HIV AIDS

Introduction

In Parts 1 and 2 of this Module, you learnt about the basic principles underlying the transmission, diagnosis, management and prevention of communicable diseases, and the application of this knowledge to vaccine-preventable diseases, malaria, tuberculosis and leprosy. In Part 3 of the Module, we focus on HIV and AIDS — a cause of increasing concern for the health of Ethiopians.

The **human immunodeficiency virus** (**HIV**) is a virus that infects humans and weakens the immune system. As a result, HIV-infected people are more prone to acquiring other infections and diseases that individuals who haven't been infected with HIV are able to fight off easily. The collection of diseases that results from HIV infection is called **Acquired Immunodeficiency Syndrom**e (**AIDS**). In this study session, we will first briefly describe the status of the HIV epidemic in Ethiopia, so you understand the magnitude of the problem and how it may affect your community. We will then describe some important functions of the immune system — the main target of HIV in the human body — so that you have a basic understanding of the biology of HIV infection, and how it eventually leads to AIDS. Finally, we will outline the different modes of HIV transmission between humans. This knowledge will help you in providing effective care and health education for your
HIV-infected clients, and in the implementation of HIV prevention measures in your community. Care, health education and prevention in the context of HIV/AIDS will be discussed in greater detail in later study sessions.

HIV and the immune response to infection

In this section, you will first learn what HIV is and then about the basic functions of the immune system, which are gradually destroyed by HIV infection. This knowledge will help you to understand how HIV induces disease in infected people.

1 What is HIV?

HIV is a **virus**, and like all viruses it is not a true cell, but a microscopic particle much smaller than a bacterium. Viruses are essentially minute 'boxes' made of proteins containing the genetic material that carries the information needed to make more viruses of the same type. But viruses cannot reproduce themselves *unless* they invade a true cell and take control of the normal chemical processes taking place in the cell. The virus turns the cell into a virus 'factory', producing millions of new viruses and killing the host cell as it sheds its load of viruses into the body.

There are different types of viruses, and HIV belongs to a group called the **retroviruses**. This name is important because the drugs that have been developed in recent years to treat PLHIV are called **antiretrovirals** (or **ARVs**), and the combination of drugs and other treatments that an individual receives is called **antiretroviral therapy** (or **ART**).

There are two species of HIV, known as HIV-1 and HIV-2. HIV-1 is the virus responsible for the majority of HIV infections in most countries, including Ethiopia. HIV-1 is more infectious and has a much greater ability to be transmitted between people than HIV-2. HIV-2 infection is mainly prevalent in West African countries, and it is thought to induce progression to HIV-associated diseases and AIDS more slowly than HIV-1.

2 The human immune system

The **immune system** is a collection of cells, tissues and organs in the human body, with the combined function of protecting us against invasion by infectious agents. In the absence of an effective immune system, our bodies would easily be invaded by **pathogenic** (disease-causing) viruses, bacteria, protozoa and parasites, which would rapidly cause our death. The exact functioning of the immune system is very complex, and explaining it in detail would go beyond the scope of this Module. Rather, we will focus here on a particular aspect of the immune system, so that you can understand what HIV does to the human body once it gets inside us.

