1

What is HIV?

Shoba's story

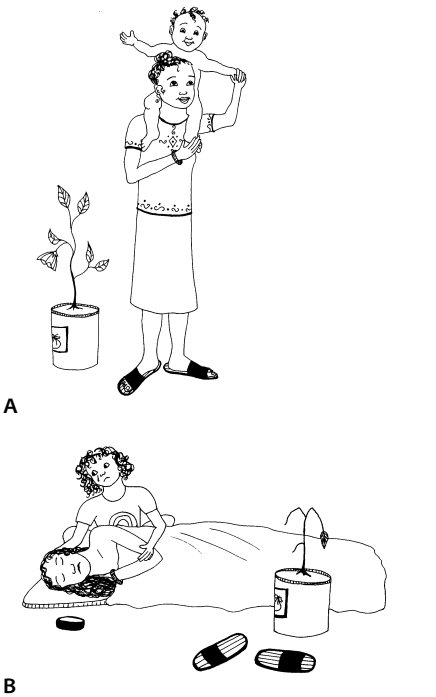
Shoba is a fifteen-year-old student in Pakistan. She has just taken a biology class. She already knew that she could prevent illness by washing her hands after going to the bathroom and before she cooks or eats. But in class, she learned about how the body defends itself against sickness. She read about 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?

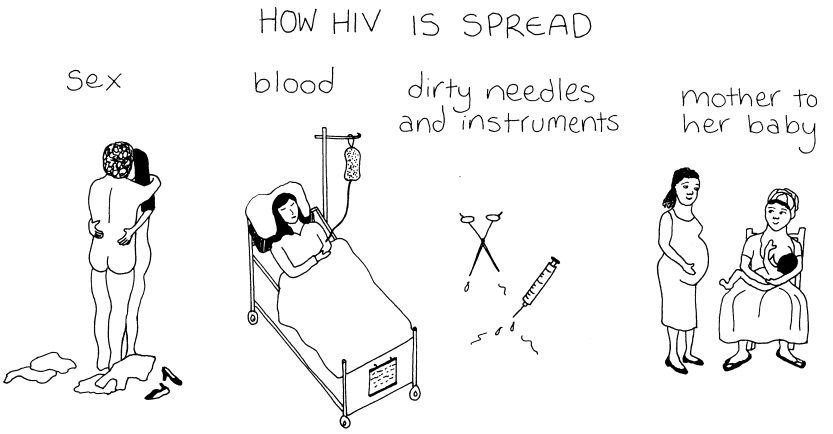
HIV stands for "human immunodeficiency virus": "human" because the virus causes disease only in people; "immunodeficiency" because the immune system, which normally protects a person from disease, becomes weak; "virus" because like all viruses, HIV is a small organism that infects living things and

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

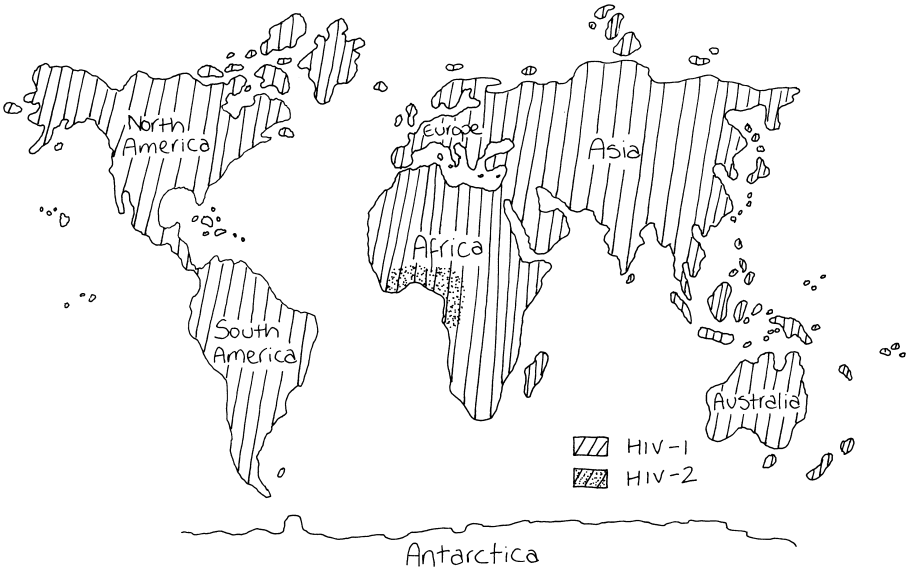


Viruses are difficult to treat with medicines. They are not affected by the medicines that work against bacteria; even powerful antibiotics like penicillin or tetracycline do not work against them. HIV is a special kind of virus called a retrovirus. It makes copies of itself in a different way than many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

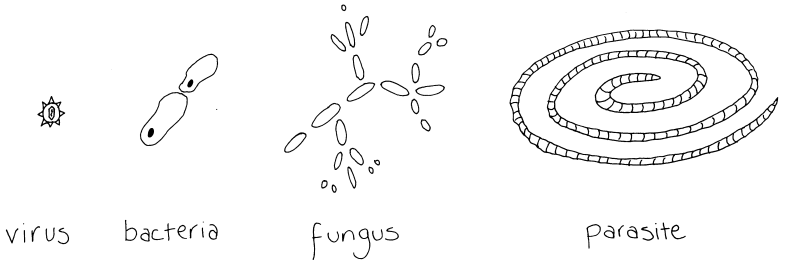
HIV is different because there is no vaccine for it. But changing behavior can also stop the spread of disease. For example, washing your hands after going to the bathroom will lower your chance of spreading diarrhea to other people. Changing behavior can also stop the spread of HIV.

