the facilitator led a discussion of the relevant teaching points. This approach was adapted by the authors for use with vaccine-preventable diseases.

Students and residents are assigned to small groups of 3 to 5 for an MCTS session. All of the small groups simultaneously address the first scenario. Each small group spends approximately 5 to 10 minutes attempting to solve the problem addressed in the scenario. The scenario is then discussed in a large group. The facilitator calls on one of the small groups to present their answers, then the facilitator and the large group discuss each small group's response to the scenario and summarize the teaching points. The facilitator should correct wrong answers and discuss the teaching points. Generally, the large-group discussion should not last more than 7 minutes per scenario. After the first scenario is discussed, each small group works on the second scenario. A large-group discussion follows. The process is repeated until all scenarios are completed or the allotted time expires.



- **MCTS MODULE DEVELOPMENT AND EVALUATION**

A multidisciplinary team at the University of Pittsburgh, with expertise in preventive medicine, public health, family practice, pediatric infectious diseases, adult infectious diseases, and education evaluation, developed the MCTS materials in consultation with a general internist at George Washington University.^{9,10}

The curricular goals are to (1) increase learner knowledge about vaccine-preventable diseases, vaccines, indications for vaccinations, and methods to increase vaccine coverage; (2) foster problem-solving abilities; (3) stimulate learning in a clinical context; and (4) help learners gain familiarity with key references such as the recommendations of the Advisory Committee on Immunization Practices (ACIP).

The first step in developing the modules was the creation of specific learning objectives that used the spectrum of Bloom's taxonomy, when possible.¹³ After development and revision of the learning objectives, actual clinical cases were sought from hospital and medical office records and modified for teaching purposes. Additional scenarios were written to address objectives not covered by the clinical cases.

Following development, the scenarios were pilot-tested with students or residents from the University of Pittsburgh School of Medicine, George Washington University School of Medicine, and Saint Margaret Memorial Hospital Family Practice Residency (Pittsburgh, Pennsylvania). The materials were subsequently revised. Formative evaluation was used for modification, via pilot-testing, of the assessment tools. Subsequently, summative evaluation was done by field-testing the materials at other medical schools and residencies for an independent evaluation.*

The purposes of the field test were to (1) examine the degree to which the students and residents met the learning objectives, (2) assess their perceptions of the teaching method, and (3) examine the feasibility and acceptability of the curriculum to the institution.⁹ Mastery levels were defined using the modified Nedelsky procedure.^{14,15} Three experts rated the likelihood that a minimally competent learner would know whether or not each alternative answer in a multiple choice question was correct. Then, the mastery level was calculated using the Nedelsky formulas and rounded, with the result that third-year medical students and second-year residents needed to achieve scores of 50% and 60%, respectively, to pass the posttest.

Results of the field test revealed that depending on the subject, 96% to 99% of MCTS learners achieved mastery on the posttest.⁹ Mean increases in scores from the 10-item pretest to the posttest were 1.9 items for adult vaccination, 1.9 items for child-hood vaccination, 2.6 items for *Haemophilus influenzae* type b, 1.8 items for hepatitis B, 3.8 items for influenza, 3.1 items for measles, and 3.9 items for pertussis, ($p < .01$ for each). Virtually all (98%) of the learners rated the MCTS sessions overall as very good or good. Furthermore, they found the sessions interesting (96%), agreed that the MCTS session made a valuable contribution to their learning (95%), rated the information learned in the session as applicable (99%), and liked MCTS as a learning method (93%).

*Field test sites included Albert Einstein College of Medicine of Yeshiva University, George Washington University School of Medicine, Hahnemann University, Kirksville College of Osteopathic Medicine, Mayo Medical School-Mayo Clinic and Foundation, the Medical Center of Delaware, Medical University of South Carolina, Ponce School of Medicine (PR), Shadyside Hospital (Pittsburg), Sutter Health Family Practice (Sacramento, CA), University of California at Irvine, University of Louisville, University of Maryland School of Medicine, University of Puerto Rico School of Medicine, West Side Family Practice Center (Ankron, OH), and West Virginia University School of Medicine.

The facilitators generally rated the materials highly. All (100%) rated the facilitator's guide as sufficiently clear; and most (97%) rated the learner materials as clear. Most (97%) rated the session overall as very good or good. Conference calls were conducted with participants at the field-test sites for further evaluation. Following field-testing, and review by CDC, the materials were revised.

This material was developed using information from the Centers for Disease Control and Prevention's publications "Pertussis vaccination: use of acellular pertussis vaccines among infants and young children — recommendations of the Advisory Committee on Immunization Practices (ACIP)." (MMWR. 1997;46(RR-7):1-25), Centers for Disease Control and Prevention. <http://www.cdc.gov/mmwr/preview/mmwrhtml/00048610.htm>

Recommended childhood and adolescent immunization schedule —United States (MMWR. 2005;53 (Nos. 51 & 52). See <http://www.cdc.gov/nip/recs/child-schedule.htm>

The facilitator should use the most recent versions available. See <http://www.cdc.gov/nip>

- **STRATEGIES FOR USING THE MCTS MODULE**

The content of the scenarios fits into the following categories: (1) description of a vaccine-preventable disease (usually the first scenario in a module), (2) missed opportunities to immunize, resulting in vaccine-preventable diseases, (3) outbreak investigation or control, (4) quality assessment and improvement of vaccination rates, and (5) vaccination decisions for a given clinical situation. The most pertinent scenarios can be selected or all can be used, at the discretion of the facilitator. If time is limited, the most important scenarios to cover for the Pertussis Prevention module are scenarios 1, 2, and 3 or 4. We recommend that facilitators limit the small group time per scenario to approximately 8 minutes, depending on the complexity of the scenario and the education level of the learners.

