

# Teaching Immunization

*for Medical Education (TIME)*



MULTISTATION CLINICAL TEACHING SCENARIOS

## Hepatitis B Prevention: Facilitator's Answer Key

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**FACILITATOR'S GUIDE****HEPATITIS B NOMENCLATURE**

HBV	Hepatitis B virus	Anti-HBs	Antibody to HBsAg
HBsAg	Hepatitis B surface antigen	Anti-HBe	Antibody to HBeAg
HBeAg	Hepatitis B e antigen	Anti-HBc	Antibody to HBcAg
HBcAg	Hepatitis B core antigen	IgM anti-HBc	IgM class antibody to HBcAg
HBIG	Hepatitis B immune globulin		

**OTHER TERMINOLOGY**

Commercial sex worker – used interchangeably with the word *prostitute*

Injection-drug user – refers to persons who illegally use injectable drugs

**SOURCES OF INFORMATION ON HEPATITIS B VACCINE**

1. Centers for Disease Control and Prevention. A comprehensive immunization strategy to eliminate transmission of Hepatitis B virus infection in the United States: Recommendations of the Advisory Committee on Immunization Practices (ACIP). Part I: Immunization of Infants, Children, and Adolescents. MMWR.2005. 54 (No. RR-16):1-33. <http://www.cdc.gov/mmwr/PDF/rr/rr5416.pdf>
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5. Centers for Disease Control and Prevention. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. Atkinson W, Wolfe S, Hamborsky J, McIntyre L, eds. 11<sup>th</sup> ed. Washington DC: Public Health Foundation, 2009.  
To download, go to <http://www.cdc.gov/vaccines/pubs/pinkbook/downloads/hepb.pdf>  
To purchase a copy of the textbook, order from the Public Health Foundation website at [http://bookstore.phf.org/product\\_info.php?products\\_id=552](http://bookstore.phf.org/product_info.php?products_id=552) or call 1-877-252-1200.
6. Centers for Disease Control and Prevention. Current Recommended Immunization Schedules for Persons Aged 0 through 6 years, 7 through 18 years, and Catch-Up -- United States. <http://www.cdc.gov/vaccines/recs/schedules/child-schedule.htm#printable>
7. Current Recommended Adult Immunization Schedule, United States. <http://www.cdc.gov/vaccines/recs/schedules/adult-schedule.htm>

## Scenario One

### Questions for Learners

1. What are the possible differential diagnoses for his chief complaint (before serological test results are available)?

Prior to laboratory test results, the differential diagnosis includes hepatitis (e.g., viral, toxic, ethanol, autoimmune) and biliary obstruction.

2. What do the liver function test results suggest?

His liver function test results suggest non-alcoholic hepatitis. In alcoholic hepatitis, the level of AST is generally twice the level of ALT. In obstructive liver diseases, LDH and alkaline phosphatase are elevated out of proportion to other liver function tests.

3. How do you interpret his hepatitis test results? What is the pattern for a chronically infected individual? What is the pattern for a person who has recovered?

He has acute HBV infection. A person chronically infected with HBV usually has HBsAg and IgG anti-HBc (rarely will a person have only the IgG anti-HBc and yet have a low-level of chronic infection). A person who has had HBV infection and recovered has IgG anti-HBc and usually anti-HBs.

4. Which hepatitis tests should have been ordered?

IgM antibody to hepatitis A virus, HBsAg, IgM anti-HBc, and antibody to hepatitis C virus are the most important tests; many physicians would add IgG (or total) anti-HBc. For confirmation of positive test results for antibody to hepatitis C, polymerase chain reaction tests for hepatitis C virus are available.

5. How likely is he to become chronically infected with HBV?

He has a  $\leq 5\%$  risk of becoming chronically infected with HBV.

**Note:** HBV DNA tests are most commonly used to manage patients on antiviral therapy.

**Take Home Point:**

- A battery of hepatitis serologic tests are needed to accurately diagnose the cause of acute hepatitis.

**Scenario Two**

1. What was the most likely source of hepatitis?

Jean most likely contracted hepatitis B virus infection through injection - drug use (IDU). Transfusion is very unlikely as the source of her infection because (1) the incubation period for hepatitis B is 45 to 160 days (average, 120), whereas Jean received a transfusion 1 year ago, and (2) the risk from transfusion is now very small. Acquisition by sexual transmission is also possible.

