

Teaching Immunization

for Medical Education (TIME)



MULTISTATION CLINICAL TEACHING SCENARIOS

Measles Prevention: Facilitator's Answer Key

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SOURCES OF INFORMATION ON MEASLES VACCINE

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<http://www.cdc.gov/mmwr/PDF/RR/RR4708.pdf>
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3. Feigin R, Cherry J, Demmler-Harrison G, Kaplan S. *Feigin and Cherry's Textbook of Pediatric Infectious Diseases*. 6th ed. Saunders. 2009.
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5. Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Atkinson W, Hamborsky J, McIntyre L, Wolfe S, eds. 11th ed. Washington DC: Public Health Foundation, 2009. This book may be viewed at <http://www.cdc.gov/nip/publications/pink> and may be purchased from the Public Health Foundation by calling 1-877-252-1200.

Answers to Questions for Learners – Scenario One

1. What are the most likely differential diagnoses for Jim's illness?

The most likely differential diagnoses are measles (rubeola), drug rash (eg. amoxicillin rash is typical in Epstein-Barr Virus infection), mucocutaneous lymph node syndrome, and pharyngoconjunctival fever.

2. What are the blue-white spots on the buccal mucosa?

Koplik's spots are blue-white spots on the buccal mucosa and are pathognomonic for measles.

3. How can Jim's disease be differentiated from the other classic exanthems of childhood? List the differences.

The following are useful in helping to distinguish Jim's disease from the other classic exanthems of childhood:

- a. Are there measles cases in the community? The occurrence of measles cases in the community increases the likelihood that the rash is due to measles.
- b. Was there a prodrome (i.e., a period of illness that preceded the rash)? Measles has a definite prodrome, consisting of coryza, cough, and conjunctivitis.
- c. Did the prodrome contain respiratory symptoms? The measles prodrome consists of conjunctivitis and respiratory symptoms, such as coryza and cough.
- d. How long was the prodrome? The measles prodrome usually lasts 2 to 4 days.

- e. How high is the fever? The fever with measles is usually over 38.3°C (101°F) and is often 40°C (104°F); this is higher than the fever from most other illnesses in the differential diagnosis.
- f. Where did the rash start? The rash caused by measles usually starts on the face and neck and progresses down.
- g. How long did the rash last? The rash caused by measles lasts at least 3 days.
- h. Are Koplik's spots present? Koplik's spots are pathognomonic for measles.
- i. Was Jim vaccinated? More than 95% of recipients of measles vaccine will develop protective immunity.

Take Home Point:

Classic signs and symptoms of measles include Koplic's spots, a prodrome of coryza, cough, and conjunctivitis, and a rash that starts on the face.

Answers to Questions for Learners – Scenario Two

1. Was Sheree's case preventable? How?

Yes, Sheree's case was preventable. She could have received measles containing vaccine on at least two occasions: (1) when she was given the fourth dose of DTaP, and (2) at the time of her office visit 2 weeks ago. A mild URI is not a valid contraindication to vaccination; this was another missed opportunity for measles vaccination.

2. Did Sheree contract measles from the child in the medical office?

Sheree most likely contracted measles from the child in the medical office. The time frame is appropriate rash typically occurs 14 days following exposure. Measles is highly infectious. It can be transmitted by airborne droplet nuclei; face-to-face exposure is not necessary. Measles transmission has been documented in medical facilities even when the susceptible persons were never in contact with the infected person. Because droplet nuclei remain suspended in the air, a susceptible person can contract measles an hour after the infected person leaves the premises, as has been documented (see abstract from Measles Outbreak in a Pediatric Practice: Airborne Transmission in an Office Setting).

3. What steps can a physician take to prevent the transmission of measles in the office setting?

Patients suspected of having measles should not be allowed in the waiting room. An isolation type room with appropriate ventilation should be used. The patient should be examined as quickly as possible and then sent out of the office. It is prudent to have the patient enter the office through a door that will minimize exposure to other individuals. Alternatives include seeing the patient in a car or on a house call. All personnel who work within medical facilities should be immune to measles and

rubella. Acceptable evidence of immunity includes (1) documentation of receipt of two doses of measles vaccine, (2) laboratory evidence of immunity, (3) documentation of physician-diagnosed measles, or (4) birth prior to 1957. Although birth before 1957 is generally considered acceptable evidence of immunity to measles, consideration should be given to recommending one dose of MMR for unvaccinated health care workers born before 1957 who do not have a history of measles disease or laboratory evidence of immunity.