- **Here are some possible settings for these materials:**

- 1) Noon conference or the equivalent – three or four of the scenarios can be covered within 45 to 60 minutes. Residents have enjoyed the change from lecture or seminar to small-group learning experience.
- 2) Small-group breakout sessions to complement lectures in pre-clinical microbiology, immunology, and epidemiology courses.
- 3) Curriculum of a primary care clerkship – the materials have been used successfully as part of primary care clerkships, including clerkships in family practice, internal medicine, and pediatrics. Several scenarios can be selected to fit within the allotted period.
- 4) Workshops for residents, fellows, or providers – a longer block of time can be devoted to covering in depth many or all of the scenarios in one or two modules.
- 5) Grand Rounds – materials have been used in multidisciplinary Grand Rounds, resulting in intriguing discussions.
- 6) A "mix and match" option allows representative adult or childhood vaccinations to be covered in any of the above settings within one session. For instance, two of the hepatitis B scenarios and two of the influenza scenarios could be covered in the same session.



- **PREPARATION LIST FOR THE FACILITATOR**

- ___ 1) Obtain a location and date to meet. A comfortable room with tables surrounded by movable chairs is ideal.
- ___ 2) For each small group, obtain an electronic copy of the *Small-Group Booklet* from ATPM's website: <http://www.atpm.org>. Published materials are no longer available.
- ___ 3) Choose the scenarios to be discussed. Typically, a group can cover three to four scenarios within one hour (students are often slower than residents).
- ___ 4) Have basic familiarity with the vaccine(s) addressed in this module, prevention strategies, and this MCTS module. Basic familiarity, rather than content expertise, is needed. See the section "Sources of Information..." for suggested resources.

- **SUGGESTED SCHEDULE FOR MCTS SESSION**

1. Arrange chairs in groups of 3 to 5, and separate students or residents into small groups.
2. Distribute one copy of the Pertussis Prevention MCTS *Small-Group Booklet* to each group along with a copy of the learning aids listed for the scenarios to be discussed.
3. Review the objectives briefly, focusing on the primary objectives.
4. Instruct the students or residents to start the first scenario by having one member of each small group read the scenario aloud. Subsequently, each small group should work on answering the questions. Instruct them to stay on the same page so everyone is working on the same scenario. To answer the questions, the learners should use their previous knowledge and experience, the resource materials, and the abstracts included in selected scenarios. Instruct them to divide the resource materials since each individual may not have time to read all of the materials.
5. Convene as a large group after 5 to 10 minutes, depending upon the complexity of the scenario. Select one group to present their answers to the questions. Critique their answers and discuss the teaching points for 5 to 7 minutes.
6. Repeat steps 4 and 5 for the remaining scenarios that you have selected.



- **SOURCES OF INFORMATION ON PERTUSSIS VACCINE**

1. Centers for Disease Control and Prevention. Pertussis vaccination: use of acellular pertussis vaccines among infants and young children — recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR*. 1997;46(RR-7):1-25.
<http://www.cdc.gov/mmwr/preview/mmwrhtml/00048610.htm>
2. American Academy of Pediatrics. Pertussis. In: Pickering LK. ed. *Red Book: 2003 Report of the Committee on Infectious Diseases*. 26th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2003: 472 - 86.
3. Chin J, ed. *Control of Communicable Diseases Manual: An Official Report of the American Public Health Association*. 17th ed. Washington, DC: American Public Health Association; 2000.
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8. Centers for Disease Control and Prevention. Recommended childhood and adolescent schedule—United States (use latest version). *MMWR*. 2005;53 (Nos. 51 & 52). Available at <http://www.cdc.gov/nip/recs/child-schedule.htm>.

Please note that much of this information is available online. Immunization schedules and recommendations change periodically, and students should be encouraged to be familiar with immunization websites such as NIP (where ACIP recommendations can be found) and to check them for the latest information.



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OBJECTIVES

Primary Objectives

- **At the end of this session, every learner should be able to accomplish the following core set of objectives:**
 1. Evaluate a patient with paroxysmal coughing and identify possible diagnoses.
 2. Appraise the risk for contracting pertussis after exposure, based upon the number and timing of vaccine doses received.
 3. Given a patient scenario, recommend appropriate pertussis vaccination.
 4. Discuss with parents general information on vaccine safety and adverse reactions, recognizing fears about vaccine safety.
 5. Given an office setting, describe procedures to facilitate vaccine administration.

Secondary Objectives

1. Identify serious disease complications, e.g., pneumonia and encephalopathy, and the age at which they are most likely to occur.
2. Describe the stages of pertussis.
3. Explain that adolescents and adults are the primary reservoir, and treat adolescents and adults with a chronic cough accordingly.
4. Given a patient scenario, recommend vaccination at the minimal allowed interval between doses, if the child is behind in vaccination.
5. Given a patient scenario, screen for valid contraindications and precautions, recognizing the difference between precautions and contraindications.
6. Recognize that (a) use of acellular pertussis vaccines is recommended over whole-cell pertussis vaccines, (b) epidemics have occurred in countries where pertussis vaccination was discontinued, and (c) the Vaccine Injury Compensation Program offers protection to providers.
7. List sources for up-to-date vaccine information.

**SCENARIO ONE**

Shala is a 3-month-old who showed symptoms of clear rhinorrhea and coughing 2 weeks ago. A diagnosis of bronchiolitis was made when she was seen by her physician 11 days ago. Since then, the cough has developed into paroxysmal bouts that are associated with posttussive emesis. She was breast-feeding well until 2 days before admission, but has not had a wet diaper for 12 hours. At night, the cough keeps her awake and is worse when she is lying down. Her past medical history includes the receipt of the first doses of diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP), pneumococcal conjugate vaccine, *Haemophilus influenzae* type b (Hib) conjugate vaccine, hepatitis B vaccine, and inactivated poliovirus vaccine (IPV) at 2 months of age. Her mother is a physician and has had a cough for 3 weeks. During the physical exam, Shala had 10 to 20 paroxysmal coughs. These were associated with cyanosis and posttussive emesis. Shala's temperature was 37.9°C (100.2°F); her respiratory rate was 32/min. Her weight was 5.1 kg (down 0.6 kg from 10 days ago). She had a mild subcostal retractions, occasional grunting, and coarse bibasilar rales. Aeration was adequate. No flaring or wheezes were noted. Her white blood cell count was 28,700/mm³ (elevated).

