Key Recommendations

- Conduct a risk assessment to determine what pathogens are likely to be encountered by personnel in a healthcare facility, and implement appropriate infection control and occupational health measures to counter identified risks.
- Educate personnel at risk of exposure about the pathogens likely to be encountered in the workplace, preventive measures available before exposure, transmission risks, and postexposure management.
- Prepare for postexposure management of less frequently encountered pathogens as well as possible.
- Follow federal recommendations for standard precautions and other workplace restrictions on certain HIV- and HBV-infected workers. No restrictions are routinely recommended for healthcare workers infected with HCV.
- Offer HBV vaccine as required by federal regulations to employees who could be exposed to HBV on the job.

See page 14 for more Action Recommendations.

Supplementary Material

- Resource List

For more tools on this topic, see the HRC Members’ Web site at http://www.ecri.org.

Bloodborne Pathogens

Healthcare and laboratory personnel risk exposure to pathogens from blood and other bodily fluids (BBF), both in their natural form and in culture.

Most incidents described in the literature involve three viruses—HIV, hepatitis B virus, and hepatitis C virus. However, cases of occupational transmission to healthcare or lab personnel via BBF are documented in the medical literature for 26 viruses, 18 bacteria/rickettsia, 13 parasites, and 3 yeasts. Still other pathogens are known to be transmitted via infected BBF, although occupational transmission to healthcare personnel has not been documented.

WHAT HRC FOUND

Employee health services is likely to focus mostly on postexposure management of the three organisms that are the source of most documented transmissions via BBF to healthcare personnel. Expert-validated guidelines are available for postexposure management of these pathogens. However, occupational exposures to BBF can transmit many pathogens other than HIV and the hepatitis viruses to healthcare workers. Postexposure management may be difficult for less common exposures for several reasons, including that healthcare workers may not know they have been exposed to the organism and that tests may not be run to look for these infections in the absence of known patient risk factors or symptoms in the patient or exposed worker.
Healthcare and laboratory personnel risk exposure to pathogens from blood and other bodily fluids (BBF), both in vivo and in vitro. A review of the medical literature from 1966 to 2006 found documented cases of occupational transmission to healthcare or lab personnel of a multitude of viruses, bacteria/rickettsia, parasites, and yeasts. (Tarantola et al.) Most incidents described in the literature involve three viruses—HIV, hepatitis B virus (HBV), and hepatitis C virus (HCV)—but occupational exposures to many other pathogens transmitted by these routes have been documented.

This Risk Analysis reviews the epidemiology, symptoms, treatments, and postexposure prophylaxis (PEP) of three major pathogens and briefly discusses other pathogens for which occupational transmission to healthcare personnel has been documented. Although healthcare facilities and laboratories will typically focus on HIV, HBV, and HCV exposures, some of the less commonly transmitted pathogens detailed here may present challenges of their own, including that healthcare and lab personnel may be unaware that an exposure has occurred and that validated PEP recommendations may be unavailable.

The use of standard precautions by healthcare workers, the implementation of sharps safety programs and the use of needleless and other safer devices, and the use of other controls to prevent occupational transmission are not covered in this Risk Analysis but are detailed elsewhere in the Healthcare Risk Control (HRC) System.

**HIV INFECTION AND AIDS**

**Epidemiology**

After decades of rapid transmission, the HIV epidemic is showing signs of stabilizing. The annual incidence of HIV infection in the world population—the number of new HIV infections in previously uninfected individuals—has declined since reaching its peak in the late 1990s (see “Figure. Estimated Number of People Newly Infected with HIV Globally, 1990 to 2007”). The share of the world’s population living with HIV infection has also leveled off at about 0.5% of global population in 2007, or 33.2 million people. The stabilization suggests that after decades of rising transmission rates, HIV has finally begun to behave as other infectious disease epidemics have behaved. In other infectious disease epidemics, once an infection has been transmitted among those people most susceptible to infection, rates of new transmission begin to drop because the share of the uninfected population that is easy to infect has become smaller.

Despite signs that transmission rates may have peaked, the number of people living with HIV infection continues to rise. Global population growth, the availability in some settings of antiretroviral treatments able to transform HIV infection from a rapidly fatal to a chronic and manageable condition, and other factors help ensure that the number of previously uninfected individuals who become newly infected is higher than the number of infected people who die each year. In 2007, an estimated 2.5 million people became newly infected with HIV and an estimated 2.1 million people died from AIDS-related illnesses.

The overall trend—a widespread but stabilizing epidemic—masks significant geographical disparities in infection prevalence and incidence. The epidemic’s epicenter, sub-Saharan Africa, is home to about 22.5 million HIV-infected people, or about 68% of the worldwide total. New HIV infections are occurring in particularly high numbers in Eastern Europe and much of Asia, adding to the approximately 6.4 million infected individuals already living in these regions. The epidemic is relatively stable in several other regions with significant numbers of HIV-infected people, such as western and central Europe, Latin America, and North America.
In North America, most of the estimated 1.3 million people with HIV infection reside in the United States, where people newly diagnosed with AIDS are disproportionately represented by members of some racial and ethnic minorities, particularly African Americans and to a lesser extent Hispanics, and by men who have sex with men. (UNAIDS; Fenton) An important shift in the epidemic’s demographics has been a rising number of infections among females. The share of HIV infections in female adults and adolescents has risen steadily since the epidemic began, from 7% in 1985 to 27% in 2005 (CDC “HIV/AIDS Surveillance”).

Also characteristic of the epidemic in the United States are HIV-infected individuals who are unaware of their serostatus. Such people account for perhaps one in four HIV-infected people in the United States and are the source of perhaps one-half of all new HIV infections in previously uninfected people. In many cases, infected individuals do not seek testing to determine their HIV status until symptoms appear suggestive of advancing HIV destruction of the immune system (e.g., opportunistic infections). For example, a study by the Centers for Disease Control and Prevention (CDC) found that 45% of individuals in 16 states had been diagnosed as having AIDS within a year of receiving an HIV diagnosis. People whose AIDS diagnosis follows so closely after their HIV diagnosis have likely been unknowingly infected with HIV for 5 to 10 years or longer. (Fenton)

CDC has recommended more widespread screening of patients presenting to U.S. healthcare facilities, in part because it may be possible to curtail the number of new infections occurring in the United States if more HIV-positive individuals were made aware of their infection. However, the CDC recommendations raise several legal and ethical issues, including the possibility that some patients may be tested for HIV without their consent and/or informed consent. (See the Risk Analysis “Patient Testing for HIV,” elsewhere in this section of the HRC System.)

