

Understanding the latest estimates of the global AIDS epidemic November 2005

1. On what data do UNAIDS and WHO base their HIV prevalence estimates?

The *precise* numbers of people living with HIV, people who have been newly infected or who have died of AIDS are not known. Achieving 100% certainty about the numbers of people living with HIV globally, for example, would require testing every person in the world for HIV every year—which is logistically impossible. But we can estimate those numbers by using other sources of data.

UNAIDS/WHO estimates are based on all pertinent, available data—including surveys of pregnant women, population-based surveys (conducted at the household level), sentinel surveillance among populations at higher risk of HIV infection, case reporting, vital registration systems (the official recording of births and deaths), as well as other surveillance information.

Different sets of data are used to calculate estimates of HIV prevalence for *generalized* (high-level) and *concentrated* (low-level) epidemics.

In countries with *generalized* epidemics, estimates of HIV prevalence are primarily based on blood samples from pregnant women in antenatal clinics (ANC). In the absence of population-based surveys that include testing for HIV antibodies, sentinel surveillance of women attending antenatal clinics generally provides the best available estimate of HIV prevalence in the population.

For countries with low-level or *concentrated* epidemics, HIV estimates are based on sentinel surveillance among key populations who are at higher risk of HIV exposure—such as injecting drug users, sex workers, or men who have sex with men.

Countries with *concentrated* epidemics sometimes have additional sources of data which can help refine estimates. In Countries such as Argentina and Brazil, which have extensive voluntary counselling and testing programmes, case reports can make estimates more precise.

Steady improvements in the modelling methodology and better data from country surveillance therefore are enabling UNAIDS/WHO to develop more accurate estimates.

The latest estimates cannot be compared directly with estimates published in previous years. Nor should these latest estimates be compared directly with those UNAIDS/WHO will publish in the years to come. Why not? Because the assumptions, methodologies and data used to produce the estimates are gradually changing, thanks to ongoing enhancement of our knowledge of the epidemic. Comparing the latest estimates with those published in previous years is liable to yield misleading conclusions.

In a nutshell, the latest estimates—for the current year and for past years—will tend to be more accurate and reliable than those produced in previous years, since they are based on improved methods and more data than earlier estimates.

2. What are the strengths and weaknesses of antenatal and household surveys?

Each of these methods has its strengths and weaknesses. Generally, estimates based on antenatal clinic data are a useful gauge of HIV infections *trends* among 15–49 year-olds.

Studies have shown that high proportions of women in most of the highly-affected countries have access to antenatal clinic services. In addition, women visiting these services are generally healthy, which avoids the sampling bias inherent in testing sick individuals. Where possible, estimates derived from antenatal clinic data have been compared at local level with HIV prevalence data acquired in population-based surveys. Such validation exercises have concluded that estimates based on antenatal clinic sentinel surveillance provide a good approximation of HIV prevalence among adults aged 15-49 (men and women combined) in the local community.

National household surveys, on the other hand, can reveal important information about the national prevalence level and about the spread of HIV, particularly among young people, men and residents in rural areas. Considered together, the various data can yield more accurate estimates of HIV infection levels and rates (and of other estimates, such as AIDS-related deaths). However, HIV and AIDS estimates (whether derived from household surveys or sentinel surveillance data) need to be assessed carefully, and the data and assumptions reviewed continually.

3. Why are UNAIDS and WHO publicizing ranges of HIV and AIDS estimates?

The ranges reflect the degree of uncertainty associated with estimates and define the boundaries within which the actual numbers lie.

In earlier UNAIDS/WHO reports, we reported point estimates (for example, fixing HIV prevalence in country X at 12.5%). In addition, we also published the ranges of uncertainty around those point estimates, depending on the quality of the data that had yielded the estimates. This was done because all estimates fall within a range of uncertainty.

Because the quality of data varies from country to country, the ranges of uncertainty surrounding our estimates can widen or narrow depending on the country. As well, presenting point estimates might have encouraged a false sense of precision, notwithstanding the fact that ranges of uncertainty were also provided.

Improved methods, enhanced data and new estimation tools are enabling a better understanding of the degrees of uncertainty that surround HIV and AIDS estimates. This is part of an ongoing process of improving estimates and developing appropriate ranges—all of which are vital for effective HIV/AIDS planning and programming at national and regional levels.