2. Which of Jean's contacts need to be informed of possible exposure? Does her case need to be reported?

The persons needing to be informed include sex partners, persons with whom needles have been shared, and persons exposed as household contacts (e.g., persons exposed by sharing toothbrushes). If feasible, all unvaccinated household members should be vaccinated. Her case should be reported to public health authorities.

3. What is the risk to Jean's boyfriend? What should be done for him?

Jean's boyfriend is at considerable risk of infection through sexual transmission, which is the most common form of HBV transmission in the United States.

Unvaccinated persons whose sex partners have acute hepatitis B virus infection should be tested for susceptibility to HBV infection and immediately after testing receive a single dose of HBIG (0.06 mL/kg) and the first dose of the hepatitis B vaccination series. If they are susceptible, they should complete the series using the age-appropriate vaccine dose and schedule. Exposed persons who have previously completed the vaccine series but whose response is unknown should receive a single booster dose. Persons who are part way through the vaccination series should receive HBIG and should complete the series.

4. What is the risk for those with whom Jean has shared needles? Given that she is willing to identify them if their names will be treated confidentially, what should be done for them?

The persons with whom Jean shared needles may be at risk and, if unvaccinated, should receive HBIG and begin the hepatitis B vaccine series. Their risk of HBV infection depends on whether or not she has used injection drugs during the last 2 months and when Jean became infected with HBV. Unvaccinated persons who have shared needles with someone who has acute hepatitis B virus infection should be tested for susceptibility to HBV infection and immediately after testing receive a single dose of HBIG (0.06 mL/kg) and the first dose of the hepatitis B vaccination series. Exposed persons who have previously completed the vaccine series but whose response is unknown should receive a single booster dose. Persons who are part way through the vaccination series should receive HBIG and should complete the series.

5. Jean was hospitalized approximately one year ago for treatment of stab wounds. Should she have received hepatitis B vaccine then?

Jean could have received hepatitis B vaccine before discharge from the hospital 1 year ago. Many authorities would consider this a missed opportunity for vaccination.

**Take Home Point:**

- Hepatitis B virus infection is relatively common and can be prevented by appropriate vaccination which includes vaccination on the basis of high-risk behaviors.

**Scenario Three****Questions for Learners**

1. If the patient has acute or chronic HBV infection, what is the risk to the nurse? Is the nurse at risk for HBV infection from the needlestick?

The nurse is at risk for HBV infection if the patient is acutely or chronically infected. The magnitude of the risk depends on the infectiousness of the patient and the amount of blood transferred. If the patient is HBeAg-positive, the risk increases. The risk of becoming infected with HBV from the needlestick is approximately 6% to 30% (30% represents HBeAg-positive patients).

2. How is hepatitis B vaccine currently produced?

Hepatitis B vaccine in the United States is produced totally by recombinant DNA technology. The vaccine does not contain whole Hepatitis B virus or plasma from other persons.

3. Can hepatitis B vaccine transmit HIV? What are the vaccine's adverse events?

Neither the recombinant vaccine nor the older plasma-derived vaccine has been associated with transmission of HIV; the plasma-derived vaccine underwent sufficient chemical processes to inactivate HIV. The adverse events are pain at the injection site (3% to 29%) and temperature  $>37.7^{\circ}\text{C}$  (0.4% to 6%); however, they do not occur more frequently than adverse events from placebo injection. Current data do not indicate an association between receipt of recombinant vaccine and Guillain-Barré syndrome. Anaphylaxis occurs rarely after vaccination at a rate of 1 per 1.1 million doses distributed. In rare cases, vaccination might trigger alopecia.

4. What should be done for the nurse?

All healthcare personnel and persons who have occupations that expose them to blood should be vaccinated; the fact that this nurse is unvaccinated is considered a missed opportunity. The health-care facility should attempt to obtain the patient's HBsAg status. The nurse may receive HBIG and should begin the hepatitis B vaccine series. Medical personnel should be tested for response to hepatitis B vaccine after 3 doses so that they can be treated appropriately if they are exposed. If they have developed protective antibody titers, there is no need for further hepatitis B vaccination, even if exposed. Post-vaccination testing should be done 1 to 2 months after completion of the vaccination series.