Biology and Detection of HIV

The HIV epidemic involves two viruses: HIV-1 and HIV-2. Most HIV-infected individuals carry some variant of HIV-1, of which three main groups exist: the M (main), N (non-M, non-O), and O (outlier) groups. (A small fraction of HIV-infected people, most of whom live in or have another connection to West Africa, are infected with the marginally less virulent HIV-2.) HIV-1 has further divided into at least nine subtypes and mutated into many recombinant forms, which exhibit characteristics of more than one viral subtype.

Some individuals are coinfected with more than one strain of HIV-1, and infection with one strain is no longer thought, as it once was, to protect an already infected individual from acquiring another strain in a new infection. The notable variation in HIV-1 is a result of the high error rate that occurs when the virus copies its genome into DNA during replication within the human cell. The virus has many opportunities to make such errors because of its rapid replication in an infected host. Half the viral population in an HIV-infected individual replaces itself within 30 minutes; thus, an HIV-infected person may produce more than 10 billion new infectious HIV particles each day. The genetic variation and rapid mutation of HIV are key characteristics that let the virus develop resistance to antiviral drugs—because mutations help the virus find ways to evade defensive mechanisms triggered by the drugs—and are a key reason that effective HIV vaccines
are so difficult to design. (Buonaguro et al.; Simon et al.; Eholié and Anglaret; Peeters)

On initial infection, HIV uses an impressive array of strategies to evade a strong host immune response, enter cells, and transform cells into HIV producers. Some evidence suggests that infection can be halted if a prophylaxis regimen is started immediately, preferably within hours of exposure, before the virus has gained a permanent foothold. Once infection is established, antivirals, although they may be successful in reducing viral counts in blood plasma to undetectable levels, are unable to rid the body of other HIV reservoirs. Drug side effects and complex treatment regimens make it difficult for many HIV-infected individuals to remain on any particular treatment regimen, and interruptions in such regimens may offer the virus opportunities to develop resistance to drugs that had been effective before treatment was interrupted. (Mahalingam et al.; Simon et al.)

Risk of Transmission

Exposures to body tissue or BBF are potentially capable of transmitting HIV infection from an HIV-infected patient to healthcare personnel or from HIV-infected healthcare personnel to uninfected patients. Preventing healthcare personnel from being exposed to blood or certain other body fluids is the best way to minimize the risk of transmitting an infection. However, experience has shown that not all exposures will be prevented. Risks of transmission vary by type and severity of exposure and possibly drug resistance. The estimated risk of HIV transmission by exposure type is as follows (U.S. PHS “Updated U.S. 2005”):

- Percutaneous injury (e.g., needlestick, cut with a sharp object)—about 0.3% (95% confidence interval, 0.2% to 0.5%)
- Bodily fluid contact with a mucous membrane—about 0.09% (0.006% to 0.5%)
- Bodily fluid contact with nonintact skin (e.g., exposed skin that is chapped, abraded, or afflicted with dermatitis) (A precise risk calculation is not available, but the risk of HIV transmission via nonintact skin is thought to be less than the transmission risk from a mucous membrane exposure.)

Among U.S. healthcare workers, CDC investigations completed between 1981 and 2006 documented 57 cases of occupational transmission of HIV. The routes of exposure were percutaneous in 48 cases, involved mucous membranes and/or the skin in 5 cases, involved both percutaneous and mucous membrane/skin exposure in 2 cases, and were of unknown route in 2 cases. The source of the exposure was HIV-infected blood in the 49 cases, concentrated virus in a laboratory in 3 cases, visibly bloody fluid in 1 case, and unspecified fluid exposure in 4 cases. In addition, CDC has documented another 140 possible cases of HIV infection or AIDS being occupationally transmitted to healthcare personnel. CDC states that more than 90% of healthcare personnel infected with HIV have nonoccupational risk factors for acquiring their infection. (CDC “Surveillance of Occupationally”)

Other types of contact may also transmit HIV infection, such as a human bite.

Potentially infectious fluids other than blood include cerebrospinal, synovial, pleural, peritoneal, pericardial, and amniotic fluid; the risk of transmission associated with these fluids has not been quantified but is thought to be considerably lower than for blood exposures. Also potentially infectious, though not implicated in occupational transmission, are semen and vaginal secretions.

Environmental surfaces should be cleaned after completion of a medical procedure in accordance with the Occupational Safety and Health Administration (OSHA) bloodborne pathogens standard, which requires use of an appropriate disinfectant such as a diluted bleach solution or a product registered with the U.S. Environmental Protection Agency as a tuberculocide or as effective against HIV or both HIV and HBV. More guidance on environmental surface cleaning can be found in CDC’s Guidelines for Environmental Infection Control in Health-Care Facilities.

Administering PEP

The U.S. Public Health Service (PHS) makes recommendations for PEP drug regimens in its guidelines for managing occupational exposures to HIV (see “Resource List”), based on limited data about PEP efficacy and toxicity. PHS offers separate PEP recommendations for percutaneous injuries and for mucous membrane and nonintact skin exposures. PHS also divides its PEP recommendations by the severity of the exposure and by the infection status of the source. This section summarizes PHS’s recommendations published
in the September 2005 Morbidity and Mortality Weekly Report: Recommendations and Reports (see “Resource List”). PHS updates these recommendations periodically, and PEP should be based on the most up-to-date PHS recommendations. (See “Management of HBV-, HCV-, and HIV-Exposed Healthcare Workers” and “CDC Guidance: Management of Healthcare Workers Exposed to HIV and Recommendations for Postexposure Prophylaxis,” elsewhere in this section of the HRC System.)

Not all exposures warrant PEP, according to PHS. PHS generally does not recommend PEP after an exposure to potentially infectious materials from a source known to be HIV-negative. If a healthcare worker begins PEP after an exposure to a source of unknown HIV status and testing reveals the source to be HIV-negative, PEP should be discontinued.

PEP is optional when the exposure is from an unknown source (e.g., a needle from a sharps disposal container) or from a source of unknown HIV status (e.g., a deceased person with no samples available for HIV testing). In these cases, PHS recommends basing a decision to administer PEP on whether an unknown source is from an environment where exposure to HIV-infected patients is likely or whether a source of unknown HIV status has risk factors for HIV infection. Even so, many healthcare facilities prefer to administer PEP when exposure is from an unknown source, such as a needlestick.