• Learning Aids

1. Figure 1: Photos of chest x-ray films
2. Pertussis. In: Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. 8th ed, 2nd printing. Atlanta, GA: Centers for Disease Control and Prevention, National Immunization Program; January 2005: 75-88.
<http://www.cdc.gov/nip/publications/pink/pert.pdf>
3. Abstract 1

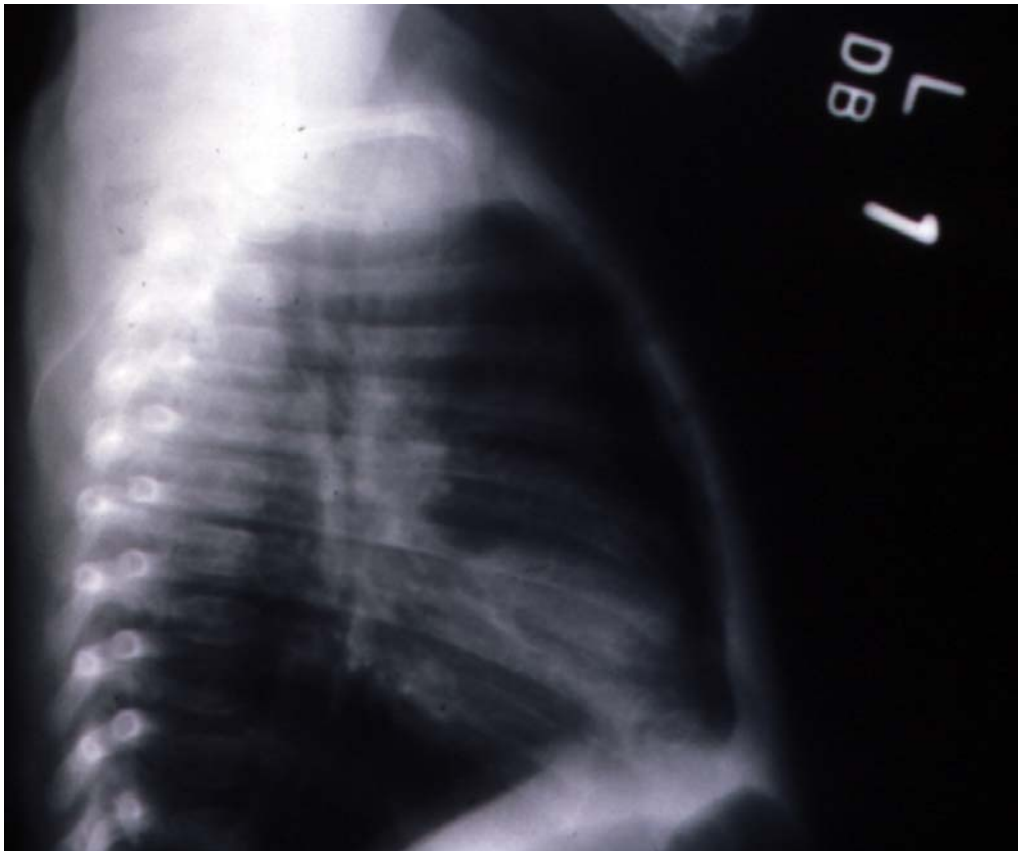
• Questions for Learners

1. What are the possible differential diagnoses for her illness?
2. What are the serious complications of her current illness?
3. What should be done for Shala?
4. From whom did Shala contract pertussis?

This page corresponds to page 7 in the *Small-Group Booklet*.



Figure 1



Source: University of Pittsburgh School of Medicine

**Abstract I****Epidemiology of pertussis and reactions to pertussis vaccine.****Hodder SL, Mortimer EA, Jr.****The changing epidemiology of pertussis in young infants: The role of adults as reservoirs of infection.**

In the United States, adults serve as important sources of infection for young children. Nelson¹ reported that in 12 of 14 reported cases of pertussis occurring in young infants from 1971 to 1977, the source of the infection was an adult. Similarly in a pertussis outbreak in Ohio in 1987, six of the nine cases of pertussis could be epidemiologically linked in a chain of transmission that involved an adult. Recent studies have indicated that subclinical pertussis, primarily in persons with waning immunity, is more frequent than previously believed. Long et al² studied 18 household contacts of four infants with pertussis. Five of the 18 contacts had symptomatic pertussis, 10 were concluded to have subclinical infection, and three were without evidence of infection.

¹Nelson JD. The changing epidemiology of pertussis in young infants: the role of adults as reservoirs of infection. *Am J Dis Child.* 1978;132:371-373.

²Long SS, Welkon CJ, Clark JL. Widespread silent transmission of pertussis in families: antibody correlates of infection and symptomatology. *J Infect Dis.* 1990;161:480-486.

Adapted from *Epidemiol Rev.* 1992;14:244



- **Answers to Questions for Learners:**

1. Q: *What are the possible differential diagnoses for her illness?*

A: The differential diagnosis of a protracted cough in infants includes infection with *Bordetella pertussis*, *Bordetella parapertussis*, *Bordetella bronchiseptica*, adenovirus, *Chlamydia pneumoniae*, *Ureaplasma urealyticum*, *Pneumocystis carinii*, and cytomegalovirus. Tuberculosis and bronchospasm following community-acquired viruses (e.g., respiratory syncytial virus, rhinovirus, coronavirus, influenza virus, and parainfluenza virus) can also cause persistent cough. Cystic fibrosis and gastroesophageal reflux are noninfectious causes of protracted cough.

Pertussis occurs in three phases: catarrhal, paroxysmal, and convalescent. The catarrhal phase is characterized by upper respiratory tract symptoms and cough. The paroxysmal phase is characterized by paroxysmal cough, posttussive emesis, and inspiratory whoop. The mother's history makes pertussis more likely than respiratory syncytial virus (RSV) or chlamydia. The immunization history has little impact on the diagnostic considerations. Pertussis vaccine efficacy is quite modest after one dose. (Household attack rate for infants with one or two doses was 75% in one study [J Pediatr 1981;98(3):362-367]). Three doses of pertussis vaccine are needed for good vaccine efficacy.

