

Clinical Tract

Module on

Epidemiology of HIV

LEARNING OUTCOMES FOR SOCIAL WORKERS, LABORATORY TECHNICIANS, PHARMACISTS, NURSING STAFF AND DOCTORS

After completion of this module the learner should:

- Describe the extent of HIV epidemiology in South Africa and Southern Africa.
- Know the different subtypes of HIV, their distribution in the world and their influence on vaccine development.
- Know the different routes and risk of HIV transmission.
- Know how this epidemiology can be monitored.

Lay counsellors and data typists do not need to study this module.

1. EPIDEMIOLOGY OF HIV

Since 1981 when the world first became aware of this new disease, HIV/AIDS infection has become one of the most feared epidemics of the 21st century facing humankind with an estimated 60 million people having been infected by the virus so far. The rate of new infection worldwide is estimated at nearly 6 million per year.

History of HIV

The current pandemic is thought to have started in mid-to-late 1970's with sporadic cases occurring in different parts of the world and given different names like "slim" disease in Africa. In 1981, the new disease affecting mainly men sleeping with men (MSM) was described in New York and later in Los Angeles and San Francisco in USA. It was initially thought to be a disease affecting only MSM but later in the same year, the disease was found to affect other population groups too. In 1982, it was established that a sexually transmitted infectious agent was causing the disease, and the name acquired immune deficiency syndrome (AIDS) was then introduced. In May 1983, a new virus believed to be the causative agent of AIDS was isolated at the Institute Pasteur in France. It was initially called lymphadenopathy associated virus (LAV). One year later, the US National cancer institute also isolated a similar virus and called it human T-cell lymphotropic virus (HTLV III). Both names were dropped in 1986 and human immunodeficiency virus (HIV) adopted.

Origin of HIV

HIV belongs to the subfamily *lentiviruses* that are part of the *retroviridae* group. There are two distinct types of viruses, HIV type 1 (HIV-1) and HIV type 2 (HIV-2).

Current molecular epidemiology data have indicated that humans are not the natural hosts of either HIV-1 or HIV-2 but instead, the viruses have entered the population as a result of zoonotic or cross-species transmission from African primates. The less virulent HIV-2 is genetically similar to the simian immunodeficiency virus that is endemic among sooty mangabeys (SIV_{sm}) while HIV-1 originated from a particular chimpanzee subspecies (SIV_{cpz}).

Direct human contact with infected chimpanzee and sooty mangabey blood during hunting, butchering and other activities resulted in zoonotic transmission of SIV to humans. The sooty mangabey monkeys are also kept as pets therefore allowing frequent human contact with infected animals. These primates act as natural hosts and reservoirs but have not been shown to develop disease from these infections.

West equatorial Africa and West African countries are the geographical regions where the seeds of the HIV epidemic appear to have been planted. Certain social, economic, and behavioural changes must have occurred in the early and mid-20th century creating circumstances that allowed the viruses to expand and reach epidemic proportions.

Subtypes

HIV-1 consists of three genetic groups:

- the major group (group M)
- the outlier (group O) and
- the "new" group (non-M/non-O) or group N, first reported in 1998

The predominant M group consists of eleven genetic subtypes (clades) designated A to K. Except for a minority of cases that originate primarily from West Africa and caused by HIV-2, HIV-1 accounts for most of the infection worldwide.

Table 1. Distribution of the predominant group M subtypes (HIV-1)

| Subtypes | Distribution |
|----------|--|
| A | West Africa, East Africa, Central Africa, East Europe, Middle East |
| B | North America, Europe, Middle East, East Asia, Latin America, New Zealand, Australia |
| C | South Africa, South Asia, Ethiopia |
| D | East Africa |
| E | South East Asia |
| F | Europe, South America |
| G and H | Russia, Central America |
| I | Cyprus |

Almost 50% of the new infection worldwide was caused by subtype C strains in 2000. Subtype C has a high incidence in Sub-Saharan African countries. Subtype A was the second most prevalent variant and subtype B the third subtype causing a significant number of HIV-1 infections globally. Group O and N subtypes are rare and are mainly found in West Africa.