Take Home Point:

Missed opportunities for vaccinating occur during visits for mild illness and contribute to the risk for contracting diseases such as measles.

Answers to Questions for Learners – Scenario Three

1. What groups were responsible for most of the cases of measles?

The groups that were most responsible were unvaccinated school-aged children and unvaccinated preschool-aged children. Philosophic exemption was the primary cause.

2. Does measles vaccine cause autism?

Multiple studies do not find an association between measles vaccine and autism, as is noted in the student guide. Unfortunately, many parents equate a temporal coincidence with causality, that is they focus on box “a” of a 2*2 table. Proper calculations include boxes a through d.

“Box A” means case counts of persons who were exposed (received MMR vaccine) and had an outcome (autism). In order to truly determine if an exposure causes an outcome, we need to know the background rate of an outcome. We also need to understand the relative risk of the outcome based on whether a person was exposed or not. Therefore, we need to know the total number of people who were exposed (case counts of those with outcome (Box A) and case counts of those without the outcome (Box B)). And we need to know case counts of how many people who are NOT exposed (case counts of those with outcome (Box C) and case counts of those without the outcome (Box D)).

A committee at the Institute of Medicine which did not have conflicts of interest reviewed the topic and concluded the following:

“Thus, the committee concludes that the evidence favors rejection of a causal relationship at the population level between MMR vaccine and autistic spectrum disorders (ASD). The committee bases this conclusion on the following evidence:

- A consistent body of epidemiological evidence shows no association at a population level between MMR vaccine and ASD.
- The original case series of children with ASD and bowel symptoms and other available case reports are uninformative with respect to causality.
- Biologic models linking MMR vaccine and ASD are fragmentary.
- There is no relevant animal model linking MMR vaccine and ASD.”

Stratton K, Gable A, Shetty P, McCormick M, eds. Measles-Mumps-Rubella Vaccine and Autism. In: *Immunization Safety Review*. Immunization Safety Review Committee, Board on Health Promotion and Disease Prevention, 2001.

3. Who would you target for intervention? What should be done?

Two main groups require intervention. For **outbreaks among preschool-aged children**, the most important intervention is to rapidly increase the vaccine coverage rate with one dose of MMR vaccine. This can be done by increasing community awareness of the outbreak and of vaccine safety through the media. MMR vaccine is recommended for infants as young as 6 months of age when exposure to natural measles is likely. During outbreaks in day care settings, a program of MMR revaccination is recommended for attendees, their siblings, and personnel born in or after 1957 who cannot provide documentation of immunity, such as age appropriate vaccination.

Measles outbreaks in schools result in this situation from lack of vaccination and secondarily from transmission of measles virus among vaccinated persons who have failed to respond to the first dose of vaccine. The most important intervention in school outbreaks is to rapidly increase the coverage levels by publicity as mentioned above and by access to vaccination for inadequately vaccinated students and school personnel born during or after 1957 who do not have documentation of immunity such as receipt of two doses of MMR. Persons born during or after 1957 who cannot provide documentation of measles immunity should be vaccinated or

excluded from attending the educational institution until 21 days after onset of rash in the last measles patient. Attention should be strongly considered to undervaccinated individuals in unaffected schools in the same geographic area.

Take Home Points:

- Measles outbreaks are a public health urgency requiring intensified vaccination efforts
- Findings from several large and well done studies indicate that measles vaccine does not cause autism

Answers to Questions for Learners – Scenario Four

1. Is Bill up-to-date on measles vaccination? What should be done for Bill?

No, Bill is not up-to-date on measles vaccination. MMR vaccination at 12 months is valid, i.e., it will count as Bill's first dose of MMR. However, Bill should have received a second dose of MMR at 4 to 6 years of age. Bill has a household exposure to measles. Measles virus is transmitted during the prodrome, the period of time before the infected individual develops a rash. Measles vaccine, given within 72 hours of measles exposure, may provide some protection. Since Bill has received a prior dose of measles vaccine and has been exposed to measles for less than 72 hours, he should receive a dose of MMR vaccine today.

