Teaching Immunization for Medical Education (TIME)

MULTISTATION CLINICAL TEACHING SCENARIOS

Pertussis Prevention:
Small Group Booklet

DEVELOPED AND REVISED BY

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ASSOCIATION FOR PREVENTION TEACHING AND RESEARCH

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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.

Students and residents are assigned to small groups of 2 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.

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. A major learning aid is needed: appropriate chapter from the CDC's Pink Book, www.cdc.gov/vaccines/pubs/pinkbook/pink-chapters.htm, slide set www.cdc.gov/vaccines/pubs/pinkbook/pink-slides.htm or a shortened version of the same slide set available at http://www.aptrweb.org/resources/curriculum_time.html, SHOTS smartphone app and online from www.immunizationed.org, and/or internet access to CDC's website www.cdc.gov/vaccines. Review the objectives briefly, focusing on the primary objectives.
3. The students or residents are 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 for that scenario. To answer the questions, the learners should use their previous knowledge and experience, the resource materials/internet, and the abstracts included in selected scenarios. They should divide the resource materials since each individual may not have time to read all of the materials.
4. 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 answers and discuss the teaching points for 5 to 7 minutes.
5. Repeat steps 3 and 4 for the remaining scenarios that have been selected.

OBJECTIVES

At the end of this session, every learner should be able to accomplish the following core set of objectives

Primary 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. Explain that adolescents and adults are the primary reservoir, and treat adolescents and adults with a chronic cough accordingly.
3. Given a patient scenario, recommend vaccination at the minimal allowed interval between doses, if the child is behind in vaccination.

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 DTaP #1, RV #1, Hib #1, PCV13 #1, IPV #1, and hepatitis B #1 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).

