Prevention of hepatitis B virus and hepatitis C virus infection among health care providers

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INTRODUCTION

Many pathogens can be transmitted to health care providers (HCP) following exposure to blood or body fluids. The most important of these are hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV).

The epidemiology and management of occupational exposures to HBV and HCV in HCP will be reviewed here. The prevention of HIV and other pathogens in HCP is discussed separately. (See "Management of health care personnel exposed to HIV" and "Immunizations for health care providers" and "Prevention and control of varicella-zoster virus in hospitals".)

EPIDEMIOLOGY OF BLOODBORNE EXPOSURES

Statistics on exposures — The Centers for Disease Control and Prevention (CDC) estimate that 5.6 million workers in the health care industry and related occupations are at risk of occupational exposure to bloodborne pathogens, including human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), and others [1]. Although the focus on post-exposure management is on HIV, HBV, and HCV, more than 30 different pathogens have caused documented occupational infection following exposure to blood or body fluids in health care personnel (HCP) or hospital laboratory personnel (table 1) [2].

All occupational exposure to blood and other potentially infectious material place HCP at risk for infection with bloodborne pathogens. The Occupational Safety and Health Administration (OSHA) defines blood to mean human blood, blood components, and products made from human blood [1]. Other potentially infectious material includes body fluids such as: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, amniotic fluid, saliva associated with dental procedures, and body fluid that is visibly contaminated with blood. All body fluids should be considered infectious in situations where it is difficult or impossible to differentiate between bloody fluids. Any unfixed tissues or organs (other than intact skin) from a human (living or dead) are also considered potentially infectious material. For laboratory personnel, other potentially infectious material includes HIV-containing cell or tissue cultures, organ cultures, HIV- or hepatitis virus-containing culture medium or other solutions, as well as blood, organs, or tissues from experimental animals infected with HIV, HBV, or HCV.

The main occupational risk for acquiring a bloodborne pathogen is a percutaneous sharps injury with a contaminated object. Mucous membrane exposure to blood or other potentially infectious material can also transmit HIV, HBV, and HCV. Reports regarding the frequency of such occupational risks are as follows:

- The CDC estimates that about 385,000 sharps-related injuries occur annually among HCP in hospitals [3].

- Data from the Exposure Prevention Network (EPINet) suggest that from 2000 to 2014, there was a significant reduction of both blood and body fluid exposures (BBFE) and sharp object injuries (incidence rate difference 7.5) [4]. The decrease was most notable from 2000 to 2011, and then leveled off from 2011 to 2014. However, the rates reported in 2008 increased compared with 2014; the rate of BBFE exposures increased 42 percent [5], and the rate of sharp object injuries increased 20 percent [6].

- Despite the overall decrease in sharp object injuries from 2000 to 2014, data from both from EPINet [4] and the University of North Carolina [7] found that from 2000 to 2014, the rate of sharp object injuries from safety-engineered devices increased. This was likely because of failure to activate the safety-engineered device and inadequate training on the use of such devices. Another study noted that the most commonly reported causes for needlestick injuries were unsafe disposal of the needles and problems with the safety feature [7].

- Data from EPINet revealed that in 2018, the rates of needlestick and sharp object injuries and BBFE were greater in teaching hospitals compared with nonteaching hospitals (the

rate of BBFE was 13.8 versus 12.6 per 100 average daily census [ADC] [5], and the rate of needlestick and sharp object injuries was 30.7 versus 29.7 per 100 ADC [6].

Underreporting of exposures remains a distinct problem, even in institutions that provide easily accessible reporting systems [8].

Risk of exposure by profession — EPINet data from 2018 documented approximately 1175 percutaneous injuries within its surveillance system. Of those, nurses reported the most frequent number (35 percent), followed by attending clinicians (16 percent), and medical trainees such as medical students, interns, residents, and fellows (17 percent) [6]. According to data from the CDC, 18 percent of HCP trainees (ie, interns, residents, and fellows) sustain a percutaneous exposure annually [9]. Long work hours and sleep deprivation result in fatigue, which is associated with a threefold increase in the risk of needlestick injuries [10,11].

Among HCP trainees, only about 50 percent of percutaneous exposures are reported to occupational health [9]. As an example, in a survey of 699 surgeons in training at 17 medical centers, almost all residents had a history of a needlestick injury by the final year of training, but more than half of the injuries were not reported [12]. The most common reason that such injuries were not reported was lack of time.

Devices associated with exposure — The two most common devices involved in percutaneous injuries include disposable syringes (24 percent) and suture needles (25 percent) [6]. These sharp devices are most commonly used for suturing, administering injections, or drawing venous blood.

Minimizing risk — Minimizing risks to HCP for acquisition of bloodborne pathogens should be an integral part of the infection control and occupational health programs in all health care facilities [8,13,14]. In one study, combining preventive methods (mandatory double gloving, a safety zone, engineered sharps-injury prevention devices, and clear communications when passing sharps) resulted in a 53 percent decrease in sharps injuries in operating rooms [15].