2. What should be done for Margaret?

Margaret also has a household exposure to measles. The options are immune globulin (IG) or MMR vaccine. Since Margaret is exposed and is less than 1 year of age, IG is preferred. IG can prevent or modify measles in a susceptible person if given within 6 days of exposure. She should receive IG today at a dose of 0.25 mL/kg. [MMR vaccine is not given prior to 12 months except in outbreak situations or exposure to measles, in which case, MMR vaccine can be administered to children as young as 6 months of age. If MMR vaccine is given before 12 months of age, it does not count as the first MMR at 12 to 15 months of age].

3. Are the parents up-to-date on measles vaccination? What should be done for them?

Neither parent is up-to-date on measles vaccination. Since Tom's father received measles vaccination prior to 12 months of age, it is not counted as the required dose at 12 to 15 months of age. Transplacental maternal antibodies from women who had measles disease persist longer than antibodies from women who received measles vaccine, and may last up to 15 months of age. Hence, measles vaccination prior to

12 months of age often is not effective. Tom's father should receive measles vaccination today since it may provide protection if given within 72 hours of exposure. [Discussion of his status as an exposed health care worker is in the answer to Question #4]. Tom's mother is not up to date. The ACIP recommends that post-high school educational institutions, such as colleges, require documentation of two doses of MMR vaccine or other acceptable evidence of measles, rubella, and mumps immunity before entry for all students at the undergraduate and graduate levels (such requirements are called prematriculation immunization requirements and may vary from institution to institution). Since Tom's mother received her first dose of measles vaccine at 15 months of age, she needs one more dose and should receive MMR today. She can continue to attend school once she is given the second dose of MMR.

4. Tom's father is a respiratory therapist in a hospital. Should he continue to work?

By definition, Tom's father does not have evidence of immunity to measles. Exposed, non-immune health care workers should be vaccinated and relieved from all patient contact and excluded from the facility from the fifth through the 21st day after exposure. Since Tom's father was vaccinated at 9 months of age, one additional option would be to test him for measles IgG antibody. He should be vaccinated whether or not this test is done, since he has a household exposure and vaccination may not be effective after 72 hours after exposure, but the antibody test could be used to determine if he can continue to have contact with patients. [If the context were a measles outbreak in a medical setting, serologic testing would not generally be recommended because arresting measles transmission requires the rapid vaccination of the institution's susceptible health care workers and resources should be allocated to this end.]

Take Home Points:

- Measles vaccine, if given within 72 hours of exposure, provides some protection.
- Adults, particularly those in high risk settings, should have evidence of immunity.

Answers to Questions for Learners – Scenario Five

1. What are possible explanations for the low vaccinations rates? List reasons. Why is there a difference in vaccination rates based on insurance status if Medical Assistance covers vaccination?

Vaccination rates may be low for one or more of the following reasons (*facilitators: emphasize categories — a complete listing of barriers is not necessary*):

- a. **Economic barriers.** Uninsured children may be referred to public clinics for vaccination, thereby delaying timely vaccination. The historical difference in vaccination rates by insurance is an argument for the Vaccines for Children Program, which provides free vaccine to providers for certain groups of children, including uninsured and Medicaid-insured children.
 - b. **Parental factors** include lack of awareness about the vaccine schedule, concerns about the immune system's capacity to handle multiple vaccines, concerns about vaccine safety (particularly autism), and competing demands on time. Medical Assistance may be a marker for lower parental education, poverty, difficulties in arranging transportation to medical facilities, and high levels of competing demands.
 - c. **Barriers within the health care system**, including lack of provider knowledge regarding simultaneous vaccination, invalid vaccine contraindications, and failure to address vaccination status at acute and chronic care visits.
2. How can Dr. Jones and the clinic staff encourage parents to bring their children to the clinic for vaccinations?