5. What office procedures can be taken to help the nurse finish the hepatitis B vaccine series, since more than 1 dose will be needed?

Reminders via telephone, e-mail, or mail help remind patients of needed vaccinations. Employee health offices should consider using tracking systems to generate such reminders for vaccination.

**Take Home Points:**

- Occupational risk of HBV can generally be prevented by appropriate pre-exposure vaccination.
- Needlestick injuries require appropriate treatment based on previous vaccination history and on response to vaccination.
- The CDC recommends serologic evaluation of vaccine response in healthcare workers at risk for blood exposure.

**Scenario Four****Questions for Learners**

1. Where was Ms. Lai most likely to have become infected with HBV?

Most likely, Ms. Lai was infected with HBV at birth from her mother or during early childhood. Approximately 70% of immigrants from Southeast Asia have been infected with HBV and approximately 10% to 20% are chronically infected.

2. What are the serious complications of her disease?

The serious complications of chronic HBV infection are cirrhosis and hepatocellular carcinoma. Persons chronically infected may also be at risk for hepatitis delta virus (HDV) superinfection. See the CDC Division of Viral Hepatitis Prevention's website for additional discussion of complications:

<http://www.cdc.gov/ncidod/diseases/hepatitis/index.htm>

3. What is her child's risk for becoming infected with HBV at the time of delivery?

The child's risk of infection at time of delivery is 10% to 90%, depending on the mother's hepatitis B e antigen status; HBeAg is a marker of increased infectivity. The risk is 70% to 90% if she is HBeAg positive and 10% to 40% if she is HBeAg negative.

4. What should be done for her child following delivery? How soon should it be done?  
At what anatomical site should the treatment be administered?

The child should receive hepatitis B vaccine intramuscularly (IM) and 0.5 mL of HBIG IM within 12 hours of birth. Hepatitis B vaccine is administered IM in the anterolateral thigh in infants.

5. How likely is it that the records about the newborn's need for hepatitis B vaccine will be sent to the physician doing well-child care? How could this be facilitated?

It is unlikely that the vaccination records will be sent; therefore, special effort is needed to communicate to Dr. Thomas the information about the chronically infected status of the mother and the treatment the child received. The child needs additional doses of vaccine at 1-2 months of age and 6 months of age. Alternatively, combination vaccines that contain hepatitis B vaccine can be used where indicated at these ages. This is the recommended schedule for infants born to chronically infected mothers. In this situation, the child should receive postvaccination screening for HBsAg between 9 to 18 months of age. The more permissive schedule for routine infant vaccination against hepatitis B should not be used. (e.g., not 6-18 months for dose 3.)

6. What should be done for the two infants for whom she babysits?

It is prudent to treat the infants as household contacts. If they have not already been vaccinated, they should be vaccinated. Persons not fully vaccinated should complete the vaccine series. Testing of unvaccinated persons for susceptibility to HBV infection may be considered at the time of administration of the first vaccine dose.

**Take Home Point:**

- Given the increased risk of perinatal HBV infection, prompt administration of hepatitis B vaccine and HBIG should occur within 12 hours of birth for infants born to currently infected mothers.

**Scenario Five****Questions for Learners**

1. Is a comprehensive strategy justified? Why or why not? List reasons.

Rationale for the comprehensive strategy to eliminate transmission of hepatitis B virus infection in the United States:

- a) An estimated 300,000 cases of hepatitis B virus infection occurred per year in the United States in the 1970s and 1980s, before widespread use of hepatitis B vaccine in the United States. (In a population that was 260 million, this was approximately 1 in 1000.)
- b) An estimated 1 to 1.25 million persons are chronically infected, all of whom are potentially infectious (1 in about 290 persons in the United States). These persons are at risk for cirrhosis, delta hepatitis, and hepatocellular carcinoma.
- c) Of reported hepatitis B cases, 16% have no known source of infection.
- d) Previous strategies to identify and vaccinate high-risk persons have had limited success. Vaccination of injection drug users and commercial sex workers (prostitutes), using a 3-dose schedule, is problematic because such persons may not complete the second and third doses and may become infected prior to vaccination.
- e) A person is at a higher risk for becoming chronically infected if he or she became infected with HBV early in life (90% for infants, 30% for children < 5 years, <5% for persons infected at > 5 years). Child-to-child transmission has been documented within families and in school settings.