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

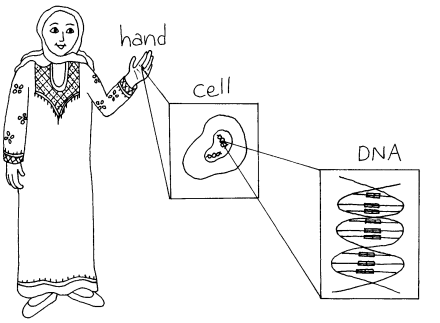
"Immune" means safe and protected. The body's immune system works to keep out invaders such as viruses (like the one that causes polio), bacteria (like the one that causes tuberculosis), parasites (like the one that causes malaria),



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

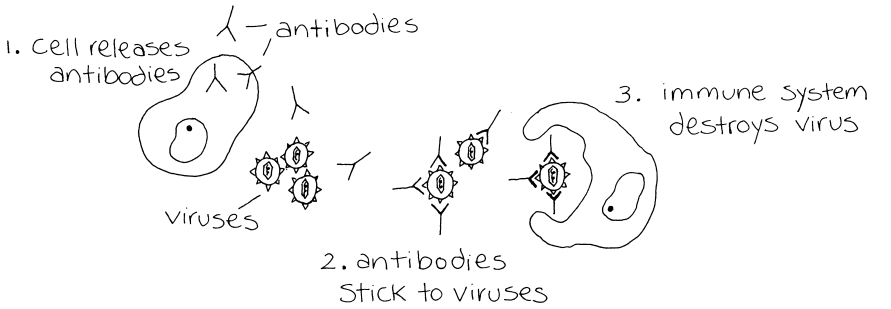
The immune system is made of different types of cells. Cells are tiny parts of a person's body that are too small to see without a microscope. The body is made up of billions of cells. Each type of cell plays a different role; some cells make up bone, others muscle, others the immune system.

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.



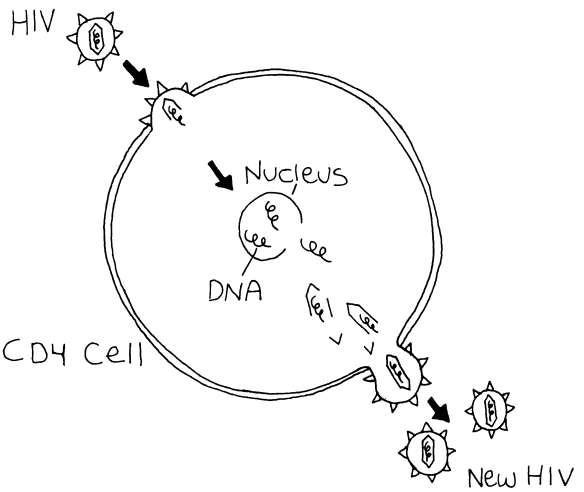
A special protein called CD4 marks the outsides of some immune system cells, making them different from other immune cells. The CD4 marking is like the stripes that make a zebra different from a horse. CD4 cells are also called helper T cells, because the body sends them to identify and defend against 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

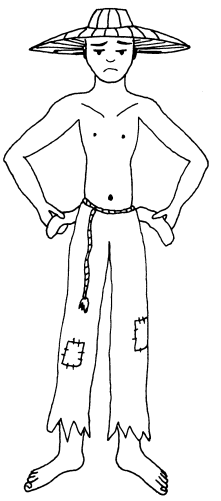
as well as its own. Each time that a new cell is made, HIV is also made. Because there is no easy way to tell the difference between DNA from HIV and DNA from the body's cells, there are no medicines that can completely remove the virus from the body.

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 lopinovir/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.

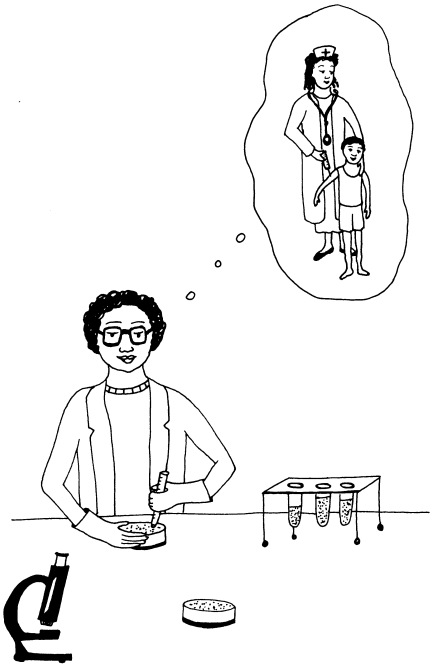


Drugs that work against HIV are sold at prices that are too expensive for most people.

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.