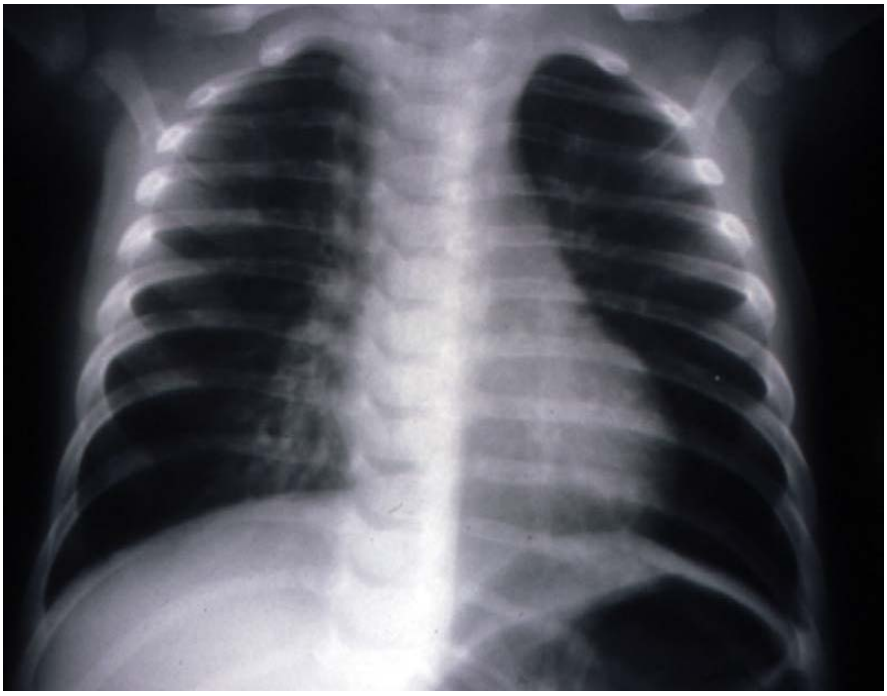
Learning Aids

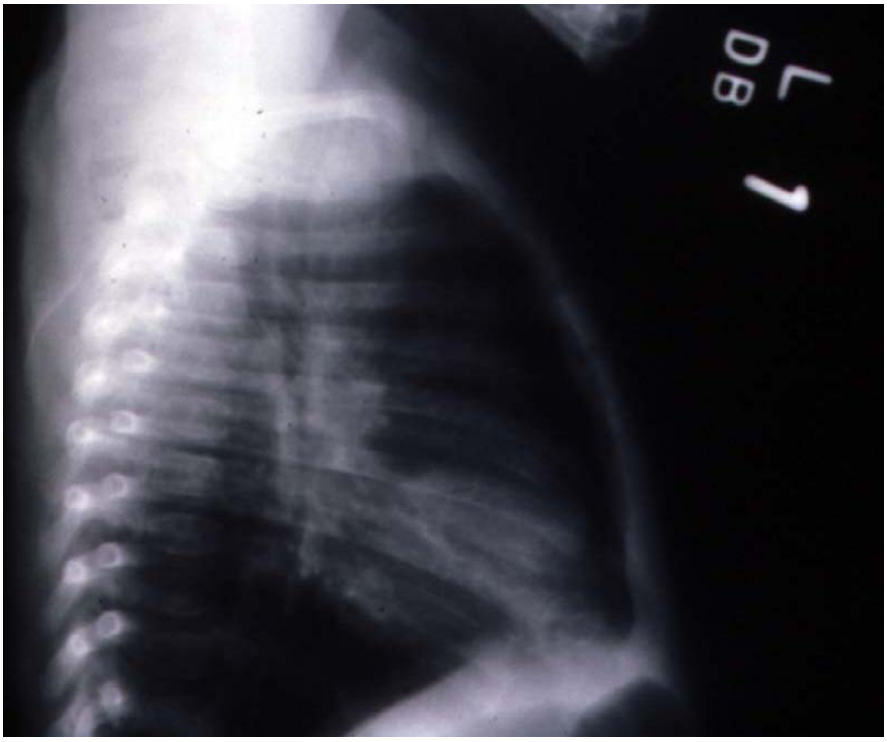
1. Figure 1: Photos of chest x-ray films, page 6.
2. Center for Disease Control and Prevention. *Pertussis: Epidemiology and Prevention of Vaccine-Preventable Diseases* http://www.cdc.gov/vaccines/pubs/pinkbook/default.htm. The Pink Book: Slide Sets http://www.cdc.gov/vaccines/pubs/pinkbook/pink-slides.htm or a shortened version of the same slide set available at http://www.aptrweb.org/resources/curriculum_time.html.
3. Abstract 1, page 7

Questions for Learners

1. What is the clinical stage of Shala's illness?
2. What are the serious complications of her current illness?
3. How should a definite diagnosis be made?
4. What should be done for Shala?
5. From whom did Shala contract pertussis?

Figure 1





Source: University of Pittsburgh School of Medicine

Abstract 1

Laboratory Diagnosis of Pertussis

The diagnosis of pertussis is based on a characteristic clinical history (cough for more than 2 weeks with whoop, paroxysms, or posttussive vomiting) as well as a variety of laboratory tests (culture, polymerase chain reaction [PCR], direct fluorescent antibody and serology). Culture is considered the gold standard laboratory test and is the most specific of the laboratory tests for pertussis. However, fastidious growth requirements make B. pertussis difficult to culture. The yield of culture can be affected by specimen collection, transportation, and isolation techniques. Because of the increased sensitivity and faster reporting of results of PCR, many laboratories are now using this method exclusively. PCR should be used in addition to, and not as a replacement for culture. Antimicrobial treatment (erythromycin) should be initiated as soon as pertussis is suspected. More information is available at http://www.cdc.gov/vaccines/pubs/surv-manual/chpt10-pertussis.pdf.

Adapted from Center for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases.* Atkinson W, Wolfe S, Hamborsky J, eds. 12th ed. Washington DC: Public Health Foundation, 2011
http://www.cdc.gov/vaccines/pubs/pinkbook/downloads/pert.pdf

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 MMR, Hib, and PCV13 at 18 months of age, but no other vaccines since then. 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 (from homepage at www.ImmunizationEd.org Click on Pertussis Cough icon).
2. Center for Disease Control and Prevention. *Pertussis: Epidemiology and Prevention of Vaccine-Preventable Diseases.* The Pink Book: Slide Sets http://www.cdc.gov/vaccines/pubs/pinkbook/pink-slides.htm or a shortened version of the same slide set available at http://www.aptrweb.org/resources/curriculum_time.html
3. Abstract 2, page 10.

Questions for Learners

1. 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?

Abstract 2

Guidelines for the Control of Pertussis Outbreaks

1. Treatment and Chemoprophylaxis

a. ***Cases***. Antimicrobial treatment (erythromycin) should be initiated as soon as pertussis is suspected. Initiating treatment ≥3 weeks after cough onset has limited benefit to the patient or contacts.

b. ***Contacts***. If pertussis is highly suspected in a patient, chemoprophylaxis of all close contacts and high-risk contacts with erythromycin is recommended regardless of their age and vaccination status. Initiating chemoprophylaxis ≥3 weeks after exposure has limited benefit for the contacts. Healthcare workers who wear a mask while in close contact with a pertussis case should still receive prophylaxis. *Note for Institutions:* Due to the closed nature of most institutions and potential repeated exposures to pertussis, entire wards or institutions may receive chemoprophylaxis.

2. Vaccination

a. If cases are occurring among young infants, consideration can be given to vaccinating infants at an accelerated schedule.