- f) Comprehensive hepatitis B vaccination has been successful in Alaska. After successful implementation of a comprehensive program to vaccinate susceptible Alaska Natives, including all newborns, the incidence of acute symptomatic HBV infection fell by over 90% [*Lancet* 1987; 2:1134-1136].
- g) The vaccine costs less than many other preventive measures. In some cases, the vaccine is even cost-saving.
- h) On the basis of studies conducted to date, long-term protection appears to exist for at least 20 years after hepatitis B vaccination. In persons who initially respond to vaccination, anti-HBs titers may decline over time; however, loss of anti-HBs after vaccination does not imply loss of protection. In vitro studies have demonstrated intact immunologic memory in B lymphocytes obtained from vaccine responders who had low or undetectable anti-HBs levels 7 to 8 years after vaccination. Moreover, natural exposure to HBV long after primary vaccination results in an anamnestic increase in anti-HBs that protects against both clinically significant acute and chronic HBV infection. Routine booster doses of hepatitis B vaccine are therefore not currently recommended for persons with a normal immune status.
- i) Since implementation of routine childhood immunization, an estimated 6,800 perinatal infections and 18,700 other infections in the first 10 years of life have been prevented annually.

2. What are the components of such a strategy?

Components of a comprehensive strategy:

- a) Universal vaccination of infants, beginning at birth.
- b) Prevention of perinatal HBV infection through
  - i) routine screening of all pregnant women for hepatitis B surface antigen (HBsAg), and

- ii) immunoprophylaxis of infants born to HBsAg-positive women and infants born to women with unknown HBsAg status.
- c) Routine vaccination of previously unvaccinated children and adolescents.
- d) Vaccination of previously unvaccinated adults at increased risk for infection.

**Take Home Point:**

- A comprehensive strategy includes universal infant vaccination, prevention of perinatal HBV infection, catch-up vaccination of unvaccinated adolescents, and vaccination of high-risk adults.

**Scenario Six****Questions for Learners**

1. Who in Dr. Ruffa's practice should receive hepatitis B vaccine? (List)

The Advisory Committee on Immunization Practices recommends catch-up vaccination of all adolescents who have not previously received hepatitis B vaccine. Persons with occupational indications include healthcare workers, students in healthcare fields, public safety workers with exposure to blood or body fluids, staff of correctional institutions, and staff of institutions for the developmentally disabled. Persons with indications according to place of residence include clients of institutions for the developmentally disabled, household contacts of chronically infected individuals, and inmates who receive medical evaluation in prisons. Persons who have medical indications include those who receive dialysis, have end-stage renal disease, HIV infection, chronic liver disease, and seek evaluation or treatment for an STD. Persons with behavior indications include injection drug users, men who have sex with men, persons NOT in a long-term, mutually monogamous relationship, (e.g, more than one sex partner in the preceding 6 months), and inmates of long-term correctional institutions. In addition, international travelers who will have close contact with the local population in areas with high or intermediate HBV endemic infection should be vaccinated. Finally, vaccination is indicated for victims of sexual assault.

2. How can Dr. Ruffa systematically identify which patients need hepatitis B vaccine?

To identify patients for vaccination, Dr. Ruffa should question each patient about occupation, sexual history (including sexual orientation and STDs), and drug history. Dr. Ruffa can revisit these issues during each periodic history and physical. The problem list in the medical record can be checked for medical indication. These areas of the chart should be updated periodically, and charts of vaccine indications

can be prominently displayed in the office, or are available via the internet or with *Shots* software. The office computer can be used to search diagnoses (e.g., STDs) to identify patients with medical indications.

3. What is the vaccine administration route and site?

For adults, hepatitis B vaccine is given by the intramuscular route in the deltoid muscle. For men and women weighing <130 lbs (<60 kg) a 5/8 --1-inch needle is sufficient to ensure intramuscular injection. For women weighing 130 -- 200 lbs (60-- 90 kg) and men 130 -- 260 lbs (60 -- 118kg), a 1--1½-inch needle is needed. For women weighing >200 lbs (>90 kg) or men weighing >260 lbs (>118 kg), a 1½-inch needle is required.