The genetic material between the subtypes overlaps by approximately 30%. A high mutation rate occurs because the reverse transcriptase enzyme of HIV-1 lacks proofreading capacity. That leads over time to a diversity of viral nucleic acid sequences. One individual might therefore be infected with a number of different HIV "strains".

The different subtypes and variants characteristic of the virus poses a major scientific challenge in the development of a single or multiple vaccines effective against all major subtypes of HIV and therefore able to control the epidemic globally. The HIV vaccine undergoing phase III trials currently in USA and Thailand (AIDSVAX) was designed to reduce susceptibility to HIV subtype B. The HIV vaccine phase I trial approved last year here in South Africa is the first in the world to test a subtype C vaccine (ArV vaccine). A safe, effective and affordable vaccine is essential for control of the pandemic.

2. THE GLOBAL HIV/AIDS PANDEMIC

More than 20 years since AIDS was first diagnosed, the new global estimates of the AIDS epidemic show that the spread of HIV/AIDS has continued in alarming proportions despite all measures taken to control the epidemic.

The Joint United Nations Programme on HIV/AIDS (UNAIDS) epidemic report delivered in the XV international AIDS conference in Bangkok in July 2004 presented a more accurate picture of the AIDS epidemic to date with more comprehensive and revised data unlike the previous years. From the report, the number of people living with HIV/AIDS worldwide has grown from 35 million in 2001 to about 38 million in 2003. Approximately 70% of this infected population is in Sub-Saharan Africa. Sub-Saharan Africa is home to only 10% of the world's population but has an estimated 25 million people living with HIV.

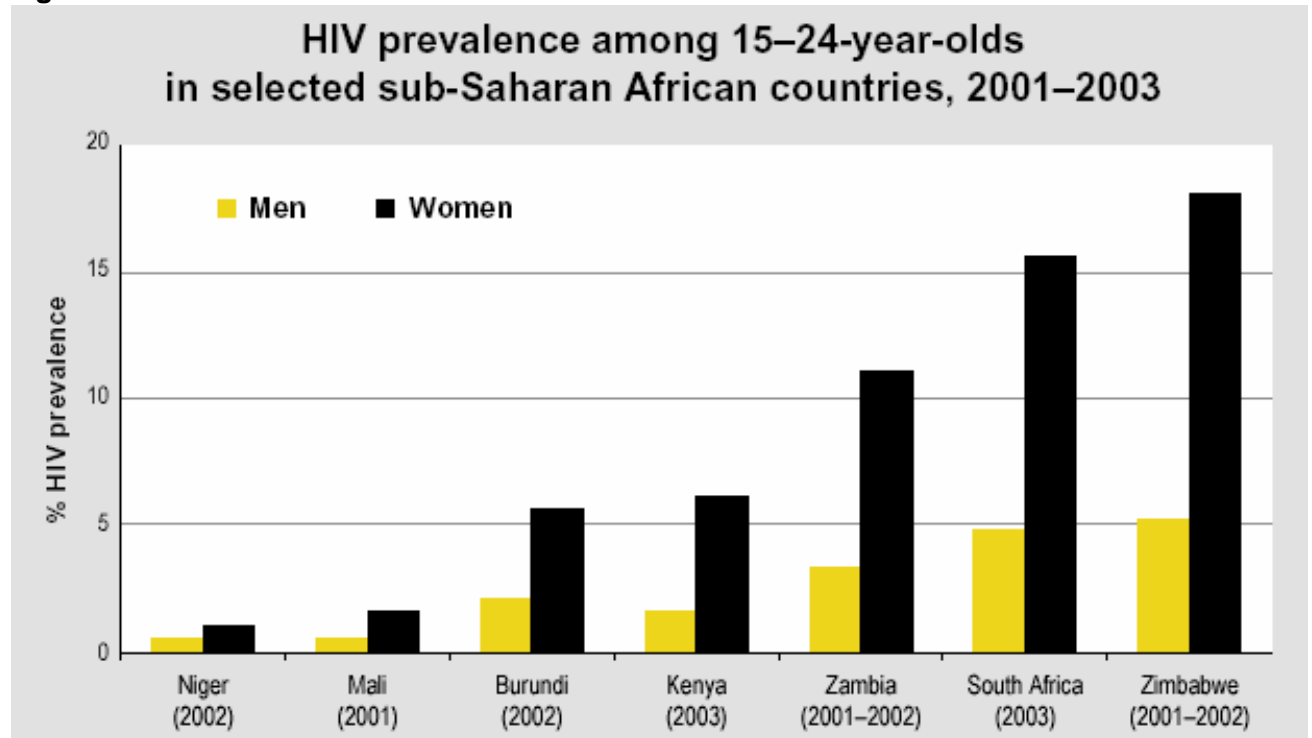
In 2003, 5 million people became newly infected with HIV worldwide. Young people between 15 – 24 years accounted for half of all the new infections. In Sub-Saharan Africa, the newly infected population was estimated at around 3 million people. Globally, more than 20 million deaths have occurred over the past two decades due to HIV/AIDS. Approximately 15 million children have lost one or both parents to AIDS (12 million are in Sub-Saharan Africa).