2

The symptoms of HIV infection

Saleema's story

Saleema is a young mother in a small village in Morocco. She has two children. Her husband works in the nearby fields. Saleema's parents both died when she was very young. When they died her brother, Hamid, moved to Paris, France, to look for work. An uncle there helped him get a job as a taxi driver. It was hard work but Hamid was able to send some money to help Saleema and her sisters. After some time Hamid became tired of his life in the city and returned to the village to work in the fields. Saleema was glad to see him but could not believe how he had changed. He was thin and felt very tired all the time. She wonders what could be wrong with him. He has fevers and sweats at night, and he seems to always have a cough and diarrhea that no medicine will cure. Saleema wants to take him to the doctor. Hamid told her that while in Paris he used drugs to try to take away his loneliness. She asks you, "What could be wrong with Hamid? Why does he have sweats at night and swollen lumps in his armpits and neck? Could this illness be because of the drugs? Should I take him to the doctor?"

HIV infection and HIV disease

HIV damages many parts of a person's body. It can do this in two ways: one is by directly invading different organs, the other is by weakening the immune system and allowing other organisms to cause disease. In this chapter we will describe the first kind of damage that HIV causes; in the Appendix we discuss the second.

HIV directly infects the cells in a person's brain, nervous system, intestines, and blood. HIV damages these cells. This affects the way a person thinks (from damage to the brain), causes pain or numbness in arms and legs (from damage to the nerves), causes diarrhea (from damage to the intestines), and causes anemia and bleeding (from damage to the blood). Although HIV can cause people to be ill, we already know that not everyone with HIV is sick. This is because there are different stages to HIV infection, beginning with the time when a person is first infected, moving through a period when no symptoms are present, reaching a time when symptoms first appear, and ending with advanced HIV disease (AIDS).

The four stages of HIV infection

1. The first few weeks after infection, when many people have symptoms like the flu.
2. The quiet period, when there are few signs of HIV disease.
3. Early HIV disease.
4. Advanced HIV disease (AIDS), when a person is very ill.

Over time, one stage leads to the next.

The first weeks of HIV infection

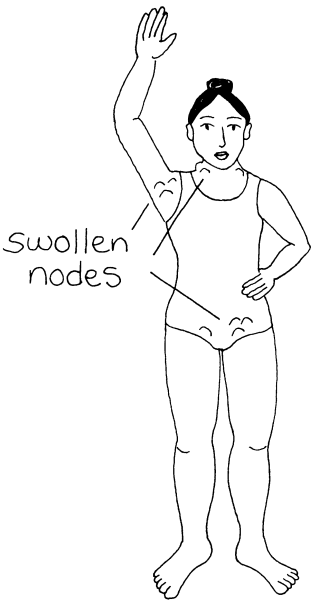
The first stage of HIV infection occurs after a person is infected with the virus. Usually people do not notice when they get HIV; they do not find out that they have the virus until later, when they are tested or become ill. A few people, however, do notice symptoms 1–4 weeks after they are infected with the virus. The symptoms are much like the symptoms of the flu: sore throat, fever, headache, stomach pain, diarrhea, and a feeling of being tired. After a week, a rash may appear on the chest, face, and neck. People may also have night sweats, muscle and joint pains, swelling in their lymph nodes, nausea, and vomiting. These symptoms usually last fewer than two weeks.

Rarely, the first stage of HIV infection can be more serious and damage a person's nervous system. The infected person may develop swelling of the brain and its covering. This can cause headache, neck stiffness, fever, confusion, nervous system problems, and coma. A person may also have problems with the nerves in the arms and legs, and problems with nerves in the face. This can cause pain, numbness, or difficulty moving. The lymph nodes can sometimes swell and stay swollen for months or even years.

Because all of these symptoms are also seen in illnesses other than HIV, we cannot say that a person has HIV just because he has one or more of these symptoms. For a person to know whether he has HIV, he needs to be tested for the virus. Unfortunately, HIV tests do not work well in the first few weeks after infection, because the tests look for antibodies, and the body of someone who has just become infected with HIV has not made antibodies yet. Most people will have antibodies within three weeks of getting HIV. Someone who thinks she may have just been infected with HIV can get tested right away and again a few weeks later. (For more about HIV testing, see Chapters 7 and 8.)

Lymph nodes

Lymph nodes, often called "glands," are the centers of a person's immune system. They become swollen and painful when a person is fighting off an infection. For example, lymph nodes in the neck often swell when a person has a throat infection. HIV also causes swollen lymph nodes, sometimes all over a person's body, and sometimes for years.



The quiet stage of HIV infection

People recover from the first symptoms of HIV infection within a few days or weeks. For several years after that they feel well, look healthy, and carry on with their daily lives. Their immune systems are able to fight the virus.

This is called the "incubation period," or the quiet stage of HIV. It is the time between the first infection with HIV and the point where a person becomes ill from the virus. For adults, this stage averages ten years. Right now, most of the people in the world who have HIV are in this incubation period. They are not experiencing any symptoms, and many of them do not even know they have the virus and could spread it.

The beginning of HIV disease

After the incubation period, people with HIV become ill. The virus weakens their immune systems enough that they develop infections that people with healthy immune systems are able to fight off. These infections—called "opportunistic infections"—and some cancers are what make people with HIV ill and define their illness as AIDS. We discuss treatments for them in the appendix. At the same time that their immune systems are weakening, people with HIV often develop swollen lymph nodes and lose weight. These general symptoms are common in people with HIV and are often not due to any specific infection.

