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Shoba's story

Shoba is a fifteen-year-old student in Pakistan. She has just taken a biology class. She already knew that she could prevent illness by washing her hands after going to the bathroom and before she cooks or eats. But in class, she learned about how the body defends itself against sickness. She read about AIDS and the immune system, and she is interested in learning more about HIV and its effect on the body. Someday she wants to be a health worker. Shoba comes to you and asks, "What is HIV? How does HIV cause AIDS? Why can't the body overcome AIDS like it can the flu? Are there pills to cure AIDS?"

What is HIV?

HIV stands for "human immunodeficiency virus": "human" because the virus causes disease only in people; "immunodeficiency" because the immune system, which normally protects a person from disease, becomes weak; "virus" because like all viruses, HIV is a small organism that infects living things and

uses them to make copies of itself. HIV causes AIDS (acquired immune deficiency syndrome). AIDS is a group of diseases that occur when a person's immune system is damaged by HIV. Most people with HIV feel healthy for the first few years after getting the virus, but later they become sick with AIDS (see Chapter 2).

Viruses are tiny organisms, even smaller than the bacteria that cause tuberculosis or cholera. They are common—so common that we all become infected with them many times throughout our lives. Viruses cause the common cold, as well as polio, measles, mumps, and the flu. These viruses can be spread by coughing, sneezing, or touching. HIV is different. Even though it also is a virus, it cannot be spread in any of these ways. HIV can be spread only by

certain sex acts, blood, dirty needles and other instruments, and from a mother to her unborn baby or a baby she is breastfeeding (see Chapters 5 and 6).



A

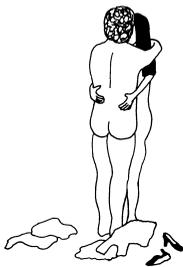


B

(A) Most people feel healthy for the first few years after getting HIV. (B) Later they become sick with AIDS.

HOW HIV IS SPREAD

Sex



blood



dirty needles and instruments



mother to her baby

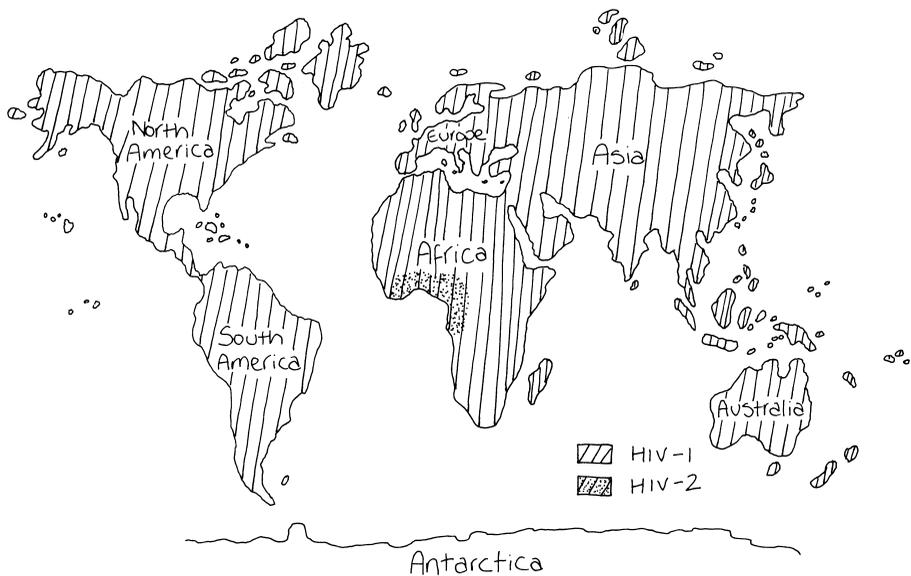


Viruses are difficult to treat with medicines. They are not affected by the medicines that work against bacteria; even powerful antibiotics like penicillin or tetracycline do not work against them. HIV is a special kind of virus called a retrovirus. It makes copies of itself in a different way than many other viruses; because of this, it is more difficult to treat. The best way to stop the

spread of viruses and the diseases they cause is to prevent people from getting infected in the first place. You can stop the spread of viruses like measles by using a vaccine.