PEP is recommended after any exposures to potentially infectious fluids or tissues from sources known to have HIV infection, with one exception. PEP can be considered as an option (but is not always recommended) after a small-volume exposure (e.g., a few drops) from an HIV-infected source patient who is asymptomatic or is known to have a low viral load.

PHS recommends that all workers occupationally exposed to materials that could transmit HIV, regardless of whether they receive PEP, receive counseling, testing, and medical evaluation.

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PHS recommends that all workers occupationally exposed to materials that could transmit HIV, regardless of whether they receive PEP, receive counseling, testing, and medical evaluation.

If PEP is offered and accepted, the PHS recommendations emphasize that PEP should begin immediately—“within hours” of the exposure. If questions exist about an appropriate regimen, PHS recommends starting the exposed worker on a basic two-drug regimen immediately, rather than delay PEP administration.

PHS recommends consulting with clinical experts in antiretroviral therapy and HIV transmission (e.g., a hospital epidemiologist, an infectious diseases consultant) both to determine whether an exposure has actually occurred and to help select PEP regimens. Such expert consultation may be particularly important when the source patient is heavily treatment-experienced or when the exposed worker is pregnant, breastfeeding, or even simply of childbearing age because of the potential effects of some antivirals on fetus or neonate development. PHS lists several resources for consultation (see “Expert Consultation on Postexposure Prophylaxis after an Occupational HIV Exposure”). However, PHS recommends immediately starting PEP even if such an expert cannot be contacted.

If information pertinent to the PEP regimen becomes available later, the regimen can be adjusted at that time. If the HIV status of the source is not known, rapid HIV testing of source patients can facilitate making a timely decision about PEP use after an occupational exposure. Healthcare facilities should consult legal counsel and their ethics committees for guidance on testing source patients who refuse HIV testing. A hypothetical risk that has been raised is that the source patient may be in the “window period” between HIV infection and seroconversion, when many tests will fail to uncover evidence of infection; however, the medical literature includes no cases of occupational transmission from patients in this window period. If PEP is offered to and taken by the occupationally exposed healthcare worker and the source is subsequently determined to be HIV-negative, PEP should be discontinued.

PHS recommends its basic PEP regimen for a majority of HIV exposures. The basic regimen consists of two drugs—one drug less than the three antivirals normally taken by HIV-infected people. PHS takes this approach primarily because a two-drug regimen is likely to have fewer side effects than a three-drug regimen, and the benefit of helping a worker to finish a full 28-day regimen of PEP is thought to outweigh the antiviral benefits of adding a third drug. Healthcare workers taking antiviral drugs as PEP do not seem to tolerate the drugs as...
well as HIV-infected individuals taking the same drugs, and side effects (most commonly, nausea, malaise, and fatigue) are the major reasons healthcare workers fail to finish a prescribed PEP regimen. Side effects are often manageable, and steps taken to manage side effects may keep an occupationally exposed worker on a PEP regimen for the full 28-day course. The primary method of managing side effects is through prescribing antimotility or antiemetic agents; changing drug dosages is also an option.

PHS recommends including a third, or even a fourth, drug in PEP regimens for exposures that pose an increased risk for transmission or that involve a source in whom antiretroviral drug resistance is likely. Exposures that PHS considers as having an increased risk for transmission include any percutaneous injury involving a large-bore hollow needle (i.e., a needle used for collecting blood or for administering intravenous, intramuscular, or subcutaneous substances), deep puncture, visible blood on device, or a needle used in a patient’s artery or vein; any percutaneous injury involving a source patient with a high viral load or symptomatic HIV disease or AIDS; or a large-volume exposure (e.g., a major blood splash) to a mucous membrane or nonintact skin from a source patient with a high viral load or symptomatic HIV disease or AIDS.

**Expert Consultation on Postexposure Prophylaxis after an Occupational HIV Exposure**

The U.S. Public Health Service (PHS), in its guidelines for managing occupational HIV exposures, advises consulting with an expert about HIV postexposure prophylaxis (PEP) in the situations listed below.

- The exposure report is delayed by more than 24 to 36 hours.
  - However, the actual window during which PEP is effective in preventing chronic HIV infection in an occupationally exposed healthcare worker remains unclear.
- The source of the exposure is unknown (e.g., a needle in a sharps disposal container or the laundry).
  - Whether to use PEP and which PEP regimen is appropriate should be decided on a case-by-case basis.
  - The severity of exposure and epidemiologic likelihood of HIV exposure should be considered in making decisions about PEP; needles or other sharp instruments should not be tested for HIV.
- The exposed person is suspected or known to be pregnant.
  - The use of optimal PEP regimens is not precluded.
  - Administration of PEP should not be denied solely on the basis of pregnancy.
- The exposed person is breastfeeding.
  - Use of optimal PEP regimens is not precluded.
  - Administration of PEP should not be denied solely on the basis of breastfeeding.
- The source virus is resistant to antiretroviral agents.
  - The influence of drug resistance on transmission risk is unknown.
  - If the source person’s virus is known or suspected to be resistant to any of the drugs considered for PEP, selection of drugs to which the source person’s virus is unlikely to be resistant is recommended.
- Resistance testing of the source person’s virus at the time of the exposure is not recommended.
- Initiation of PEP should not to be delayed while results of resistance testing are pending.
- The initial PEP regimen exhibits toxicity.
  - Adverse symptoms (e.g., nausea, diarrhea) are common with PEP.
  - Symptoms can often be managed without changing PEP regimen by prescribing antimotility or antiemetic agents.
  - In other situations, modifying the dose interval (i.e., taking drugs after meals or administering a lower dose of drug more frequently throughout the day, as recommended by the manufacturer) might help alleviate symptoms when they occur.

When consultation is warranted, PHS recommends contacting either local experts or the National Clinicians’ Post-Exposure Prophylaxis Hotline (PEPline) by telephone at (888) 448-4911 or online at http://www.ucsf.edu/hivcntr/Hotlines/PEPline.