All health care facilities are required by OSHA to undertake measures to reduce occupational exposures to bloodborne pathogens, and include the use of engineering controls that minimize the risk of sharp injuries (eg, needleless intravenous medication systems, blunted suture needles) [9,14,16]. Key measures required by OSHA include the following:

- All HCP with "reasonably anticipated" exposure to blood or blood contaminated body fluids must receive yearly education on the epidemiology of bloodborne pathogen transmission and means of minimizing such risks.

- All at-risk HCP must be offered hepatitis B immunization at no cost to the employee. HCP who refuse immunization must sign an OSHA mandated declination form.

- Health care facilities must provide certain engineering controls proven to reduce exposure to risk, such as leakproof secondary containers for transporting blood and impervious needle disposal containers.

- Health care facilities must provide personal protective equipment (PPE) and HCP must use PPE when performing procedures during which it is reasonably anticipated that exposure to blood might occur. PPE consists of gloves for possible hand contact with blood, and impervious gowns and face/eye shields when splashes, sprays, or spatters of blood or other potentially infectious material may be generated.

"Standard" precautions (formerly called universal precautions) should be used for the care of all patients. These precautions consist of wearing gloves when touching blood, body fluids (with the exception of sweat), and contaminated items. A mask, gown, and eye protection or a face shield should be worn during procedures and patient care activities that are likely to generate splashes and sprays of blood, body fluids, secretions, and excretions. Hand hygiene is required before and after all patient encounters, even if gloves are worn. In addition, HCP who have exudative lesions or weeping dermatitis on their hands should refrain from all direct patient care. An additional discussion on the use of standard precautions is found elsewhere. (See "Infection prevention: Precautions for preventing transmission of infection", section on 'Standard precautions'.)

Other strategies that have been effective in reducing blood exposures include: double gloving for high risk surgical/obstetrical procedures; blunted suture needles; self-sheathing needles; needleless connectors and infusion sets; and enhanced education (table 2) [8,17-33]. The Centers for Disease Control and Prevention has developed a workbook for designing, implementing, and evaluating a sharps injury prevention program that is available on the CDC website [14].

Risk of acquisition following exposure — The risk that a HCP will acquire HBV or HCV as a result of an occupational exposure will depend upon several factors (table 3) [8,34]. These include:

- Prevalence of the infectious agent in the general population and within the patient population served by the health care facility

- Frequency of exposures capable of transmitting the infectious agent

- Nature of the exposure and efficiency of transmission for that exposure (ie, exposure via percutaneous, mucosal, or nonintact skin)
- Which virus(es) are present in the contaminated fluid and the titer of virus (ie, viral load) in that fluid
- Availability and efficacy of pre- and post-exposure prophylaxis

HBV infection — HBV is highly infectious and the risk of transmission depends upon the hepatitis B surface antigen (HBsAg) and hepatitis B e antigen (HBeAg) status of the source. The risk of developing serologic evidence of HBV infection after a percutaneous injury ranges from 37 to 62 percent if the source patient is both HBsAg positive and HBeAg positive, and ranges from 23 to 37 percent if the source is HBsAg positive but HBeAg negative [35-37]. The risk of developing clinical hepatitis after exposure ranges from 22 to 31 percent if the source patient is both HBsAg positive and HBeAg positive, and ranges from 1 to 6 percent if the source is HBsAg positive but HBeAg negative [36].

Despite the high risk of transmission, the number of HBV infections among HCP declined by approximately 98 percent from an estimated 17,000 infections in 1983 to 263 acute HBV infections in 2010 [9,37]. This is due in large part to efforts aimed at immunizing all HCP against HBV. (See "Immunizations for health care providers".)

HCV infection — Sharp injuries are the most common route for HCV transmission to HCP. The CDC estimates the average incidence of HCV seroconversion to be 1.8 percent (range, 0 to 7 percent) after a needle stick or sharps exposures from a source with HCV infection [36]. Other studies have shown similar rates of transmission [38-40].

The risk of seroconversion depends upon the type of percutaneous injury. As an example, in a study of 626 UK health care workers, the type of procedure (ie, blood sampling versus not blood sampling) and depth of injury (ie, deep versus superficial) were independently associated with an increased risk of HCV seroconversion (adjusted odds ratios of 5.75 and 21.99, respectively) [40].

PRE-EXPOSURE PROPHYLAXIS

Hepatitis B — The introduction of hepatitis B vaccination for HCP has been highly successful in reducing HBV infection. The use of hepatitis B vaccination for pre-exposure prophylaxis is presented elsewhere. (See "Immunizations for health care providers", section on 'Hepatitis B vaccine'.)

Hepatitis C — Pre-exposure prophylaxis for HCV is not available.

POST-EXPOSURE MANAGEMENT

Definition of exposure — Health care providers (HCP) are at risk for hepatitis B virus (HBV) and/or hepatitis C virus (HCV) infection if they are exposed to blood and/or certain other body fluids [9,36,37]. An exposure can occur through:

- A percutaneous injury (eg, a needlestick or cut with a sharp object)
- Contact with mucous membranes or nonintact skin (eg, exposed skin that is chapped, abraded, or afflicted with dermatitis)

Blood is the most important source of HBV and HCV transmission in HCP. Other body fluids, such as cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, and amniotic fluid are considered potentially infectious. Semen and vaginal secretions have been implicated in the sexual transmission of HBV, but they have not been implicated in occupational transmission from patients to HCP [9]. Although body fluids such as feces, sputum, urine, and sweat contain low quantities of HBV, they are **not** considered potentially infectious unless they contain visible blood [36].