4. What can Dr. Ruffa do to encourage compliance with the second and third doses of hepatitis B vaccine?

Methods to encourage compliance include the following:

- a) Reminding patients by mail, e-mail, or telephone.
- b) Educating patients about disease severity, the immunization schedule, and the importance of the second and third doses.
- c) Having office staff ask immunization status at registration or during vital signs and vaccinate under standing orders.
- d) Having the computer generate “tickler” reminders that determine and track any needed immunizations.

5. When should the second and third doses of hepatitis B vaccine be given if the schedule is interrupted?

If the vaccination series is interrupted after the first dose, the second dose should be administered as soon as possible. The second and third doses should be separated by an interval of at least 8 weeks. If only the third dose is delayed, it should be

administered when feasible. There is never a need to restart the series if intervals are prolonged.

6. For whom is post-vaccination serologic testing indicated?

Infants born to HBsAg+ women, hemodialysis patients, immunodeficient persons, sex partners of persons with chronic HBV infection, and healthcare personnel who have contact with patients or blood.

**Take Home Points:**

- High-risk indications for vaccination are complex, requiring a careful history to determine when vaccines are needed.
- Office systems including reminders and standing orders may help compliance with the full 3 doses.

**HEPATITIS B SAMPLE TEST**

This test was developed using expert knowledge and classical psychometric statistics, such as item difficulty and item discrimination, during the pilot phase of development. It may be used as a sample examination.

**1. Chris, a radiology technician, is chronically infected with HBV. Who does not need contact tracing?**

- a) Current sex partner
- b) Roommate
- c) Co-worker who had an accidental needlestick contaminated with Chris' blood.
- d) "Drinking friends"
- e) Sex partner from 1 year ago

**2. Which of the following is true?**

- a) If the hepatitis B vaccination series is stopped, it must be restarted
- b) The second dose is recommended 1 to 2 months after the first
- c) The third dose is recommended 1 month after the second
- d) The third dose is recommended 6 to 20 months after the second
- e) None of the above

**3. Common reasons that persons refuse hepatitis B vaccine include all of the following except**

- a) Fear of contracting HIV
- b) Cost
- c) Desire to donate blood
- d) Concern about systemic adverse events
- e) Belief that they are unlikely to be exposed

**4. The most common sources, in descending order, of HBV infection in the United States are**

- a) Sexual, medical, injection drug use (IDU)
- b) Sexual, IDU/unknown
- c) IDU, sexual, medical, unknown
- d) IDU, sexual, household contact
- e) IDU, sexual, unknown

**5. The rationale for routine infant hepatitis B immunization includes**

- a) The failure of previous immunization strategies in the United States
- b) The burden of hepatitis B in the United States
- c) The difficulty in vaccinating persons who are engaged in high-risk behaviors
- d) The proportion of persons who become infected with HBV but have no known risk factors
- e) All of the above

**6. Which of the following is most likely to lead to chronic infection with HBV?**

- a) Unprotected sex with a commercial sex worker (prostitute)
- b) Experimentation with injection drugs
- c) Birth to a mother who is chronically infected
- d) A contaminated needlestick to a medical professional
- e) None of the above

**7. Which of the following characteristics is not an indication for hepatitis B vaccine?**

- a) Occupation of food handler in seafood restaurant
- b) Multiple sex partners in the last 6 months
- c) Travel overseas to an endemic area
- d) Occupation of emergency medical technician
- e) 1 month old and unvaccinated

**8. All of the following statements about hepatitis B vaccine are true except**

- a) Hepatitis B vaccine is currently made by recombinant technology
- b) Immunity is known to last at least 15 years in most adult recipients
- c) The dose needed varies by the age of the recipient
- d) If immunity wanes below 500 mIU/mL, then protection is lost

**9. Which of the following tests is/are appropriate?**

- a) Hepatitis B IgM core antibody in a person with multiple sex partners and jaundice
- b) Hepatitis B surface antigen in a pregnant woman
- c) Hepatitis B surface antibody in a physician who completed the hepatitis B vaccine series 1 month ago
- d) Total anti-HBc in a developmentally delayed person who has been in an institution for 15 years and has not been vaccinated against hepatitis B
- e) All of the above

**HEPATITIS B TEST ANSWER KEY**

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