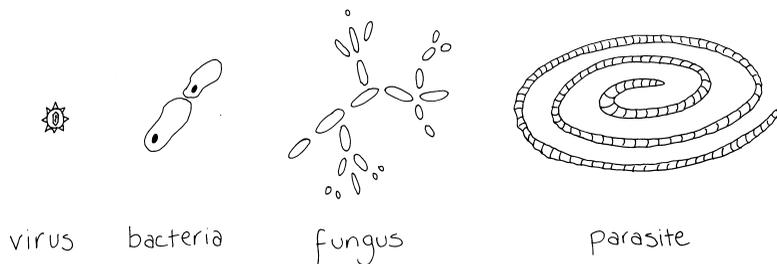
HIV is different because there is no vaccine for it. But changing behavior can also stop the spread of disease. For example, washing your hands after going to the bathroom will lower your chance of spreading diarrhea to other people. Changing behavior can also stop the spread of HIV.

There are two types of human immunodeficiency virus: HIV-1 and HIV-2. Like sister and brother, they have similarities and differences. HIV-1 is found in all parts of the world. HIV-2 is found mostly in West Africa. Since the spread of both viruses can be prevented in the same ways, we will discuss HIV-1 and HIV-2 together as “HIV.”



The immune system

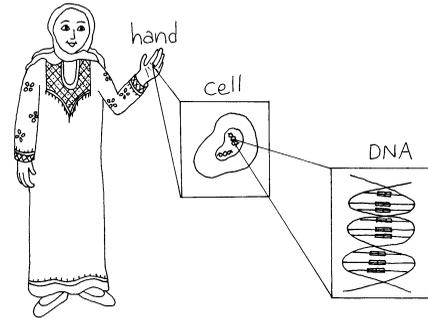
“Immune” means safe and protected. The body’s immune system works to keep out invaders such as viruses (like the one that causes polio), bacteria (like the one that causes tuberculosis), parasites (like the one that causes malaria),



and fungi (like the one that causes yeast infections). These organisms can infect people and cause disease and death.

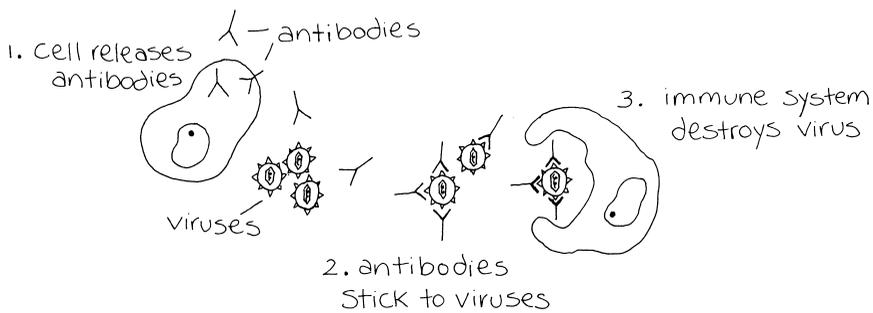
The immune system is made of different types of cells. Cells are tiny parts of a person's body that are too small to see without a microscope. The body is made up of billions of cells. Each type of cell plays a different role; some cells make up bone, others muscle, others the immune system.

Cells of the immune system, like most other cells in the body, have a center called a nucleus. The nucleus, or "headquarters" of the cell, contains DNA (deoxyribonucleic acid), or genes. The nucleus acts as chief of the cell and controls its activities. It tells the cell when to make a new substance needed by the body or when to make another cell. For each person, the DNA in all cells is the same. Each cell uses different parts of the same DNA to lead its activities.



People are made up of billions of cells. Every cell contains DNA.

If the immune system meets something from outside the body, it makes small (microscopic) particles made of protein called antibodies. These stick to invaders and help the rest of the immune system find and destroy them. This allows a person to avoid illness, or to become well if already ill.