Ways to improve parental compliance include the following:

- a. Mail, telephone, or e-mail reminders to patients. The computer can be used to assess vaccination status. The results can be used to generate reminders to those who are not up-to-date.
 - b. Provide vaccination records for patients that list the date for the next vaccination.
 - c. Provide parental education about disease severity, vaccine safety, the capacity of the immune system to handle vaccination, and the vaccination schedule.
3. Once a child has arrived at the clinic, what can Dr. Jones and the clinic staff do to improve vaccination rates, i.e., decrease missed opportunities?

Vaccination rates can be improved by the following:

- a. Assessing vaccination rates, setting a target goal for the practice, and monitoring progress; these are powerful interventions and key teaching points. Assessment of clinic immunization rates can be conducted successfully using computers, registries, specific clinic assessment immunization software, or manual record reviews.
- b. Using the office computer, identify patients who need vaccinations based on age. Send reminders to inform parents of needed vaccinations, and place reminders on or in patient medical records about needed vaccinations.
- c. Have the nursing staff address vaccination status during measurement of vital signs. Checklists or electronic messages can be used to communicate the information to the provider.
- d. Develop a system to screen patients for needed vaccinations coupled with standing orders for the nurse to administer the needed vaccines according to a protocol, without the need for an individual physician order for each patient.

Take Home Point:

System interventions such as standing orders and assessment of vaccination status by computerized algorithms can raise vaccination rates.

Answers to Questions for Learners – Scenario Six

1. Does Mildred need any vaccinations?

Yes; a second dose of MMR is indicated because Mildred is a health care professional. All personnel who work within medical facilities should be immune to measles, mumps, and rubella. Acceptable evidence of measles immunity is documentation of receipt of two doses of measles containing vaccine, laboratory evidence of immunity, documentation of physician diagnosed measles, or birth before 1957. Acceptable evidence of mumps immunity includes 2 doses of MMR, history of mumps based on health-care provider diagnosis, or laboratory evidence of immunity. For unvaccinated health-care personnel born before 1957 who do not have other evidence of mumps immunity, administering 1 dose on a routine basis should be considered and administering a second dose during a mumps outbreak should be strongly considered. Acceptable evidence of immunity to rubella is documentation of receipt of one dose of rubella containing vaccine, laboratory evidence of immunity, or birth before 1957 except for women of childbearing potential. For women of childbearing age, regardless of birth year, rubella immunity should be determined and women should be counseled regarding congenital rubella syndrome.

2. Are vaccinations contraindicated in this case?

Pregnancy is a valid contraindication to MMR due to the theoretical risk to the fetus. However, sexual activity is not a contraindication to MMR. Pregnancy testing is not needed routinely prior to MMR administration. Routine practices for vaccinating women of child-bearing age include (1) asking if they are pregnant or planning to become pregnant, (2) excluding those who say they are, and (3) vaccinating those who plan to receive the vaccine after explaining the theoretical risk to the fetus. Women should be counseled to avoid pregnancy for 28 days after vaccination with measles, mumps, or rubella-containing vaccines. As the risk of MMR during

pregnancy is theoretical and CDC data suggest no risk to the fetus, inadvertent MMR administration during pregnancy is not an indication for therapeutic abortion.

Mildred does not have any valid contraindication to MMR. Allergy to duck feathers is not a valid contraindication to MMR. And Mildred's sister is not at risk if Mildred receives MMR. Severely immunocompromised persons should not be given MMR vaccine. However, the attenuated, live viruses in MMR are not transmitted to other persons. Vaccinating susceptible close contacts of immunocompromised persons should reduce the risk for the immunocompromised person of exposure to measles, mumps, or rubella infection. Some immunocompromised persons, such as asymptomatic and symptomatic HIV-infected patients without evidence of severe immunosuppression, can receive MMR vaccine when indicated. A detailed discussion can be found in the ACIP recommendations. Anaphylaxis after egg ingestion is no longer considered a valid contraindication since recent data suggest that most anaphylactic reactions to measles-containing vaccines are due to components of the vaccines other than egg antigens. The risk for serious allergic reactions following vaccination of persons allergic to eggs is extremely low and skin-testing with MMR is not predictive of allergic reactions to MMR vaccination. Therefore, MMR may be administered to children who are allergic to eggs without skin-testing or use of protocols that require gradually increasing doses of vaccine. MMR vaccine contains trace amounts of neomycin; hence, anaphylaxis to neomycin contraindicates MMR although the more common adverse reactions to neomycin are delayed or cell-mediated immune responses (i.e., contact dermatitis).

