FEATURE ARTICLE
Continuing Education

Bloodborne Pathogens

What You Need to Know—Part II

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The potential for exposure to a bloodborne pathogen can happen in almost any occupational health setting. Health care environments are the highest risk areas, but exposures from accidents can occur in a variety of settings, from manufacturing to an office area. Every occupational health clinician should have a basic knowledge of bloodborne pathogens.

Part I of this article (Vol. 50, No. 1, pp. 38-45) focused on the milestones in the regulation of bloodborne pathogen exposures and the risks of transmission and prevalence of exposures to hepatitis B (HBV), hepatitis C (HCV), and human immunodeficiency virus (HIV) among health care workers. Part II defines bloodborne pathogens in more detail and focuses on the general prevalence, risk groups, prophylaxis, and treatment of HBV, HCV, and HIV.

BLOODBORNE PATHOGENS

Definition

Bloodborne pathogens are any pathogenic microorganisms found in the blood or other bodily infectious material that can cause disease in humans. Examples of bloodborne pathogens with the potential to cause disease in humans include malaria, syphilis, viral hemorrhagic fever, arboviral infections, Creutzfeldt-Jakob disease, relapsing fever, and adult T-cell leukemia and lymphoma (Occupational Safety and Health Administration [OSHA], 2001). The three bloodborne pathogens of greatest concern to health care workers are HBV, HCV, and HIV.

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Bloodborne pathogens such as HBV, HCV, and HIV are found in highest concentration in blood or body fluids containing visible blood. Body fluids that may be potentially infectious, especially for HBV or HIV, include amniotic fluid, cerebrospinal fluid, pericardial fluid, peritoneal fluid, pleural fluid, and synovial fluid. Breast milk, semen, and vaginal secretions have not been associated with transmission in the health care setting, although these secretions can transmit bloodborne pathogen infections via sexual or perinatal routes. Unfixed tissue, organs (dead or living), and concentrated virus in any form in a laboratory are all considered infectious material requiring exposure evaluation. Body fluids of low infectious potential, unless blood is present, include feces, urine, vomitus, sweat, tears, nasal secretions, and saliva (Centers for Disease Control and Prevention [CDC], 2001a).

HEPATITIS B

History and Epidemiology

Hepatitis B virus is a DNA hepadnavirus. The hepatitis B virus consists of an internal core DNA and a protein (hepatitis B core antigen [HbcAg]) and an outer coat of lipid and protein (hepatitis B surface antigen [HbsAg]). The hepatitis B surface antigen (HbsAg) was first described in 1965, and the Dane particle (i.e., complete hepatitis B virion) was identified in 1970. The first recorded cases of serum hepatitis, later identified as hepatitis B, was described following administration of the smallpox vaccine containing human lymph to shipyard workers in Germany in 1833. Testing of blood products for the hepatitis B virus began in 1969 and was mandatory by 1972 (Robinson, 2000).

The National Center for Infectious Diseases [NCID], (2001a) reports a decline in new incidence of hepatitis B from 450,000 cases in the 1980s to 80,000 cases in 1999. Immunization of children and adolescents accounts for

Table 1

Common Blood Tests for Hepatitis B, Hepatitis C and HIV

Abbreviation	*Name*	*Explanation*
Hepatitis B		
HbsAG	Hepatitis B surface antigen	Test for hepatitis B acute or chronic infection.
HbsAB	Hepatitis B surface antibody	Test for hepatitis B antibodies either from past infection or from immunization.
HbeAG	Hepatitis B e antigen	Test for high infectivity of hepatitis B.
HbcAB	Hepatitis B core antibody	Test for antibodies to hepatitis B from prior infection.
Hepatitis C		
HCV-EIA	Hepatitis C enzyme immunoassay	Test to detect antibodies for hepatitis C.
RIBA	Recombinant immunoblot assay	Confirmatory test to detect hepatitis C antibodies.
HCV RNA qualitative	Hepatitis C RNA qualitative PCR test	Test to detect presence or absence of hepatitis C virus in serum.
HCV RNA quantitative	Hepatitis C RNA quantitative PCR test	Test to measure the level of hepatitis C virus in the serum.
HIV		
HIV ELISA	Human immunodeficiency virus enzyme-linked immunosorbent assay	Test to detect the presence of HIV antibodies.
Western blot	Western blot technique	Confirmatory test to detect antibodies to HIV.
Viral load	HIV viral load	Test to measure the level of HIV virus in the serum.

much of the decline. Approximately 1.5 million people are chronically infected with hepatitis B in the United States. Twenty to 30% of individuals chronically infected with hepatitis B acquired their infection as children.

Transmission

Hepatitis B has been found in highest concentrations in the blood and serous fluids, and in less concentration in fluids such as saliva, vaginal fluid, and semen. Transmission of hepatitis B in health care workers occurs primarily through blood contact through percutaneous exposure, mucous membrane, or nonintact skin. Evidence suggests nonintact skin may be the most frequent mode of transmission in health care workers. Indirect inoculation can occur through abrasions, cutaneous scratches, burns, lesions, or mucosal surfaces from blood contaminated inanimate objects (CDC, 2001a).