Pertussis: Chapter 10. In: Centers for Disease Control and Prevention. Manual for the Surveillance of Vaccine-Preventable Diseases. Centers for Disease Control and Prevention, Atlanta, GA, page 9.
http://www.cdc.gov/vaccines/pubs/surv-manual/chpt10-pertussis.pdf

3. Exclusion

Health Care Workers

a. Workers with symptoms should be excluded from work for at least the first 5 days of antimicrobial therapy. Asymptomatic workers who have had close contact with a case should be put under close surveillance and given prophylaxis.

b. Health care workers with symptoms of pertussis who cannot or refuse to take antimicrobial therapy should be excluded from work for 21 days from onset of cough. The use of a respiratory mask is not sufficient protection.

Modified from Zanardi L & Vitek C: Center for Disease Control and Prevention. Guidelines for the Control of Pertussis Outbreaks. Center for Disease Control and Prevention: Atlanta, GA, 2000
http://www.cdc.gov/vaccines/pubs/pertussis-guide/guide.htm

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, two doses of RV, two doses of inactivated influenza 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 Immunization Schedule*—United States. http://www.cdc.gov/vaccines/recs/schedules/child-schedule.htm or Shots smartphone app and online www.immunizationed.org
2. Recommended and Minimum Ages and Intervals Between Doses of Routinely Recommended Vaccines http://www.cdc.gov/vaccines/pubs/pinkbook/downloads/appendices/A/age-interval-table.pdf
3. Abstracts 3 and 4, page 12
4. Center for Disease Control and Prevention. *Pertussis: Epidemiology and Prevention of Vaccine-Preventable Diseases.* The Pink Book: Slide Sets http://www.cdc.gov/vaccines/pubs/pinkbook/pink-slides.htm or a shortened version of the same slide set available at: http://www.aptrweb.org/resources/curriculum_time.html

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 and why?
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 (VICP)? Why does the VICP exist?

Abstract 3

Vaccine Injury Compensation Program.

The Vaccine Injury Compensation Program (VICP) 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.

General Recommendations on Immunization, Recommendations of the Advisory Committee on Immunization Practices (ACIP) MMWR, December 1, 2006/ 55(RR15);1-48
http://www.cdc.gov/mmwr/PDF/rr/rr55 15.pdf

Abstract 4

Bacteriology of pertussis.

Zimmerman RK, Wald ER.

The etiology of pertussis is *Bordetella pertussis*. 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. 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).

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.