HBV has also been transmitted by fomites such as finger-stick devices used to obtain blood for glucose measurements, multi-dose medication vials, jet gun injectors, and endoscopes. HBV can survive on counter tops for seven days and remains capable of causing infection during that time period [41]. HCV has also been demonstrated to remain infectious for prolonged periods of time; one study found that HCV may be able to remain infectious on inanimate surfaces at room temperatures for several weeks [42].

Initial management

Wound care — If an HCP has been exposed to blood or a body fluid that contains blood, wounds and skin sites that have been in contact with blood or body fluids should be washed with soap and water, and mucous membranes should be flushed with water. Caustic agents (eg, bleach) should **not** be applied to the wound; similarly the injection of antiseptics or disinfectants into the wound is **not** recommended [37]. The use of topical antiseptics (eg, 2 to 4% chlorhexidine) is not contraindicated; however, the use of these agents and/or expressing fluid by squeezing the wound have not been shown to reduce the risk for HBV transmission.

Obtaining Information — Trained medical personnel (eg, occupational health providers) should obtain information about the source patient, the exposed HCP, and the type of exposure

to determine an appropriate post-exposure treatment plan. If the exposure is a result of a human bite that penetrated skin, both the person biting and the person who was bitten should be evaluated for post-exposure prophylaxis. Based upon the recommendations of the US Centers for Disease Control and Prevention (CDC) [36,37] and the Occupational Safety and Health Administration (OSHA) [16], the following information should be obtained:

- **Source Patient** – The hepatitis B surface antigen (HBsAg) and hepatitis C virus (HCV RNA) status of the source patient should be assessed. After obtaining informed consent, all source patients should be tested for HBsAg and HCV RNA, even if they had previous negative tests, unless:
  - The source patient is known to be infectious (ie, HBsAg-positive or HCV RNA-positive)
  - The injured HCP has completed the three-dose hepatitis B vaccine series along with documentation of an adequate vaccine response (ie, HBV surface antibody [anti-Hbs] ≥10 milli-international units/mL). In that case, only HCV RNA status needs to be reassessed. (See "Immunizations for health care providers", section on 'Follow-up testing after immunization'.)
- **HCP** – The following information should be obtained from the injured HCP and verified from their medical/occupational health record:
  - Dates of hepatitis B immunizations
  - Post-immunization quantitative titer, if known
  - Previous testing (if available) for HBV and HCV
  - Tetanus immunization status (table 4)
  - Current medications
  - Current or underlying medical conditions that might influence use of/response to vaccination
- **Exposure** – The following information regarding the exposure should be obtained:
  - The date and time of the exposure
  - Nature of the exposure (ie, nonintact skin, mucosal, percutaneous, human bite)
  - Type of fluid (ie, blood, blood contaminated fluid, or other contaminated fluid)
  - Body location of the exposure and contact time with the contaminated fluid
  - For percutaneous injuries, a description of the injury (eg, depth of wound, solid versus hollow needle, sharp use in source patient)

All information should be recorded on the injured HCP medical/occupational health record. Many health care facilities regard information obtained on HCP as confidential and place it in a separate medical record accessible only to the occupational health clinician or nurse.

A detailed discussion on the evaluation of HCP exposed to HIV is found elsewhere. (See "Management of health care personnel exposed to HIV".)

HBV exposure

Initial assessment — Post-exposure management of HCP with a possible exposure to HBV depends first upon the immune status of the HCP and second upon the HBsAg status of the source patient. If the HBsAg status of a source patient cannot be determined, the HCP should be managed as if the source patient is HBsAg positive.

The HBV status (ie, HBsAg, anti-HBs) of all HCP should be known prior to potential exposures to blood and body fluids (see "Immunizations for health care providers", section on 'Assessing immunity'). If the HBV status of the HCP is unknown, one should obtain baseline anti-HBs and HBsAg status before determining post-exposure management since there is a seven-day window before hepatitis B immune globulin must be administered. (See 'Hepatitis B Immune Globulin (HBIG)' below.)

- HCP may have evidence of immunity based upon past HBV infection (ie, anti-HBc and anti-HBs positive). Such individuals are felt to be protected against HBV infection.
- For HCP without evidence of prior HBV, the risk of infection depends upon their vaccine status, which is defined as follows (see "Immunizations for health care providers", section on 'Follow-up testing after immunization'):
  - Vaccine responder – If the hepatitis B surface antibody (anti-HBs) level after completing a hepatitis B vaccine series is ≥10 milli-international units/mL, the individual is considered a vaccine responder and is felt to be protected against HBV infection.
  - Vaccine nonresponder – If the anti-HBs remains <10 milli-international units/mL after completing a hepatitis B vaccine series on two separate occasions, the individual is considered a vaccine nonresponder.
  - Vaccine response unknown – If the hepatitis B vaccine series was completed, but post-vaccine serologic testing was not performed, the individual has an unknown vaccine response.