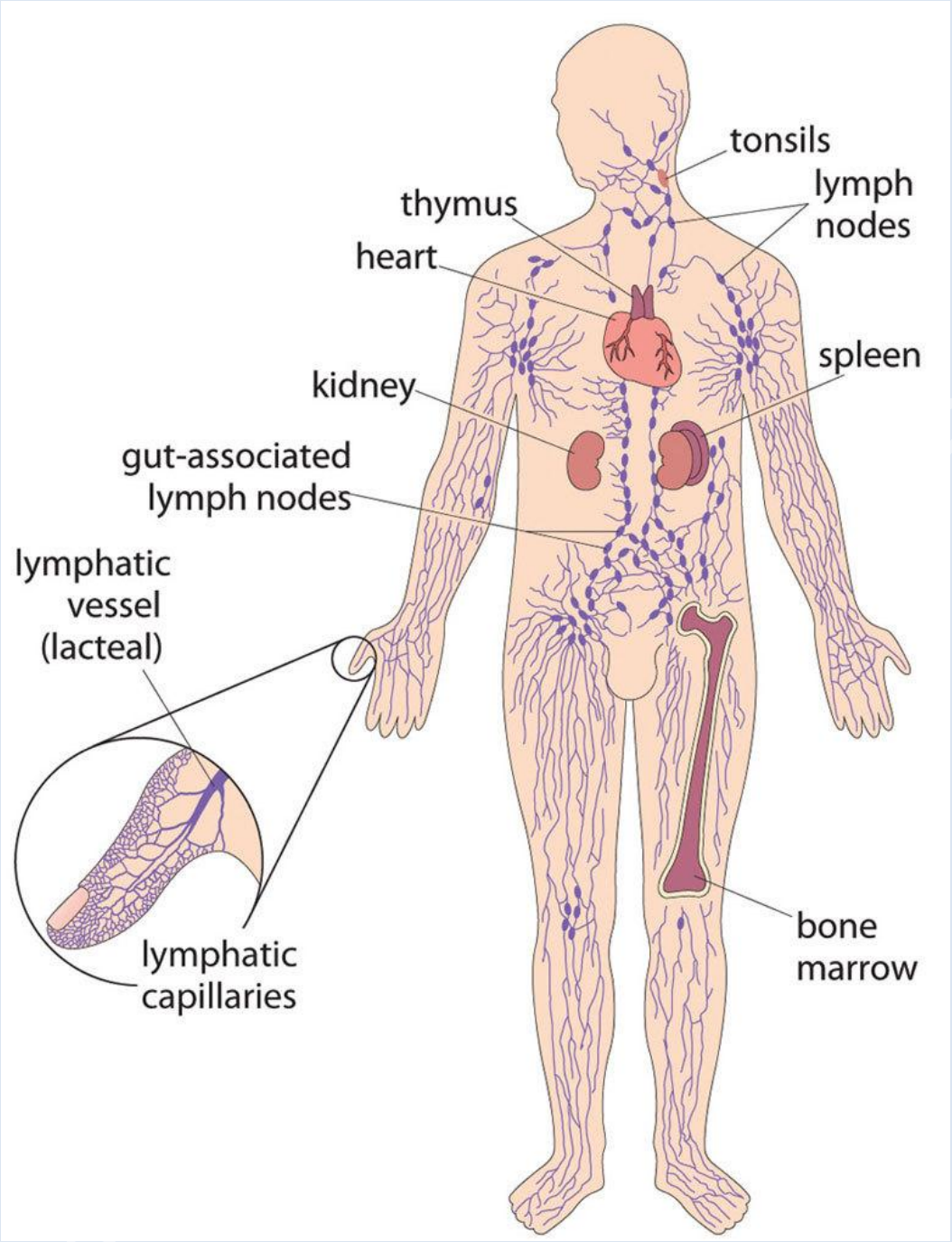

Figure 20.3 The sites in the body (in addition to the blood) where cells of the human immune system are concentrated.

Biologists and doctors use the term ‘leukocytes’ instead of white blood cells; we will use both terms in this study session. You will probably say ‘white blood cells’ when talking to your clients.

The immune system first recognises infectious agents as not being a normal part of the body, or, in other words, ‘foreign’ to the body. Then the cells of the immune system organise a concerted attack against the infectious agents in order to destroy

them. These immune cells are most often known as **white blood cells** — although the name is misleading because they are found throughout the body's tissues and organs, as well as in the blood, as Figure 20.3 shows. There are several different types of white blood cells, and we will say more about one of them shortly.

The immune response by a person's white blood cells takes a few days to build up during the first time that a particular type of infectious agent gets into his or her body. During this delay, there is usually time for the infectious agents to multiply and cause symptoms of the illness. However, as the immune attack builds up, it may become strong enough to eliminate the infection, and the person recovers spontaneously from a so-called **self-limiting infection**. But in some types of infection, the immune response cannot protect the person sufficiently from the infectious agents, they become more and more ill, and without medical intervention they may eventually die. This is what happens in PLHIV unless they receive modern medical treatments.

One important feature of the immune system is that it very quickly recognises the *same* infectious agents if they have invaded that individual in the past. This is known as **immunological memory**. It enables the immune system to organise a stronger, faster and more efficient attack if it comes across the same infectious agent again in the future. You will see later that the immune system manages to keep HIV under control for months or years after it first invades the body, but eventually it becomes overwhelmed by the virus.