Other consultation resources recommended by PHS include the HIV/AIDS Treatment Information Service, available online at http://aidsinfo.nih.gov, and the HIV Antiretroviral Pregnancy Registry (Wilmington, North Carolina), available by telephone at (800) 258-4263, by fax at (800) 800-1052, by e-mail at registry@nc.crl.com, and online at http://www.apregistry.com/index.htm. PHS recommends reporting HIV infections in healthcare personnel and PEP failures to the Centers for Disease Control and Prevention by telephone at (800) 893-0485 and reporting unusual or severe toxicity to antiretroviral agents to the U.S. Food and Drug Administration by telephone at (800) 332-1088 or online at http://www.fda.gov/medwatch.

**Source:** U.S. Public Health Service. Updated U.S. Public Health Service guidelines for the management of occupational exposures to HIV and recommendations for postexposure prophylaxis. MMWR Recomm Rep 2005 Sep 30;54(RR-9):1-17.
PEP should not be delayed because of suspected drug resistance in a source patient’s HIV strains. However, if the source patient is known or suspected to be infected with HIV that is resistant to one or more drugs, then PHS recommends selecting a PEP regimen that includes only drugs to which the virus is unlikely to be resistant. Drug resistance may be suspected if the source patient’s viral levels and/or counts of CD4+ T cells (a type of white blood cell whose bloodstream levels are a key marker of HIV disease stage) are not responding well or at all to a treatment regimen. Under such circumstances, it may be difficult to determine to which of several antivirals in the source patient’s regimen the virus is resistant. Resistance testing at the time of occupational exposure is impractical, because results would not be available for one to two weeks, and no data is available suggesting that changing the initial PEP regimen after one to two weeks reduces viral transmission.

An exposed worker who tests positive for HIV infection should be referred for medical management to a specialist with expertise in HIV treatment and counseling.

Attention should also be paid to potential interactions between drugs in the PEP regimen and other medications being taken by the worker, including over-the-counter medications and supplements such as herbals. Protease inhibitors (e.g., Crixivan) and nonnucleoside reverse transcriptase inhibitors (e.g., nevirapine) have the greatest potential for interactions with other drugs. More information on drug interactions is available in the PHS guidelines and elsewhere in the medical literature.

Follow-up measures include advising an exposed worker to use precautions to prevent secondary transmission (e.g., avoid blood or tissue donations, breastfeeding, or pregnancy), particularly during the first 6 to 12 weeks after exposure; informing the worker about PEP drug toxicities and interactions and the need to adhere to the regimen; and considering reevaluating the worker 72 hours after the exposure, especially if additional information becomes available about the exposure or the source individual.

PHS recommends using an enzyme immunoassay test for HIV antibodies rather than a rapid HIV test to monitor the exposed worker for seroconversion. The test should be given at the time of exposure to establish a baseline; follow-up testing should be performed at 6 weeks, 12 weeks, and 6 months after exposure. Additional follow-up testing for 12 months after the exposure is recommended if the source individual was coinfected with HIV and HCV and the exposed worker seroconverts to hepatitis C infection. Extended follow-up may be warranted under other circumstances as well. Regardless of the time elapsed since exposure, a test should be performed on any exposed individual who has an illness compatible with an acute retroviral syndrome. An exposed worker who tests positive for HIV infection should be referred for medical management to a specialist with expertise in HIV treatment and counseling.

A worker receiving PEP should be monitored for drug toxicity by testing at baseline and again two weeks after starting PEP.

PHS encourages close follow-up care for several reasons. Close follow-up care might result in better adherence to PEP regimens, better management of associated symptoms, improved detection of serious adverse effects, and serologic testing among a larger proportion of exposed personnel to determine whether infection has been transmitted after occupational exposures. Better follow-up care could also reassure healthcare personnel who become anxious after an exposure.

HIV-Infected Personnel

While individuals with HIV can work safely as healthcare personnel because compliance with standard precautions helps prevent transmission of the virus during most procedures, CDC recommends that healthcare workers who are infected with HIV not perform exposure-prone procedures unless they have sought counseling from an expert review panel and have been advised under what circumstances, if any, they may continue to perform these procedures. Such circumstances would include notifying prospective patients of the worker’s seropositivity before the patients undergo exposure-prone invasive procedures by the worker. CDC defines exposure-prone procedures as those that include digital palpation of a needle tip in a body cavity or the simultaneous presence of the healthcare worker’s fingers and a needle or other sharp instrument or object in a poorly visualized or highly confined anatomic site, such as a patient’s body cavity, subcutaneous tissues, and/or mucous membranes. CDC states that exposure-prone procedures would include, among other procedures, various oral, cardiothoracic, colorectal, and obstetric/gynecologic procedures. (See “Management
HEALTHCARE RISK CONTROL

of HBV-, HCV-, and HIV-Exposed Healthcare Workers’ and “CDC Guidance: Management of Healthcare Workers Exposed to HIV and Recommendations for Postexposure Prophylaxis,” elsewhere in this section of the HRC System.)

The review panel should include experts who represent a balanced perspective, possibly including the worker’s personal physician, an infectious disease specialist, an expert in the exposure-prone procedure being considered, public health personnel, and a member of the healthcare facility’s infection control committee such as a hospital epidemiologist. Workers who practice outside an institutional setting could contact public health officials for assistance in the review process. The panel must recognize the importance of confidentiality and the privacy rights of the infected worker. A worker whose practice is modified because of his or her infection status should, where possible, be provided appropriate alternative patient care responsibilities.

CDC recommends considering on a case-to-case basis, in consultation with public health officials, whether to retrospectively notify patients who have had exposure-prone procedures performed by healthcare workers infected with HIV.

Cases of documented HIV transmission from a healthcare worker to a patient are extremely rare but not unheard of, including six patients infected by a dentist with AIDS in Florida around 1991, transmission from an orthopedic surgeon with AIDS to a patient in France in 1999, and a possible transmission, in France in 2000, from a night-shift nurse not involving documented exposure to blood. (Moloughney; Goujon et al.)

A worker whose practice is modified because of his or her infection status should, where possible, be provided appropriate alternative patient care responsibilities.

HEPATITIS

Hepatitis, an inflammation of the liver that can lead to liver damage and death, has several possible causes, including the six hepatitis viruses: hepatitis A, B, C, D, E, and G. Of these, HBV and HCV are of most concern from an occupational exposure standpoint in the healthcare setting. The other four viruses are less worrisome for various reasons. Hepatitis A virus (HAV) and hepatitis E virus, which cause only acute, self-limiting disease, have not yet had documented occupational transmissions via BBF to healthcare workers. Such occupational transmission has been documented, however, for hepatitis D virus (HDV) and hepatitis G virus (HGV). Although HDV infection may lead to severe illness, such infection is rare because the virus only causes disease in individuals also infected with HBV. HGV is not yet known to cause any significant disease.