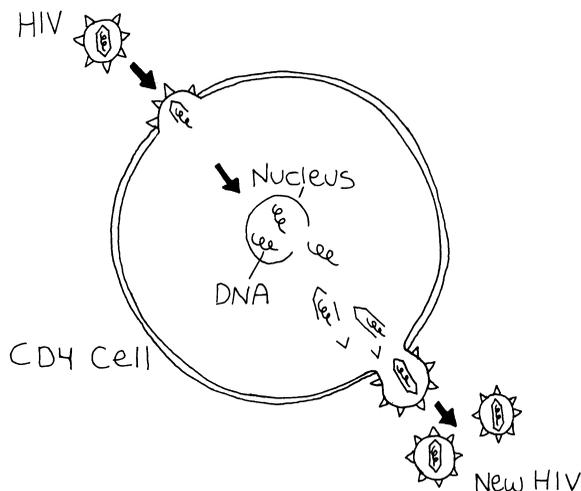
A special protein called CD4 marks the outsides of some immune system cells, making them different from other immune cells. The CD4 marking is like the stripes that make a zebra different from a horse. CD4 cells are also called helper T cells, because the body sends them to identify and defend against invaders like viruses and bacteria. However, HIV enters cells that have CD4 on their surface. In other words, the CD4 cells are attacked by the same virus, HIV, that they are trying to defend against.

This is a serious problem, because the body needs CD4 cells to defend itself against diseases. This is why people with HIV often become sick from organ-

isms that people without HIV can usually fight off. Bacteria, fungi, other viruses, and parasites take the “opportunity” to infect a person with a weak immune system. The illnesses they cause are called “opportunistic infections,” and they can kill someone with HIV.

HIV inside a cell

When HIV gets inside the body, it looks for CD4 cells. When it finds a CD4 cell, it attaches itself to the cell and enters it. Once inside, HIV finds the DNA in the cell nucleus. HIV makes a copy of itself from DNA building materials in the cell. This copy then hides itself in the CD4 cell’s DNA. Under a microscope, the cell’s DNA appears normal, even though it is now mixed with HIV DNA. Once safely hidden in the cell’s DNA, HIV can do one of two things. It can stay quietly in the cell, or it can turn on the cell’s DNA and use the cell’s machinery to make copies of itself. To make copies it uses a protein called reverse transcriptase. If it begins reproducing, it can make thousands of new HIV. These new viruses leave the cell and enter other CD4 cells and the same thing happens again. Some people think the virus makes a billion copies of itself every day.



HIV enters CD4 cells and makes copies of itself.

When the HIV DNA lies inside of the cell’s DNA, there is no way for the body to get rid of it. HIV hides so well that the body does not even know it is there. This ability to hide lets HIV spread within the body. In addition to making copies of itself within affected cells, HIV has another way of reproducing. When the cell decides it is time to make another cell, it reproduces HIV DNA

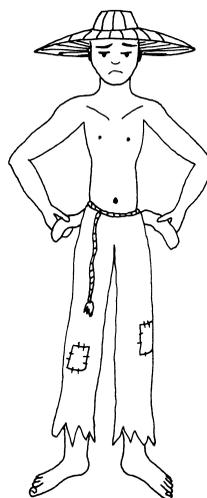
as well as its own. Each time that a new cell is made, HIV is also made. Because there is no easy way to tell the difference between DNA from HIV and DNA from the body's cells, there are no medicines that can completely remove the virus from the body.

Medicines against HIV

People are making medicines that work against the illnesses that people get after HIV weakens their immune system. They are also looking for ways to stop HIV from reproducing, and they are trying to make vaccines that would prevent a person from getting HIV. In the Appendix we describe medicines used to treat HIV-related opportunistic infections. In this section we will discuss some medicines that work directly against HIV.