2. Q: *What are the serious complications of her current illness?*

A: The serious complications of pertussis include apnea, seizures, secondary bacterial pneumonia, cyanosis, hypoxia, encephalopathy, and death.

3. Q: *What should be done for Shala?*

A: Shala should be hospitalized and receive intravenous hydration, supplemental oxygen, and antibiotics, (erythromycin is the drug of choice with azithromycin and clarithromycin as alternative choices). She should be placed on an apnea monitor or oximeter.

4. Q: *From whom did Shala contract pertussis?*

A: The incubation period ranges from 5 to 21 days is typically 7 to 10 days. Since Shala developed her cough on day 7 of her mother's cough (Shala's mother has had a cough illness for 3 weeks and Shala has coughed for 2 weeks), Shala most likely contracted pertussis from her mother.

SCENARIO TWO

Rose, a 3-year-old, has a cough illness and a positive culture for pertussis. Questioning her parents revealed the following information:

| Name | Age (years) | Relationship to Rose | Number of DTP or DTaP Vaccinations | Symptomatic?* |
|--------|-------------|----------------------|------------------------------------|---------------|
| George | 35 | Father | 5 | Yes |
| Sheree | 34 | Mother | 5 | No |
| Todd | 14 | Brother | 5 | Yes |
| Skip | 5 | Brother | 5 | No |
| Rose | 3 | Self | 2 | Yes |

DTP = diphtheria and tetanus toxoids and pertussis vaccine; DTaP = diphtheria and tetanus toxoids and acellular pertussis vaccine.

*Rhinorrhea and ≥ 2 weeks of paroxysmal cough.

George, a resident physician at a local hospital where pertussis has been diagnosed, was the first in the family to have a paroxysmal cough. Review of Rose's records show that she received measles-mumps-rubella vaccine (MMR) and Hib conjugate vaccine at 18 months of age. She had a mild upper respiratory tract infection 2 months ago when she was last seen by her primary care physician.

• Learning Aids

1. Recording of Rose's cough. [Click here.](#)
2. Pertussis. In: Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. 8th ed, 2nd printing. Atlanta, GA: Centers for Disease Control and Prevention, National Immunization Program; January 2005: 75-88.
<http://www.cdc.gov/nip/publications/pink/pert.pdf>
3. *Recommended Childhood and Adolescent Immunization Schedule—United States*.
<http://www.cdc.gov/nip/recs/child-schedule.htm>
4. Abstracts 2, 3, and 4

• Questions for Learners

1. What is the clinical case definition of pertussis? Do the persons with the symptoms have pertussis?
2. Why did George and Todd develop pertussis? What should be done for them?
3. Why did Rose develop pertussis? Was Rose's illness preventable?
4. What should be done for Sheree and Skip?
5. Are George's patients at risk? What should be done for George's patients? Should he continue to see patients?

This page corresponds to page 10 in the *Small-Group Booklet*.

Abstract 2**Case definitions for infectious conditions under public health surveillance.
Centers for Disease Control and Prevention.****Pertussis (Revised 9/96)**

Clinical Case Definition: a cough, illness lasting ≥ 2 weeks with one of the following: paroxysms of coughing, inspiratory “whoop,” or posttussive vomiting, without other apparent cause

Probable Case: a case that meets the clinical case definition, is not laboratory confirmed, and is not epidemiologically linked to a laboratory-confirmed case

Confirmed Case: a case that is laboratory-confirmed or one that meets the clinical case definition and is either laboratory confirmed or epidemiologically linked to a laboratory-confirmed case

Abstracted from MMWR 1997;46(RR-10):25.

Abstract 3**Spread of pertussis by hospital staff.**

Kurt TL, Yeager AS, Guenette S, Dunlop S.

Two separate outbreaks of pertussis occurred within a 3-month period on the pediatric units at the University of Colorado Medical Center. Secondary cases developed among adult members of the hospital staff, as well as among pediatric patients. While most adults were only mildly ill, two adults were seriously incapacitated. Pertussis agglutination titers were performed on sera from 341 adults. Results emphasize the susceptibility of adults to pertussis, and suggest that exposure to pertussis is high among pediatric house officers, medical students, and pediatric nurses as compared to the general population.

Abstracted from JAMA 1972;221(3):264-267

Abstract 4**Diphtheria, tetanus, and pertussis: recommendations for vaccine use and other preventive measures: recommendations of the Advisory Committee on Immunization Practices (ACIP).
Centers for Disease Control and Prevention.****Prophylaxis for contacts of pertussis patients.**

Erythromycin prophylaxis should be administered for 14 days to all household and other close contacts of persons with pertussis, **regardless of age and vaccination status.** Alternative choices are trimethoprim-sulfamethoxazole for 14 days for patients who cannot tolerate erythromycin or azithromycin for 5 days or clarithromycin for 7 days. Although data from controlled clinical trials are lacking, prophylaxis of all household members and other close contacts may prevent or minimize transmission. All close contacts <7 years of age who have not completed the four-dose primary series should complete the series with the minimal intervals. Those who have completed the primary series but have not received a dose of DTP or DTaP within 3 years of exposure should be given a booster dose. Three acellular pertussis vaccines are available for use among infants: Tripedia[®], DAPTACEL[®], and Infanrix[®]. Acellular pertussis vaccine efficacy is estimated at 80% to 85% for vaccines licensed in the United States.

Adapted from MMWR. 1991;40(RR-10):1-28, and updated with information from CDC.

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- **Answers to Questions for Learners**

Note to facilitator:

This scenario covers a lot of information and may take the learners longer than 8 to 10 minutes.

1. Q: *What is the clinical case definitions of pertussis? Do the persons with symptoms have pertussis?*

A: A clinical case of pertussis is defined as “a cough illness lasting ≥ 2 weeks with one of the following: paroxysms of coughing, inspiratory ‘whoop,’ or posttussive vomiting, without other apparent cause.” A case is considered to be confirmed if laboratory confirmed or epidemiologically linked to a laboratory-confirmed case [MMWR 1997;46(RR-10):25]

Yes, the persons with symptoms—Rose, Todd, and George—meet the clinical case definition of pertussis.