HIV, weight loss, and malnutrition

Many people live in communities where food is scarce and where malnutrition is a serious problem. Not only do people need enough food, they need different kinds of food. For example, a person who is eating cassava and nothing else will become very ill. If a person is sick from not getting enough of the right kinds of food, he has malnutrition. Malnutrition can cause diseases as well as weight loss. One of the most important ways of staying healthy is to eat well and drink clean water. This is especially true for people with HIV and AIDS. They are likely to become malnourished from constantly being sick, from diarrhea that prevents their bodies from absorbing the nutrients in food, from loss of appetite, and from mouth infections that make eating difficult. Weight loss is so common in people with HIV that in some areas of Africa AIDS is called "slim disease."

Eating a balanced diet of different foods helps people with HIV stay strong and healthy. A balanced diet is one in which different foods from all of the basic nutrient groups are eaten each day. The basic nutrients are proteins, carbohydrates, fats and oils, and vitamins and minerals.

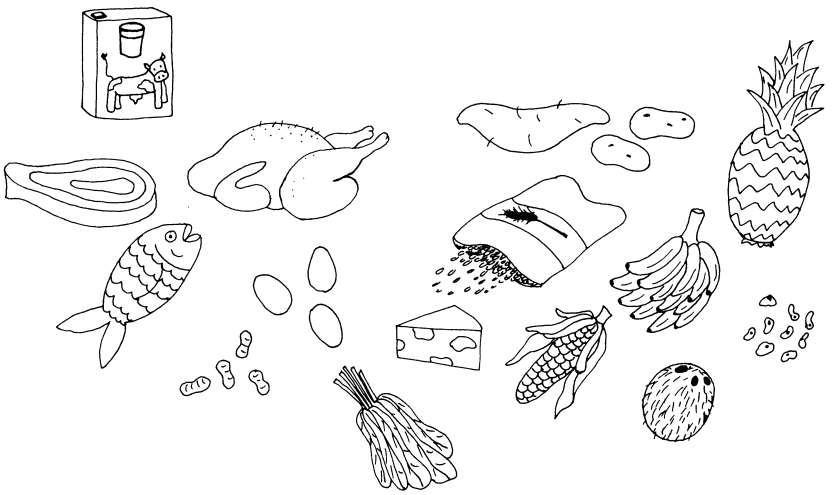
The basic nutrient groups

Proteins help the body grow and heal. Foods that have high amounts of protein include fish and other seafood, meat (for example, beef, pork, lamb, and goat), fowl (for example, chicken, turkey, and duck), eggs, milk, cheese, beans, rice, peas, cereals, nuts, tofu, and other soybean products.

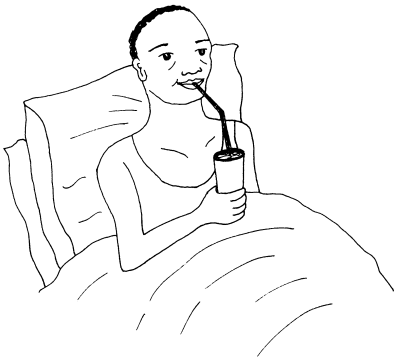
Carbohydrates give the body energy. Starches and sugars are types of carbohydrates. Starches are in corn, rice, wheat, oats, buckwheat, millet, noodles, plain and sweet potatoes, squash, cassava, plantains, and taro. Sugars are found in sugarcane, beets, refined sugar, candy, honey, and fruit. Starches in potatoes and wheat give the body a steady source of energy. Refined sugars such as candy give the body sugar and no other nutrients. Eating too many sugars can also cause tooth decay and gum disease.

Fats and oils help the body store energy. There is twice as much energy in fat as in protein or carbohydrates. This means that eating fats and oils helps people gain weight. Fats and oils also taste good. The problem with fat for many people is that it causes them to have heart disease and to be overweight. This is usually not a problem for people with HIV, because they are trying to gain weight. Foods with fat include oil, lard, butter, margarine, nuts, sesame, soybean, coconut, avocado, cream, milk, and red meat like beef, pork, and lamb.

Vitamins and minerals are necessary in small amounts for a person's health. They are contained in many different foods, especially vegetables and fruits. This is one reason a varied diet is important for a person's health—it gives a variety of vitamins and minerals.



If someone has trouble eating



People with HIV may have nausea and vomiting. Teas or medicines may help with this. For people with mouth sores, cool, non-spicy foods make eating less painful. For people who have trouble swallowing, moving the head forward and using softer foods will make swallowing easier. Care should be taken when drinking to avoid choking. Drinking through a straw may help. Sometimes problems with eating or swallowing may be due to a disease that can be treated, like a yeast infection in the mouth. In these cases, encourage people to see a health worker for treatment.

Women and children have special nutritional needs. This is because women lose a lot of nutrients through menses, pregnancy, and breast-feeding. Children need extra food because they are growing quickly. Women and children who have HIV need even more food to stay healthy because HIV places more demands on their bodies.

In HIV disease, each infection needs to be treated as well as possible. The Appendix discusses treatments for the most common diseases that affect people with HIV.

Answering Saleema's questions

"What could be wrong with Hamid? Why does he have sweats at night and swollen lumps in his armpits and neck? Could this illness be because of the drugs? Should I take him to the doctor?"