UNAIDS and WHO are confident that the actual numbers of people living with HIV, people who have been newly infected or who have died of AIDS lie within the reported ranges.

4. If UNAIDS and WHO claim the current estimates are more accurate, why are the ranges for some countries so large?

The ranges reflect the degrees of uncertainty around HIV estimates in particular countries. Accordingly, the ranges vary, depending on the quality of HIV data available in different countries.

Four factors determine the extent of the ranges around the HIV estimates:

- (i) The HIV prevalence level. Ranges tend to be smaller when HIV prevalence is higher. Thus the bounds around the best estimate of adults living with HIV in Botswana are relatively small (330,000 – 380,000) while they are much wider in a lower prevalence country such as Senegal (22,000 – 89,000).

- (ii) The quality of the data. Countries with better quality data have smaller ranges than countries with poorer quality data. The ranges for Asia and the Pacific are comparatively broad—which reflects the fact that HIV surveillance of key populations (such as injecting drug users, sex workers and men who have sex with men) is relatively poor in most countries in that region. In general, the ranges for sub-Saharan Africa are narrower, because of recent improvements in the collection and interpretation of HIV data in that region. Uganda and the Democratic Republic of Congo both have very similar estimates of adult prevalence. However Uganda, which has a very strong surveillance system, has a much smaller range around its estimate of adult prevalence (2.8% - 6.6%) than does the Democratic Republic of Congo (1.7% - 9.9%), where the quality of surveillance is weaker when judged by a standard set of criteria.
- (iii) The number of steps or assumptions used to arrive at an estimate. The more steps and assumptions, the wider the range is likely to be (since each step introduces additional uncertainties). For example, ranges around estimates of adult HIV prevalence are smaller than those around estimates of HIV incidence among children, which require additional data on the probability of mother-to-child HIV transmission. The latter are based on prevalence among pregnant women, the probability of mother-to-child HIV transmission, and estimated survival times for HIV-positive children. There is therefore greater uncertainty in these estimates than for adult prevalence alone.
- (iv) The type of epidemic (generalized or low-level/concentrated). Ranges tend to be wider in countries with low-level or concentrated epidemics than in countries with generalized epidemics. Why? In low-level or concentrated epidemics, one needs to estimate both the numbers of people in the groups at higher risk of HIV infection *and* HIV prevalence rates in those groups.

5. How confident are UNAIDS and WHO about the estimates of the number of people who die of AIDS each year?

Estimates of adult AIDS mortality are based on several assumptions and sets of data—including estimates of the numbers of adults and children who are HIV-infected, and estimations of survival times for adults and children infected with HIV.

In some countries with *generalized* epidemics, estimates of deaths derived from vital registration systems or census rounds can provide additional information. Those data can be used, for example, to gauge changes in age patterns of mortality over time and thereby provide an independent estimate of deaths due to AIDS. However, in most countries with generalized epidemics, coverage of vital registration is too low to provide useful information on AIDS mortality.

Generally, mortality estimates are most reliable in countries where prevalence is declining or has been steady for some time. This is because AIDS mortality in a given year is largely dependent on prevalence levels 5-10 years earlier.

Estimating adult new infections and mortality in countries with low-level or *concentrated* epidemics is more difficult. Some at-risk groups are likely to have a different background mortality, in other words they are more prone to other causes of death. (for example, injecting drug users are vulnerable to fatal drug overdoses and other life-threatening hazards). As well, some people tend to drift out of such at-risk groups. All this can have substantial effects on patterns of mortality. Unfortunately, country-specific data on mortality and on changes in risk behaviour are seldom available. However, some countries with low-level/concentrated epidemics have well-functioning vital registration systems that include the cause of death.

6. Has the epidemic peaked in sub-Saharan Africa?

In sub-Saharan Africa, adult HIV prevalence appears to have stabilized. However, it is important to realise that a stable prevalence is only possible if HIV-associated deaths are replaced by new infections. Thus, a stable prevalence in sub-Saharan Africa still represents over 3 million new infections each year.

The number of people living with HIV in the region rose dramatically in the late 1980s and 1990s, and was still growing in 2005, although at a slower rate. This slower growth is a result of a peak in new infections which occurred in the mid-1990s and a rapid increase in the annual number of people who die of AIDS.