Hepatitis B

HBV is relatively efficient at infecting a previously uninfected person during an exposure to infected BBF. Once infection is established, HBV undergoes an incubation period lasting 45 to 180 days and averaging 60 to 90 days. After this period, some individuals who are infected—few children under age 5 but perhaps 70% of adults—progress to symptomatic acute infection, which may be severe enough to require hospitalization. Signs and symptoms of acute infection include jaundice (i.e., yellowing of the skin or the whites of the eyes), dark urine, light-colored stools, fatigue, abdominal pain, loss of appetite, nausea, vomiting, fever, diarrhea, headache, muscle pain, joint pain, and/or stomach pain. In rare cases, a fulminant (i.e., particularly severe) infection leads to death; about 100 to 200 people in the United States die each year from fulminant acute hepatitis. There is no treatment for acute hepatitis B.

Many acute HBV infections result in full recovery, including clearance of the virus from the body, and generally also impart immunity to further infection. (However, it is possible for a person who has acquired immunity through having an acute HBV infection to contract HBV again after infection with a viral strain or variant different from the one that caused the initial infection.) Regardless of whether they have been vaccinated against HBV, healthcare workers who have fully recovered from a past acute HBV infection are likely to have developed immunity to new infection.

However, some acute HBV infections lead to a persistent, or chronic, infection. Acute HBV infection becomes chronic in 90% of infants infected at birth, 30% of children infected at ages one to five, and 6% of individuals infected after age five. Chronic disease can lead to cirrhosis (scarring) of the liver, hepatocellular carcinoma (liver cancer), liver failure requiring liver transplant, and/or death.
Individuals with chronic HBV infection might not look or feel sick, even when cirrhosis is occurring or during the early stages of liver cancer. In the past, chronically infected people who seemed healthy were called “hepatitis B carriers,” although that term has fallen out of favor because it gives the misperception that the carriers are not at risk for complications from chronic HBV infection. About 15% to 25% of people with chronic HBV infection are likely to die from chronic liver disease. About 5,000 people in the United States die annually from liver problems caused by HBV.

Most people with chronic HBV infection will eventually undergo seroconversion, a process that marks the end of high levels of viral replication in the bloodstream and, at a somewhat later time, the end of detectable levels of HBV DNA in the bloodstream. While seroconversion occurs within a few weeks in acute HBV infection, it may take a decade or longer in a chronically infected person. It is the prolongation of this stage of the infection that leads to cirrhosis and other severe side effects in chronically infected individuals. Antiviral medicines to treat chronic HBV infection seek to hurry this process along and are able to reduce liver damage in about one-half of patients. If left untreated, about 5% of people with chronic HBV infections seroconvert each year.

HDV is able to replicate efficiently only in people also infected with HBV. As a result, HDV infection occurs primarily as a simultaneous coinfection with HBV or as a superinfection in a person chronically infected with HBV. Although rare, coinfection with HDV may lead to severe illness and raises the likelihood of fulminant liver failure during acute infection. In chronically infected people, HDV coinfection makes effective treatment of HBV infection more difficult. HDV is also more likely than any other hepatitis virus to cause cirrhosis.

Since many acute HBV infections likely go unreported, the number of healthcare workers becoming infected on the job is probably higher than estimated.

HBV: Epidemiology

Worldwide, about 2 billion people have been infected with HBV, and more than 350 million are chronic carriers. About 8% to 10% of the population is chronically infected with HBV in sub-Saharan Africa, most of Asia, and the developing countries of the Pacific. High rates of chronic infection are also found in regions bordering the Amazon River in South America, in the southern parts of Eastern and Central Europe, in the Middle East, and in India.

By contrast, less than 1% of the population is chronically infected in North America and Western Europe. About 5% of Americans have been infected with HBV at some point during their lifetime, and an estimated 1.25 million Americans are chronically infected, of whom 20% to 30% acquired their infection in childhood.

People at high risk of infection include healthcare workers occupationally exposed to blood or other potentially infectious bodily fluids on the job, sex partners of infected individuals (condom use might reduce transmission risk), injecting drug users, people who receive a tattoo or body piercing done with tools that might have someone else’s blood on them, infants born to infected mothers, infants or children from areas with high rates of HBV infection, household contacts of a chronically infected person who share personal care items with blood on them (e.g., toothbrushes, razors), and hemodialysis patients. HBV transmission has also been reported after a human bite.

With approximately 75% of healthcare workers vaccinated against HBV as of 2003 and standard precautions commonly used, few cases of symptomatic acute HBV infection are reported among healthcare workers. Among 2,102 cases of symptomatic acute HBV infections in the United States in 2006 that were reported to CDC, just 11 involved a person who reported that one of his or her risk factors was being a medical worker with an occupational blood exposure. (No risk factors were reported to CDC for another 2,545 such infections.) Since many acute infections, particularly asymptomatic infections, likely go unreported, the number of healthcare workers becoming infected on the job is probably higher. A 1999 estimate put it at 1,000 workers a year. (CDC “Surveillance for Acute”; Margolis)

HBV: Transmission

In the occupational setting, HBV infection is transmitted primarily when blood from an infected person enters the body of a person who is not infected. For a person without HBV immunity, the risk of becoming infected with HBV after a blood exposure is high. For example, the risk of developing clinical hepatitis B from a single
needlestick or a cut exposure to HBV-infected blood is 1% to 6% if the blood lacks the hepatitis B antigen (HBeAg) and 22% to 31% if the blood contains HBeAg. (The presence of HBeAg is a marker of high viral levels in the blood; this marker disappears when chronically infected people experience seroconversion, bringing to an end the disease stage involving rapid viral replication.) Because not everyone infected with HBV has symptoms, a blood test is the only way to tell for certain if someone is infected with HBV. Although percutaneous injuries (e.g., from a needlestick or other sharp) are among the most efficient modes of HBV transmission, other direct and indirect BBF exposures to nonintact skin or mucous membranes probably account for more new occupational HBV infections in the healthcare setting.