Table 2. Regional HIV and AIDS statistics and features, end 2003

| | Adults & children living with AIDS | Adults & children newly infected | Adults & children deaths due to AIDS |
|--|---|---|---|
| Sub-Saharan Africa | 25.0 million | 3.0 million | 2.2 million |
| N. Africa & Middle East | 480 000 | 75 000 | 24 000 |
| South & Southeast Asia | 6.5 million | 850 000 | 460 000 |
| East Asia | 900 000 | 200 000 | 44 000 |
| Latin America | 1.6 million | 200 000 | 84 000 |
| Caribbean | 430 000 | 52 000 | 35 000 |
| Eastern Europe & Central Asia | 1.3 million | 360 000 | 49 000 |
| Western Europe | 580 000 | 20 000 | 6 000 |
| North America | 1.0 million | 44 000 | 16 000 |
| Oceania | 32 000 | 5 000 | 700 |
| Total | 37.8 million | 4.8 million | 2.9 million |

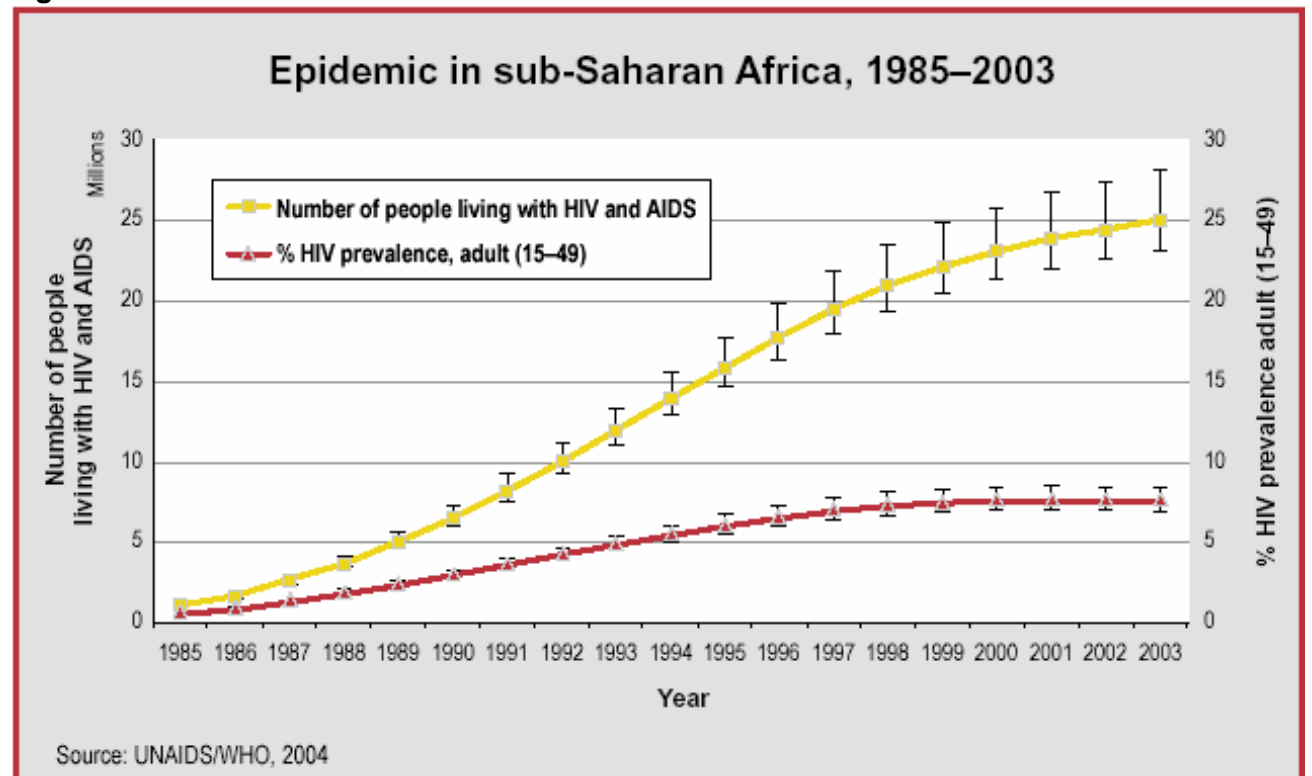
From: UNAIDS/WHO 2004

Figure 1



From: UNAIDS/WHO 2004

Figure 2



Source: UNAIDS/WHO, 2004

As of December 2003, almost half of the people infected with HIV worldwide were women and about 57% in Sub-Saharan Africa. Women, especially in Africa are harder hit than men due to the increased susceptibility of acquiring HIV infection and the vulnerable position posed by existing gender and cultural inequalities.

As evidenced by this report, Sub-Saharan Africa remains the global epicenter of this epidemic although Asia and Eastern Europe are the regions experiencing the fastest-growing epidemics in the world currently. Six Sub-Saharan countries have a HIV prevalence of over 20%. Botswana, a country of less than 2 million people, has an adult HIV prevalence rate of 37.3% and Swaziland has an adult HIV prevalence rate over 35%. South Africa, with 5.3 million HIV positive people, has the largest