3. What can physicians do to ensure that their patients who have an occupational indication for MMR receive it?

To ensure that patients with an occupational indication for MMR receive it, physicians can do the following:

- a. Systematically ascertain occupation and MMR status during the initial history; preprinted or electronic intake forms should include medical and social history and occupation
 - b. Update occupation data periodically
 - c. Post occupational indications for MMR and other vaccines in a prominent place in the office
 - d. Evaluate adults for needed vaccinations and other preventive services, based on both occupation and chronic medical conditions
4. By which route is MMR administered?

MMR should be administered subcutaneously (MMR given intramuscular is valid but subcutaneously is recommended).

Take Home Points:

- Occupation as a health care worker places one at risk for contracting infectious diseases; thus, diligence is needed to properly vaccinate.
- Vaccine contraindications should be followed carefully, without adding false precautions.

MEASLES 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. MMR should be administered by which route?
 - a. Intradermal.
 - b. Intramuscular into gluteal muscle (upper outer-quadrant).
 - c. Oral.
 - d. Intranasal.
 - e. Subcutaneous.

2. Investigations of measles outbreaks in the United States found that missed opportunities to administer MMR occur
 - a. When the fourth dose of DTaP is administered but not MMR.
 - b. Because IPV was administered at the previous visit.
 - c. Due to interruption of the cold chain (vaccine refrigeration system).
 - d. When parents did not administer acetaminophen prophylactically.
 - e. Because only one private company manufactures MMR.

3. Evidence to support that measles is highly infectious includes all of the following except
 - a. Direct transmission occurs frequently.
 - b. Airborne transmission occurs.
 - c. Droplet nuclei remain infectious for approximately 1 hour.
 - d. Maternally-acquired passive immunity lasts more than 6 months.
 - e. Household attack rates in unvaccinated persons are high.

4. Important points about MMR safety include all the following except
 - a. MMR contains attenuated viruses.
 - b. The viruses are not transmitted to other individuals.
 - c. MMR is a killed vaccine.

- d. MMR is safe for the child of a pregnant woman.
 - e. MMR is safe for individuals who are allergic to duck dander.
5. Which one of the following patients does not have a valid contraindication to MMR?
- a. A child with a congenital immunodeficiency.
 - b. A child who is infected with human immunodeficiency virus (HIV), but is asymptomatic.
 - c. An adult who is pregnant.
 - d. An adult who develops anaphylaxis after contact with neomycin.
 - e. An adult who is on prolonged, high doses of steroids for Sarcoidosis.
6. The following individuals are being seen in a primary care physician's office for a routine examination and have all had one previous dose of MMR. Which does not have an indication for MMR?
- a. A 25-year-old traveling in Africa.
 - b. A nurse working in an oncology unit.
 - c. A 21-year-old college student majoring in chemistry, who has received one dose of MMR.
 - d. A fire fighter born in 1955.
7. Which of the following most likely indicates measles?
- a. An erythematous maculopapular "sandpaper" rash that was preceded for 2 days by sore throat and abdominal pain.
 - b. An erythematous maculopapular rash on the cheeks that was preceded for 3 days by fever and headache.
 - c. An erythematous maculopapular rash on the trunk and neck with high fever but the child otherwise appears well.
 - d. An erythematous macular rash that started on the face and spread downward over the entire body; it was preceded for 4 days by conjunctivitis, cough, and fever.

- e. A generalized erythematous maculopapular rash with fever that was preceded by malaise and tender cervical adenopathy.
8. Which of the following procedures have been used to improve vaccination rates over several years?
- a. Evaluation of vaccination rates in the practice by attending physician.
 - b. Reminders about specific missing vaccinations that are generated by the office computer.
 - c. Phone call reminders.
 - d. Evaluation by nursing staff of vaccination status when vitals are taken and recording of missing vaccinations in the patient's chart.
 - e. All of the above.

MEASLES TEST ANSWER KEY

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