Among other sources, transmission of infection via HBV in dried blood on environmental surfaces has been demonstrated. HBV can remain viable for seven or more days in dried blood at room temperature on environmental surfaces, on needles, and on medical instruments and may be able to transmit an infection from such a surface, needle, or instrument even in the absence of visible blood. Environmental surfaces should be cleaned after completion of a medical procedure in accordance with the OSHA bloodborne pathogens standard (see the discussion Risk of Transmission). HBV transmission may also be possible from contaminated surfaces of medical devices. Needles should be handled and disposed of with care. Critical or semicritical patient care devices should be sterilized or disinfected with a sterilant or high-level disinfectant approved by the U.S. Food and Drug Administration. (For more on device disinfection and sterilization, see the Risk Analysis “Reprocessing in Central Service,” elsewhere in this section of the HRC System.)

In addition to blood, the other body fluids thought most likely to transmit HBV infection are serum, wound exudates, semen, and vaginal secretions. Other potentially infectious bodily fluids include cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, and amniotic fluid. By contrast, feces, nasal secretions, saliva, sputum, sweat, tears, urine, and vomitus are not considered potentially infectious unless they contain blood.

**HBV: Vaccination**

Vaccines capable of preventing HBV infection have been available since 1982. The availability of the vaccines has helped reduce the number of new HBV cases in the United States from occupational exposure from more than 10,000 in 1983 to fewer than 400 in 2001. In addition, routine vaccination of children and adolescents has helped reduce total number of new HBV cases in the United States from about 260,000 on average during the 1980s to about 51,000 in 2005. A combined HAV/HBV vaccine is also available for people who are at high risk of contracting either disease, such as laboratory workers handling both HAV and HBV samples.

Healthcare workers who have developed immunity to the virus after receiving the HBV vaccination series are at virtually no risk for infection from an exposure to HBV. (In a very few cases, HBV variants have been found that are able to cause infection despite vaccination but these “vaccine-induced escape mutant” viruses are very rare.) As of 2004, nearly 81% of healthcare workers aged 18 to 49 and nearly 91% of healthcare workers who considered themselves to be at high risk of HBV infection have received the vaccine.

OSHA’s bloodborne pathogens standard (29 CFR § 1910.1030) requires that employers make available the hepatitis B vaccine and vaccination series to all employees who have occupational exposure to bloodborne pathogens at no cost to the employee, after the employee receives OSHA-required training in bloodborne pathogens and within 10 working days of initial assignment to an area where such an occupational exposure is possible. (For more on bloodborne pathogens issues, see “OSHA’s Bloodborne Pathogens Standard,” elsewhere in this section of the HRC System.) The employer must make the vaccine available unless the employee has previously received the complete HBV vaccination series, antibody testing has revealed that the employee is immune, or the vaccine is contraindicated for medical reasons. Employees declining the HBV vaccine must sign a declination statement. Employees signing a declination statement can request and receive the HBV vaccination at a later date if they remain occupationally at risk for HBV.

The National Childhood Vaccine Injury Act of 1986 requires that every recipient of certain vaccines, including HBV vaccine, receive a Vaccine Information

HBV vaccination normally requires a series of three shots over a four- to six-month period, with the shots typically given at zero, one, and six months. If an HBV or HAV vaccination series is interrupted, the series will normally be resumed with the next dose in the series—not restarted from the beginning. A single dose of vaccine seems to prevent infection in 5% to 35% of exposures; two doses, in 50% to 90% of exposures; and the full series of three doses, in 85% to 100% of exposures. The protection offered from a single dose of vaccine is thought to last for a shorter period of time than the full series.

HBV vaccines are thought to be generally safe. No confirmed evidence indicates that HBV vaccine can cause chronic illnesses. The vaccine has several contraindications listed on its VIS.

Vaccination confers protection against clinical illness from acute infection and against an acute infection turning into a chronic infection for at least 15 years and possibly longer. After many years, the number of antibodies against hepatitis B may drop to low or undetectable levels in the blood of a vaccine recipient. However, even in the absence of such antibodies, the immune system is thought to retain an immunologic memory of the HBV antigen that will lead to rapidly increased production of antibodies to a protective blood count in the event of another exposure, even 20 or more years after vaccination. Because the vaccine is thought to provide possibly lifelong immunity, CDC does not recommend providing a booster dose of the vaccine to immunocompetent people. (Immunocompromised individuals, such as hemodialysis patients or patients with AIDS, may require a booster dose to maintain a protective response.)

Most vaccine recipients do not require a blood test after completing the vaccine series to make sure that the vaccine has conferred protection against HBV infection. However, healthcare workers, or others whose medical management will depend on knowledge of their immune status (e.g., after a potentially infectious exposure), should receive a postvaccination blood test to ensure that the vaccination series has triggered a protective response. Such testing should occur one to two months after the receipt of the third dose. A protective response is one in which the blood count of antibodies to HBV surface antigen is greater than 10 milli-international units per milliliter (mIU/mL). If the healthcare worker’s blood test shows a protective response, further testing is not necessary. If the vaccination series did not provide immunity, which is the case in about 1% to 5% of immunocompetent recipients, another series should be given and another postvaccination test should be administered. If the worker is still nonresponsive after a second series, he or she should be tested for chronic HBV infection. If the worker has such an infection, he or she should be given appropriate counseling and medical management. If the worker does not have such an infection, he or she should be considered susceptible to HBV infection and counseled to take precautions to prevent HBV infection and to obtain PEP after any known or potential HBV exposure.

**HBV: Postexposure Prophylaxis**

The decision to administer PEP and the selection of a PEP regimen after an occupational exposure with the potential to transmit HBV will depend on several factors: the likelihood that the exposure can cause an infection, the infection status of the exposure source, whether the healthcare worker has been vaccinated, and whether a previous vaccination of the worker triggered an antibody response known to be protective. For specific recommendations, refer to the most recent PHS recommendations on PEP.