number of people living with HIV worldwide. West Africa has a much lower HIV prevalence of less than 10% while in Central and East Africa it ranges from 4 – 13%. Almost 2.2 million deaths occurred in the Sub-Saharan region last year due to AIDS (75% of all AIDS-related deaths worldwide) and 3 million people became newly infected in the same period. The increase in AIDS deaths gives an apparent stabilization in HIV prevalence rates.

If large-scale treatment programmes are not implemented, it is postulated that the life expectancy will drop to 49 years for persons born between 1995 and 2000 in seven African countries where HIV prevalence is above 20%. In Zambia, Zimbabwe and Swaziland, life expectancy is expected to drop to below 35 years if treatment is not made available. Sadly, only 7% of the 5 – 6 million people requiring ARVs in developing countries had access to drugs by end of 2003 and the prevention programmes reach only one in five people at risk of HIV infection.

A severe epidemic in Africa has led to a reduced workforce and overcrowding of health facilities which are already overburdened with insufficient resources and infrastructures. Disintegration of households due to reduced income, loss of breadwinners to the epidemic and increased expenditure on medical and other costs has caused increased poverty and hunger in affected households.

Military conflicts and natural disasters in Africa have also contributed immensely in worsening the transmission of HIV infection by increasing poverty, migration, prostitution, intravenous drug use and other social ills. The economic devastation caused by all these factors poses a major threat to political stability in many African nations.