2. Q: *Why did George and Todd develop pertussis? What should be done for them?*

A: Waning immunity and the high rate of pertussis transmission among household contacts are the most likely causes for the illness in George and Todd. Pertussis can occur in adolescents and adults because vaccine-induced immunity wanes, leaving many persons unprotected by the time they reach adolescence. (The scenario does not give sufficient information to determine why Sheree did not develop pertussis; she may have had pertussis previously.)

George and Todd should receive erythromycin. Erythromycin is unlikely to decrease the duration of pertussis symptoms when given in the later part of the paroxysmal stage, but it will decrease communicability to other persons. Erythromycin is effective in ameliorating symptoms if taken during the catarrhal stage, and some evidence suggests that it may help clinically if initiated early in the paroxysmal stage. Alternative choices are trimethoprim-sulfamethoxazole for 14 days for patients who cannot tolerate erythromycin or azithromycin for 5 days or clarithromycin for 7 days.

3. Q: *Why did Rose develop pertussis? Was Rose’s illness preventable?*

A: Rose developed pertussis because she was undervaccinated.

Yes, Rose’s illness was preventable. She could have received DTaP simultaneously with MMR and Hib vaccines when she was 18 months old. She could have received DTaP 2 months ago when she was seen by her physician for upper respiratory tract infection. Acellular pertussis vaccine efficacy is estimated at 80% to 85% for vaccines licensed in the United States.

4. Q: *What should be done for Sheree and Skip?*

A: Sheree and Skip are at risk of infection since they are household contacts; they should receive erythromycin. Skip, having been vaccinated rather recently, is at least risk but should still receive erythromycin. Alternative choices are trimethoprim-sulfamethoxazole for 14 days for patients who cannot tolerate erythromycin or azithromycin for 5 days or clarithromycin for 7 days.

5. Q: *Are George's patients at risk? What should be done for George's patients? Should he continue to see patients?*

A: Yes, the risk of acquiring pertussis for patients with whom George has have close contact is high. Outbreaks have occurred in medical settings with transmission chains involving both patients and medical personnel.

The patients George has seen since his cough illness began should receive erythromycin and DTaP vaccine if they are not up-to-date in their vaccination schedule, or if the patients are ≤ 7 years of age and the minimal interval has elapsed between doses of DTaP.

George should stop seeing patients until he has taken erythromycin for 5 days; he should complete a 14-day course of erythromycin. Alternative choices are trimethoprim-sulfamethoxazole for 14 days for patients who cannot tolerate erythromycin or azithromycin for 5 days or clarithromycin for 7 days.

Note to facilitator about adult pertussis vaccination:

During field testing, questions arose about vaccinating adults against pertussis. Whole-cell pertussis vaccine causes high reaction rates when given to adults (*Lancet* 1975;2:540-543). Acellular pertussis vaccine appears to be safe and immunogenic in adults (*JAMA* 1993;269:53-56). Acellular pertussis vaccines are not licensed for use in adults and expert groups have not recommended their use. Some authorities suggest that acellular pertussis vaccination in adulthood might be helpful in reducing pertussis disease (*J Infect Dis* 1990;161:473-479).



SCENARIO THREE

Stephanie, a 2-year-old, is in the office for a well-child exam, the results of which are normal. Her vaccination history reveals that she has received three doses of DTaP, three doses of IPV, four doses of Hib, three doses of hepatitis B vaccine, and four doses of pneumococcal conjugate vaccine. She had chickenpox at age 1 year. Following her third dose of DTaP 6 months ago, she developed a temperature of 38.9°C (102°F) and became fussy. Stephanie's sister has a history of a major motor (grand mal) seizure disorder.

- **Learning Aids**

1. *Recommended Childhood and Adolescent Immunization Schedule*—United States.
<http://www.cdc.gov/nip/recs/child-schedule.htm>
2. *Pertussis Vaccination: Use of Acellular Pertussis Vaccines Among Infants and Young Children—Recommendations of the Advisory Committee on Immunization Practices (ACIP)*; sections: Summary (p.1); Acellular Pertussis Vaccines (p. 3); Table 5: Routine diphtheria, tetanus, and pertussis vaccination schedule for children aged ≤ 7 years—United States, 1997 (p. 17); Vaccination of infants and young children who have a personal or family history of seizures (pp. 19-20); Adverse Reactions (pp. 20-21); Contraindications (p. 21); Precautions (pp. 21-22); and Vaccine Injury Compensation (p. 22).
<http://www.cdc.gov/mmwr/preview/mmwrhtml/00048610.htm>
3. Abstracts 5 and 6

- **Questions for Learners**

1. Does Stephanie need any vaccinations? What is the minimal interval between DTaP doses?
2. What antigens are in the various acellular pertussis vaccines?
3. Can DTaP cause fever? What can be done to reduce the likelihood of fever after DTaP vaccination?
4. Should Stephanie receive any further doses of DTaP? What is a precaution?
5. What is the Vaccine Injury Compensation Program? Why does the VICP exist?

This page corresponds to page 12 in the *Small-Group Booklet*.

Abstract 5**Vaccine Injury Compensation Program.**

The Vaccine Injury Compensation Program (VICP), established by the National Childhood Vaccine Injury Act of 1986, is a system under which compensation can be paid on behalf of an injured person whose injury was temporally related to vaccination. The program is intended as an alternative to civil litigation under the traditional tort system in that negligence need not be proven. A vaccine injury table was created which lists the vaccines covered and the injuries and conditions for which compensation may be paid. The table also defines the period of time during which the first symptom or substantial aggravation of the injury must appear. The VICP has greatly reduced vaccine-related liability risks for physicians and manufacturers.

Adapted from Centers for Disease Control and Prevention. General Recommendations on Immunization: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR. 1994;43(RR-1):27, and VICP materials.