Hepatitis B is considered a strong virus and can live on inanimate surfaces such as tables, bed rails, or monitors for a week or more. Hepatitis B infections were especially common in hemodialysis units prior to improved compliance standards. Wiping surfaces with standard germicidal cleaning agents kills the virus. The hepatitis B virus can also be inactivated by heating it at 98ºC for approximately 2 minutes (Beltrami, 2000). All purpose environmental disinfectants are not thought to be effective against hepatitis B (CDC, 2001a; Sattar, 2001).

The incubation period for hepatitis B ranges from 4 weeks to 28 weeks with an average of 60 to 110 days (Robinson, 2000). Hepatitis B infection can be mild or asymptomatic, particularly in children. The symptoms of hepatitis B infection may include anorexia, malaise, jaundice, fatigue, abdominal pain, nausea, and vomiting. Most adults with acute hepatitis B recover and develop protective antibodies. Only 2% to 10% of adults have chronic infection. In children, 30% to 90% develop chronic infection. Chronic carriers remain infectious and can later develop liver failure or liver cancer (NCID, 2001a).

Risk Groups

Individuals at highest risk for hepatitis B include (NCID, 2001a):

- Intravenous (IV) drug users.
- Male homosexuals.
- Infants and children of immigrants from disease endemic areas such as Asia and sub Saharan Africa.
- Infants born to infected mothers.
- Individuals with multiple sexual partners or diagnosis of a sexually transmitted disease.
- Sexual or household contacts of infected individuals.
- Health care and public safety workers.
- Hemodialysis clients.

The risk of developing hepatitis B from a blood transfusion remains extremely low because of improved screening and testing methods.

Testing

The primary marker for acute or chronic hepatitis B infection is the hepatitis B surface antigen (HbsAg). The HbsAg can be detected as early as 1 to 2 weeks after infection. The HbsAg may no longer be present after 3 months in individuals who recover from acute hepatitis B. The HbsAg will remain positive in chronic carriers. The HbsAg test is the most efficient diagnostic tool to test for the possibility of hepatitis B infectivity. Another test that may be used to test infectivity is the HBeAg. The hepatitis B e antigen (HBeAg) is a marker for an individ-

Table 2

Summary of Bloodborne Pathogens

	Hepatitis B	*Hepatitis C*	*HIV*
Virus type	DNA hepadnavirus	RNA flavivirus	RNA retrovirus
Risk to health care workers	30% (unvaccinated person) 6% to 62% range	2% to 3% (unvaccinated person) 0% to 7% range	0.3% percutaneous 0.1% mucous membrane
Transmission	Blood, serous fluids, saliva, vaginal fluid,* semen*	Blood	Blood, serous fluids, semen,* vaginal secretions,* breast milk*
Incubation period	4 weeks to 28 weeks	2 weeks to 24 weeks	6 days to 6 weeks
Number estimated infected in the United States	1.25 million	4 million	800,000 to 900,000
Risk groups	Intravenous (IV) drug users, sexually active heterosexuals and homosexual males, infected mothers, hemodialysis patients, household contacts of infected person, infants and children of immigrants from disease endemic areas, health care workers	IV drug users, individuals with multiple sexual partners, hemodialysis patients, recipients blood transfusions or solid organs prior to 1992, recipients of clotting factors prior to 1987, infants born to highly infected mothers, health care workers	Homosexual males, IV drug users, heterosexual partners, infected mothers, recipients of blood or plasma prior to blood or plasma prior to 1985, recipients of clotting factors prior to 1987
Sequelae	2% to 10% adults develop chronic infection, 30% to 90% of children	85% develop chronic infection Leading cause of liver transplants	HIV can lead to AIDS and premature death
Prevention	Universal precautions Hepatitis B vaccine, HBIG	Universal precautions	Universal precautions
Prophylaxis	Hepatitis B vaccine, HBIG	No approved post exposure prophylaxis	Anti-retrovirals
Treatment	Alfa-interferons, nucleosides	Alfa-interferons in combination with ribavirin	Anti-retrovirals

** These fluids are generally not associated with transmission in health care workers.*

ual who is highly infectious with a high titer of hepatitis B in the serum. (Beltrami, 2000).

The hepatitis B surface antibody test (HbsAB or Anti HBs) is a marker for immunity to hepatitis B. Individuals may test positive for hepatitis B antibodies either from past infection or through immunization. The antibody to hepatitis B core antigen (HbcAB or Anti HBc) indicates acute or prior infection with hepatitis B at some indefinite time (Betrami, 2000) (see Table 1).