Hamid is very sick and needs to see a doctor to find out what is wrong. The fact that he used drugs while in Paris means he is at high risk for HIV disease, especially if he injected them. People with HIV usually do not know when they got the virus because the first symptoms are like having a bad cold. Later, people have swollen lymph nodes, night sweats, and diarrhea. Hamid has all of these symptoms, and he has lost weight. These are bad signs. If he has HIV, there are medicines that can help him. If Hamid does not have HIV but another disease, like tuberculosis, then he will also need treatment. It is important to find out so that Hamid can get help.

3

Who has HIV?

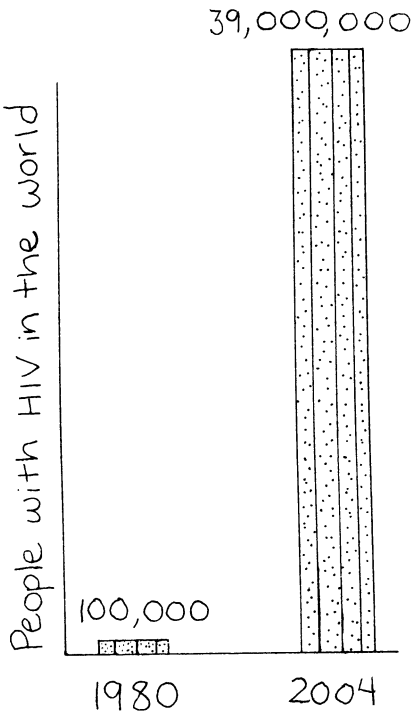
Min-Soo's story

Min-Soo is a student in your health training class. He comes from a village on the edge of a large town in South Korea. Recently a person in his community was diagnosed with AIDS. People are scared. Min-Soo is working with a project that teaches people about HIV. His friends have asked him many questions. They have asked where AIDS came from and which country has the most AIDS. They also want to know who gets HIV. Min-Soo knows these questions are about the "epidemiology" of HIV. He stays after your lesson to ask some more questions. "Where was AIDS first found? Which country has the most AIDS? How do we know that HIV is not spread by mosquitoes or sneezing? What does it really mean when they say that 15% of adults living in the capital of Rwanda have HIV?"

A short history of the HIV epidemic

HIV and AIDS have spread to almost all countries in the world. The virus is so common now that in some communities one of every 3 or 4 young adults are infected. When a disease becomes this widespread, it is called an epidemic. Epidemiology is the study of diseases in populations. It can be used to understand the spread of HIV. We must understand the spread of HIV if we are to stop the epidemic.

The first official case of AIDS was found in 1981 in the United States, but researchers believe that by that time many people all over the world had HIV. They think that in 1980, about 100,000 people worldwide had HIV. Most of the people who had the virus were not sick and did not realize they were infected. Today, over 39 million people, including 2 million children, have HIV. This is almost 400 times the number of people infected in 1980. You can see that HIV is spreading quickly to people all over the world.



The number of people with HIV in the world is growing.

HIV in the world

Over 39 million people with HIV

- around 22 million men
- around 17 million women

Of the 39 million

- around 80% got HIV during sex; of these, 80% got HIV during sex between men and women
- around 10% got HIV during injection drug use
- around 5% are children infected by mothers who have HIV
- around 5% got HIV through blood

Numbers of people with HIV in different parts of the world

- around 26 million in Africa
- around 1 million in North America
- around 2 million in Latin America
- around 8 million in Asia
- around 2 million in Europe and Central Asia

Because HIV is spreading so quickly, we cannot know exactly how many people have it. The HIV epidemic is like a fire that is spreading through a forest—by the time you have put out part of it, you find it has moved to a new area of the woods.

Global cooperation

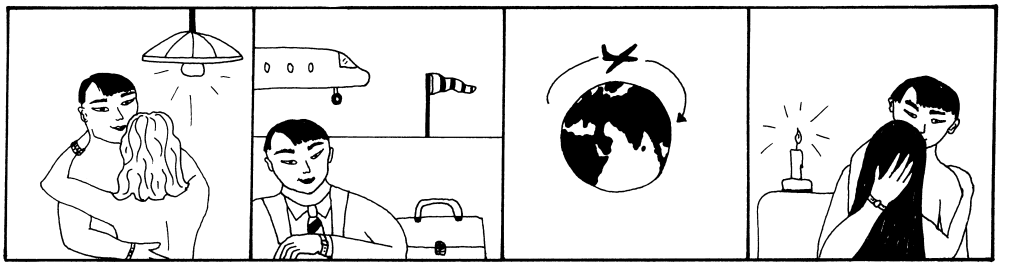
Sometimes HIV seems like some other country's or community's problem. It is easy to find another community that has more infections than yours. But because we are all connected, HIV is a threat to everyone. A global view is needed to stop the spread of HIV.

In the beginning of the AIDS epidemic, people pointed fingers at other people or countries and blamed them for the problem. This happens with almost every new disease. Some people in the United States said HIV came from Africa and the Caribbean and that homosexual men (men who have sex only with men) were the cause. Now we know that this is not true, but countries in Africa and the Caribbean were insulted by the finger-pointing.