**HBV: Infected Healthcare Personnel**

Individuals with chronic HBV infection can work safely as healthcare personnel. Compliance with standard precautions will help prevent transmission of the virus during most procedures. However, CDC recommends that chronically infected workers who test positive for HBeAg (an antigen whose presence indicates that the worker is highly infectious) should not perform exposure-prone procedures unless they have sought counsel from an expert review panel and been advised under what circumstances, if any, they may continue to perform these procedures. Such circumstances would include notifying prospective patients of the worker’s
Hepatitis C is an inflammation of the liver caused by infection with HCV. The disease is sometimes called non-A, non-B hepatitis. In the United States, about 3.9 million individuals have or have had acute or chronic HCV infection, including about 2.7 million with chronic infection. Worldwide, about 170 million people are chronically infected. Better screening of the blood supply and prevention efforts aimed at intravenous drug users have helped reduce the new case count from about 242,000 annually in the late 1980s to 25,000 in 2001. About 1% to 2% of healthcare workers are infected with HCV, a lower rate than in the general population. Occupational exposures account for about 4% of HCV infections in the United States. (CDC “Hepatitis C”)

HCV is primarily transmitted via contact with the blood of an infected person. The individuals at the highest risk of HCV transmission are those who inject illegal drugs. Other risk groups include people who receive blood transfusions screened for HCV during the window period before a recently infected donor produces detectable antibodies to HCV, infants born to infected mothers whose blood is positive at delivery, and healthcare workers who may be exposed to HCV-contaminated blood on the job. Occupational infection in healthcare workers is primarily through needlesticks, although there are case reports of HCV infection following blood splashes to the eye and one report of infection after an exposure to nonintact skin. Needlestick is a relatively inefficient means of transmission; the average incidence of infection is 1.8% after a needlestick from an HCV-positive source. Factors increasing risk of transmission after a needlestick include the needlestick causing a deep injury or being caused by a hollow-bore needle. HCV can survive outside the body and still transmit infection for four days.

HCV outbreaks among groups of patients are often related to unsafe injection practices, such as reuse of syringes and needles or use of contaminated multiple-dose medication vials. Infections of patients by healthcare workers are rare, and most involve the reuse or sharing of needles used by the healthcare worker for self-injection during substance abuse. (CDC has available a Web page of resources on injection safety; see “Resource List.”) Other possible cases of worker-to-patient transmission involve surgeons; one cluster of HCV infections in patients was traced to an anesthesia assistant who continued working in the operating room, without wearing gloves, while developing acute HCV infection. (Henderson) There are no known cases of patient infection caused by a healthcare worker performing an invasive procedure, and no restrictions are routinely recommended for healthcare workers infected with HCV.

The incubation period between exposure and infectious disease is 2 to 26 weeks, averaging 6 to 7 weeks. Despite high levels of viral replication in the blood, only about 20% of individuals experience symptoms of acute HCV infection. When symptoms occur, they most commonly include jaundice, fatigue, and muscle aches. Other symptoms of acute infection may include loss of appetite, nausea, vomiting, low-grade fever, pale or clay-colored stools, dark urine, generalized itching, ascites (i.e., abnormal fluid buildup in the abdominal cavity), and bleeding varices (i.e., dilated veins in the esophagus). Fulminant HCV infection causing liver failure during acute infection is rare.

Chronic HCV infection occurs when the body fails to eradicate the virus during acute infection; this is the case in 70% to 85% of infections. Chronic HCV infection can cause cirrhosis, digestive tract hemorrhage, liver failure, and liver cancer. HCV infection is the top cause of liver transplantation in the United States and Europe, and about 8,000 to 10,000 individuals die each year in the United States from the effects of chronic HCV infection. About 40% to 60% of untreated cases will progress to liver disease. The median time from infection to
cirrhosis is 30 years, with a range of perhaps 20 to 40 years. Faster progression to cirrhosis is associated with several factors, including older age at infection, male gender, alcohol consumption, HIV or HBV coinfection, and low CD4+ T-cell count. Being overweight and having diabetes may also speed cirrhosis. The treatments available for chronic infection, pegylated interferon and ribavirin, eradicate the virus in 50% to 60% of chronically infected people and reduce progression to cirrhosis in other cases. (Poynard et al.; CDC “Hepatitis C”)

Many people who are infected with HCV do not have symptoms until cirrhosis (liver scarring) occurs, after many years of chronic infection. Patients presenting with symptoms more often complain about extrahepatic manifestations, such as fatigue or myalgia, than about liver-related symptoms. (Poynard et al.)

CDC does not recommend providing PEP of immunoglobulin or antivirals to workers occupationally exposed to HCV-infected blood. Instead, after an occupational exposure, the source should be tested for antibodies to HCV. If the source tests positive, the worker should be given baseline tests for alanine aminotransferase and HCV antibodies. Positive HCV antibody tests should be confirmed by a supplemental test (e.g., a recombinant immunoblot assay) or polymerase chain reaction testing, which will confirm the presence of antibodies to the virus. Follow-up testing on the worker should be conducted four to six months later, or four to six weeks later for an earlier diagnosis. An infected worker should be counseled by a specialist for medical evaluation and management.

OTHER PATHOGENS

Occupational exposures to BBF can potentially transmit many pathogens other than HIV and the hepatitis viruses to healthcare workers. Some of these organisms of interest to healthcare facilities are reviewed in this section.

Postexposure management of less common pathogen exposures may be difficult for several reasons, including that healthcare workers may not know they were exposed to the organism and tests may not be run to look for these infections in the absence of known patient risk factors or symptoms in the patient or exposed worker. Even when the exposure is known, no expert guidelines may be available for postexposure treatment.

Other pathogens potentially transmissible via occupational exposures to BBF lack documented accounts of transmission to healthcare workers. These include cytomegalovirus, Epstein-Barr virus, human T-lymphotropic virus (HTLV)-1, HTLV-2, parvovirus B19, rabies, and TT virus.

Viral hemorrhagic fever (VHF) viruses. VHF viruses with documented occupational transmission to healthcare workers include Machupo, Lassa, hantavirus, Ebola, Marburg, Crimean-Congo, Sabia, dengue, yellow fever, Junin, Guanarito, and Kyasanur. Other VHF viruses include chikungunya and Omsk fever.

Many occupational exposures involved outbreaks among care-giving healthcare workers in Asia or Africa who lacked proper protective equipment when exposed to potentially infectious BBF of infected patients. Filoviruses (e.g., Ebola, Marburg) and arenaviruses (e.g., Lassa fever) are particularly infectious after direct contact with infected blood and bodily secretions. Laboratory workers also have documented occupational exposures to some viral hemorrhagic fever viruses that resulted in infection.

In the developed world, the primary threat from VHF viruses is likely to be their potential use as biological weapons—for example, in a bioterrorism event against the civilian population. In case of such an event, VHF dispersal would likely occur in aerosol form, but infectious BBF could become an occupational risk when infected civilians present to hospitals or other healthcare facilities. Much is unknown about VHF transmission. However, for several VHFs, infections acquired percutaneously, such as through a needlestick, seem to have the shortest incubation periods and the highest mortality rates. For some viruses, contact with other bodily fluids, including sweat or respiratory droplets, may be potentially infectious, and other transmission routes, including contact with mucous membranes or nonintact skin, may transmit infection. In nature, many of these viruses are transmitted via arthropods, such as mosquitoes, or by contact with infected animals.

