

HEPATITIS B VIRUS (HBV) & HEPATITIS C VIRUS (HCV)

PATHOGEN SAFETY DATA SHEETS - INFECTIOUS SUBSTANCES

INFECTIOUS AGENT

NAME: Hepatitis B virus (HBV).

SYNONYM OR CROSS REFERENCE: HBV, hepatitis B, HBV infection, type B hepatitis, serum hepatitis, homologous serum jaundice, Australia antigen hepatitis, and HB.

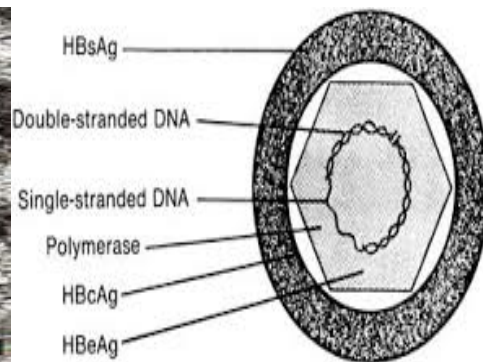
CHARACTERISTICS: HBV is a member of the *Hepadnaviridae* family, has a circular DNA genome that is partially double stranded and partly single stranded. HBV is comprised of a number of clinically important viral proteins, including the envelope protein, hepatitis B surface antigen (HBsAg), hepatitis B core antigen (HBcAg), and a soluble nucleocapsid protein, the hepatitis B e antigen (HBeAg).

Eight genotypes of HBV have been identified (A to H), that show differential geographical distributions and clinical outcomes. For example, genotypes B and C are prevalent in Asia, while A and D are more common in Europe, the Middle East, and India, and A and C are the most common in North America.



TEM micrograph of Hepatitis B virus¹⁾

(TEM = Transmission Electron Microscopy)



Diagrammatic structure of the hepatitis B virus²⁾

HAZARD IDENTIFICATION

PATHOGENICITY / TOXICITY: *Acute hepatitis B infection:* Persons with acute hepatitis B infection may be asymptomatic or present with a clinical picture varying from mild to severe hepatitis. Persons with symptomatic acute HBV infections can show signs and symptoms that include nausea, abdominal pain, vomiting, fever, jaundice, dark urine, changes in stool color, and hepatomegaly (enlargement of liver) or splenomegaly (enlargement of spleen) as well as signs of liver dysfunction. The outcome of acute HBV infection is usually good with complete recovery from any liver damage and seroconversion to anti-HBs, which represents a long-term protection from HBV infection.

Chronic hepatitis B infection: Defined as the persistence of HBsAg for more than 6 months. Persons with chronic HBV infection may be asymptomatic or may suffer from symptoms such as fatigue, anorexia, nausea, abdominal discomfort and liver dysfunction. They are at substantially increased risk for developing chronic liver diseases, including cirrhosis of the liver and primary hepatocellular carcinoma.

EPIDEMIOLOGY: HBV infection is a worldwide health problem. Two billion people worldwide have been infected with HBV, 360 million have chronic HBV infection and 600,000 die each year from HBV-related liver diseases or hepatocellular carcinoma. HBV infection is most prevalent in Asia, Africa, Southern Europe and Latin America where the prevalence of HBsAg carriers in the general population ranges from 2-20 %. In these areas, HBV infection mainly occurs in childhood and early infancy. North America, Northern Europe, and the Oceanic region are low prevalence areas, where HBV infection typically occurs in adolescence and early adulthood.

HOST RANGE: Humans are the only known natural host. Chimpanzees are susceptible as an experimental animal.

INFECTIOUS DOSE: Unknown

MODE OF TRANSMISSION: HBV is transmitted by percutaneous or mucosal exposure to infected blood or other body fluid. HBV transmission has been observed with numerous forms of human contact such as perinatal/mother to child, household (non sexual), sexual, needle sharing, and occupational/health-care-related.

INCUBATION PERIOD: Usually 24-180 days (average 60-90 days). The variation depends on the amount of virus in the inoculum, mode of transmission, and other host factors.

COMMUNICABILITY: All persons who are HBsAg positive are potentially infectious, and blood can be infectious for several weeks before the onset of clinical symptoms.

