

# Factsheet HIV lifecycle

## Key points

- The immune system is the body's natural defence system.
- To survive, HIV needs to infect cells in which new viruses can be made.
- Different anti-HIV drugs target different steps in the process of HIV infecting cells.



The human immune system protects the body. It is made of many different cells that are spread throughout the body, each playing different roles and moving around the body as needed.

## Blood cells

There are two major types of cells in the blood. The most common are red blood cells or erythrocytes, which carry oxygen to the body tissues, and carry away carbon dioxide. The other group are white blood cells, or leukocytes. These are the immune cells.

**It is estimated that about 10.3 billion new HIV virions are produced every day in people who are not on HIV treatment.**

Some white blood cells recognise specific foreign organisms to which the body has been exposed in the past. These specific immune cells are called lymphocytes. Other white blood cells are non-specific and can attack a range of different foreign organisms: these include neutrophils, eosinophils and natural killer cells.

## Lymphocytes

There are two different types of lymphocytes. B-lymphocytes (sometimes just called B-cells) produce antibodies. An antibody is a protein that can lock onto a distinctive part of a specific foreign organism. When this happens, the antibody signals to other immune cells to attack the organism.

T-lymphocytes (sometimes just called T-cells) are called different names depending on the molecules on their surface. CD4 cells (also known as CD4 T-lymphocytes, or T-helper cells) play a co-ordinating role in the immune system. They help B-lymphocytes identify

foreign organisms (which they produce antibodies against). They also secrete substances that enable CD8 cells to reproduce. CD4 cells also activate macrophages (see below) to kill certain organisms, including many causes of AIDS-related illness. When CD4 cells are destroyed by HIV, all these parts of the immune system are disrupted. CD8 cells (also known as CD8 T-lymphocytes or cytotoxic T-cells) attach themselves to abnormal body cells, notably cells that have been infected by viruses, and kill them.

## Other immune cells

Natural killer cells (or NK cells) attack tumour cells and virus-infected cells in a similar way to lymphocytes. But while each lymphocyte can only recognise and attack cells infected by one specific virus, natural killer cells can attack a wider range.

Eosinophils attack organisms that are too big to be eaten by a single phagocyte, like worms.

The phagocytes are cells that attack and destroy foreign cells by engulfing them. There are two main types of phagocytes:

- Macrophages roam the blood and the body tissues, killing organisms that can cause AIDS-related illness and cells infected by viruses.
- Neutrophils leave the blood to go to tissues where infection or inflammation is developing. They mainly attack bacteria and fungi.

## Viruses

HIV is a virus. Viruses are microscopic germs that are unable to reproduce (replicate) by themselves. Instead they need to find and infect a cell that will act as a host in which new viruses can be made.

When HIV is outside a cell it is known as a virion and is surrounded by a protective envelope. The envelope surrounds a number of viral proteins and some genetic material – a 'blueprint' containing all the information necessary to make new viruses.

Viruses can be divided into two forms: those whose genetic material is made of DNA, and those whose genetic material consists of RNA (such as HIV). RNA viruses are called retroviruses. HIV is a retrovirus and the reproductive process of HIV and other retroviruses involves an additional step that is not needed by DNA viruses.

## Fusion

Viruses often have a specific cell in the host human, animal or plant that they particularly like to infect. The main cells that HIV infects are those carrying a molecule called CD4 on their surface. CD4 is found on immune cells, most particularly on T-helper cells and on macrophages.

HIV gets inside these cells by binding to the CD4 receptor using a molecule on the surface of the virus called gp120. Once HIV has bound to CD4, it activates other proteins on the surface of the human cell known as CCR5 and CXCR4 in order to complete its fusion with the cell.

## Reverse transcription

Once fusion has occurred, the inside of the virus (the RNA and some important enzymes) is absorbed into the human cell. A viral enzyme called reverse transcriptase performs the process required to translate HIV's genetic material (RNA) into DNA.

## Integration

The newly formed viral DNA is then integrated with the DNA of the human host cell using a viral enzyme called integrase. This allows HIV to reprogramme the human cell to make more HIV.

## Transcription

In this stage, the two strands of DNA divide and form a new strand of viral RNA, sometimes called messenger RNA.

## Translation

Next the protein building blocks, which will go on to form the new HIV particle, are assembled within the human cell. These blocks are laid out in turn through the translation of the information contained in the messenger RNA.

## Viral assembly

The protein building blocks are then cut into smaller pieces by a viral enzyme called protease. These pieces form the structure of the new HIV particle, including each of the enzymes and proteins needed to repeat the reproductive process. Once this assembly has occurred, the new viral particle buds off the human cell, floats off into the bloodstream and is able to infect other cells. It is estimated that about 10.3 billion new HIV virions are produced every day in people who are not on HIV treatment.

## HIV treatment

Different types of anti-HIV drugs target these different steps.

The *How treatment works* leaflet in our illustrated series, *The basics*, looks at HIV treatment in relation to the HIV lifecycle. You can find all the leaflets in the series at [www.aidsmap.com/thebasics](http://www.aidsmap.com/thebasics)

To find out more about HIV treatment, you may find some of our information booklets

useful, including *Anti-HIV drugs* and *Taking your HIV treatment*. You can find all the leaflets in the series at [www.aidsmap.com/booklets](http://www.aidsmap.com/booklets)

## Find out more

**How treatment works** Basic leaflet with pictures

**Taking your HIV treatment** Information booklet

**CD4 cell counts** Simple factsheet