- Not vaccinated – Such individuals were not vaccinated or did not complete the three-dose series.

It is important to note that two types of hepatitis B vaccines are available; the standard yeast-derived vaccines that use an aluminum adjuvant require three doses, whereas a newer vaccine (HepB-CpG), which uses a novel adjuvant, is administered as a two-dose series (table 5). Ideally, one should not mix the standard three-dose vaccine and HepB-CpG in the same series; however, if that was not feasible (eg, due to vaccine availability), a two-dose vaccine series should only be considered complete when both doses consist of HepB-CpG. (See "Hepatitis B virus immunization in adults".)

Approach to post-exposure prophylaxis — Our approach to post-exposure management of HCP potentially exposed or exposed to HBV infection is based upon the recommendations from the CDC [9,37], which are summarized in the table (table 6) and discussed in detail below.

HCP with evidence of prior HBV infection — No post-exposure management is required if the HCP has evidence of past HBV infection (anti-HBs-positive) (see "Hepatitis B virus: Screening and diagnosis in adults", section on 'Serologic markers'). Such individuals are felt to be protected against HBV infection and do not require post-exposure treatment.

HCP who are vaccine responders — No post-exposure management is required if the HCP received and adequately responded to the three-dose hepatitis B vaccine series. (See "Immunizations for health care providers", section on 'Follow-up testing after immunization'.)

HCP who are vaccine nonresponders — The source patient should be tested for HBsAg if the HCP is a vaccine nonresponder (ie, anti-HBs remains <10 milli-international units/mL after completing the hepatitis B vaccine series on two separate occasions). If the HBsAg is positive or if it cannot be obtained, the HCP should receive two doses of hepatitis B immunoglobulin (HBIG). The second dose of HBIG should be given one month after the first dose. (See 'Hepatitis B Immune Globulin (HBIG)' below.)

HCP who have unknown vaccine response — The source patient should be tested for HBsAg and the HCP should be tested for anti-HBs if the vaccine response is unknown. These tests should be done as soon as possible after the exposure and should occur simultaneously.

- If the anti-HBs titer is ≥10 milli-international units/mL, no post-exposure prophylaxis for HBV is needed.

- If the anti-HBs titer is <10 milli-international units/mL, post-exposure management depends upon the HBsAg status of the source patient:

- If the source patient is HBsAg positive or if the status cannot be obtained, the HCP should receive one dose of HBIG and a dose of the hepatitis B vaccine (they should be given simultaneously but at different injection sites). The HCP should then receive one or two more doses of the hepatitis B vaccine (depending upon the vaccine formulation) to complete the series (table 5). (See 'Hepatitis B Immune Globulin (HBIG)' below and "Immunizations for health care providers", section on 'Vaccines and dosing schedules'.)

  To determine immunity, the HCP should have anti-HBs testing performed one to two months after the last dose of the hepatitis B vaccine series and at least six months after HBIG was administered. (See "Immunizations for health care providers", section on 'Follow-up testing after immunization'.)

- If the source patient is HBsAg negative, the HCP should receive one dose of the hepatitis B vaccine followed by repeat anti-HBs testing one to two months later. If the anti-HBs remains <10 milli-international units/mL, then the HCP should complete the vaccine series followed by anti-HBs testing one to two months after the second dose. (See "Immunizations for health care providers", section on 'Follow-up testing after immunization'.)

HCP who have not received or completed the vaccine series — The source patient should be tested for HBsAg status if the HCP has no documentation of being vaccinated and/or has not completed the hepatitis B vaccine series. Clinicians should not check anti-HBs among HCP who are incompletely vaccinated. Testing such HCP for anti-HBs is potentially misleading since an anti-HBs titer ≥10 milli-international units/mL has only been validated as an indicator of immunity for persons who have completed an approved vaccination series (table 5) [9]. (See 'Initial assessment' above.)

- If the source patient is HBsAg positive or if the status cannot be obtained, the HCP should receive one dose of HBIG and the first dose of the hepatitis B vaccine series. These can be administered simultaneously (but at different injection sites). The HCP should then complete the hepatitis B vaccine series. (See 'Hepatitis B Immune Globulin (HBIG)' below and "Immunizations for health care providers", section on 'Vaccines and dosing schedules'.)

- If the source patient is HBsAg negative, the HCP should complete the hepatitis B vaccine series and be tested for response the same way that we do for all other HCP. (See "Immunizations for health care providers", section on 'Follow-up testing after immunization'.)

Follow-up testing after exposure — If the source patient was HBsAg positive or if the status could not be obtained, one should perform follow-up testing with anti-HBc and HBsAg six months after the exposure to assess for HBV transmission in HCP who were not HBV immune at the time of exposure. (See "Hepatitis B virus: Screening and diagnosis in adults", section on 'Serologic markers'.)

During this six month period, HCP should refrain from donating blood, plasma, organs, tissue, or semen [9]. However, they can resume their normal health care duties.