A lack of effective vaccines or antiviral medicines means that treatment and PEP options are nonexistent for several VHFs. Infection control efforts would play a prominent role in preventing healthcare-associated VHF transmission, including patient isolation, postmortem isolation, healthcare worker use of personal protective equipment, handling of laboratory specimens per biological safety level (BSL)-3 or BSL-4 practices, and environmental decontamination. Specific precautions will vary depending on which virus is suspected or
known to be the source of an outbreak. (Tarantola et al.; Borio et al.)

Practices at BSL-1 through BSL-4, which relate to lab practices and techniques, safety equipment, and lab facilities, are described in *BioSafety in Microbiological and Biomedical Laboratories*, published by CDC and the National Institutes of Health (see “Resource List”).

**Zoonotic viruses.** Transmission of several zoonotic viruses has been documented, primarily in veterinary and laboratory settings. Though mostly benign, some zoonotic exposures have been fatal. In particular, exposure to virus B, also known as *Herpesvirus simiae*, from monkeys has been fatal in nearly two-thirds of 25 documented infections. After a recent exposure, CDC changed its guidelines to recommend that lab workers wear goggles to protect against splashes during many activities around macaque monkeys, with face shields possibly used as secondary protection. (Tarantola et al.; CDC “Fatal Cercopithecine”)
**Herpes viruses.** Transmission of herpes simplex virus via needlestick and exposure to nonintact skin has been documented in healthcare workers; antiviral PEP may be effective in preventing infection after a needlestick. One probable case of varicella zoster virus (i.e., chickenpox) transmission to a healthcare worker via needlestick has also been reported. (Tarantola et al.; Manian)

**Viruses used as vectors in gene therapy.** An emerging issue is exposure of healthcare and laboratory workers to viral and other vectors used in gene therapy. In gene therapy, a virus is used as a vector to deliver into a patient’s cells genes intended to treat a variety of acquired and inherited disorders. Viruses being engineered to serve as vectors in administering genes and being administered to patients in the clinical setting include retroviruses, adenoviruses, poxviruses, adeno-associated viruses, and herpes viruses. Some nonviral vectors have also been developed for use as vectors for gene delivery.

The only documented case of gene therapy known to have transmitted the virus—a recombinant vaccine virus transmitted to a laboratory worker via a needlestick—did not result in seroconversion, likely because the worker had been vaccinated against smallpox years earlier. Initial efforts have been made to assess the consequences of such exposures and preventive and postexposure measures. If such incidents become more common, further effort is likely on this front. (Tarantola et al.; Evans and Lesnaw; Li and Huang)

**Bacteria.** Reports of bacterial and rickettsia transmission to healthcare workers following exposure to BBF have been common for decades, although better infection control practices have resulted in fewer bacterial transmissions in recent years. Occupational transmission via BBF exposures has been documented for many bacteria/rickettsia, including the following: *Brucella abortus* (brucellosis), *Burkholderia mallei* (Glanders), *Mycobacterium spp.*, *Neisseria gonorrhoeae*, *Pasteurella multocida*, *Rickettsia rickettsii* (Rocky Mountain spotted fever), *R. tsutsugamushi*, *R. typhi* (typhus), *Staphylococcus aureus*, *S. pyogenes* and other streptococci, and *Treponema pallidum*. Most exposures cause a lesion at the site of injury, although some progress to symptoms such as bacteremia or inflammation. Postexposure management varies by microorganism. (Tarantola et al.)

**Parasites.** *Plasmodium* spp. infections (causing malaria) are the most frequently reported form of occupationally transmitted parasitic infections to healthcare workers. Other documented transmissions via BBF have involved *Leishmania* spp. (causing leishmaniasis), *Trypanosoma* spp. (causing trypanosomiasis), and *Toxoplasma* spp. (causing toxoplasmosis). Postexposure management varies by organism. (Tarantola et al.; Herwaldt)

**Fungi.** Occupational transmission of medically important fungi to healthcare workers via BBF is rare but has been reported via scalpel cut or needlestick for three fungi: *Blastomyces dermatitidis*, *Cryptococcus neoformans*, and *Sporotrichum schenckii*.

**CJD/vCJD.** Creutzfeldt-Jakob disease (CJD) and variant CJD (vCJD) are rare and fatal diseases that cause degeneration of the brain. Currently, no diagnostic test is available for either CJD or vCJD, and the protein suspected to cause the disease could be present in a symptomless patient’s body. The World Health Organization (WHO) has developed infection control guidelines for transmissible spongiform encephalopathies (see “Resource List”).

CJD is primarily a disease of unknown cause (85% to 90% of cases), occurring at a rate of about one per million population, although a few cases are accounted for by genetic inheritance or by exposure to the causative agent in contaminated surgical equipment, cornea or dura mater transplants, or human-derived pituitary growth hormones. By contrast, vCJD is strongly linked to exposure, probably through food, to a transmissible spongiform encephalopathy of cattle called bovine spongiform encephalopathy. Compared to CJD, vCJD strikes younger individuals (29 years of age on average, compared to 65 for CJD) and has a longer duration of illness (14 months at median, compared to 4.5 months for CJD). (WHO)

CJD and vCJD are known to be transmissible through blood transfusion. CJD cases have been reported in healthcare workers. However, the number of such cases is not disproportional to the rate in the non-healthcare-worker population, and the disease’s rarity and long incubation period makes it difficult to trace these cases to an occupational exposure. (Tarantola et al.)

**ACTION RECOMMENDATIONS**

- Conduct a risk assessment to determine what pathogens are likely to be encountered by personnel in a healthcare facility, and implement appropriate infection control and occupational health measures to counter identified risks.
• Educate personnel at risk of exposure about the pathogens likely to be encountered in the workplace, preventive measures available before exposure, transmission risks, and postexposure management.

• Prepare for postexposure management of less frequently encountered pathogens as well as possible.

• Follow federal recommendations for standard precaution use by and other workplace restrictions on certain HIV- and HBV-infected workers. No restrictions are routinely recommended for healthcare workers infected with HCV.

• Offer HBV vaccine as required by federal regulations to any employee who could be exposed to HBV on the job.

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