Prevention, Prophylaxis, Treatment

Prevention, prophylaxis, and treatment are all available for HBV. Hepatitis B is the only one of the three most virulent bloodborne pathogens that has a vaccine for prevention. Hepatitis B is a DNA virus—a virus much easier to replicate and, therefore, much easier to create vaccines and treatment. The hepatitis B vaccine has been available since 1982. It was initially a plasma derived vaccine, and in 1992 it was taken off the U.S. market. The recombinant vaccine has been available since 1986. Many health care workers still remain reluctant to take the vaccine for fear they are taking a plasma derived vaccine. Health care workers need to be reassured the hepatitis B vaccine is safe, even during pregnancy, and is not produced from blood products.

A three dose vaccine series is required during a 6 month period. Primary vaccination with hepatitis B is approximately 90% effective. If an employee does not respond to the initial series, a second three dose series is recommended. Approximately 30% to 50% of individuals will respond to the second three dose series. If the series is interrupted at any time, the CDC (2001a) recommends resuming the series where it was left off. Employees who do not respond to the second three dose series are considered nonresponders. Six doses of the hepatitis B vaccine is generally considered the maximum recommended.

Antibodies should be checked 1 to 2 months after the completion of the vaccine series per current CDC guidelines. Employees evaluated more than 6 months after completing the vaccination series who are low level responders could have antibody levels below the 10 IU/ml and be falsely classified as nonresponders. These employees should consider receiving a booster dose and having their antibody status checked in 1 month. If an employee has a positive antibody response, no additional doses of the vaccine are required. For primary or secondary nonresponders, the CDC (2001a) suggests considering an evaluation for HbsAg. Employers should assume the costs of the complete vaccine series and antibody test. Further evaluation of nonresponders may be the responsibility of the employee.

If an employee has documented positive antibodies against hepatitis B, there is no need to periodically retest or boost the employee (CDC, 2001a). Studies have shown detectable hepatitis B antibodies do wane. Funderburke (2000) found 21% of health care workers had nonreactive titers 7 or more years after immunization. Other reports indicate that by 8 years after vaccination, as many as 60% of the individuals lose detectable antibodies (Bolyard, 1998). Despite low or undetectable hepatitis B antibodies, individuals are thought to be able to mount a protective immunologic response and are protected in the event of an exposure.

Several researchers have attempted to identify factors affecting nonresponse to the hepatitis B vaccine. Wood (1993) found the following are associated with lack of antibody response:

- Male gender.
- Smoking.
- Being overweight.
- Increasing age.

Zuckerman (1997) had similar findings related to gender, weight, and age, but also reported site and route of injection and immunosuppression affected antibody response. Injecting hepatitis B vaccine into the deltoid muscle instead of the gluteus muscle has proven more effective. It may also be helpful to use a longer needle on obese employees to increase probability of absorption into the muscle.

Nonresponders are at risk for hepatitis B and should be counseled about the importance of following standard precautions and of obtaining the hepatitis B immunoglobin (HBIG) for any known or probable exposure. Postexposure prophylaxis against HBV in an unprotected health care worker using HBIG within 1 week of exposure is approximately 75% effective. Initiation of the hepatitis B vaccine series at the same time provides added protection. The CDC (2001a) recommends known nonresponders receive two doses of HBIG.

Two classes of drugs are currently available for treatment of chronic hepatitis B. Alpha interferons have been effective agents in treatmenting chronic hepatitis B for many years. More recently, nucleoside analogs (e.g., lamivudine) have been used with positive outcomes (Robinson, 2000) (see Table 2).

HEPATITIS C

History and Epidemiology

Hepatitis C is an RNA flavivirus. The virus was first identified in 1988 and testing for the virus began in 1990. Prior to 1988, the unknown disease was called non A, non B hepatitis. As an RNA virus, the hepatitis C virus mutates frequently. Mutated forms of HCV are different enough that although individuals develop antibodies against HCV, they are not protected against the virus as with hepatitis B. Six different genotypes and more than 90 subtypes of HCV exist. In the United States, 70% of HCV infected individuals have genotype 1 virus, which is the most difficult HCV genotype to treat (CDC, 1998b; NCID, 2001b).

Hepatitis C is the most common bloodborne pathogen in the United States. Approximately 4 million people are infected with hepatitis C in the United States, and 170 million people are infected worldwide. It is the leading cause of cirrhosis and the most common reason for liver transplants. Approximately 8,000 to 10,000 deaths per year in the United States are related to hepatitis C. This is expected to triple in the next 10 to 20 years (CDC, 1998b).

During the 1980s, approximately 240,000 people per year were infected with hepatitis C. By 1998, only 41,000 people were newly infected. The 80% reduction in new hepatitis C cases is thought to be through better blood product testing and a decrease in IV drug use. Hepatitis C has been called the silent epidemic because many individuals who contracted the disease 10 to 20 years ago are just beginning to have symptoms (NCID, 2001b).