Abstract 6**Bacteriology of pertussis.****Zimmerman RK, Wald ER.**

The etiology of pertussis is *Bordetella pertussis*, an aerobic gram-negative rod. Components (antigens) that are important in the organism's ability to cause disease include (1) a tracheal cytotoxin which destroys cilia, making it difficult to clear the thick mucus; (2) pertussis toxin which causes lymphocytosis, contributes to damage of the cilia, and helps attachment to respiratory epithelium; (3) filamentous hemagglutinin, which helps the bacteria attach to cilia of the respiratory tract; (4) pertactin, which also helps bacterial attachment to the cilia; and (5) fimbriae, which have an uncertain role in pathogenesis. Acellular pertussis vaccines contain purified antigenic components of *Bordetella pertussis*, including inactivated pertussis toxin and may contain one or more other components (e.g. filamentous hemagglutinin, pertactin, and fimbriae types 2 and 3).

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- **Answers to Questions for Learners**

1. Q: *Does Stephanie need any vaccinations? What is the minimal interval between DTaP doses?*

A: Stephanie needs the fourth dose of pertussis vaccine, preferably as DTaP and a dose of MMR. Simultaneous administration of these vaccines is recommended, and is safe.

The recommended minimum interval between the third and fourth doses of DTaP is ≥ 6 months; however, DTaP #4 does not need to be repeated if administered ≥ 4 months after DTaP #3. (The minimum interval between the first and second doses, and between the second and third doses, is 4 weeks.)

2. Q: *What antigens are in the various acellular pertussis vaccines?*

A: Acellular pertussis vaccines contain purified antigenic components of *Bordetella pertussis*. In particular, acellular vaccines contain inactivated pertussis toxin and may contain one or more other components (e.g. filamentous hemagglutinin, a 69-kilodalton outer membrane protein called “pertactin,” and fimbriae types 2 and 3). Three acellular pertussis vaccines are available for use among infants: Tripedia[®], DAPTACEL[®], and Infanrix[®]. Components that are important in the organism’s ability to cause disease include (1) a tracheal cytotoxin which destroys cilia, making it difficult to clear the thick mucus; (2) pertussis toxin which causes lymphocytosis, contributes to damage of the cilia, and helps attachment to respiratory epithelium; (3) filamentous hemagglutinin, which helps the bacteria attach to cilia of the respiratory tract; (4) pertactin, which also helps bacterial attachment to the cilia; and (5) fimbriae, which have an uncertain role in pathogenesis.

3. Q: *Can DTaP cause fever? What can be done to reduce the likelihood of fever after DTaP vaccination?*

A: Yes, a temperature $>38.3^{\circ}\text{C}$ occurs in 3% to 5% of infants after acellular pertussis vaccination (DTaP) [Table 3 in ACIP recommendations: MMWR 1997;46(No.RR-7):9]. DTaP is much less likely to cause fever than is whole-cell DTP.

If pneumococcal conjugate vaccine (PCV) was given with the third dose of DTaP, it could have contributed to the fever. When given with DTaP but at another site, fever $\geq 38^{\circ}\text{C}$ occurred in 15% to 24% of those vaccinated with PCV compared with 9% to 17% of those receiving the control vaccine (experimental meningococcal conjugate vaccine).

Acetaminophen or ibuprofen prophylaxis reduces postvaccination fever and may be used when there is a family history or seizure disorders, or when fever is to be reduced or avoided. Acetaminophen or ibuprofen may be given at the time of vaccination and every 4 hours for 24 hours.

4. Q: *Should Stephanie receive any further doses of DTaP? What is the precaution?*

A: Yes, neither a temperature of 38.9°C (102°F) nor a family history of seizures is a precaution or a contraindication to further doses of DTaP.

Precautions are situations involving certain adverse events after vaccination (such as a hypotonic hyporesponsive episode or seizures) that prompt the vaccine-provider and parents to evaluate, on an individual basis, the risks and benefits of administering subsequent doses of pertussis vaccine.

5. Q: *What is the Vaccine Injury Compensation Program? Why does the VICP exist?*

A: The Vaccine Injury Compensation Program (VICP) is a no-fault federal program established to provide compensation for injuries that are temporally related to administration of a vaccine covered by the program. (Stephanie's fever and fussiness after the third dose of DTaP is not a compensable condition.)

Since October 1, 1988, the VICP has been funded by a vaccine excise tax and has reduced the liability risks for physicians and manufacturers. Persons with alleged injuries are to go through the VICP before filing a civil tort claim, and the amount attorneys can obtain is limited. If a person accepts an award from the VICP, they cannot use the tort system for those injuries. If a person files a claim and does not accept or receive a VICP award, then they can file with the civil tort system against the provider or manufacturer. The VICP exists to protect patients, providers, and manufacturers.



SCENARIO FOUR

Dr. Queen is the medical director of a clinic that provides primary care for developmentally delayed children. Many children attending the clinic have trisomy 21 (Down syndrome); hence, they may have concurrent cardiac disorders and seizures. Dr. Queen was concerned about the number of pertussis cases in the community and the threat to children of the clinic, so he reviewed the vaccination records for infants attending his clinic.