There are several types of drugs that work to stop HIV. To be effective, several drugs must be used together. These drugs given together are called antiretroviral therapy (ART). One type of drug that fights HIV is the reverse transcriptase inhibitor. Examples of this type of medicine are zidovudine (AZT), stavudine (d4T), lamivudine (3TC), nevirapine, efavirenz, and emtricitabine. Reverse transcriptase inhibitors work by stopping HIV from becoming part of the cell's DNA. Another type of drug is a protease inhibitor, such as lopinavir/ritonavir and nelfinavir. Protease inhibitors stop HIV from putting itself together and reproducing. The last type of drug for ART is called a fusion inhibitor, such as enfurvirtide, which prevents HIV from entering cells.

By slowing the ability of the virus to make copies of itself, ART is often able to keep people alive for many years. However, it cannot get rid of HIV and cure a person of HIV disease. HIV becomes part of a person's body; there is no way yet to completely remove the virus. This means that medicines have to be taken for life. This leads to another problem: if a person does take medicines against HIV regularly, the medicines eventually stop working because the virus gets used to them. Furthermore, even though they fight HIV, these drugs sometimes harm the person who takes them.

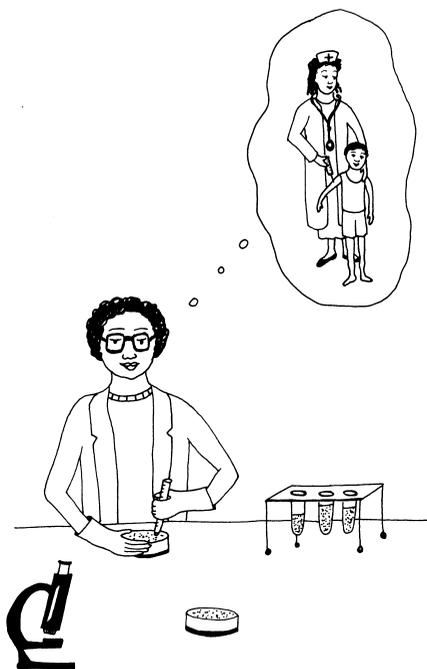


Drugs that work against HIV are sold at prices that are too expensive for most people.

Drugs for HIV are expensive, however activists have fought to make drug companies lower their prices for people living in poor countries. Currently the drugs usually cost between \$250 and \$750 per year. Many governments and organizations are also providing these drugs for free either through their own funding or with the support of international donors. Poor countries are also now making or buying generic versions of these drugs, so they are becoming more available.

The future

People are trying to make a vaccine to prevent HIV. Vaccines protect people against infections by causing the body to make antibodies. Vaccines help the immune system remember how a virus “looks”; the next time the immune system sees the virus, it attacks quickly, before a person becomes sick. For example, if someone has been vaccinated against mumps, his body makes antibodies, just as if he had a real infection with mumps. People do not get mumps twice. So, people who have been vaccinated against mumps do not get the disease. This is the way vaccines prevent infection. It will take many years to develop a good vaccine for HIV, so changing people’s behavior is, for now, the only method to stop the spread of the virus.



It will take many years to develop a good vaccine against HIV.

Answering Shoba’s questions

“What is HIV? How does HIV cause AIDS? Why can’t the body overcome AIDS like it can the flu? Are there pills to cure AIDS?”

HIV is neither an animal nor a plant. It is a virus. A virus lives inside plants, animals, or fungi and uses these (its “hosts”) to survive. Diseases caused by viruses include the flu, chicken pox, mumps, polio, and herpes, as well as

AIDS. It is especially difficult for the body's defenses to fight HIV because it hides in the cells of the immune system—the very cells that are used to defend the body. The weakened immune system is unable to fight off infections that are usually not a problem for healthy people. In this way HIV causes AIDS, a group of diseases that occur when HIV has damaged a person's immune system. HIV is so damaging to the immune system that without treatment, most people with HIV will die from AIDS. This is why it is so important to teach people how to avoid getting or spreading HIV, and to strengthen their immune systems by fighting malnutrition and other diseases.

There is no medicine that can cure AIDS or even rid a person of HIV. But medicines can reduce the amount of HIV in a person's body and can treat the illnesses or opportunistic infections that affect people with HIV. These medicines can help people with HIV to live much longer, healthier lives. People with HIV can also stay healthier when they have clean water to drink, good nutrition, and support from their communities.