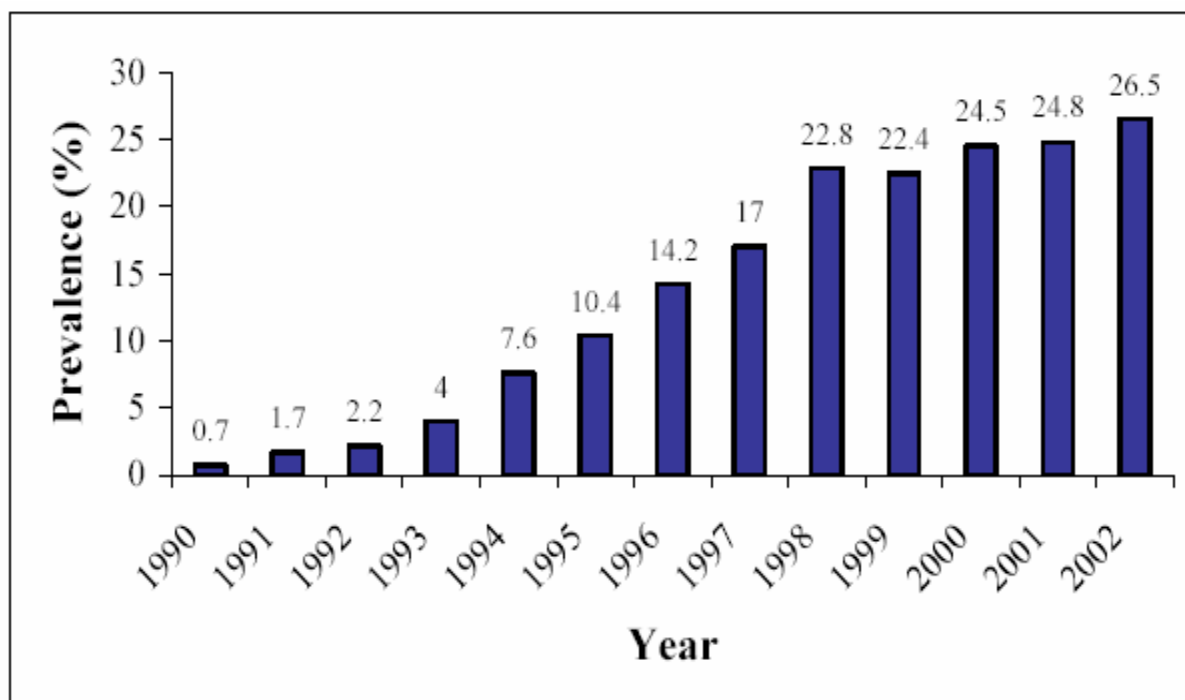
Therefore, this epidemic is not only a medical calamity but also a public health, social political and economic disaster.

3. THE HIV EPIDEMIC IN SOUTH AFRICA

The Department of Health in South Africa performs a yearly national HIV-prevalence survey of women attending public antenatal clinics. After data collection, a statistical model is formed to project the demographics of the epidemic. The 2002 antenatal sentinel survey report estimated that 5.3 million South Africans were HIV positive by the end of that year (4.74 million estimate in 2001). In keeping with the global trend, 2.95 million females between 15 – 49 years and 2.3 million men in the same age group were infected with HIV.