- **Learning Aids**

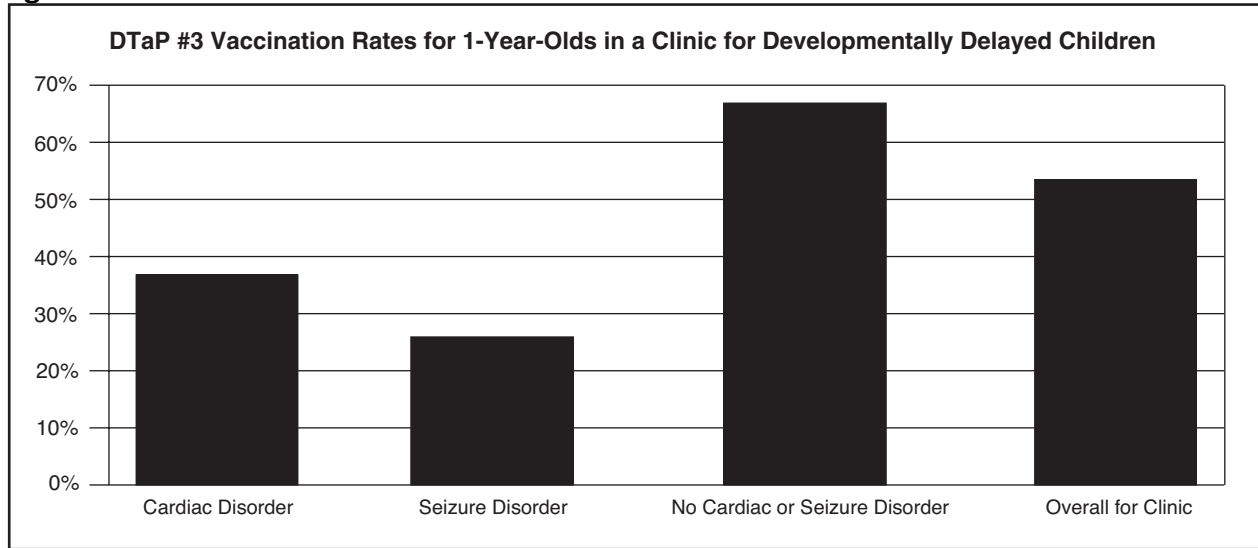
1. Figure 2
2. Abstracts 7 and 8
3. *Standards for Child and Adolescent Immunization Practices*.
<http://www.cdc.gov/nip/recs/rev-immz-stds.htm>
4. *Pertussis Vaccination: Use of Acellular Pertussis Vaccines Among Infants and Young Children—Recommendations of the Advisory Committee on Immunization Practices (ACIP)*; sections: Contraindications (p. 21); and Precautions (pp. 21-22)
<http://www.cdc.gov/mmwr/preview/mmwrhtml/00048610.htm>

- **Questions for Learners**

1. Why are the vaccinations rates low?
2. What can be done to raise the rates?
3. What are the valid contraindications to DTaP? Is a cardiac disorder a valid contraindication to DTaP? Is a seizure disorder a valid contraindication for DTaP?
4. What is a precaution? What are the precautions to DTaP?

This page corresponds to page 14 in the *Small-Group Booklet*.

Figure 2

**Abstract 7****Failure to vaccinate against whooping cough.****Stevens D, Baker R, Hands S.**

We describe a prospective study in which we investigated why children fail to get vaccinated against whooping cough. The study included an assessment of the attitudes of parents and professionals and the impact of differing views of the contraindications. There was considerable disagreement among the professionals on the interpretation of the contraindications to immunization; the most common reason for omitting pertussis vaccine was advice from the doctor based on dubious contraindications, such as a family history of epilepsy, a family history of mental retardation, or prematurity.

Adapted from *Arch Dis Child* 1986;61:382-387.

Abstract 8**Evaluation of a follow-up system in county health department's immunization clinic.****Tollestrup K, Hubbard BB.**

We designed a pilot follow-up system using two mailed reminders and evaluated it for use in the immunization clinic of a relatively large county health department in the state of Washington. Compliance with the recommended interval for DTP immunization increased by 33.9% in the group of children receiving two postcard reminders compared to the control group. Over half of the respondents (52%) in the control group and 28% in the intervention group reported that transportation barriers and inconvenient clinic hours prevented their return.

Adapted from *Am J Prev Med* 1991;7:24-28

**STANDARDS FOR CHILD AND ADOLESCENT IMMUNIZATION PRACTICES****Availability of Vaccines**

1. Vaccination services are readily available.
2. Vaccinations are coordinated with other healthcare services and provided in a medical home when possible.
3. Barriers to vaccination are identified and minimized.
4. Patient costs are minimized.

Assessment of Vaccination Status

5. Healthcare professionals review the vaccination and health status of patients at every encounter to determine which vaccines are indicated.
6. Healthcare professionals assess for and follow only medically indicated contraindications.

Effective Communication about Vaccine Benefits and Risks

7. Parents/guardians and patients are educated about the benefits and risks of vaccination in a culturally appropriate manner and in easy-to-understand language.

Proper Storage and Administration of Vaccines and Documentation of Vaccinations

8. Healthcare professionals follow appropriate procedures for vaccine storage and handling.
9. Up-to-date, written vaccination protocols are accessible at all locations where vaccines are administered.
10. Persons who administer vaccines and staff who manage or support vaccine administration are knowledgeable and receive ongoing education.
11. Healthcare professionals simultaneously administer as many indicated vaccine doses as possible.
12. Vaccination records for patients are accurate, complete, and easily accessible.
13. Healthcare professionals report adverse events following vaccination promptly and accurately to the Vaccine Adverse Events Reporting System (VAERS) and are aware of a separate program, the National Vaccine Injury Compensation Program (NVICP).
14. All personnel who have contact with patients are appropriately vaccinated.

Implementation of Strategies to Improve Vaccination Coverage

15. Systems are used to remind parents/guardians, patients, and healthcare professionals when vaccinations are due and to recall those who are overdue.
16. Office- or clinic-based patient record reviews and vaccination coverage assessments are performed annually.
17. Healthcare professionals practice community-based approaches.

Adapted from The National Vaccine Advisory Committee. *Standards for Child and Adolescent Immunization Practices*. Pediatrics 2003; 112:958-963.

Copies of the Standards may be requested from the NIP website: <http://www.cdc.gov/nip/publications/default.htm>.



- **Answers to Questions for Learners**

1. Q: *Why are the vaccination rates low?*

A: Vaccination rates may be low for one or more of the following reasons:

- a. Overly cautious interpretation of vaccine contraindications.
- b. Valid deferral of DTaP vaccination for unvaccinated infants with an evolving neurologic disorder until the disorder is stabilized. It is also valid to defer DTaP vaccination for infant with neurological events, such as seizures between DTaP doses, until the disorder is clarified.
- c. Lack of simultaneous vaccine administration.
- d. Parental concerns about vaccine safety.
- e. Missed opportunities to vaccinate during acute and chronic care visits.
- f. Lack of transportation or other economic barriers. The Vaccines for Children Program (VFC) and Children's Insurance Program (CHIP) have greatly reduced economic barriers to vaccination.
- g. Inconvenient hours that the clinic is open.

The students or residents may suggest other reasons from their experience or outside reading.