Hepatitis B Immune Globulin (HBIG) — Hepatitis B Immune Globulin (HBIG) provides anti-HBs and generally protects against infection with HBV for three to six months. The standard adult dose is 0.06 mL/kg and should be given intramuscularly. HBIG should ideally be administered within 24 hours of exposure, but if this is not possible (eg, testing the source patient takes more than 24 hours), it **must** be given within seven days. HBIG has been estimated to be 75 percent effective in preventing HBV infection [9]. However, the efficacy of HBIG has only been evaluated when given within a week of exposure.

HCV exposure — The management of HCP potentially exposed to HCV involves early diagnosis and treatment of HCV infection, should it occur. The approach below is based on the guidelines from the United States CDC [43,44].

There is no role for post-exposure prophylaxis for persons exposed to HCV [8,45-48]. Although HCV direct-acting antivirals (DAAs) have dramatically improved the treatment outcomes of patients with chronic HCV infection, and may be used for treatment of acute HCV infection [49], there are insufficient data to recommend their use for post-exposure prophylaxis [50,51]. In addition, studies evaluating other agents (eg, interferon alfa-2b in humans and intravenous immune globulin in animals), failed to demonstrate any benefit in preventing HCV transmission [47,48].

Initial evaluation

Assessing the status of the source — After a potential exposure to HCV, the source patient should be tested for HCV as soon as possible (preferably within 48 hours) after the exposure [43,44].

- The source patient should be tested using a nucleic acid test for HCV RNA, if possible. (See "Screening and diagnosis of chronic hepatitis C virus infection", section on 'HCV RNA assays'.)

- In most settings, a reasonable alternative is to test the source patient for antibodies to HCV (anti-HCV) and then, if positive, test for HCV RNA. When this approach is used, it is best to perform reflex testing for HCV RNA using the same specimen. (See "Screening and diagnosis of chronic hepatitis C virus infection", section on 'Antibody testing'.)

  However, initial nucleic acid testing for HCV RNA should be used if the source patient is known or suspected to have recently engaged in behaviors that increase their risk for HCV acquisition (eg, injection drug use within the previous four months), or if the source's risk for HCV infection cannot be reliably assessed. Persons with recently acquired acute infection typically have detectable HCV RNA levels as early as one to two weeks after exposure. (See "Clinical manifestations, diagnosis, and treatment of acute hepatitis C virus infection in adults", section on 'HCV RNA timing and patterns'.)

Baseline testing of the HCP — Health care personnel (HCP) should have an initial baseline test for anti-HCV with subsequent testing for HCV RNA if positive. This baseline testing should be performed as soon as possible (preferably within 48 hours) after the exposure to rule out pre-existing HCV infection.

Follow up evaluation

- **HCP with evidence of current HCV infection** – HCP with evidence of current HCV (baseline anti-HCV and HCV RNA are both positive) should be referred to a specialist for follow up. The management of persons with HCV is discussed elsewhere. (See "Overview of the management of chronic hepatitis C virus infection".)

- **HCP without evidence of current HCV** – For HCP without current HCV infection (baseline anti-HCV test is negative or baseline anti-HCV test is positive but HCV RNA is negative), follow up testing is warranted if the source patient is HCV RNA positive (even if the HCV RNA level is less than the lower limit of quantitation of the assay). Follow up testing should also be performed if the HCV status of the source patient cannot be adequately assessed (eg, the source is anti-HCV-positive but the RNA status is unknown or no testing was performed). (See 'Assessing the status of the source' above.)

  Follow up testing should be performed:

  - **Three to six weeks after the exposure** – When HCV status is assessed during this time-period, nucleic acid testing for HCV RNA should be performed.

  - **Four to six months after the exposure** – For most HCP, anti-HCV testing is suitable for evaluating the HCV status at this time point, with follow up nucleic acid testing for HCV

RNA testing if positive. Anti-HCV seroconversion typically occurs 8 to 11 weeks after exposure.

However, nucleic acid testing for HCV RNA can be considered for persons who are immunocompromised or have liver disease since delayed seroconversion have been documented among persons with immunosuppression. Nucleic acid testing for HCV should also be used for those who were anti-HCV positive/HCV RNA negative at baseline.

Any HCP who has anti-HCV seroconversion or tests positive for HCV RNA on follow up should be referred to a specialist since HCV treatment is associated with an excellent cure rate. (See "Clinical manifestations, diagnosis, and treatment of acute hepatitis C virus infection in adults".)

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Human bites" and "Society guideline links: Prevention of hepatitis B virus and hepatitis C virus infection among health care providers".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topics (see "Patient education: Blood or body fluid exposure (The Basics)")

SUMMARY AND RECOMMENDATIONS

- **Risk factors for exposure to blood born pathogens** – The main occupational risk for acquiring a bloodborne pathogen is a percutaneous sharps injury with a contaminated object. Mucous membrane exposure to blood or other potentially infectious material can also transmit hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV). (See 'Statistics on exposures' above.)

  The two most common devices involved in injuries include disposable syringes and suture needles. These sharp devices are most commonly used for suturing, drawing venous blood, and administering injections. (See 'Devices associated with exposure' above.)