3 Lymphocytes and the immune response to infection

We will now describe how the immune system attacks a virus (such as HIV), but note that similar processes occur when bacteria and protozoa invade the human body. The most important group of white blood cells in our defence against infection are the **lymphocytes**, of which there are several types (Figure 20.4). Lymphocytes called *B cells* are responsible for producing special proteins called **antibodies** against the invading infectious agents. Antibodies are proteins that bind to viruses (and other infectious agents), attracting other types of lymphocyte (we have called them *cytotoxic T cells* in Figure 20.4) to come and destroy the invaders. Viruses can only multiply inside the body's own cells, so destroying our own body cells if they have been infected by viruses is a price worth paying, because it slows down the production of more viruses.

Cytotoxic means 'able to kill cells'.

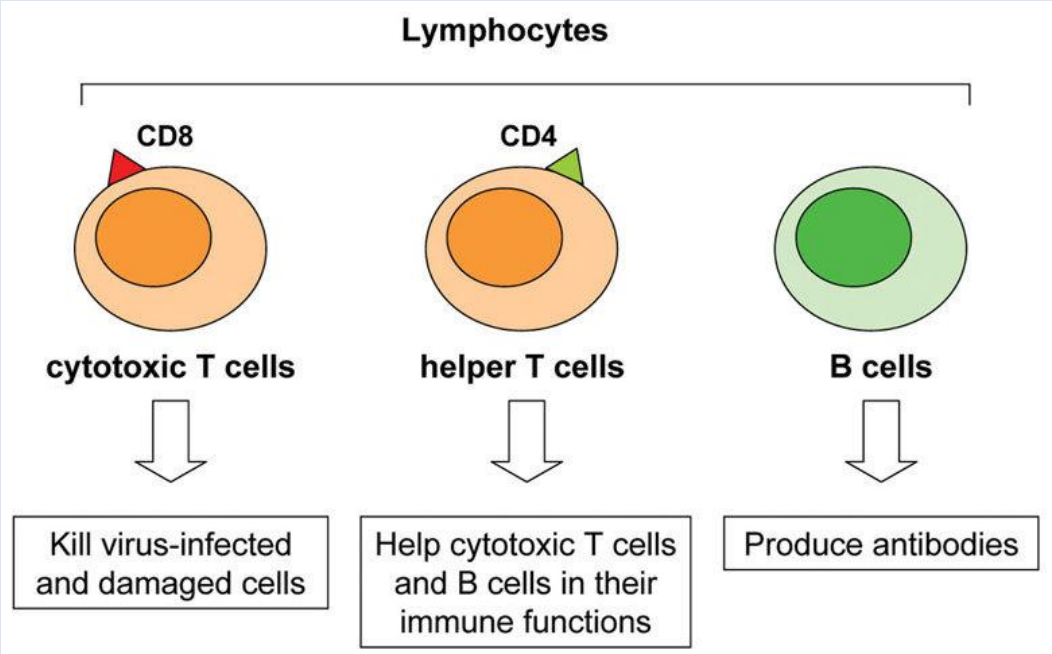

Figure 20.4 Three types of lymphocytes involved in the immune response against infectious agents in the human body. (Diagram: Dr Ignacio Romero)

Most importantly, the *helper T cells* in Figure 20.4 'help' all the other cells of the immune system to make antibodies and attack invading infectious agents. These cells are also known as **CD4 lymphocytes** (or **CD4 cells**) because they have a special protein on their surface called CD4. These are the terms we will use in this Module. Without a large number of CD4 lymphocytes circulating around the body acting as 'helpers', the functioning of the whole immune system collapses, and the person is defenceless against invasion by infectious agents.

4 Lymph nodes

If you look back at Figure 20.3, you can see that lymphocytes accumulate in sites located throughout the body, including the **lymph nodes** (or lymph glands). When an infection occurs, cells of the immune system, particularly lymphocytes, divide and produce more cells that help fight the infection. This process results in the lymph nodes becoming enlarged, as a result of the increased number of lymphocytes they contain. The lymph nodes in the neck can sometimes be seen as small swellings under the skin, or felt by touching with your fingers, if you have a bad cold or a throat infection. Enlarged lymph nodes may also be felt in the armpits and groin during some other infections. They return to their normal size once the infection has been eliminated.

How does HIV disable the immune system?

In this section, we explain how infection with HIV disables the human immune system. The key to this lies in the CD4 lymphocytes.