DISSEMINATION

RESERVOIR: Humans

ZOONOSIS: None

VECTORS: None

STABILITY AND VIABILITY

DRUG SUSCEPTIBILITY: Sensitive to antivirals such as interferon- α , pegylated interferon α -2a, lamivudine, adefovir, entecavir, telbivudine, and tenofovir.

SUSCEPTIBILITY TO DISINFECTANTS: Treatment of HBV diluted in phosphate buffered saline with 1% non-ionic detergent (Triton X-100) plus 0.3% tri-n-butyl-phosphate leads to HBV inactivation. HBV is also inactivated by formaldehyde, glutaraldehyde, sodium hypochlorite (5,000 ppm available chlorine), quaternary ammonium compounds, and alcohols (70-80%).

PHYSICAL INACTIVATION: Moist heat at 98°C for 1 minute will partially inactivate HBV in a 1:10 serum dilution. Incubation at 60°C for 10 hours (pasteurization) will also inactivate HBV.

SURVIVAL OUTSIDE HOST: HBV can survive and remain infectious on environmental surfaces for at least 7 days.

FIRST AID / MEDICAL

SURVEILLANCE: Monitor for symptoms. Demonstration in sera of specific HB antigens and/or antibodies (HBsAg, anti-HBs, HBeAg, anti-HBe, and anti-HBc) using enzyme immunoassay techniques (e.g. ELISA = enzyme-linked immunosorbent assay) confirm diagnosis. Other tests include radioimmunoassay, polymerase chain reaction (PCR), real-time PCR, and non-PCR based deoxyribonucleic acid (DNA) assays.

FIRST AID/TREATMENT: Following exposure to HBV the affected area should be washed immediately with soap and water. Mucous membranes and conjunctivae should be irrigated thoroughly with water. If the material involved is known to contain HBV or be positive for HBsAg then hepatitis B immunoglobulin (HBIG) should be given, ideally within 48 hours of exposure.

Seven drugs are licensed in the United States for treatment of HBV infection: interferon- α , pegylated interferon α -2a, lamivudine, adefovir, entecavir, telbivudine, and tenofovi.

IMMUNISATION: Two types of HB vaccine have been licensed and shown to be highly effective against all subtypes of HBV. The first, prepared from plasma from HBsAg-positive persons, is still widely used. The second is synthesized using recombinant DNA. Vaccination against HBV should now be the norm in laboratory personnel.

PROPHYLAXIS: Previously unimmunized adults exposed to HBsAg positive blood should receive HBIG as soon as possible as well as immunization with HB vaccine unless natural immunity can be confirmed.

LABORATORY HAZARDS

LABORATORY-ACQUIRED INFECTIONS: The rates of HBV infection have been reported to be several times greater in laboratory staff than the general population and is one of the most frequently reported laboratory acquired infection.

SOURCES/SPECIMENS: Blood, cerebrospinal fluid, saliva, semen, synovial fluid, breast milk, bile, feces, nasopharyngeal washings, sweat, peritoneal, pleural, pericardial, amniotic, and unfixed tissues and organs.

PRIMARY HAZARDS: Percutaneous (e.g. needle stick) or mucous membrane exposures to blood that might contain HBsAg.

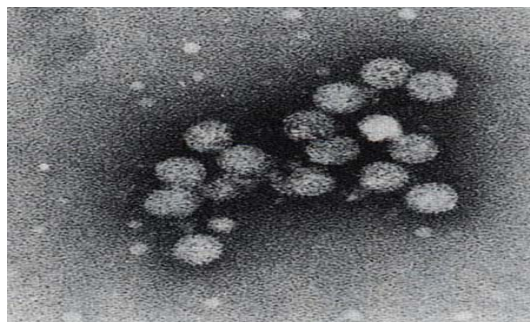
SPECIAL HAZARDS: There is a potential for infection via aerosols and HBV contaminated surfaces.