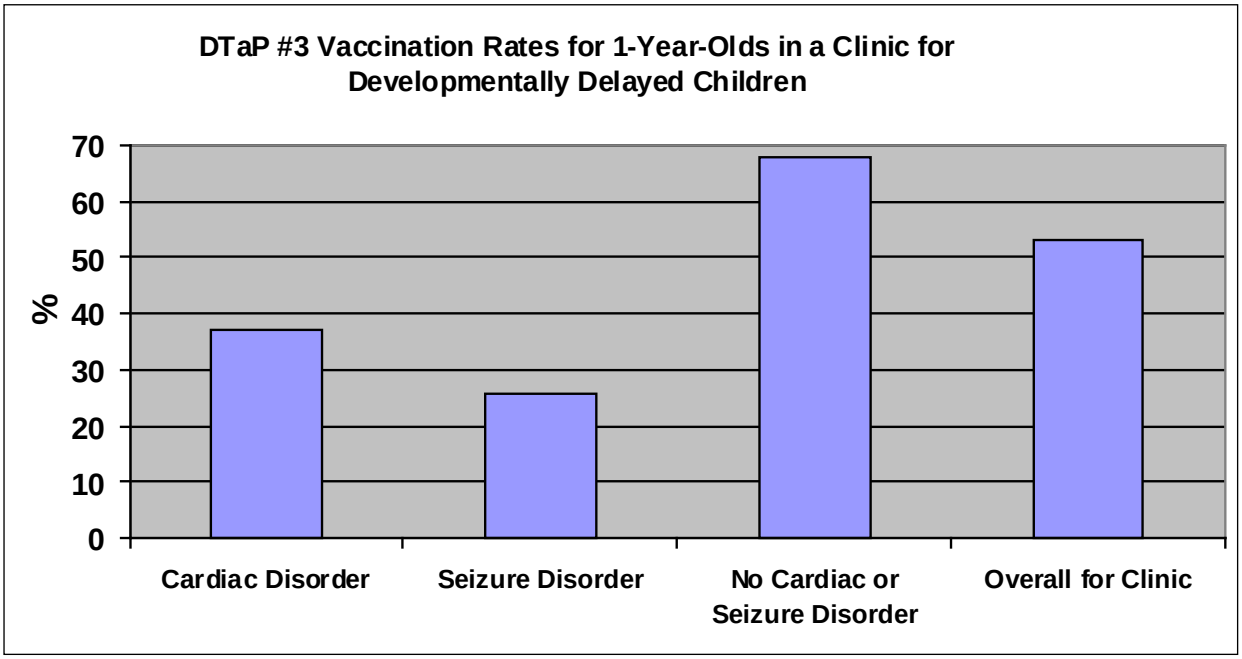
Learning Aids

1. Figure 2, page 14.
2. Abstract 5, page 14
3. *Standards for Child and Adolescent Immunization Practices*, page 15. http://pediatrics.aappublications.org/content/112/4/958.full
4. Center for Disease Control and Prevention. *Pertussis: Epidemiology and Prevention of Vaccine-Preventable Diseases.* The Pink Book: Slide Sets http://www.cdc.gov/vaccines/pubs/pinkbook/pink-slides.htm or a shortened version of the same slide set available at: http://www.aptrweb.org/resources/curriculum_time.html

Questions for Learners

1. Why are the vaccination 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?

Figure 2



Abstract 5

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.

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.

SCENARIO FIVE

Joshua is a 2-month-old brought to the clinic by his mother for a well-child health supervision visit. He is healthy, breastfed, and received hepatitis B vaccine #1 in the hospital. His exam is normal and he is growing well.

His mother is quite hesitant about any vaccines due to internet articles about vaccine safety and ingredients in vaccines. She brings a sample web site printout:

"The ingredients in childhood vaccines should shock everyone. They contain a staggering number of chemicals, heavy metals and animal byproducts. Who would knowingly inject such materials into their precious children? Consider DTaP which has formaldehyde, aluminum, thimerosal (mercury), and sheep red blood cells."

Learning Aids

1. Abstracts 6 and 7, pages 17 and 18.

Questions for Learners:

1. Why do vaccines contain chemicals?
2. How would you approach Joshua's mother?
3. How would you respond to her concerns and the website?

Abstract 6

DTaP Excipients and Rationale

Includes ingredients and substances used in manufacturing that may be present in only trace amounts in the final product

Excipient	Rationale	Vaccine examples
Aluminum hydroxide Aluminum phosphate Aluminum sulfate ≤.625mg per dose	Adjuvant to increase immune response	All brands of DTaP have aluminum
Formaldehyde, formalin, ≤ 0.1 mg per dose	Antimicrobial, preservative	All brands of DTaP
Glutaraldehyde	Toxin detoxifier	Daptacel, Infanrix
2-phenoxyethanol	Preservative	Daptacel, Infanrix
Bovine extract	Culture media	Infanrix,
Polysorbate 80	Surfactant	Infanrix,

Information from Grabenstein JD in ImmunoFacts: Vaccines & Immunologic Drugs, reprinted in Appendix B, Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases.* Atkinson W, Wolfe S, Hamborsky J, McIntyre L, eds. 11th ed. Washington DC: Public Health Foundation, 2009

Abstract 7

Addressing Parents' Concerns: Do Vaccines Contain Harmful Preservatives, Adjuvants, Additives, or Residuals?

Paul A. Offit and Rita K. Jew

Vaccines often contain preservatives, adjuvants, additives, or manufacturing residuals in addition to pathogen-specific immunogens. Some parents, alerted by stories in the news media or information contained on the World Wide Web, are concerned that some of the substances contained in vaccines might harm their children. We reviewed data on thimerosal, aluminum, gelatin, human serum albumin, formaldehyde, antibiotics, egg proteins, and yeast proteins. Both gelatin and egg proteins are contained in vaccines in quantities sufficient to induce rare instances of severe, immediate-type hypersensitivity reactions. However, quantities of mercury, aluminum, formaldehyde, human serum albumin, antibiotics, and yeast proteins in vaccines have not been found to be harmful in humans or experimental animals.

The requirement for preservatives in vaccines arose from many incidents in the early 20th century of children who developed severe and occasionally fatal bacterial infections after administration of vaccines contained in multidose vials. Removal of preservative-level thimerosal from infant vaccines has occurred.

Aluminum salts are adjuvants. Because aluminum is one of the most abundant elements in the earth's crust and is present in air, food, and water, all infants are exposed to aluminum in the environment. For example, breast milk contains approximately 40 micrograms of aluminum per liter, and infant formulas contain an average of approximately 225 micrograms of aluminum per liter. Vaccines contain quantities of aluminum similar to those contained in infant formulas.

Formaldehyde is an essential intermediate in human metabolism and is required for the synthesis of thymidine, purines, and amino acids. Therefore, all humans have detectable quantities of formaldehyde in their circulation (approximately 2.5 microgram of formaldehyde/mL of blood). Assuming an average weight of a 2-month-old of 5 kg and an average blood volume of 85 mL/kg, the total quantity of formaldehyde found naturally in an infant's circulation would be approximately 1.1 mg—a value at least 10-fold greater than that contained in any individual vaccine.

Abstracted from *Pediatrics* 2003; 112;1394-1397