- **Risk of infection after exposure** – The risk that a health care provider will acquire a bloodborne pathogen as a result of an occupational exposure will depend upon several factors, including the prevalence of the infectious agent in the patient population, the nature of the exposure, and the availability of pre- and post-exposure prophylaxis. (See 'Risk of acquisition following exposure' above.)

  - **Hepatitis B virus** – For individuals who are not immune to HBV and do not receive post-exposure prophylaxis, the risk of developing serologic evidence of HBV infection ranges from 23 to 62 percent after a percutaneous injury from a hepatitis B surface antigen-positive source patient. (See 'Risk of acquisition following exposure' above.)

  - **Hepatitis C virus** – The Centers for Disease Control and Prevention (CDC) estimates the average incidence of HCV seroconversion to be 1.8 percent (range, 0 to 7 percent) after a needle stick or sharps exposures from a HCV-positive source. (See 'Risk of acquisition following exposure' above.)

- **Preventing infection**

  - **Pre-exposure prophylaxis** – All health care providers (HCP) should be immunized against hepatitis B virus. Pre-exposure prophylaxis is not available for hepatitis C infection. (See 'Pre-exposure prophylaxis' above.)

  - **Post-exposure management**

    - **Wound care** – After exposure to a bloodborne pathogen, exposed mucous membranes should be flushed with water. Wounds and skin sites that have been in contact with blood or body fluids should be washed with soap and water. (See 'Wound care' above.)

- **Exposure to HBV** – Post-exposure prophylaxis with the hepatitis B vaccine and/or hepatitis B immune globulin should be administered to HCP who are not immune to HBV virus. The type of prophylaxis is determined by their vaccine status. (See 'Post-exposure management' above.)

- **Exposure to HCV** – There is no post-exposure prophylaxis for persons exposed to HCV blood or contaminated body fluids. Thus, HCV testing should be performed to identify infection early in its course. (See 'Post-exposure management' above.)

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Topic 3647 Version 33.0

GRAPHICS

Documented occupational infections following exposure to blood or body fluids in healthcare workers or laboratory personnel

Viral infections
Bolivian viral hemorrhagic fever (needlestick, nonintact skin)
Crimean Congo viral hemorrhagic fever (nonintact skin)
Dengue (needlestick)
Ebola viral hemorrhagic fever (nonintact skin)
Hepatitis B virus (needlestick, nonintact skin, mucous membranes)
Hepatitis C virus (needlestick, nonintact skin, mucous membranes)
Hepatitis D virus (needlestick)
Hepatitis G virus (needlestick)
Herpes simplex 1 (needlestick, nonintact skin)
Human immunodeficiency virus 1 (needlestick, nonintact skin)
Lassa viral hemorrhagic fever (nonintact skin)
Marburg viral hemorrhagic fever (needlestick, nonintact skin)
Varicella zoster virus (needlestick)
Yellow fever virus (nonintact skin)

Bacterial and rickettsial infections
Corynebacterium diphtheriae (needlestick)
Corynebacterium striatum (scalpel cut)
Mycobacterium leprae (needlestick)
Mycobacterium marinum (needlestick)
Mycobacterium tuberculosis (needlestick)
Rickettsia rickettsii (needlestick)
Staphylococcus aureus (needlestick)
Streptococcus pyogenes (scapel cut)
Streptococcus pyogenes {necrotizing fasciitis}(nonintact skin)

Fungal and parasitic infections
Blastomyces dermatitidis (scalpel cut)
Cryptococcus neoformans (needlestick)
Leishmania sp. (needlestick, nonintact skin)
Plasmodium falciparum (nonintact skin)
Plasmodium malariae (needlestick, nonintact skin)
Plasmodium vivax (needlestick)
Trypanosoma brucei (needlestick)

Adapted from: Tarantola, A, Abiteboul, D, Rachline, A. Infection risks following accidental exposure to blood or body fluids in health care workers: a review of pathogens transmitted in published cases. Am J Infect Control 2006; 34:367.

Graphic 69942 Version 1.0

Potential interventions to reduce the risk of percutaneous injuries

General measures
Puncture-resistant sharps disposal containers
Use of safer needles (eg, needles that can be resheathed without placing the operator at increased exposure, needles with blunted tips)
Needleless connectors for infusion sets
Improved education
Measures to prevent sharp injuries during surgery
Double gloves for high risk surgical or obstetrical procedures (ie, when glove puncture may occur)
Use of "no-touch" techniques that emphasize the use of instruments, rather than hands, for retracting and exploring tissue
Avoiding hands of two or more operators in the operative field simultaneously
Prohibition of hand-to-hand passage of sharp instruments
Blunted suture needles
Use of alternatives to needles and other sharp instruments (eg, tape skin closure, staples, tissue glue, electrocautery)

David Weber, MD, MPH.