2. Q: *What can be done to raise the rates?*

A: a. Ways to improve parental compliance include the following:

- 1) Postcard reminders or autodialing machine sending telephone messages to patients. The billing computer can be used to assess vaccination status and results used for generating postcards or phone calls to those who are not up-to-date with vaccinations.
 - 2) Provision of personal vaccination cards for patients that list both the schedule and the date for the child's next vaccination.
- b. Office vaccination practices can be improved by the following:
- 1) conducting periodic audits to assess vaccination rates in practice;
 - 2) administering vaccines simultaneously if more than one is indicated;
 - 3) having a dedicated spot in the medical record for vaccination information;
 - 4) using all clinical encounters to screen and, when indicated, vaccinate; and
 - 5) training on valid and invalid contraindications.

The Community Preventative Services Task Force has conducted a landmark review on ways to increase immunization rates: www.thecommunityguide.org/vaccine/default.htm

3. Q: What are the valid contraindications to DTaP? Is a cardiac disorder a valid contraindication to DTaP? Is a seizure disorder a valid contraindication to DTaP?

A: The contraindications and precautions to DTaP are given in the following table, which is adapted from ACIP recommendations. A cardiac disorder is not a valid contraindication to DTaP. Seizures prior to any dose of DTaP is a valid reason to delay DTaP until the neurological disorder is clarified; however, delaying DTaP until the second 6 months of life will increase the risk of febrile seizures. See Answer 1-b, above.

CONTRAINDICATIONS AND PRECAUTIONS TO FURTHER DTP AND DTaP VACCINATION

Contraindications

An immediate anaphylactic reaction to DTP or DTaP vaccination

Encephalopathy not attributable to another identifiable cause occurring within 7 days following DTP or DTaP vaccination

Precautions

Temperatures of $\geq 40.5^{\circ}\text{C}$ (105°F) within 48 hours of DTP or DTaP vaccination, not due to another identifiable cause

Collapse or shock-like state (hypotonic-hyporesponsive episode) within 48 hours of DTP or DTaP vaccination

Persistent crying lasting ≥ 3 hours, occurring within 48 hours of DTP or DTaP vaccination

Convulsions with or without fever occurring within 3 days of DTP or DTaP vaccination

4. Q: What is the precaution? What are the precautions to DTaP?

A: The precautions listed in the table above are situations in which an adverse reaction has occurred in temporal relation to receipt of DTP or DTaP. The decision to give subsequent doses of vaccine containing the pertussis component should be carefully considered. These events have not been associated with permanent sequelae. In circumstances in which the benefits outweigh the possible risks, such as during an outbreak of pertussis, DTaP may be administered.

If a valid contraindications has occurred following either DTaP or whole-cell DTP, **neither** DTP or DTaP should be given consequently. If the contraindication was encephalopathy, the series should be completed with DT. If the contraindication was an immediate anaphylactic reaction, further vaccination with any of the three components of DTaP or whole-cell DTP should be deferred because of uncertainty as to which component of the vaccine might be responsible. Because of the importance of tetanus vaccination, persons who experience anaphylactic reactions may be referred to an allergist for evaluation, if specific allergy can be demonstrated, desensitized to tetanus toxoid.



PERTUSSIS SAMPLE TEST

This test was developed using expert knowledge and psychometric methods for the construction of criterion-referenced tests. It may be used as a sample examination.

1. Which of the following is not a complication of pertussis?

- a. Apnea
- b. Pneumonia
- c. Encephalopathy
- d. Seizures
- e. Metabolic alkalosis

2. Which of the following is a valid precaution for DTaP?

- a. Family history of mental retardation
- b. Personal history of allergic rhinitis
- c. Temperature of 39.4°C (103°F) following last DTaP vaccination
- d. Seizure 1 day after last DTaP vaccination
- e. Premature infant who is 2 months old

3. Which of the following about DTaP vaccine is false?

- a. Vaccine efficacy is 96 to 99 percent after three doses
- b. Vaccine efficacy varies by the number of doses received
- c. The routine schedule includes a series of five doses
- d. Vaccine efficacy decreases with time since immunization
- e. None of the above

4. The primary source of infant cases of pertussis is:

- a. Grade-school children
- b. Preschool-aged children, because they are not fully vaccinated
- c. Adults, due to waning immunity
- d. Other infants, due to immature immunity
- e. None of the above

5. Which of the following children does not have a precaution or contraindication to subsequent doses of DTaP?

- a. Child with a temperature of 39.4°C (103°F) following the first dose of DTaP
- b. Child with a hypotonic-hyporesponsive episode following the second dose of DTaP
- c. Child with high-pitched, prolonged crying following the third dose of DTaP
- d. Child with anaphylaxis following the fourth dose of DTaP
- e. Child with a seizure following the fourth dose of DTaP

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- 6. The patients in a clinic have a vaccination rate of 55% at 2 years of age. Methods to increase patient compliance with vaccinations include all the following except:**
- Increase the number of hours that the clinic is open.
 - Send postcards reminding parents about vaccinations that their child needs.
 - Call parents to remind them about appointments for vaccinations.
 - Post lists of valid and invalid contraindications near the refrigerator that contains vaccines.
 - Provide vaccination cards and list the dates for the child's next vaccinations on the cards.
- 7. Which of the following family members of a 5-year-old with pertussis is least likely to develop pertussis?**
- The 35-year-old mother who was fully vaccinated as a child.
 - The 13-year-old sister who was fully vaccinated as a child.
 - The 3-month-old brother who received the first dose of DTaP last month.
 - The 15-month-old sister who received 4 doses of DTaP.
 - All family members are equally likely to develop pertussis.
- 8. Which of the following DTaP vaccination records is entirely acceptable?**
- 2, 4, 7, and 12 months, and 4 years.
 - 2 weeks, 3 months, 5 months, and 15 months, and 4 years.
 - 2 (half dose), 3 (half dose), 4, 6, and 17 months, and 4 years
 - 6 weeks, 3 months, 6 months, 15 months, and 4 years.
 - None of the above.



PERTUSSIS TEST ANSWER KEY

1. E
2. D
3. A
4. C
5. A
6. D
7. D
8. D