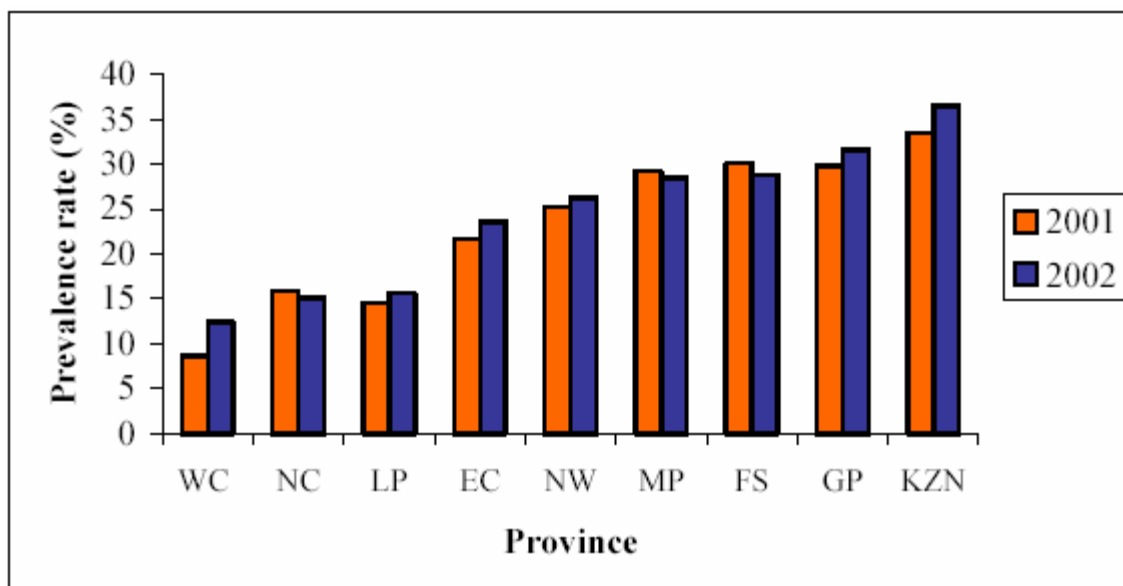
About 91 271 babies became infected by vertical transmission (MTCT) in the same period. The national HIV prevalence of pregnant women who were HIV positive was 26.5% and the most affected age group was females between 25 and 29 years with an estimated 34.5% prevalence rate.

Figure 3. HIV prevalence trends among antenatal clinic attendees in South Africa 1990 – 2002.



From; National HIV and Syphilis Antenatal Sero-prevalence Survey in South Africa 2002

Figure 4. HIV prevalence by province among ANC attendees in South Africa: 2001 and 2002.



From; National HIV and Syphilis Antenatal Sero-prevalence Survey in South Africa 2002

Looking at the different provinces in 2002, KwaZulu-Natal had the highest HIV prevalence with a rate of 36.5%, Gauteng (31.6%) second highest, Free state (28.8%), Mpumalanga (28.6%) and Western cape the lowest with a prevalence rate of 12.4%.

4. MAJOR FACTORS ACCELERATING THE EPIDEMIC IN SOUTH AFRICA

These factors can be categorized broadly into two groups:

- immediate determinants and
- underlying determinants

Immediate determinants

- behavioural factors
 - frequency of unprotected sexual intercourse
 - multiple sexual partners
- biological factors such as high prevalence of sexually transmitted diseases

Underlying determinants

- socioeconomic factors such as poverty, migrant labour system with family disruptions
- commercial sex practices
- lack of formal education with high level of illiteracy
- low status of women due to gender discrimination with male dominance
- high mobility because of good transportation system leading to rapid transmission of the virus to new communities
- stigmatization and discrimination of infected persons

5. TRANSMISSION OF HIV

HIV infection is a communicable disease with the following modes of transmission:

- sexual transmission – heterosexual, homosexual and rarely orogenital routes
- vertical transmission – mother-to-child transmission (MTCT)
- parenteral transmission (using injections via different routes)
 - through intravenous drug use
 - transfusion of blood and blood products
 - occupational exposure to the virus

Sexual transmission is the most common mode of HIV transmission. This can be heterosexual transmission or men having sex with men (MSM). The virus can still be sexually transmitted by persons on antiretroviral treatment (ARVs).

Sexual transmission

Heterosexual transmission is by far the most common mode of infection, especially in Sub-Saharan Africa. More than 80% of infections occur through heterosexual transmission. The risk of acquiring HIV infection through vaginal intercourse is approximately 0.1% with each sexual exposure and about 1% for each sexual exposure through anal intercourse. The risk of transmission is also influenced by other concomitant factors, like sexually transmitted infections, the amount of circulating HIV in the blood (viral load) and trauma during sex such as in rape. Age-specific infection rates in Africa strongly follow patterns of sexual behaviour and those of sexually transmitted infections.