Transmission

Hepatitis C has been found in blood only. It is primarily transmitted by blood or blood products via percutaneous routes, and less frequently through a splash to mucous membranes. In health care workers, transmission by hollow bore needles is the most prevalent route. However, transmission by splashes to conjunctiva has been reported. There has been no documented transmission of HCV to health care workers by nonintact skin (CDC, 2001a).

Recipients of blood transfusions prior to July 1992 and recipients of clotting factors prior to 1987 accounted for a large portion of the HCV infection before the introduction of blood product testing and virus inactivation procedures. The risk of HCV infection from a blood transfusion is now less than one per million transfused units (NCID, 2001b).

Limited information exists about the survival of hepatitis C in the environment. It has been shown that RNA in plasma or serum can be stable at 4ºC for up to 7 days, but data on virus infectivity of the specimen do not exist. Some have speculated HCV is not as infectious on environmental surfaces as HBV, but is more infectious than HIV. No studies have linked environmental contamination with hepatitis C as a significant risk of transmission in health care settings. Germicidal chemicals are an important disinfectant against HCV. As in the case with HBV, general purpose environmental cleaners are not likely to prevent HCV transmission (CDC, 2001a; Sattar, 2001).

The average incubation period for acute hepatitis C is 6 to 7 weeks, with a range of 2 weeks to 6 months. As many as 60% to 80% of individuals with acute hepatitis C have no symptoms; 20% to 30% may have jaundice; and 10% to 20% may have nonspecific, influenza like symp-

toms, such as fatigue, nausea, myalgia, loss of appetite, and abdominal pain. Because symptoms are mild and often mirror a transient influenza like illness, hepatitis C often remains undiagnosed. Approximately 85% of individuals with acute infection develop chronic disease. Chronic carriers may have no symptoms or may eventually develop cirrhosis and end stage liver disease. The remaining 15% of individuals with acute HCV recover with the disappearance of HCV RNA from the blood and a return to normal liver enzymes (CDC, 1998b; NIH, 1997).

Risk Groups

Intravenous drug users remain the primary risk group for hepatitis C. Sixty to 80% of individuals who use IV drugs are infected with HCV. Other major risk groups include:

- Recipients of blood or solid organs prior to 1992.
- Recipients of clotting factors prior to 1987.
- Hemodialysis clients.
- Infants born to infected mothers.
- Individuals with multiple sexual partners.
- Health care workers.

Sexual transmission of hepatitis C is less than 5% in monogamous relationships, and other risk factors may exist in this seroconverted group of individuals. Some evidence suggests individuals who use cocaine intranasally and share equipment may be at higher risk. Tattooing, body piercing, or acupuncture with improper hygienic technique pose a potential risk, but little data currently exist related to the precise risk of HCV. Approximately 10% of acute HCV cases and 30% of chronic hepatitis C cases have no recognized source of infection (NCID, 2001c; National Digestive Diseases Information Clearinghouse [NDDIC], 2002).

Testing

Antibody testing for hepatitis C has been available since 1992 and has been improved several times. Antibodies for hepatitis C can be detected by enzyme immunoassay (EIA). The EIA detects antibodies for HCV, but does not detect whether the infection is acute, chronic, or resolved. The EIA is a screening test to detect HCV in clients. Occasionally, false positives are detected on the EIA. A confirmatory test called the recombinant immunoblot assay (RIBA) has a more specific assay and can be used to confirm false positives (CDC, 1998b).

Because antibodies to HCV can take up to 3 months to be detected, the best approach to diagnosing hepatitis C is through testing HCV RNA using polymerase chain reaction (PCR) assay. The HCV RNA test is also the best approach in immunocompromised individuals who may not produce enough antibodies for detection with EIA. The HCV RNA PCR testing currently is used most frequently for monitoring response to treatment for hepatitis C (NDDIC, 2002).

A qualitative test for HCV RNA detects the presence or absence of HCV in the blood. A quantitative test for HCV RNA detects the volume of HCV in the blood. The HCV RNA test can detect the virus in the serum within 1 to 3 weeks after exposure. The HCV RNA test requires special handling, and only a few select laboratories currently perform this type of expensive testing (NIDDK, 2002; NIH, 1997).

Recently, the Food and Drug Administration (FDA) approved PCR HCV RNA assay for general use. Large hospital facilities may now develop testing in their own laboratories and save valuable time and money in the diagnosis and treatment of hepatitis C (see Table 1).

Prevention, Prophylaxis, Treatment

A vaccine for hepatitis C does not currently exist. In addition, it may be extremely difficult to develop a vaccine because of the nature of the mutations of the virus and the number of genotypes and subtypes. The best prevention for health care workers is standard precautions. Two preventive interventions that have had an effect with the general population are blood supply screening and education about high risk behaviors associated with HCV. Although the incidence of new hepatitis C has dramatically decreased in the past decade, there is concern a large number of individuals may have been infected years ago and do not know it. In 1999, the CDC began a massive public health campaign about hepatitis C to raise awareness among health professionals and the general public. Further information is expected to become available as more research focusing on the prevention, diagnosis, and treatment of hepatitis C is published.