1 HIV infects the CD4 lymphocytes

Like all viruses, HIV has to enter (i.e. infect) healthy cells in the body in order to produce more copies of itself. These newly-produced viruses are then released into the blood in order to infect other susceptible cells. You may think of an HIV-infected cell as a sort of HIV factory. However, not all cells in the human body can be infected by HIV. Its main targets are the CD4 lymphocytes. Figure 20.5 shows in more detail the mechanism of infection of a CD4 lymphocyte by HIV.

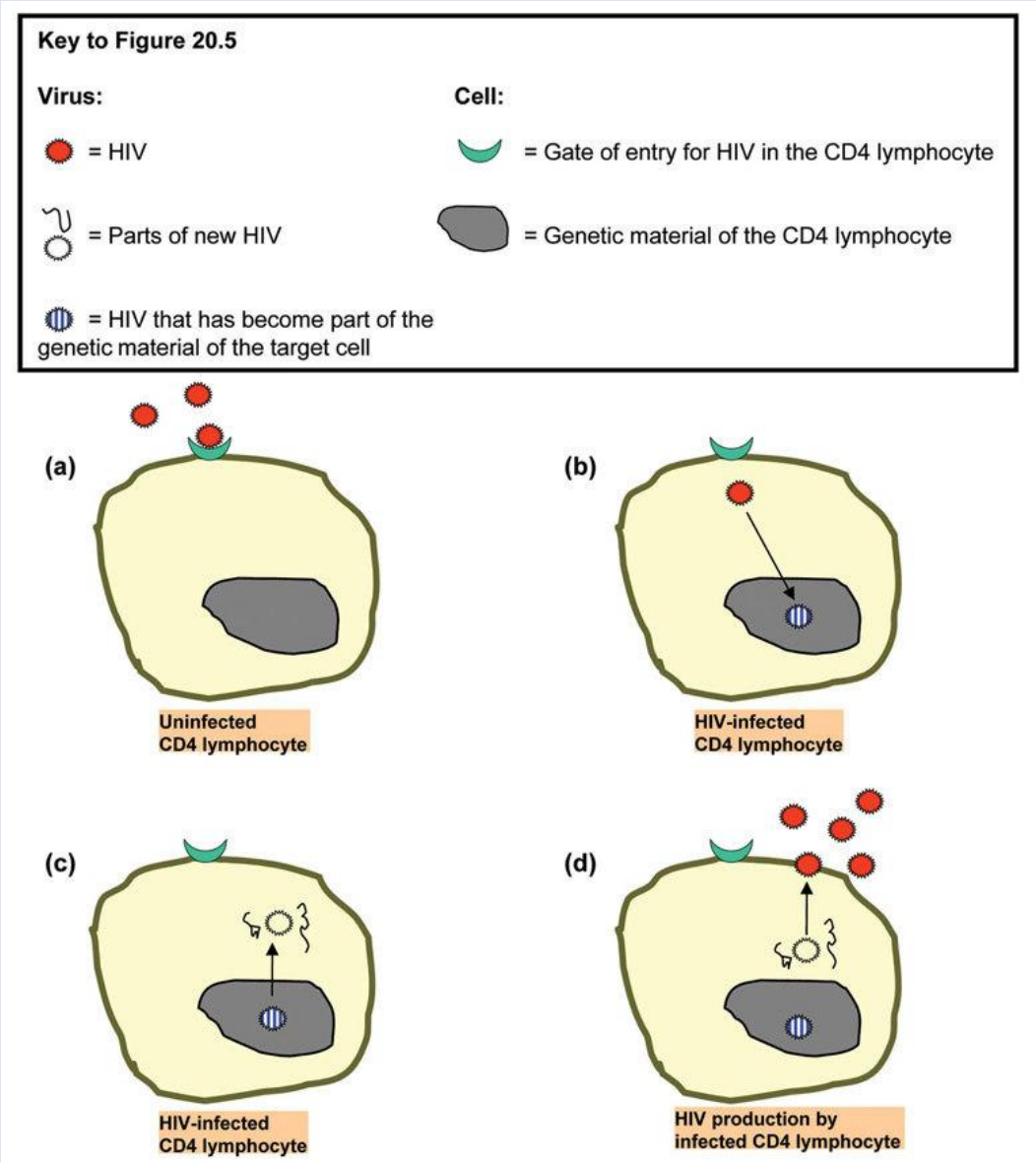

Figure 20.5 the life cycle of HIV. (a) HIV binds to proteins located on the surface of the target cell, in this case a CD4 lymphocyte. (b) HIV enters the cell, changes its structure and becomes part of the genetic material of the infected cell. (c) Many copies of HIV's genetic material are produced inside the cell, together with viral proteins necessary to construct more viruses. (d) HIV's genetic material and proteins assemble at the surface of the cell, and millions of new viruses are released outside the cell, where they can infect other CD4 lymphocytes.
(Diagram adapted by: Drs Aschalew Endale and Ignacio Romero, from Participants Manual, WHO/IMAI, *Integrated Management of Adolescent and Adult Illness*, Basic Clinical HIV Care, ART and Prevention Training Course, 2007)

2 How does HIV damage our immune system?

In a newly HIV-infected person, the virus enters some of the CD4 lymphocytes, which produce many new copies of the virus and shed them into the body. The

CD4 lymphocytes eventually die as they release their load of viruses. The new copies of HIV circulate in the body and attack other CD4 lymphocytes, which in turn produce more HIV and then die. This goes on and on — more and more CD4 lymphocytes are destroyed, as more and more HIV copies are made.

Question

What effect will the destruction of many CD4 lymphocytes have on the immune system's ability to protect the person from other infections?

Answer

The CD4 lymphocytes give essential help to the other types of lymphocytes that make antibodies, or kill virus-infected cells in the body; without this help, the rest of the immune system cannot function properly.

End of answer

Over time, the number of CD4 lymphocytes declines to the extent that the immune system cannot protect the person from illnesses like chest infections and diarrhoeal diseases that it would normally fight off. We will return to this point shortly.

The progression from HIV infection to AIDS

Understanding the difference between HIV and AIDS, and the natural course of an HIV infection, is important when you teach community members about HIV transmission and prevention. It also explains why you need to refer PLHIV quickly if they develop new health problems, or their health deteriorates.

1 The natural course of HIV infection