Mother-to-child transmission

There is a 25 – 35 % chance of transmission from infected mother to fetus or infant in the absence of prophylactic antiretroviral therapy or any other interventions to the mother during pregnancy, labour and delivery, and to the baby following birth.

Transmission of HIV can occur during:

- intrauterine during the pregnancy - especially if the acute primary infection to the mother occurs during pregnancy. This is due to the high level of viremia in the weeks following acute infection.
- intrapartum (during delivery) – period of highest infection rate in MTCT due to contact of baby with maternal blood and vaginal secretions in the birth canal.
- postpartum through breast feeding – accounts for 5 – 15 % of infant infections after delivery with the risk being highest in the early months of breastfeeding.

Parenteral transmission

- transfusions – patients who receive HIV-infected blood or blood products. The risk is mainly due to blood donation in window period where the donor has not yet seroconverted.
- intravenous drug use – by sharing infected needles (more common in industrialized nations and Asia)
- nosocomial HIV transmission
 - from provider-to-patient is exceedingly rare. It has been reported in the 1990 case of a Florida dentist in USA who infected six of his patients and later a case involving a French orthopedic surgeon who infected one of his patients
 - reusing of unsterilised needles and medical equipment

Occupational risk

A small but definite risk in health care workers and other support staff who come into contact with HIV-infected specimens especially sharp objects, and also with tissues or body fluids contaminated with blood. The majority of these infections are via percutaneous injuries, but mucocutaneous transmissions have been reported with increased risk if contact was made for a long period with large quantities of blood.

The risk of HIV infection from a contaminated needle stick (percutaneous) injury is approximately 0.3% per exposure. Hepatitis B virus infection risk is 6 – 30 % and that of hepatitis C virus is 1.8 %.

So far, there is no evidence to suggest transmission of HIV by:

- hand holding or hugging
- sharing bathroom facilities
- sharing eating utensils
- social kissing
- mosquito and other insect bites or
- food handling

6. MONITORING THE EPIDEMIC

This is mainly done by widespread data collection. It can be by surveillance studies of:

- voluntary counseling and testing of HIV (VCT) which is diagnostic and linked to an individual therefore must be confidential
- anonymous and unlinked sentinel surveys such as:
 - pregnant women attending antenatal clinic
 - blood donors
 - patients attending sexually transmitted infections (STI) clinics
 - military recruits or other types of recruitments

After data collection, a statistical model is formed to project the demographics of the epidemic. The data becomes more useful when linked with details of demography and risk behaviours like different age groups, gender, infections like STIs and other variables.

Limitations of global data collection

- variable incubation period of infection
- existing differences between countries in case definitions of AIDS
- underreporting due to various reasons such as political sensitivity, lack of reporting infrastructure and limited funding and resources
- non-presentation of individuals with HIV/AIDS by seeking care in the private sector or to avoid stigmatization and discrimination
- HIV/AIDS is not a notifiable disease in most countries
- patient refusal to consent to testing

7. FURTHER READING

- The Joint United Nations Programme on AIDS (UNAIDS) Global AIDS epidemic report – 2004 <http://www.unaids.org>
- National HIV and Syphilis Antenatal Sero-prevalence Survey in South Africa 2002 – <http://www.doh.gov.za>
- Braunwald E, Fauci AS, Kasper DL, *et al.* HIV/AIDS and related disorders; *Principles of Internal Medicine textbook*, Harrison's 15th Edition; 2001: chapter 309.
- Halm BH, Shaw GM, De Cock KM, *et al.* AIDS as a Zoonosis: Scientific and Public Health Implications; *Science*; **278**: January 2000.
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- Allen DM, Simelela NP, Makubalo L. Epidemiology of HIV/AIDS in Southern Africa; *Southern African Journal of HIV Medicine*, July 2000:9-11.
- Evian C. Why the latest antenatal HIV prevalence survey results are still bad news. *Southern African Journal of HIV Medicine* 2003;**13**:29-30.