No approved prophylaxis is currently available for hepatitis C. Administration of immune globulin is not recommended after an exposure. To date, no studies related to using antivirals for post exposure prophylaxis (PEP) have been published, and the FDA has not approved antivirals for this indication. Studies focusing on how interferon affects chronic HCV infection suggest the drug may work best after an established infection is present (CDC, 2001a).

Despite the lack of data, there is interest in the idea of using antivirals, such as peginterferon, as PEP for a 28 day course, similar to prophylactic treatment after an HIV exposure. Early investigative studies are currently being conducted about the use of peginterferon for a 28 day period post-exposure, but there are little published data on this.

Without approved prophylaxis available for HCV, the standard post-exposure management for HCV is to test for HCV antibodies and an alanine transaminase level at baseline, repeating the tests again at 4 to 6 months. If the findings are positive, the CDC (2001a) recommends follow up with a specialist, such as a hepatologist.

The most aggressive testing management of exposures to HCV is to test for HCV RNA as early as 4 to 6 weeks post-exposure and again at 12 weeks. This aggressive testing using HCV RNA by PCR still may be considered experimental. The rationale for using PCR HCV RNA testing is that early identification and treatment of HCV has shown higher rates of resolved infection (CDC, 2001a; Noguchi, 1997). In a recent study on the early treatment of acute hepatitis C infection using interferon alfa-2b, Jaeckel (2001) reported a 98% response rate. Thirty two percent of the participants in this study had sustained needlestick injuries.

A combination of alpha interferon and ribavirin had been the most effective treatment for chronic hepatitis C, with sustained response rates of 38% to 43% (Zeuzem, 2000). In the past year, pegylated interferon treatment regimens have been replacing standard interferon therapy because of the ease of administration and improved efficacy. In a study by Zeuzem (2000), peginterferon alfa-2a once per week was more effective than interferon alfa-2a three times per week.

Peginterferon alfa-2a (Pegasys®), produced by Hoffman La Roche (Basel, Switzerland) and peginterferon alfa-2b (PEG-INTRON®), produced by Schering-Plough (Madison, NJ), both have been approved for use. Early trials using a pegylated interferon and ribavirin show the most promise for sustained response. Hepatitis C is a difficult virus to eradicate, and the search continues for improved therapies (see Table 2).

HIV

History and Epidemiology

Human immunodeficiency virus is a RNA retrovirus that causes acquired immune deficiency syndrome (AIDS). The first reported cases of AIDS were described in 1981 (CDC, 1981). During the 1980s, the number of new cases and resulting deaths increased dramatically. Since the mid 1990s, there has been a progressive decline. Individuals are living longer with HIV before progressing to AIDS, and opportunistic infections are less prevalent. Human immunodeficiency virus is now considered a chronic disease. Prevention strategies, early recognition of the disease, effective diagnosis, prophylaxis, and new antiretroviral medications have all contributed to the decline (CDC, 2001b).

As of June 2001, the CDC (2002) reported 321,481 people living with AIDS and an additional 134,269 living with HIV in the United States. Worldwide, an estimated 36 million individuals are infected with HIV and AIDS (CDC, 2001c). The exact prevalence of HIV in the United States is difficult to quantify. Although AIDS is a reportable disease in all 50 states, 17 states do not report complete surveillance data on HIV (CDC, 2002). The CDC (2001e) has estimated as many as 800,000 to 900,000 individuals may be living with HIV or AIDS in the United States. The larger estimate takes into account incomplete reporting in all states, anonymous test results not included in surveillance data, and the probability that many are not aware of their HIV status.

Transmission

Human immunodeficiency virus can be transmitted perinatally, sexually, or percutaneously. It has been identified in a number of body fluids, but only blood, semen, breast milk, and vaginal secretions have been implicated as sources of infection. Blood and bloody secretions remain the greatest risk of HIV transmission to health care workers (Stansbury, 2000).

Human immunodeficiency virus is a fragile virus that cannot survive outside a warm medium—it needs a living host to reproduce and maintain infectivity. Dried blood or body fluids have no risk of environmental transmission (CDC, 2001d). As with other bloodborne viruses, germicidals are the best solutions to kill HIV. Studies assessing the inactivation of HIV have found both betadine at a minimum concentration of 0.25% and chlorhexidine gluconate at concentrations greater than or equal to 0.2% kill the virus (Harbison, 1989; Kaplan, 1987).

Risk Groups

Homosexual individuals remain the highest risk group for acquiring HIV. Intravenous drug users and sexually active heterosexual individuals also have a high incidence of HIV and AIDS. Mother to child transmission has dramatically dropped in the United States, but remains a significant mode of transmission in developing countries without access to antiviral medications and testing procedures. Since the screening of donated blood and plasma in 1985 and the heat treatment of clotting factors, transmission of HIV through blood or blood products is extremely rare (CDC, 2001b).