INFECTIOUS AGENT

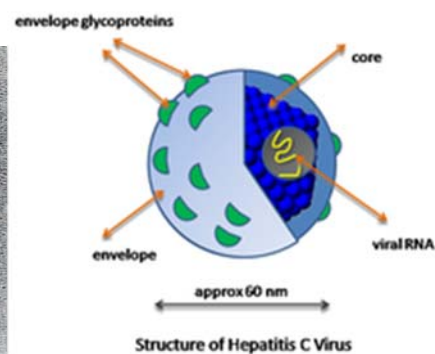
NAME: Hepatitis C virus (HCV).

SYNONYM OR CROSS REFERENCE: HCV, non-A non-B hepatitis, parenterally transmitted non-A non-B hepatitis, non-B transfusion-associated hepatitis, post-transfusion non-A non-B hepatitis, and HCV infection.

CHARACTERISTICS: HCV belongs to the *Flaviviridae* family and *Hepacavirus* genus, and is a small (50nm), single-stranded, enveloped RNA virus. HCV was originally characterized in 1989, and has 6 major genotypes and over 100 subtypes. The main genotypes of HCV in North America are types 1, 2, and 3.



Hepatitis C virus³⁾



Diagrammatic structure of the hepatitis C virus⁴⁾

HAZARD IDENTIFICATION

PATHOGENICITY / TOXICITY: *Acute HCV infection:* Asymptomatic in most patients (60-75%). The syndrome of acute hepatitis is often preceded or accompanied by symptoms of fatigue, myalgia, low-grade fever, right upper quadrant pain, nausea, vomiting, jaundice, mild hepatosplenomegaly (enlargement of liver and spleen), maculopapular rash (rash characterized by a flat, red area on the skin that is covered with small confluent bumps), and arthralgia (pain in a joint). These symptoms may last for 2 to 12 weeks.

Chronic HCV infection: While a minority of those infected will spontaneously clear an acute infection with HCV, in most cases (50-85%), the infection will become chronic. Some patients with chronic HCV infection experience: malaise, nausea, abdominal pain and pruritus (severe itching of the skin). Fluctuating alanine transferase levels are characteristic. The late sequelae of chronic HCV infection include serious health consequences such as chronic hepatitis, cirrhosis, and hepatocellular carcinoma. If cirrhosis develops, patients may experience jaundice, splenomegaly, ascites (accumulation of fluid in the peritoneal cavity causing abdominal swelling), oesophageal varices (extremely dilated sub-mucosal veins in the third of the esophagus), and hepatic encephalopathy (a spectrum of neuropsychiatric abnormalities in patients with liver dysfunction). Extrahepatic manifestations are uncommon but may include mixed essential cryoglobulinaemia, membranous or membranoproliferative glomerulonephritis, non-Hodgkin's lymphoma, Sjorgren's syndrome, lichen planus, and porphyria cutanea tarda.

EPIDEMIOLOGY: HCV infection is seen worldwide, with the World Health Organization (WHO) estimating a prevalence of 2.2% to 3%, or approximately 170 million people. The WHO African region and WHO Eastern Mediterranean region have the highest prevalence of HCV infection.

HOST RANGE: Humans. Chimpanzees have been used as experimental hosts.

INFECTIOUS DOSE: Unknown

MODE OF TRANSMISSION: In North America HCV is mainly transmitted parenterally by infected needles, particularly those used by intravenous drug users. Other parenteral routes exist such as blood transfusion, organ transplantation, contaminated medical equipment, and from tattoo and body piercing equipment. However, for the last decade or so the risk of HCV infection through blood transfusion in Canada, and North America as well, is negligible. Less common routes of HCV transmission are via sexual contact, from sharing razors and/or toothbrushes, and from mother to child during pregnancy and childbirth.

INCUBATION PERIOD: Ranges from 2 to 12 weeks.

COMMUNICABILITY: Can be transmitted from person-to-person. Transmission rate between mother and developing child is influenced by maternal levels of viraemia (greater than 10^6 copies per ml blood), and also co-infection of the mother with HIV.

DISSEMINATION

RESERVOIR: Humans

ZOONOSIS: None

VECTORS: None

STABILITY AND VIABILITY

DRUG SUSCEPTIBILITY: Sensitive to interferon- α (IFN), pegylated interferon, and ribavirin. New antiviral treatments that work by targeting hepatitis C protease and polymerase are currently in clinical trials.

