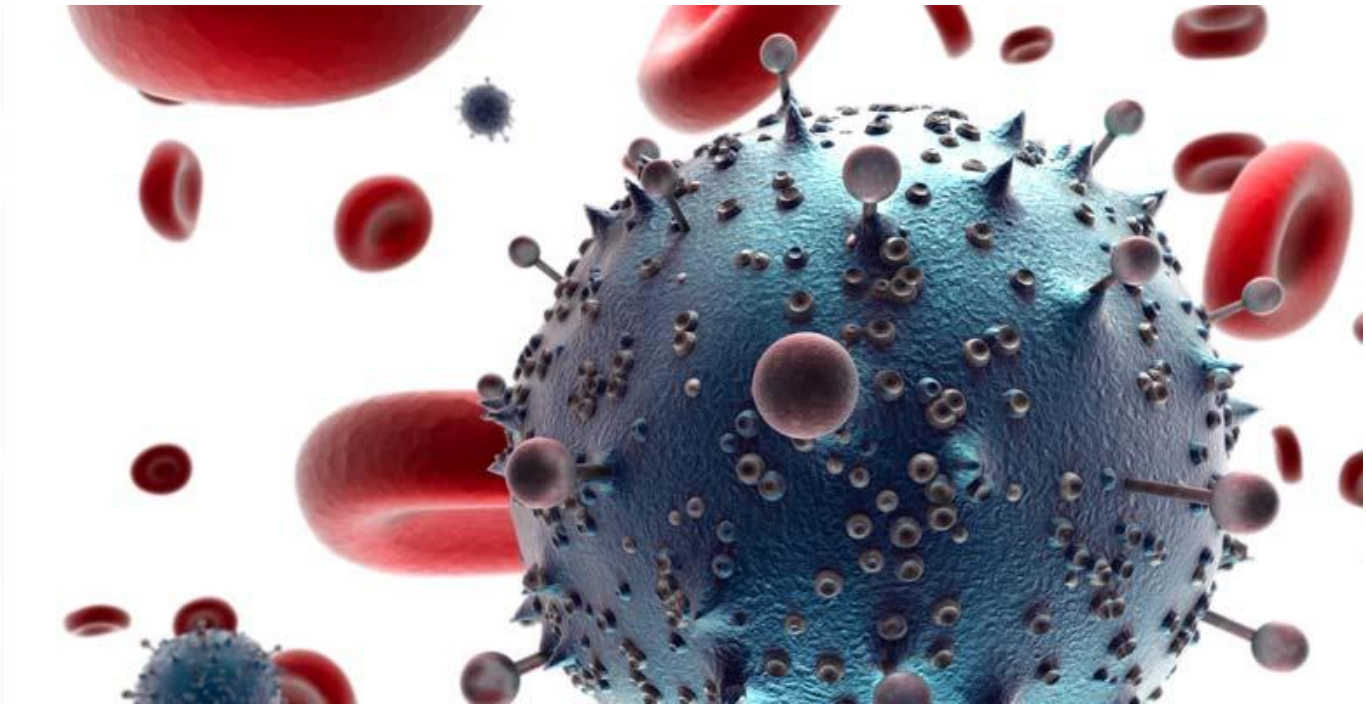
The science of HIV and AIDS - overview



KEY POINTS

- HIV stands for Human Immunodeficiency Virus and is different to AIDS, which is the advanced stage of HIV infection.
- The HIV virus can be spread through infected blood, breast milk, semen, and anal or vaginal fluids contaminating the blood stream.
- The HIV virus attacks the immune system by using the body's defence cells to replicate, while simultaneously destroying the same cells that protect the body from illness.
- If HIV is not treated with antiretroviral treatment - which works by preventing the virus from replicating - then the body is exposed to opportunistic infections which can cause serious illnesses.

Explore this page to find out more about how HIV is transmitted, how HIV replicates inside the body, how HIV causes illness and treatment for HIV.

HIV stands for: Human Immunodeficiency Virus.

AIDS stands for: Acquired Immune Deficiency Syndrome.

The ill health that HIV can cause is related to immune deficiency. The virus attacks and weakens the immune system, which is the body's natural defence system against infections and diseases.

While many millions of people are living with HIV, most of them will never progress to the most advanced stage of infection, known as AIDS, thanks to antiretroviral treatment.

How HIV is transmitted

HIV is found in the blood and sexual fluids of a person living with HIV and in the breast milk of a woman living with HIV. Transmission may occur if a sufficient quantity of these body fluids get into someone else's bloodstream.

The most common way in which HIV is transmitted is during sexual intercourse without a condom or a female condom.