The incubation period for HIV ranges from 6 days to 6 weeks (Jaffe, 1992). The CDC (1998a) reports 81% of the health care workers who developed HIV experienced symptoms within a median of 25 days.

Seroconversion to HIV in studies of homosexual men, IV drug users, and individuals with hemophilia has invariably been between 3 and 12 weeks after infection (Del Rio, 2000). In an analysis of 51 health care workers infected with HIV, the estimated mean interval to antibody development was 46 days (Busch, 1997).

Ninety-five percent of individuals develop antibodies to HIV within 6 months (Ciesielski, 1997). Three instances of delayed seroconversion in health care workers beyond 6 months are known (CDC, 1998a). In only one case was DNA sequencing able to confirm the source client. In two instances, there was co-infection with HCV in the source client. It has been hypothesized in cases of co-infection, a delay in seroconversion may occur. However, the exact mechanism is unknown. The CDC (2001a) currently recommends testing up to 1 year if a health care worker seroconverts for HCV in cases of dual infection of both HIV and HCV in a source client.

Primary HIV syndrome symptoms include:

- Fever.
- Lymphadenopathy.
- Myalgia.
- Arthralgia.
- Sore throat.
- Anorexia.
- Nausea.
- Vomiting.
- Diarrhea.
- Sweats.
- Photophobia.
- Fatigue.
- Rash.

Some individuals have no symptoms, initially. Later, opportunistic diseases associated with AIDS may present. These may include cytomegalovirus, herpes simplex, candidiasis, Karposi's sarcoma, or pneumocystis carinii (Del Rio, 2000).

Testing

Testing for the presence of HIV antibodies is conducted using the enzyme linked immunosorbent assay (ELISA or EIA) technique. The HIV ELISA can occasionally produce a false positive, so laboratories are instructed to repeat the test if the first result is positive. One reason for false positives is the threshold is set low to decrease the probability of false negatives. A false positive can occur in (Jaffe, 1992):

- Individuals with autoimmune disorders, multiple myeloma, or various forms of liver disease.
- Recipients of multiple blood transfusions, such as individuals with renal failure.
- Multiparous women.

Other causes of false positives include human error, hemolysis, or a reactive rapid plasmin reagin test (Demeter, 2000).

Confirmation of a positive test is conducted using the Western blot technique (Demeter, 2000). A positive ELISA and Western blot indicates the presence of HIV antibodies and HIV infection.

Rapid HIV tests are now available to detect HIV antibodies. In facilities where HIV EIA results may not be available for more than 24 to 48 hours, the rapid HIV test may be the preferred method. Recent studies comparing rapid HIV testing for both HIV-1 and HIV-2 strains have shown 100% specificity and sensitivity when compared to the EIA and Western blot testing (Aidoo, 2001; Reynolds, 2002). Rapid HIV testing has also been shown to be cost effective in some occupational health settings (Kallenborn, 2001).

The PCR technique is available to detect HIV viral loads. The HIV viral load testing is best used to determine treatment options, but is not recommended for routine detection of infection in health care workers (CDC, 2001a) (see Table 1).

Prevention, Prophylaxis, Treatment

No vaccine is currently available to prevent HIV. The primary means of prevention for health care workers against HIV are standard precautions and safe work practice and engineering controls.

Antiretroviral agents are available for both prophylaxis and treatment. Prophylaxis for HIV exposure has been formally available since 1996 when the CDC first issued provisional guidelines. The CDC (1996) based its decision on studies suggesting prophylaxis with antiretrovirals may reduce the risk of transmission of HIV in both occupational and maternal child exposures. A retrospective case control study focusing on health care workers showed the use of zidovudine (AZT) reduced the risk of HIV infection by 79% (CDC, 1995). Studies of mothers infected with HIV found the administration of AZT during pregnancy, labor, and delivery decreased the risk of HIV in infants by 67%. Early post-exposure prophylaxis is thought to inhibit HIV replication. Studies have shown systemic infection does not occur immediately and, therefore, a brief window of opportunity exists to prevent viral replication (CDC, 2001a).

Three classes of antiretroviral medications are available for the prophylaxis and treatment of HIV:

- Nucleoside reverse transcriptase inhibitors (NRTI).
- Nonnucleoside reverse transcriptase inhibitors (NNRTI).
- Protease inhibitors (PI).

Each class of drugs works in a different way to affect viral replication (see Table 2).

SUMMARY

Bloodborne pathogen exposures remain a significant occupational hazard to all health care professionals. Primary preventive strategies, such as standard precautions and the availability of the hepatitis B vaccine to all health care workers, have been instrumental in decreasing the potential for life threatening exposures to HBV, HCV, and HIV. Updated work practices and engineering controls, including the use of safer medical devices, will continue to further reduce the potential risk of exposures to workers.