In the past, some countries were afraid to admit that they had people with AIDS for fear of losing money from tourists. Some of these countries are now openly saying that HIV is a problem for them. They are working with the international community to stop AIDS. Understanding that HIV and AIDS are a problem for every country and taking action to stop its spread are important for the world. Countries that ignored the epidemic have more HIV and AIDS now than many of those that worked toward stopping the spread of the virus early. In the end, it is not important to know where the virus started. It *is* important to know where it is going.

How HIV is spread worldwide

More than 300 million people cross international boundaries each year. Changes in transportation have made it easier for HIV to spread. Someone with the virus can travel from London, England to a small village in Asia in a day. If he has unsafe sex with a person in the village, HIV can spread across the world with him. The same can occur if someone from a village visits a city, becomes infected, and returns home. This is how the virus moves. It spreads from person to person, village to village, and city to city. For a virus like HIV there are no borders. Where people move, HIV moves.



As we said in Chapter 1, HIV can only be spread through sex, blood, dirty needles or other instruments, and from a mother to her baby. HIV does not necessarily affect the same people first in every community. For example, in India most people with HIV got the virus from having heterosexual sex—sex between a man and a woman. In Russia most people with HIV got the virus from sharing used needles while injecting drugs. There are a few reasons why people who take part in a particular risky behavior may be affected first or affected more by HIV:

- Certain behaviors (like injecting drugs) may be more common in some countries or regions.
- The first people to contract HIV in a certain region will pass the virus on within their own communities. So if a gay man (a man who only has sex with other men) is the first to be infected in a certain town, he will pass the virus on to other men who have sex with men in that town first.

Cities and disease

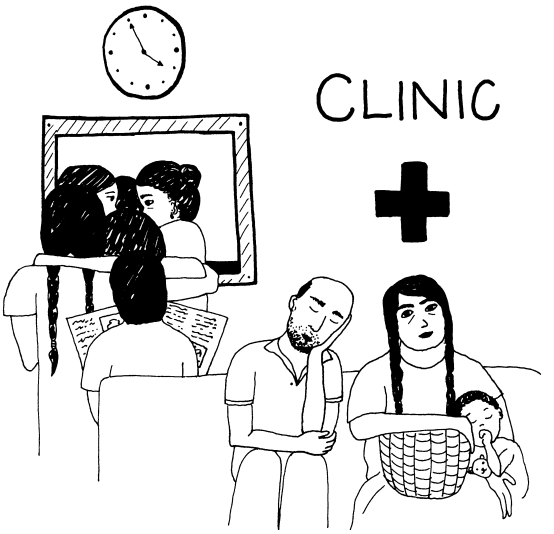
Half of the world's population lives in cities. Diseases like tuberculosis and the flu spread more quickly in the city because people are crowded together. HIV also spreads faster in cities, for many reasons. For example, people in cities tend to have sex with a greater number of partners. More people move to cities every year. As more people move to cities it is likely that HIV will spread even faster than it already does.

Because a certain group of people may be the first to get HIV, others in the community may see HIV as only affecting people who are members of that group. But unless the whole community works to stop HIV right away, it will quickly spread and infect people from many different parts of the community. HIV may be seen as a disease of gay men, or of drug users, of prostitutes, or of unfaithful husbands. But HIV will infect anyone who is exposed, including faithful wives, newborn babies, and people who have never taken illegal drugs.

Effects of HIV on the community

Most people with HIV are adults from 20 to 40 years of age. This means people are dying at an age when they are vital members of their communities. Illness and death at these ages affect the strength and productivity of a community. In most places, women and men between the ages of 20 and 40 take care of their own children and sometimes even their parents, grandparents, or grandchildren. When these men and women die, children and the elderly are often left without support. AIDS has killed either one or both parents of millions of children around the world. In most countries there are not enough orphanages to support all of the children whose parents die from AIDS. This is just one way AIDS changes families and communities.

The spread of HIV has also changed health care. More hospital beds are needed for people who are sick with AIDS. Because hospitals and clinics are so busy, less attention can be given to everyone who is sick. In one African country, three top officials of the ministry of health died of AIDS in one year. There was no one in the country who was qualified to replace them. This affected the health of the entire country.



Because of HIV, hospitals and clinics have become even more crowded.

War and HIV

War can increase the spread of HIV in many ways. During wartime soldiers move from place to place. Soldiers with HIV or other sexually transmitted diseases spread them to new communities.

Soldiers also often attack clinics and hospitals. This means that services such as HIV counseling, testing, and medical care may stop. Sometimes hospitals and clinics are forced to close.

During war, parents are killed and families broken apart. Because men in particular may be killed or sent away to fight, the meaning of social customs such as marriage and sex also changes. Husbands and wives may have more sex partners when they are separated.

As people lose their homes and animals, fear and hunger make them leave the countryside for the protection of cities. War often brings poverty and despair, driving people into drug use or prostitution. These changes make it easier for HIV to spread to people who before might have been safe from the virus.

War changes people's ideas about life. When people are surrounded by so much upheaval and death, they do not worry about catching HIV because it does not kill for years, whereas bullets or bombs may kill them tomorrow.

In the late 1970s, a war occurred in southern and western Uganda. This war made it easier for HIV to spread. It left many people homeless, poor, or living as refugees in the capital. With the movement of troops, the arrival of truck drivers from the coast, and the new refugees, HIV spread rapidly. By the mid-1990s, 10% to 25% of the younger people in some areas of Uganda had HIV, and over a million children were orphaned by HIV.

