Pathogen Safety Data Sheets: Infectious Substances – Human immunodeficiency virus (HIV)

Section I - Infectious Agent

NAME: Human immunodeficiency virus (HIV).

SYNONYM OR CROSS REFERENCE: HIV, acquired immune deficiency syndrome, AIDS. Was previously known as lymphadenopathy-associated virus, human T-lymphotropic virus type III (HTLV-III), immunodeficiency-associated virus, and AIDS-associated retrovirus.

CHARACTERISTICS: HIV is a member of the Retroviridae family, genus Lentivirus. HIV is an icosahedral, enveloped virus, of approximately 100 to 110 nm in diameter, and has a single-stranded, linear, positive-sense RNA genome. HIV has two recognised strains: HIV-1 and HIV-2. Upon entry into the host cell, retroviral RNA is converted to DNA by a virally encoded reverse transcriptase enzyme, the DNA transcript is integrated into the host's chromosomal DNA.

Section II - HAZARD IDENTIFICATION

PATHOGENICITY/TOXICITY: AIDS is characterised by symptoms and infections caused by the breakdown of the immune system (by destruction or functional impairment of CD4 receptors) due to HIV infection. HIV can infect many cell types, mainly lymphocytes, but also macrophages, and microglia in the brain, and other neurological cells, resulting in profound asthenia, dementia and damage to the peripheral nervous system. Due to immunodeficiency, patients succumb to various fungi, parasites, bacteria, and/or viruses and are prone to certain tumours. Globally, Mycobacterium tuberculosis is the most common cause of death of HIV-infected individuals. The clinical features of HIV infection vary depending on the stage of the disease. Acute infection is accompanied by non-specific "flu-like" and "mononucleosis-like" symptoms such as myalgia, arthralgia, diarrhoea, nausea, vomiting, headache, hepatosplenomegaly, weight loss, and neurological symptoms. Early-stage disease refers to the period of clinical latency between the time of the primary infection and the development of symptoms indicative of advanced immunodeficiency. Typically, when the patient's CD4+ T-cell count falls below 500 cells/µL.
syndromes indicative of depressed cell mediated immunity can appear. Examples include oropharyngeal and recurrent vulvovaginal candidiasis, bacillary angiomatosis, recurrent or multidermatomal herpes zoster, listeriosis, infections due to \textit{Rhodococcus equi}, pelvic inflammatory disease, oral hairy leukoplakia associated with Epstein-Barr virus, cervical dysplasia, long lasting diarrhoea, idiopathic thrombocytopenic purpura, and peripheral neuropathy \cite{10, 21}. Late-stage disease refers to the period when the patient's CD4+ T-cell count falls below 200 cells/µL \cite{10, 21}. The loss of the integrity of cell-mediated immune responses allows ubiquitous environmental organisms with limited virulence to become life threatening pathogens \cite{6}. Examples of conditions (as set out by the US Centers for Disease Control and Prevention) include candidiasis of bronchi, trachea, lungs or oesophagus, invasive cervical cancer, coccidioidomycosis, cryptococcosis, cryptosporidiosis, cytomegalovirus disease (other than liver, spleen, or nodes), cytomegalovirus retinitis (with loss of vision), HIV-related encephalopathy, herpes simplex, histoplasmosis, isosporiasis, Kaposi's sarcoma, Burkitt's lymphoma, immunoblastic lymphoma, primary lymphoma of the brain, \textit{Mycobacterium avium} complex, \textit{Mycobacterium tuberculosis}, \textit{Pneumocystis jirovecii} pneumonia, recurrent pneumonia, progressive multifocal leukoencephalopathy, recurrent salmonella septicaemia, toxoplasmosis of the brain, and wasting syndrome due to HIV \cite{21}.

\textbf{EPIDEMIOLOGY:} HIV is a major global problem with approximately 25 million HIV-related deaths and another 40.3 (36 to 45.3) million infected individuals worldwide \cite{17}. AIDS was first described in 1981. The new retrovirus (HIV-1) was found in tissues from AIDS patients in 1983 and the causative relationship between HIV and AIDS was established in 1984 \cite{3, 12}. HIV-2 was discovered in 1986 and is the least pathogenic form of HIV, displaying low rates of transmission and rarely causing AIDS \cite{4}. The majoritiy of people with HIV live in the developing world (approximately 95% of the individuals infected worldwide). Sub-Saharan Africa is by far the worst-affected area in the world \cite{10}. This region has slightly more than 10% of the world's population but is home to more than 60% of the total population living with HIV/AIDS \cite{10}.