DRUG RESISTANCE: Resistance has been observed to be emerging against IFN and the current methods of therapy, and the outcome of treatment is highly dependent on viral genotype.

SUSCEPTIBILITY TO DISINFECTANTS: HCV ribonucleic acid (RNA) is readily degraded by 2% glutaraldehyde when added to biological samples at 37°C, and soaking medical equipment (such as gastroendoscopes) in 3% glutaraldehyde is effective at limiting HCV transmission. Phenolic compounds (0.4 to 3%) are effective at inhibiting HCV binding and infectivity in VERO cell cultures. Furthermore, treatment of HCV diluted in phosphate buffered saline with 1% non-ionic detergent (Triton X-100) plus 0.3% tri-n-butyl-phosphate leads to inactivation.

PHYSICAL INACTIVATION: HCV is inactivated when incubated at 60°C for 10 hours (pasteurization).

SURVIVAL OUTSIDE HOST: HCV is relatively unstable; however, in plasma it can survive drying and environmental exposure to room temperature for at least 16 hours.

FIRST AID / MEDICAL

SURVEILLANCE: Monitor for symptoms. The initial test for HCV infection is an enzyme immunoassay for HCV antibodies. PCR methods are also used to detect HCV RNA. Other tests include the branched DNA assay and transcription mediated amplification.

FIRST AID/TREATMENT: Treatment success rates with antiviral therapy have improved significantly over the last 10 years. Mono-therapy with pegylated interferon (addition of polyethylene glycol to interferon-α) and combined therapy of pegylated interferon with ribavirin, or standard interferon with ribavirin, are common methods of treating HCV infection.

IMMUNIZATION: None; however, several vaccines that prevent initial infection or viral persistence, or that clear viraemia in individuals with chronic HCV infections, are in development.

PROPHYLAXIS: Post exposure prophylaxis with immune globulin or antiviral agents is not recommended.

LABORATORY HAZARDS

LABORATORY-ACQUIRED INFECTIONS: Unknown, although seroprevalence studies have reported antibody to HCV rates of 1% among hospital based (including laboratory workers and healthcare providers) in Western countries.

SOURCES/SPECIMENS: Blood, blood products, and bodily fluids, tissues, or equipment contaminated with HCV infected blood.

PRIMARY HAZARDS: Needle stick injury, or cuts with sharp instruments.

SPECIAL HAZARDS: None

HEPATITIS B VIRUS (HBV) & HEPATITIS C VIRUS (HCV) EXPOSURE CONTROLS / PERSONAL PROTECTION

RISK GROUP CLASSIFICATION: Risk Group 2.

CONTAINMENT REQUIREMENTS: Containment Level 2 facilities, equipment, and operational practices for work involving infectious or potentially infectious material, animals, or cultures.

PROTECTIVE CLOTHING: Lab coat. Gloves when direct skin contact with infected materials or animals is unavoidable. Eye protection must be used where there is a known or potential risk of exposure to splashes.

OTHER PRECAUTIONS: All procedures that may produce aerosols, or involve high concentrations or large volumes should be conducted in a biological safety cabinet (BSC). The use of needles, syringes, and other sharp objects should be strictly limited. Additional precautions should be considered with work involving animals or large scale activities.

HANDLING AND STORAGE

SPILLS: Allow aerosols to settle and, wearing protective clothing, gently cover spill with paper towels and apply an appropriate disinfectant, starting at the perimeter and working towards the centre. Allow sufficient contact time before clean up.

DISPOSAL: Decontaminate all wastes that contain or have come in contact with the infectious organism by autoclave, chemical disinfection, gamma irradiation, or incineration before disposing.

STORAGE: The infectious agent should be stored in leak-proof containers that are appropriately labeled.

REFERENCE

Pathogen Safety Data Sheet (PSDS) for hepatitis B virus and hepatitis C virus has been modified from the ones produced by the Public Health Agency of Canada as educational and informational resources for laboratory personnel working with infectious substances.

- 1) Picture from Wikipedia
- 2) Picture from www.glowm.com
- 3) Picture from www.epidemic.org
- 4) Picture from Wikipedia