HIV and other diseases

People with HIV are more likely than people without HIV to get certain cancers like Kaposi's sarcoma and lymphoma, and opportunistic infections like cryptococcal meningitis and thrush. Some people have worried that these diseases would spread to people without HIV. But these cancers and infections do not spread to other people. So far the only disease that people with HIV are likely to spread to other people is tuberculosis (TB).

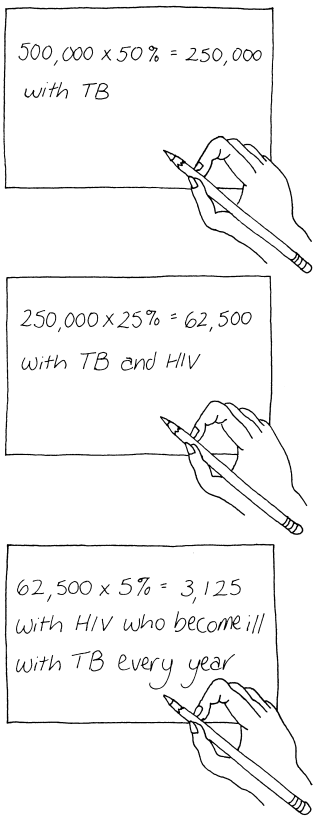
The epidemiology of tuberculosis and HIV

People with HIV live many years before they become ill. People infected with tuberculosis (TB) can also live many years without becoming ill, because the bacteria that cause TB can live quietly in a person. Unfortunately, people who have HIV and TB infection become ill with TB much more often than people who do not have HIV.

Most of the diseases that people with HIV get are not passed to others. TB is different in that it can be spread to other people. About 5% of people with HIV and TB infection will become sick from TB each year. It is believed that in some areas of the world, around 50% of the people are already infected with TB. The spread of HIV is especially dangerous for these people.

Find a pencil and paper and follow the numbers in this imaginary example:

The town of Mycolandia in East Africa has 500,000 people and 50% of them are infected with TB. This means that 250,000 people have TB in their body. Most are not sick from TB. The TB bacteria are just living quietly.



In Mycolandia, 25% of the people have HIV. This means 25% of the 250,000 people infected with TB also have HIV. In other words, 62,500 people have both infections.

If 5% of people with both TB and HIV infection become sick with tuberculosis in one year, that means that 3,125 people with HIV will become ill with TB disease each year. Each person who becomes ill with TB can spread it to other people. If a person with TB is treated with the right antibiotics, he will no longer spread the TB bacteria and he will feel better.

How do we study the HIV epidemic?

The HIV epidemic can be divided into two parts: people with HIV and people with AIDS. People with HIV who do not have AIDS are difficult to count because they usually are not ill. You need a test to know if someone has HIV. It is easier to count how many people have AIDS because they are sick from HIV disease and usually go to a health worker for treatment. The World Health Organization (WHO) has a definition of AIDS that uses the presence of certain diseases and does not require a blood test (see the first box in the appendix, and the second and third boxes from the end of the appendix). It takes many years for people with HIV to get AIDS. If we only count people with AIDS, we will think that many fewer people have HIV than really do.

It is too expensive to test everyone for HIV. This is where the tools of epidemiology, such as screening (testing groups of people) and surveillance (regularly monitoring the rates of a disease), come in handy. By testing certain groups of people and using math, it is possible to come up with an idea of how many people have HIV, who they are, and where they are living.

Let us imagine you want to know how many women giving birth in your city have HIV. One way is to test every woman giving birth. But this would cost too much if you live in a big city where many women give birth each year. Another way would be to choose two or three hospitals from different parts of the city and spend one month testing every woman giving birth. The results of this study could be used to get a general idea of how many women giving birth in the city have HIV. If 500 women gave birth at the hospitals where you did testing and 50 had HIV, then 10% of all women giving birth at the hospitals in a one-month period had HIV. If you already know that in the entire city, about 1,000 women give birth to babies in a one-month period, then you could multiply 10% by 1,000 and estimate that about 100 women with HIV give birth to children every month in the city. This means that in a year, about 1,200 women with HIV give birth to children in the city. This number is an estimate.

An estimate is a best guess. Sometimes estimates are not correct. You can get an idea of how good an estimate is by thinking about where your calculations might be wrong. For example, if the hospitals where you did your testing were in parts of the city where many people with HIV live, then the number of women with HIV giving birth would be higher there than in other hospitals in the city. This would mean 1,200 is an overestimate and the true number is less. Good estimates provide information that can be used to focus resources without having to test everyone, but be careful: bad estimates can lead to bad decisions and wasted resources.

In New York City in the United States, studies of drug injectors showed that sharing needles spread HIV. Around 70% of the people injecting illegal drugs had HIV. Less than 1% of the rest of the population had HIV. Studies like this one helped people plan special programs to try to stop the spread of HIV among drug injectors. If in your community only a small percentage of drug injectors have HIV, then it would be especially useful to set up a program to talk with drug users about the dangers of sharing used needles, to show them how to sterilize needles, and, if possible, to provide them with new, clean needles. This could keep the rate of HIV infection low. Do not wait until most drug injectors are already infected to start your work.