Globally, infants who acquire the disease from their mothers constitute about 11% of all HIV infections \cite{10}. Ten percent of infections worldwide are associated with injection drug use; 5 to 10% are transmitted by sex between men; and 5 to 10% occur in health care settings \cite{10}. The predominant means of infection is sex between men and women, which accounts for nearly two thirds of new infections, and 85% of existing infections worldwide \cite{10, 17}. About 50% of all new HIV infections worldwide occur in individuals younger than 25 years old \cite{10}.

\textbf{HOST RANGE:} Humans \cite{3, 6, 8, 10, 13, 15, 17, 20, 23}.

\textbf{INFECTION DOSE:} Unknown.

\textbf{MODES OF TRANSMISSION:} HIV is transmitted either by exposure of the virus to oral, rectal, or vaginal mucosa during sexual activity; by intravascular inoculation through transfusion of contaminated blood products; by using contaminated equipment during injection drug use; or from mother to infant during pregnancy, delivery or breastfeeding \cite{6, 16}. There are no obvious differences in disease manifestations in individuals infected by mucosal versus blood-borne routes \cite{6}. Sexual transmission accounts for more than 90% of HIV infections worldwide \cite{6, 16}.
**INCUBATION PERIOD:** Variable. Commonly the time from infection to the development of detectable antibodies is generally 1 to 3 months; however, the time from HIV infection to diagnosis of AIDS had an observed range of less than 1 year to 15 years or longer [11].

**COMMUNICABILITY:** The highest levels of per-act risk for HIV transmission from person-to-person are: blood transfusion from an infected donor, needle sharing by infected injection-drug users, receptive anal intercourse, and percutaneous needle injuries [6], [11], [12], [20]. Insertive anal intercourse, penile-vaginal exposures, and oral sex represent substantially less per-act risk [6], [11], [20]. HIV can also be passed from mother to child *in utero* (vertical) as well as during childbirth, and from breast milk [6], [11]. HIV has also been documented to have been transmitted by bite injuries [22]. The period of communicability begins early after HIV infection and is thought to last throughout the life of the infected individual [11]. Infectiousness is related to viral load.

**Section III - DISSEMINATION**

**RESERVOIR:** Humans [6], [8], [10-12], [16], [17], [22].

**ZOOONOSIS:** None, although current evidence suggests that HIV-1 and HIV-2 entered into the human population through multiple zoonotic infections from simian immunodeficiency virus-infected non-human primates [17].

**VECTORS:** No laboratory or epidemiological evidence suggests that biting insects have transmitted HIV infection [11], [16].

**Section IV – STABILITY AND VIABILITY**

**DRUG SUSCEPTIBILITY:** Antiretroviral agents from 5 drug classes are currently available to treat HIV infection, namely: the nucleoside reverse transcriptase inhibitors (NRTIs), nucleotide reverse transcriptase inhibitors (NtRTIs), non-nucleoside reverse transcriptase inhibitors (NNRTIs), proteinase inhibitors (PIs), and fusion inhibitors [10], [15].

**SUSCEPTIBILITY TO DISINFECTANTS:** HIV is susceptible to fresh 2% glutaraldehyde, 2% Jodopax (detergent and iodine), hypochlorite, iodine, phenolics, and to a lesser extent 70% ethanol, NaOH and isopropanol [7], [9], [18].

**PHYSICAL INACTIVATION:** HIV is inactivated by ultraviolet (UV) light; however, the level of the inactivation is heavily influenced by the proximity of the UV source to the sample and the concentration of protein in the sample environment. HIV is easily inactivated in a cell free medium; however, in cell associated samples and blood samples complete inactivation requires much longer exposures to the UV source [7]. HIV is also inactivated at pH higher or lower than the optimal level of 7.1 [18]. A temperature of 60°C for 30 minutes will likely inactivate HIV; however, higher temperatures and incubations may be required depending on the initial titre of the virus [18].

**SURVIVAL OUTSIDE HOST:** HIV can remain viable in blood in syringes at room temperature for 42 days, and in blood and cerebrospinal fluid from autopsies for up to 11 days [1], [2]. Although drying...
in the environment is known to cause a rapid reduction in HIV concentration, under experimental conditions, Cell-free HIV dried onto a glass coverslip in 10% serum can survive for longer than 7 days, depending on the initial titre.

Section V - FIRST AID / MEDICAL

SURVEILLANCE: HIV is diagnosed by tests that assess whether an individual's immune system has produced an HIV-specific immune response. Common tests include the indirect binding assay, antibody capture assay, the double antigen sandwich, ELISA, immunofluorescence, Western blotting, line immunoassays, and PCR, as well as viral isolation.

