

# HUMAN IMMUNODEFICIENCY VIRUS

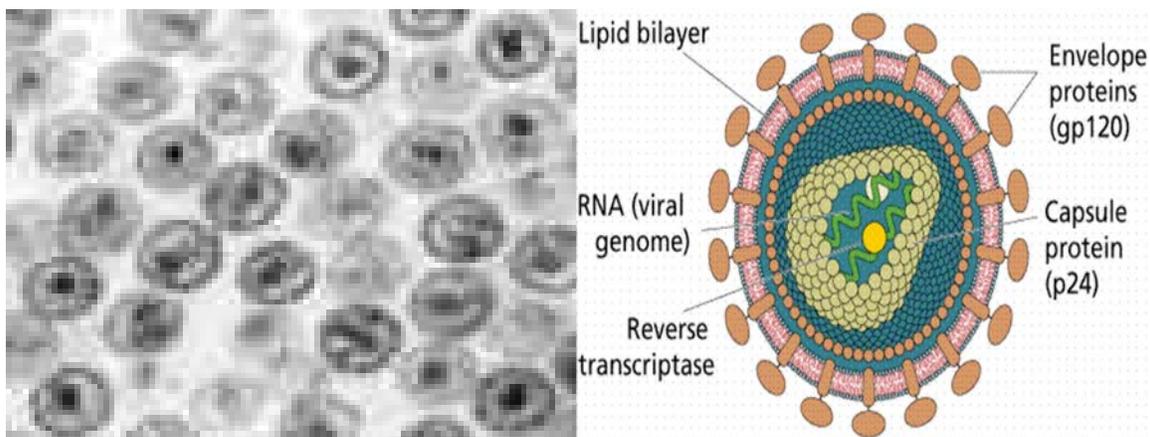
## PATHOGEN SAFETY DATA SHEET - INFECTIOUS SUBSTANCES

### 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 recognized 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.



Electron micrograph of HIV<sup>1)</sup>

Diagrammatic structure of HIV<sup>2)</sup>

### HAZARD IDENTIFICATION

**PATHOGENICITY/TOXICITY:** AIDS is characterized by symptoms and infections caused by the breakdown of the immune system 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 tumors. 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, diarrhea, 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.

**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. 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. HIV-2 was discovered in 1986 and is the least pathogenic form of HIV, displaying low rates of transmission and rarely causing AIDS. The majority 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. 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.

Globally, infants who acquire the disease from their mothers constitute about 11% of all HIV infections. 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. 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. About 50% of all new HIV infections worldwide occur in individuals younger than 25 years old.

**HOST RANGE:** Humans

**INFECTIOUS DOSE:** Unknown

**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. There are no obvious differences in disease manifestations in individuals infected by mucosal versus blood-borne routes. Sexual transmission accounts for more than 90% of HIV infections worldwide.

**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.

**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. Insertive anal intercourse, penile-vaginal exposures, and oral sex represent substantially less per-act risk. HIV can also be passed from mother to child *in utero* (vertical) as well as during

childbirth, and from breast milk. HIV has also been documented to have been transmitted by bite injuries. The period of communicability begins early after HIV infection and is thought to last throughout the life of the infected individual. Infectiousness is related to viral load.

## **DISSEMINATION**

**RESERVOIR:** Humans

**ZOOZOSIS:** 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.

**VECTORS:** No laboratory or epidemiological evidence suggests that biting insects have transmitted HIV infection.

## **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.

**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.

**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. HIV is also inactivated at pH higher or lower than the optimal level of 7.1. A temperature of 60°C for 30 minutes will likely inactivate HIV; however, higher temperatures and incubations may be required depending on the initial titer of the virus.

**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. 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 titer.

## **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 post exposure 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).

## 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. During 1985–2013, 58 confirmed and 150 possible cases of occupationally acquired HIV infection among HCWs were reported to CDC.

**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.

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

**PRIMARY HAZARDS:** Needle stick, 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.

## EXPOSURE CONTROLS / PERSONAL PROTECTION

**RISK GROUP CLASSIFICATION:** Risk Group 3.

**CONTAINMENT REQUIREMENTS:** Containment Level 2 facilities and equipment for work involving clinical specimens and non-culture procedures. Containment Level 3 facilities, equipment, and operational practices for all work culturing HIV and for activities involving non-human primates and any animals experimentally infected or inoculated with HIV.

**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.

## **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 sterilization, chemical disinfection, and/or incineration.

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

## **REFERENCE**

Pathogen Safety Data Sheet (PSDS) for human immunodeficiency 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 [pathmicro.med.sc.edu](http://pathmicro.med.sc.edu)
- 2) Picture from [www2.estrellamountain.edu](http://www2.estrellamountain.edu)