Occupational health clinicians are in a pivotal position to foster primary preventive strategies. Ongoing education to health care professionals about the general prevalence, risk of transmission, and availability of prophylaxis and treatment is imperative. Knowledge related to the importance of taking basic precautions through the use of gloves, gowns, and masks has been proven to decrease exposure incidents. Many health professionals are experts in their specialty areas, but are unfamiliar with the latest data related to the prevention and treatment of exposures to bloodborne pathogens. Some perceive they are at little risk, and others have untoward fears.

Secondary preventive intervention strategies are evolving each year through the use of new prophylactic medications for HIV and the possibility of prophylaxis for HCV. Occupational health clinicians must be updated about the latest strategies for the management of bloodborne pathogen exposures (see Appendix for a list of resources).

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IN SUMMARY

Bloodborne Pathogens

What You Need to Know—Part II

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1. Occupational health clinicians need to be familiar with the latest information related to the general prevalence, risk groups, prophylaxis, and treatment of hepatitis B (HBV), hepatitis C (HCV), and human immunodeficiency virus (HIV). Understanding common blood tests for the three most common bloodborne pathogens is essential for clinicians working in a health care setting.

2. The most virulent bloodborne pathogen is HBV. Hepatitis B is found in highest concentrations in blood and serous fluids and in less concentration in fluids such as saliva, vaginal fluids, and semen. It is the only bloodborne pathogen that has effective prevention, prophylaxis, and treatment available.

3. Hepatitis C is an RNA virus found only in the blood. It is the most common bloodborne pathogen in the United States. Early identification of HCV through polymerase chain reaction (PCR) assay RNA testing and aggressive treatment has shown higher rates of resolved infection.

4. Human immunodeficiency virus is a fragile RNA virus that cannot survive for long outside a warm medium. Rapid HIV tests may be the preferred method to detect HIV antibodies in facilities where HIV enzyme immunoassay (EIA) results may not be available for more than 24 to 48 hours. Early postexposure prophylaxis has been effective in decreasing the risk of HIV transmission in health care workers.

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Appendix

Bloodborne Pathogen Resources

Bloodborne Pathogen Websites:

Occupational Safety and Health Administration bloodborne pathogen website
http://www.osha-slc.gov/SLTC/bloodbornepathogens/index.html

National Institute for Occupational Safety and Health website on bloodborne infectious diseases: HIV/AIDS, hepatitis B virus, and hepatitis C virus. Provides links.
http://www.cdc.gov/niosh/bbppg.html

American Nurses Association site on needlesticks and bloodborne pathogens.
http://www.nursingworld.org/needlestick/nshome.htm

Hepatitis B Websites:

Centers for Disease Control and Prevention (CDC): National Center for Infectious Diseases hepatitis B homepage
http://www.cdc.gov/ncidod/diseases/hepatitis/b/index.htm

Immunization Action Coalition: Hepatitis B articles and resources
http://www.immunize.org/hepb/index.htm

HIVandHepatitis.com: Basic information on hepatitis B, disease, treatment, general news stories, useful for general public.
http://www.hivandhepatitis.com/hep_b.html

Hepatitis C Websites

CDC National Center for Infectious Diseases site on hepatitis C: Links to online training on hepatitis C for health care professionals, article on national hepatitis C prevention strategy, and other references.
http://www.cdc.gov/ncidod/diseases/hepatitis/c/index.htm

National Institute of Diabetes and Digestive and Kidney Diseases, National Digestive Diseases Information Clearinghouse: Chronic hepatitis C, current disease management publication.
http://www.niddk.nih.gov/health/digest/pubs/chrnhepc/chrnhepc.htm

Hepatitis Foundation website. Helpful site for individuals who have hepatitis.
http://www.hepfi.org/index.html

HIV/AIDS Websites:

HIVandHepatitis.com: Useful site for the general public. News stories, treatments, coinfection issues.
http://www.hivandhepatitis.com/hiv_aids.html

Journal of the American Medical Association site: Resource for health care professionals on HIV and AIDS.
http://www.ama-assn.org/special/hiv/hivhome.htm

CDC: *Morbidity and Mortality Weekly Report (MMWR)*: HIV and AIDS reports
http://www.cdc.gov/mmwr/hiv_aids20.html

Further contact information:

Hepatitis Branch of the CDC (1-888-443-7232 or 1-888-4HEPCDC)
24-hour toll free Hepatitis Information Center. Recorded information targeted to both providers and patients. Can request information on hepatitis and general education material by mail or by fax.

CDC National STD and AIDS hotline (1-800-227-8922 or 1-800-342-AIDS)
Referral center for sexually transmitted diseases (STDs), AIDS, HIV, and Hepatitis C. Resource for general questions. Referrals for anonymous or confidential testing, free printed materials available.

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Bloodborne Pathogens: What You Need to Know—Part II

This issue of the AAOHN JOURNAL contains a Continuing Education Module on "Bloodborne Pathogens: What You Need to Know—Part II." 1.1 contact hours of continuing education credit will be awarded by AAOHN upon successful completion of the posttest and evaluation.