FIRST AID/TREATMENT: AIDS must be managed as a chronic disease. Antiretroviral treatment is complex, involving a combination of drugs and resistance will appear rapidly if only a single drug is used. The 5 available classes of antiretroviral drugs, NRTIs, NtRTIs, NNRTIs, PIs and fusion inhibitors, can be combined to provide highly active antiretroviral therapy (HAART). For many (but not all) patients, HAART converts an inexorably fatal disease into a chronic disease with a fairly good prognosis.

IMMUNIZATION: None.

PROPHYLAXIS: HIV postexposure prophylaxis regimens are based on the nature of the exposure. The majority of HIV exposures will warrant a two drug regimen, using 2 NRTIs or 1 NRTI and 1 NtRTI. Combinations include: zidovudine (ZDV) and lamivudine (3CT) or emtricitabine (FTC); stavudine (d4T) and 3TC or FTC; and tenofovir (TDF) and 3TC or FTC.

The addition of a third or fourth drug should be considered for exposures that pose an increased risk of transmission. The preferred drugs in this case are proteinase inhibitors such as lopinavir/ritonavir (LPV/RTV).

Section VI - LABORATORY HAZARD

LABORATORY-ACQUIRED INFECTIONS: Although there have been many reported cases of HIV infection through occupational transmission, the numbers of laboratory acquired infections are low. As of 2001, there have been a total of 57 cases of documented occupationally acquired HIV among U.S. health care workers.

SOURCES/SPECIMENS: Blood, semen, vaginal secretions, cerebrospinal fluid, synovial fluid, peritoneal fluid, pleural fluid, pericardial fluid, amniotic fluid, other specimens containing visible blood, breast milk, unscreened or inadequately treated blood products, and infected human tissues.

Faeces, nasal secretions, sputum, sweat, vomitus, saliva, tears, and urine, are not considered potentially infectious unless they are visibly bloody.

PRIMARY HAZARDS: Needlestick, contaminated sharp objects, and/or direct contact of non-intact skin or mucous membranes with HIV-infected specimens/tissues.
SPECIAL HAZARDS: Extreme care must be taken to avoid spilling and/or splashing infected materials. HIV should be presumed to be in/on all equipment and devices coming in direct contact with infected materials.

Section VII - EXPOSURE CONTROLS / PERSONAL PROTECTION

RISK GROUP CLASSIFICATION: Risk Group 3.

CONTAINMENT REQUIREMENTS: Please refer to the Biosafety Directive for Human Immunodeficiency Virus (HIV) and Human T-cell Lymphotropic Virus Type 1 (HTLV-1).

PROTECTIVE CLOTHING: Solid-front gowns with tight-fitting wrists, gloves, and respiratory protection should be worn over laboratory clothing when infectious materials are directly handled.

OTHER PRECAUTIONS: All activities with infectious material should be conducted in a biological safety cabinet (BSC) or other appropriate primary containment device in combination with personal protective equipment. Centrifugation of infected materials must be carried out in closed containers placed in sealed safety cups, or in rotors that are unloaded in a biological safety cabinet. The use of needles, syringes, and other sharp objects should be strictly limited. Open wounds, cuts, scratches, and grazes should be covered with waterproof dressings. Additional precautions should be considered with work involving animals or large scale activities.

Section VIII - HANDLING AND STORAGE

SPILLS: Allow aerosols to settle and, while wearing protective clothing, gently cover the spill with paper towels and apply 1% sodium hypochlorite starting at the perimeter, working inwards towards the centre. Allow sufficient contact time before clean up.

DISPOSAL: Decontaminate all materials for disposal by steam sterilisation, chemical disinfection, and/or incineration.

STORAGE: Infectious material should be stored in sealed, leak-proof containers that are appropriately labelled.

Section IX - REGULATORY AND OTHER INFORMATION

REGULATORY INFORMATION: The import, transport, and use of pathogens in Canada is regulated under many regulatory bodies, including the Public Health Agency of Canada, Health Canada, Canadian Food Inspection Agency, Environment Canada, and Transport Canada. Users are responsible for ensuring they are compliant with all relevant acts, regulations, guidelines, and standards.

UPDATED: September 2016.

PREPARED BY: Centre for Biosecurity, Public Health Agency of Canada.
Although the information, opinions and recommendations contained in this Material Safety Data Sheet are compiled from sources believed to be reliable, we accept no responsibility for the accuracy, sufficiency, or reliability or for any loss or injury resulting from the use of the information. Newly discovered hazards are frequent and this information may not be completely up to date.

Copyright ©
Public Health Agency of Canada, 2016
Canada

REFERENCES:


Winterlude is 40 and fabulous!
Get ready to party and enjoy a few blasts from the past!

**The RCMP is hiring**

A uniform with your name on it is waiting for you.

**Explore new heights**

Check out the 100+ jobs in the Canadian Armed Forces.