Graphic 96775 Version 1.0

Risk of acquisition of bloodborne pathogens

	HBV	HCV	HIV
Seroprevalance, general population	0.42 percent (95 percent CI, 0.32-0.55)	1.8 percent (95 percent CI, 1.5-2.3)	0.31-0.42 percent
Seroprevalance in healthcare providers compared to general population	Increased in the past	Similar	Similar
Viral particles/mL of serum or plasma	10^2-10^8	1->10^6	1-10^7
Risk of infection by mode of exposure			
Percutaneous	6-30 percent	1.8 percent (range, 0-7 percent)	0.3 percent (95 percent CI, 0.2-0.5)
Mucosal	Risk not quantified, transmission documented	Risk not quantified, transmission documented	0.09 percent (95 percent CI, 0.006-0.5)
Nonintact skin	Risk not quantified, transmission not documented	Risk not quantified, transmission not documented	<0.1 percent, risk not completely quantified
Human bite	Risk not quantified, transmission documented	Risk not quantified, transmission documented	Risk not quantified, transmission documented
Infective material leading to HCW infection			
Documented	Blood, blood products	Blood, immunoglobulin preparations	Blood, blood products, bloody fluids
Possible	Semen, vaginal fluid, bloody fluids, saliva	Bloody products, bloody fluids, semen, vaginal fluid	Semen, vaginal fluid, cerebrospinal fluid, breast milk, exudates, serosal fluids, amniotic fluid, saliva (during dental exams)
Unlikely	Urine, feces	Saliva, urine, feces	Saliva, urine, feces

Courtesy of David Weber, MD, MPH.

Graphic 76403 Version 2.0

Wound management and tetanus prophylaxis

Previous doses of tetanus toxoid*	Clean and minor wound		All other wounds[¶]	
	Tetanus toxoid-containing vaccine[Δ]	Human tetanus immune globulin	Tetanus toxoid-containing vaccine[Δ]	Human tetanus immune globulin[◇]
<3 doses or unknown	Yes[§]	No	Yes[§]	Yes
≥3 doses	Only if last dose given ≥10 years ago	No	Only if last dose given ≥5 years ago[¥]	No

Appropriate tetanus prophylaxis should be administered as soon as possible following a wound but should be given even to patients who present late for medical attention. This is because the incubation period is quite variable; most cases occur within 8 days, but the incubation period can be as short as 3 days or as long as 21 days. For patients who have been vaccinated against tetanus previously but who are not up to date, there is likely to be little benefit in administering human tetanus immune globulin more than 1 week or so after the injury. However, for patients thought to be completely unvaccinated, human tetanus immune globulin should be given up to 21 days following the injury; Td or Tdap should be given concurrently to such patients.

DT: diphtheria-tetanus toxoids adsorbed; DTP/DTwP: diphtheria-tetanus whole-cell pertussis; DTaP: diphtheria-tetanus-acellular pertussis; Td: tetanus-diphtheria toxoids absorbed; Tdap: booster tetanus toxoid-reduced diphtheria toxoid-acellular pertussis; TT: tetanus toxoid.

* Tetanus toxoid may have been administered as DT, DTP/DTwP (no longer available in the United States), DTaP, Td, Tdap, or TT (no longer available in the United States).

¶ Such as, but not limited to, wounds contaminated with dirt, feces, soil, or saliva; puncture wounds; avulsions; or wounds resulting from missiles, crushing, burns, or frostbite.

Δ The preferred vaccine preparation depends upon the age and vaccination history of the patient:

- <7 years: DTaP.
- Underimmunized children ≥7 and <11 years who have not received Tdap previously: Tdap. Children who receive Tdap at age 7 through 9 years should receive another dose of Tdap at age 11 through 12 years.
- ≥11 years: A single dose of Tdap is preferred to Td for all individuals in this age group who have not previously received Tdap; otherwise, Td or Tdap can be administered without preference. Pregnant women should receive Tdap during each pregnancy.

◇ 250 units intramuscularly at a different site than tetanus toxoid; intravenous immune globulin should be administered if human tetanus immune globulin is not available. Persons with HIV infection or severe immunodeficiency who have contaminated wounds should also receive human tetanus immune globulin, regardless of their history of tetanus immunization.

§ The vaccine series should be continued through completion as necessary.

¥ Booster doses given more frequently than every 5 years are not needed and can increase adverse effects.

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2. *Havers FP, Moro PL, Hunter P, et al. Use of tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccines: Updated recommendations of the Advisory Committee on Immunization Practices - United States, 2019. MMWR Morb Mortal Wkly Rep 2020; 69:77.*

Graphic 61087 Version 34.0

Recommended doses of recombinant hepatitis B vaccines licensed in the United States for persons aged 18 years and older

	Age group and associated conditions	Volume (mL)	Dose HBsAg (mcg)	Recommended schedule
Single-antigen vaccines				
Recombivax HB				
Pediatric/adolescent formulation	18 through 19 years	0.5	5	0, 1, and 6 months
Adult formulation	≥20 years	1	10	
Dialysis formulation	Adults on hemodialysis and other immunocompromised adults aged ≥20 years	1	40	0, 1, and 6 months
Engerix-B	18 through 19 years	0.5	10	0, 1, and 6 months
	≥20 years	1	20	
	Adults on hemodialysis and other immunocompromised adults aged ≥20 years	2*	40	0, 1, 2, and 6 months
Heplisav-B[¶ Δ]	≥18 years	0.5	20	0 and 1 months
PreHevbrio[Δ ◇]	≥18 years	1	10	0, 1, and 6 months
Combination vaccine				
Twinrix (combined HepB-HepA vaccine)	≥18 years	1	20	Standard: 0, 1, and 6 months Accelerated: 0, 7, and 21 to 30 days, and 12 months

This table should be used in conjunction with UpToDate content on hepatitis B virus immunization in adults. Recommended doses for persons <18 years of age can be found in the UpToDate content on hepatitis B vaccines for children.