Question the experts and their studies

How do we know the number of people with HIV in a country? It would be very difficult to test all of the people living in any country. Instead, people test different groups and estimate what percentage of the entire population is infected. When someone says that 10% of people in an area have HIV, a few questions should come to mind. The first question to ask is, "Who is saying this?" Is it someone who is actually testing people and who would know about how many people are positive, or is it someone who is just guessing? Ask how the study was done. Who was tested? Was it only people in a big city? If so, the estimated number is likely to be higher than the true number for the whole region, because in most parts of the world, people in cities are more likely to have HIV. Were only sex workers tested? If so, the estimate will be higher than the true number in the general population, because sex workers are more likely to have HIV. Were the people who were tested over 60 years old? If so, the estimate is likely to be lower than it should be, because people over 60 are less likely to have HIV than people in their twenties. Most of epidemiology is based on estimates, so be careful and ask questions!

Epidemiology can also be used to find out what happens to people once they have HIV. Questions such as "How long do people with AIDS live? With what diseases do people with HIV become sick? How do they die? What medicines help?" can be answered by closely watching people with HIV and carrying out studies.

A very short dictionary of epidemiology

The words that people use to talk about the spread of disease can be confusing. Here are some definitions:

Rate. Rate is one of the most important ideas in epidemiology. Rate is the amount of something in relation to something else. It is usually shown as a proportion or percentage. Often it contains the idea of time. For example, imagine that 10,000 cases of AIDS have been reported to the ministry of health over the past ten years. You could tell someone this information alone, or you could say that the country only has a population of 100,000 people, and the rate of AIDS is 0.1, or 10% (10,000 cases divided by 100,000 people).

Ten thousand cases is more serious in this country than in a country where 10,000,000 people live. In the second country, the rate of AIDS is 0.001, or 0.1% (10,000 cases divided by 10,000,000 people). You can see how the number of cases of AIDS or HIV infection is often less important than the rate of disease or infection. When someone tells you the number of people with AIDS in an area, always ask for the number of people living there. This will give you an idea of the rate of disease.

Incidence. The incidence of a disease is how often new cases of it appear in a population during a set period of time, usually one year. For example, if you wanted to know the incidence of HIV in a village, you could test all the people in the village and record that information as your baseline. Then test all of the same people one year later. Count the number of people who did not have HIV during the first test but did have the virus during the second test. Divide this number by the total number of uninfected people in the village. The result is the incidence of HIV in this village (the number of new infections per person per year).

Imagine that 1,000 people live in the village. One hundred of them had HIV the first time you tested them. One year later, 150 people had HIV. This means 50 new people were infected. Fifty new infections among the 900 people who were not originally infected means the incidence of HIV infections was 0.055, or 5.5%.

Prevalence. Prevalence is the proportion of people who have a disease in a community at any one point in time. In the example above, the prevalence of HIV would be 10% the first year (100 cases among 1,000 people living in the village) and 15% the second year (150 cases among 1,000 people living in the village).

Bias. Bias occurs when an unexpected factor affects the results of a study. For example, imagine you want to find out how many pregnant women in your town have HIV. You test all the pregnant women who come to your medical clinic over a three-month period. Since people with HIV are more likely to be sick and come to the clinic, and you tested all pregnant women who came to the clinic, you will find more women with HIV than if you tested every pregnant woman in the town. Testing only sick pregnant women influenced your results. Your study was affected by bias. Bias can happen even when you are trying to avoid it. If you ask questions with a tone that tells people that you want them to answer in a certain way, you can bias your results. For example, if you want to know how many people inject drugs but ask, "You do not use those illegal, deadly drugs do you?" then fewer people will answer yes than really do use drugs. Your results will be biased.

AIDS can be seen as the footprints that HIV has left as it spreads from person to person. Epidemiology is used to examine these footprints in order to understand where the virus is going and how to stop its spread. Knowing the size of the HIV problem in your community helps you prepare for the future. Education and prevention programs can involve the people who need them most. By continuing to gather information about HIV you will know whether or not you are slowing the spread of HIV.

Answering Min-Soo's questions

"Where was AIDS first found? Which country has the most AIDS? How do we know that HIV is not spread by mosquitoes or sneezing? What does it really mean when they say that 15% of adults living in the capital of Rwanda have HIV?"

AIDS was first described in 1981 in Los Angeles in the United States, when five patients became sick with an unusual pneumonia that occurred in people with weak immune systems. The virus causing AIDS was found by a group in France a few years later.

From studying the epidemiology of AIDS, we know that HIV is not spread by mosquitoes or sneezing. Almost all people with HIV can trace their infection back to sex, blood, dirty needles or instruments, or from mother to baby at birth. If mosquitoes could spread HIV, then AIDS would be seen in the same people who have malaria. We would see more children and old people with HIV. This is not the case. Similarly, HIV is not spread through sneezing or other "casual contact" with people who have HIV. Health care workers do not get the virus through casual contact, even though they spend many hours caring for people who have HIV. Within families, HIV is spread only through sex or from a mother to her baby; people do not get ill from living with and caring for family members who have HIV.

No one has tested all of the adults living in the capital of Rwanda for HIV. What people have done is tested a group of people and estimated what percentage of the entire population is infected. Thus, 15% is a statistical guess. You can explain to Min-Soo that the idea that 15% of the adults in the capital of Rwanda have HIV is an estimate made from several different studies.