A certificate will be awarded and the scored test will be returned when the following requirements are met by the participant: 1) The completed answer sheet is received at AAOHN on or before January 31, 2004; (2) A score of 70% (7 correct answers) is achieved by the participant; (3) The answer sheet is accompanied by a $10.00 processing fee. Expect up to 6 weeks for delivery of the certificate.

Upon completion of this lesson, the occupational health nurse will be able to:

1. Define the bloodborne pathogens of greatest concern to health care workers.
2. Identify the epidemiology, transmission, and testing for hepatitis B, hepatitis C and human immunodeficiency virus (HIV).
3. Describe the prevention, prophylaxis, and treatment for hepatitis B, hepatitis C, and HIV.

AAOHN is accredited as a provider of continuing education in nursing by the American Nurses Credentialing Center's Commission on Accreditation. California provider number CEP9283. Louisiana provider number LSBN3.

Contact hour credits received for successful completion of the posttest and evaluation may be used for relicensure, certification, or re-certification.

Directions: Circle the letter of the best answer on the answer sheet provided. (Note: You may submit a photocopy for processing.)

1. Which of the following body fluids is most likely to be potentially infectious for the human immunodeficiency virus (HIV) or hepatitis B?
A. Urine.
B. Cerebrospinal fluid.
C. Vomitus.
D. Saliva.

2. The occupational health nurse cautions health care workers that this bloodborne pathogen may live on inanimate surfaces such as bedrails or monitors for up to 1 week or more:
A. Hepatitis B.
B. Hepatitis C.
C. HIV.

3. Which of the following is true regarding the vaccine for prevention of hepatitis B?
A. It is produced from blood products.
B. It is given in a 2 dose vaccine series.
C. The series is given over a 4 month period.
D. Primary vaccination is approximately 90% effective.

4. The occupational health nurse counsels that post-exposure prophylaxis against hepatitis B in an unprotected health care worker using hepatitis B immunoglobin (HBIG) within 1 week of exposure is approximately _____ effective.
A. 35%.
B. 50%.
C. 75%.
D. 90%.

5. In health care workers, the most prevalent route of hepatitis C transmission is through:
A. Nonintact skin.
B. Hollow bore needle puncture.
C. Splash to mucous membranes.
D. Contact with contaminated environmental surfaces.

6. The occupational health nurse recommends which of the following to monitor response to treatment for hepatitis C (HCV)?
A. Recombinant immunoblot assay (RIBA).
B. Hepatitis C enzyme immunoassay (HCV-EIA).
C. HCV RNA qualitative.
D. HCV RNA polymerase chain reaction (PCR).

7. The best intervention for protecting health care workers from hepatitis C is:
A. Universal precautions
B. Vaccination.
C. Administration of immune globulin.
D. Administration of interferon.

8. The Centers for Disease Control and Prevention (2001e) estimates that _____ people may be living with HIV or acquired immune deficiency syndrome (AIDS) in the United States.
A. 320,000.
B. 500,000.
C. 800,000.
D. 2 million.

9. The occupational health nurse considers that the highest risk group for acquiring HIV is:
A. Intravenous drug users.
B. Homosexuals.
C. Heterosexual partners of individuals with AIDS.
D. Children of women with AIDS.

10. The occupational health nurse recommends this testing to determine treatment options for a health care worker with HIV:
A. HIV enzyme linked immunosorbent assay (ELISA).
B. Western blot.
C. Rapid HIV testing.
D. HIV viral load.

ANSWER SHEET
Continuing Education Module

Bloodborne Pathogens: What You Need to Know—Part II

February 2003

(Goal: To gain ideas and strategies to enhance personal and professional growth in occupational health nursing.)

Mark one answer only!
(You may submit a photocopy of the answer sheet for processing.)

1.	A	B	C	D		**6.**	A	B	C	D
2.	A	B	C	D		**7.**	A	B	C	D
3.	A	B	C	D		**8.**	A	B	C	D
4.	A	B	C	D		**9.**	A	B	C	D
5.	A	B	C	D		**10.**	A	B	C	D

EVALUATION (must be completed to obtain credit)

Please use the scale below to evaluate this continuing education module.

	4 - To a great extent	3 - To some extent	2 - To little extent	1 - To no extent
1. As a result of completing this module, I am able to:				
A. Define the bloodborne pathogens of greatest concern to health care workers.	4	3	2	1
B. Identify the epidemiology, transmission, and testing for hepatitis B, hepatitis C, and human immunodeficiency virus (HIV).	4	3	2	1
C. Describe the prevention, prophylaxis, and treatment for hepatitis B, hepatitis C, and HIV.	4	3	2	1
2. The objectives were relevant to the overall goal of this independent study module.	4	3	2	1
3. The teaching/learning resources were effective for the content.	4	3	2	1
4. How much time (in minutes) was required to read this module and take the test?	50	60	70	80

Please print or type: (this information will be used to prepare your certificate of completion for the module).
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