As you learnt in Study Session 1 of this Module, an infected person may not show symptoms of the disease right away — it generally takes some time to develop a disease after an infection. Likewise, when we say someone is 'infected with HIV', we mean that the person has the virus in their blood, and this has been confirmed by doing a laboratory analysis for HIV, or a rapid diagnostic test (RDT) on their blood. Note that an HIV-infected person may not have any symptoms and may look healthy, but they can still transmit the virus to their sexual partner(s).

During the first years of infection, the immune system, although weakened by the loss of some of its CD4 lymphocytes, still functions quite well. The infected person will have no symptoms, or only minor symptoms — perhaps a little loss of weight, or inflammation of the sinuses in the head. Many HIV-infected people do not know that they have acquired the virus at this stage.

Over several years, the person's immune system gradually becomes weaker, and they become vulnerable to persistent communicable diseases that they would previously have fought off before symptoms even developed, or would have quickly recovered from. These diseases are called **opportunistic infections (OIs)** because the infectious agents that cause them only have the 'opportunity' to multiply in the body because the PLHIV's immune system has been so badly affected by HIV.

In adults, it usually takes around 5–10 years after HIV infection before the person becomes very sick, if he/she is not taking ART. The natural course of HIV infection is shorter in children and infants when compared to adults. In Section 31.1 you will learn why HIV-infected children progress faster to AIDS.

2 Clinical staging of HIV disease and AIDS

As time passes and the number of CD4 lymphocytes declines even further, to a very low level, the incidence of opportunistic infections and other health problems in PLHIV increase, and the person is said to have reached a particular stage of HIV disease. The final stage of this progressive deterioration is known as AIDS — **Acquired Immunodeficiency Syndrome** — based on diagnostic criteria developed by the World Health Organization (WHO).

Modes of transmission of HIV

Now you know what HIV does once it has infected someone. But how is HIV transmitted from person to person? Getting infected with HIV does not happen as easily as, for instance, infection by the viruses that cause measles or influenza, which are transmitted in airborne droplets, typically during normal social contact with an infected person.

HIV needs 'transport' to get into the body of another person. This 'transport' can be blood, semen (the male sexual secretion containing sperm), vaginal fluid, or breastmilk.

Question

Suggest some ways in which these transport media could be transferred from one person to another.