HBsAg: hepatitis B surface antigen; HepB: hepatitis B; HepA: hepatitis A.

* This is a double dose of the standard formulation of Engerix-B for patients ≥20 years of age (Engerix-B does not have a separate dialysis formulation).

¶ HepB-CpG (sold as Heplisav-B) is a recombinant yeast-derived vaccine that contains 3000 mcg of immunostimulatory phosphorothioate oligodeoxyribonucleotide as an adjuvant.

Δ There are insufficient data to inform vaccine-associated risks with Heplisav-B and PreHevbrio in pregnancy. Thus, providers should vaccinate pregnant persons needing HepB vaccination with Engerix-B, Recombivax HB, or Twinrix. In addition, data are not available to assess the effects of Heplisav-B and PreHevbrio on breastfed infants or on maternal milk production and excretion.

◇ The mammalian-derived recombinant hepatitis B vaccine (trivalent), sold as PreHevbrio, was approved for use in the United States in December 2021.

Data from:

1. *Schillie S, Vellozzi C, Reingold A, et al. Prevention of hepatitis B virus infection in the United States: Recommendations of the Advisory Committee on Immunization Practices. MMWR Recomm Rep 2018; 67:1.*
2. *Schillie S, Harris A, Link-Gelles R, et al. Recommendations of the Advisory Committee on Immunization Practices for Use of a Hepatitis B Vaccine with a Novel Adjuvant. MMWR Morb Mortal Wkly Rep 2018; 67:455.*
3. *Weng MK, Doshani M, Khan MA, et al. Universal Hepatitis B Vaccination in Adults Aged 19–59 Years: Updated Recommendations of the Advisory Committee on Immunization Practices — United States, 2022. MMWR Morb Mortal Wkly Rep 2022; 71:477.*

Graphic 117603 Version 7.0

Post-exposure management of personnel after occupational percutaneous and mucosal exposure to blood and body fluids

Health care personnel status	Post-exposure testing		Post-exposure prophylaxis		Post-vaccinati serologi testing
	Source patient (HBsAg)	HCP testing (anti-HBs)	HBIG*	Vaccination	
Documented responder[Δ] after complete series[◇]	No action needed				
Documented nonresponder[§] after 2 complete series[◇]	Positive/unknown	–[¥]	HBIG x2 separated by 1 month	–	No
	Negative	No action needed			
Response unknown after complete series[◇]	Positive/unknown	<10 milli-international units/mL[¥]	HBIG x1	Initiate revaccination	Yes
	Negative	<10 milli-international units/mL	None		
	Any result	≥10 milli-international units/mL	No action needed		
Unvaccinated/incompletely vaccinated or vaccine refusers	Positive/unknown	–[¥]	HBIG x1	Complete vaccination	Yes
	Negative	–	None	Complete vaccination	Yes

Anti-HBc: antibody to hepatitis B core antigen; anti-HBs: antibody to hepatitis B surface antigen; HBIG: hepatitis B immune globulin; HCP: health care personnel; HBsAg: hepatitis B surface antigen.

* HBIG should be administered intramuscularly as soon as possible after exposure when indicated. The effectiveness of HBIG when administered >7 days after percutaneous, mucosal, or nonintact skin exposures is unknown. HBIG dosage is 0.06 mL/kg.

¶ Should be performed one to two months after the last dose of the hepatitis B vaccine series (and four to six months after administration of HBIG to avoid detection of passively administered anti-HBs) using a quantitative method that allows detection of the protective concentration of anti-HBs (≥10 milli-international units/mL).

Δ A responder is defined as a person with anti-HBs ≥10 milli-international units/mL after completing the hepatitis B vaccine series.

◇ A complete series usually consists of three doses administered at 0, 1, and 6 months, but a four-dose accelerated series may have been provided or a two-dose series of Heplisav-B. Refer to the topic that discusses hepatitis B immunization in adults for additional information on hepatitis B vaccination.

§ A nonresponder is defined as a person with anti-HBs <10 milli-international units/mL after completing two hepatitis B vaccine series.

¥ HCP who have anti-HBs <10 milli-international units/mL, or who are unvaccinated or incompletely vaccinated and sustain an exposure to a source patient who is HBsAg positive or has unknown HBsAg status, should undergo baseline testing for HBV infection as soon as possible after exposure, and follow-up testing approximately six months later. Initial baseline tests consist of total anti-HBc; testing at approximately six months consists of HBsAg and total anti-HBc.

Adapted from: CDC Prevention of Hepatitis B Virus Infection in the United States: Recommendations of the Advisory Committee on Immunization Practices. MMWR Recomm Rep 2018;67:1.

Graphic 93306 Version 3.0

Contributor Disclosures

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