The walls of the vagina and the rectum are mucous membranes, as are the inner lining of the foreskin and the urethra of the penis. Mucous membranes are delicate tissues which provide a less effective barrier to infection than the skin on the outside of the body.

Any tears or bleeding in these tissues (which may be invisible) make it easier for HIV to get into the bloodstream. The presence of HIV in semen or vaginal fluids means the virus may pass through these mucous membranes during unprotected sex.

Sexually transmitted infections (STIs) such as herpes or gonorrhoea can cause ulcerative sores on mucous membranes, also making infection more likely.1

Other ways in which HIV is transmitted include:

- from a woman living with HIV to her baby, during pregnancy, childbirth or breastfeeding
- through sharing equipment used to inject drugs, such as needles and syringes
- from blood transfusions and organ transplants, when they have not been carefully screened for HIV
- healthcare workers accidentally injuring themselves with previously used syringes and other medical instruments.

HIV is found in the semen, blood, vaginal and anal fluids and breast milk of an infected person. It cannot be transmitted through sweat, saliva or urine.

How HIV replicates inside the body

Once a person is infected with HIV, the virus begins to attack and destroy the CD4 cells of the immune system. CD4 cells (also known as T-helper cells) are a type of white blood cell that play a major, co-ordinating role in the immune system.

The reason HIV can cause such serious illness is that the cells the virus uses to replicate itself are the same cells that the body normally uses to fight infections.

Scientists' understanding of how HIV uses CD4 cells to replicate (make copies of itself) and spread throughout the body have helped them design antiretroviral drugs. Different medicines block HIV from replicating.

Case study: Two examples of medicine interfering with different stages of HIV's life cycle

Inside the CD4 cell, HIV uses reverse transcriptase (an enzyme) to convert its RNA into DNA. Drugs known as nucleoside reverse transcriptase inhibitors (NRTIs) block this process.

HIV uses an enzyme called protease to break up the long chains of protein that form the virus. Another class of drugs, called protease inhibitors (PIs), prevent this happening.

Other classes of antiretroviral drugs - such as entry inhibitors and integrase inhibitors - interfere with different stages of the life cycle.2

HIV-infected cells may be found throughout the body, including in the blood, brain and intestines. Even when HIV treatment has suppressed the level of HIV in blood plasma over a long period of time, HIV can still be found in 'viral reservoirs' in blood and lymphoid tissues. If HIV treatment is stopped, HIV will replicate again.3

How HIV causes illness

Strictly speaking, HIV does not have its own symptoms. The virus prevents the body's immune system from working properly, which increases the probability of the individual experiencing a range of other infections and health problems. These are known as 'opportunistic infections'.

If HIV is not treated, the range and number of possible infections and health problems may rise. Experiencing a collection of these infections is the most advanced stage of HIV, which is when a person is also said to have AIDS.

Case study: Opportunistic infections

MK fell ill and spent two weeks in hospital after having unprotected sex on a first date. He took two months off of work, but colleagues noticed he was losing weight when he returned. He began to frequently suffer from long-term coughs and colds, night sweats, swollen lymph nodes and fevers.

Although these are not specifically symptoms of HIV, MK's doctor advised him to have counselling and take an HIV test - the only way to know. Following his positive test results, he also suffered mitral valve prolapse and pneumonia. But his condition improved once he began receiving treatment. Read more of MK's story.

However, it's important to stress that people with HIV do not necessarily progress to AIDS. Effective antiretroviral treatment slows the replication of the virus, restores immune function and prevents the development of opportunistic infections. People who begin antiretroviral treatment late frequently respond well to treatment.

The timing and occurrence of opportunistic infections, the response of the immune system, and the response to treatment vary from person to person.

Treatment for HIV

A combination of three or four antiretroviral drugs is taken to treat HIV. As each antiretroviral drug class targets a different step in the life cycle of HIV, combining drugs from at least two different drug classes provides a more effective way to prevent replication of the virus than a single drug.

The aim of antiretroviral treatment is to have an ‘undetectable’ viral load – this means there is only a tiny amount of HIV in the body. This prevents damage to the immune system and consequent illness. The low levels of HIV also significantly reduce the chances of onward HIV transmission.4

Unfortunately the drugs are not a cure – they cannot totally eradicate HIV from the body.

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- 1. Aidsmap ‘Route and susceptibility: mucous membranes and target cells’ [accessed June 2015]
- 2. AIDSInfo (2015) ‘The HIV Life Cycle’
- 3. Chun, TW & Fauci, AS, (2012) ‘HIV reservoirs: pathogenesis and obstacles to viral eradication and cure’, AIDS, Vol 26, issue 10, 1261–1268
- 4. Aidsmap (2014) ‘Viral Load’

Last full review: 01 May 2015

Last updated: 27 July 2017

Next full review: 01 May 2018