Answer

HIV can be transmitted through sexual intercourse with an infected person; through transfusion of contaminated blood, or blood products, in medical treatment; through sharing of needles, syringes and cutting or perforating objects contaminated by HIV-infected blood or body fluids; through the blood of an infected mother passing into the baby during pregnancy or delivery; and finally through the breastmilk of an infected mother being fed to the baby.

End of answer

1 Transmission through sexual relations

Unsafe sex (sexual intercourse without a condom) is responsible for the majority of HIV infections worldwide. HIV is primarily considered as a **sexually-transmitted infection (STI)**, an infection that is transmitted through sexual intercourse. Different types of sexual practice have different degrees of risk for transmitting HIV, as described below.

Anal sex

Anal sex refers to the penetration by the male penis into the anus of another person. It represents the biggest risk of infection if one of the partners is HIV-infected, because the anal **mucosa** does not produce natural lubrication, is fragile, and wounds and bleeds very easily during anal sex. Also, the penis can have **microlesions** (tiny areas of damaged tissue that are too small to be visible with the eyes), which permit the entrance of the virus into the bloodstream. The soft tissue of the male foreskin in uncircumcised men is especially vulnerable to infection during both anal and vaginal (see below) sex.

Mucosa (also known as mucous membrane) is a very thin layer of moist tissue that lines some organs and body cavities, including the mouth, anus and the reproductive tract.

Vaginal sex

Figure 20.6 An HIV/AIDS awareness-raising poster used in Ethiopia to warn of the dangers of unprotected sex and inform people about ways they can protect themselves from HIV infection. (Photo: Carrie Teicher)

Vaginal sex involves penetration of the female vagina by the male penis, and is the most common type of sexual practice. HIV can be found in large quantities in the semen of infected men, and to a lesser amount in the vaginal secretions of infected women. The risk of infection is still high in vaginal sex, but less than with anal sex, because the vagina produces natural lubrication and is more elastic. However, unprotected vaginal sex represents a serious risk of HIV infection, because the vaginal mucosa (as well as the penis) can have microlesions which permit entry of the virus into the body. Figure 20.6 is a poster which was designed to raise awareness about the dangers of unprotected vaginal sex, and to inform people about ways to reduce the risk of HIV infection

Oral sex

The term **oral sex** means there is contact between the genitals and the mouth. Compared to anal and vaginal sex, oral sex represents the smallest risk for HIV transmission. However, very small wounds in the mouth can allow entry of the virus into the body.

Other STIs increase HIV transmission risk

Note that in all types of sexual practice, the presence of other STIs causing damage to the genitals (discharge or ulcers) increases the risk of acquiring and transmitting HIV. This is because, in people with an STI, transmission of HIV is easier due to the presence of lesions in the genital mucosa.

5.1 Transmission through blood contact

The blood is another way of transmitting HIV. HIV can be transmitted through transfusion of an infected blood or blood products; sharing contaminated needles and syringes to inject illegal drugs; accidental puncturing of the skin by contaminated instruments during healthcare; and sharing contaminated piercing or cutting instruments used in tattooing or harmful traditional practices, like *uvulectomy* (cutting out the uvula in the roof of the throat) and *female genital mutilation* (cutting the clitoris and labia).

5.2 Transmission from mother to child

HIV can be transmitted from an infected mother to her child through the placenta during pregnancy, or (more often) during labour and delivery. Also, breastfeeding can transmit the virus from mother to child because the breastmilk of an infected mother contains HIV, which can penetrate the mucosa lining the baby's gastrointestinal tract.

Figure 20.7 A poster raising awareness about work-related issues connected with HIV. (Source: http://indiandevelopmentfoundation.blogspot.com/2008/12/facts-about-hivaids.html)

Myths about HIV transmission

Knowing how HIV is *not* transmitted, and educating community members about the myths that some may believe, helps to increase the *inclusion* of PLHIV in society, and reduce the stigmatisation and discrimination they often experience.

Myths about HIV transmission

HIV is *not* transmitted by:

- tears, saliva, sweat or urine
- personal contacts — kisses on the mouth, hugging, handshakes
- social contact — at work, in school, in cafés and restaurants
- air or water — sneezing, coughing or swimming
- contact with common items — pens, toilets, towels, sheets, soap
- insects — mosquito bites or bites by other insects.