It is now clear that across most of sub-Saharan Africa (including parts of southern Africa), HIV prevalence among pregnant women visiting antenatal clinics has been roughly level for several years—albeit at very high levels in Southern Africa. This apparent ‘levelling off’ of HIV prevalence has been interpreted by some observers as an indication that the AIDS epidemic might have reached a turning point in sub-Saharan Africa. Unfortunately, available evidence does not offer grounds for such conclusions.

Even though HIV prevalence rates have stabilized in this region the actual *number* of people infected continues to grow because of population growth. Applying the same prevalence *rate* to a growing population will result in increasing *numbers* of people living with HIV.

6.1 What might be causing the apparent stabilization of HIV prevalence in sub-Saharan Africa?

Two factors are causing the apparent stabilization of prevalence rates observed in much of the region: AIDS mortality rates and HIV incidence. High and, in some countries, rising rates of AIDS mortality and continuing high HIV incidence offsetting this mortality are the cause of this appearance of levelling off. In Zambia, for example, national HIV prevalence appears to have stayed relatively stable for the past 8–10 years. Since it is estimated that close to 80,000 people living in Zambia have been newly infected annually over that period, overall prevalence has remained roughly level because AIDS has killed as many people each year. HIV prevalence might therefore appear stable, but it hides a persistently high number of annual, new HIV infections and an equally high number of AIDS deaths.

On the otherhand, as ART coverage increases, it is possible that we will see prevalence levels increase as more people infected with HIV live longer.

But we are not, unfortunately, witnessing a decline in this region’s epidemic. In the absence of effective interventions, the epidemic will continue to wreak havoc in these countries.

6.2 There is no such thing as the “African” AIDS epidemic

It is important to remember that there is not one, typical “African” AIDS epidemic. In seven countries, adult HIV prevalence is below 2%, while in six other countries it is over 20%. These extreme differences in prevalence levels fall roughly into geographically separate areas. Seven countries of southern Africa (Botswana, Lesotho, Namibia, South Africa, Swaziland, Zambia, Zimbabwe) have prevalence above 15%, with Botswana and Swaziland having prevalence around 30%. In West Africa, HIV prevalence is much lower with no country having a prevalence above 10% and most having prevalence between one and five percent. Adult prevalence in countries in Central and East Africa

falls somewhere between these two groups, ranging from 3% to 13%.

The countries of the region also differ in the time course of their epidemics, with epidemics starting earlier in East and Central Africa and much later in countries in southern Africa. Extreme cases of this difference include Uganda (where adult HIV prevalence peaked in the early 1990s) and Madagascar (which detected virtually no HIV infection among pregnant women during the 1980s and 1990s but where adult prevalence has now increased to 1.8%).

7. Is the percentage of women infected with HIV rising globally?

No, this estimate is roughly the same as it was in 2001. UNAIDS estimates that almost half (46%) of adults (15-49) living with HIV globally are women. However, the numbers of women living with HIV globally are rising. This is because the overall numbers of people living with HIV are rising. By far the majority of women living with HIV are in sub-Saharan Africa. In sub-Saharan Africa, young women are much more likely to be HIV-infected than young men – a ratio of over 30 to 10.

The concentration of HIV infected children in sub-Saharan Africa reflects the estimate that 57% of HIV infected adults in that region are women. No other region proportionately has as many women living with HIV, however in North Africa & the Middle East and the Caribbean, women already account for nearly half of the adults living with HIV. In most other regions the percentage of women among adults living with HIV is increasing.

8. Are more young people becoming infected with HIV?

UNAIDS estimates that of the 40.3 million people living with HIV globally, more than 10 million are young people, aged 15-24 years. Since more people overall are becoming infected with HIV, the numbers of young people living with the virus are therefore increasing. Globally, about half of all new adult infections are among young people aged 15-24 years.

9. Which are the more accurate sources of data: sentinel surveillance or case reporting?

Case reporting generally tends to substantially underestimate the number of people living with HIV. Most countries that rely on case reporting focus the data collection on specific at-risk groups, often missing other groups. In general, case reporting tends to focus heavily on injecting drug users. Often the data collected reflect trends only among those users who interact with officialdom (for example, through being arrested or attending drug treatment clinics).

However, in countries that have extensive voluntary counselling and testing programmes (such as Argentina and Brazil), case reports may enable more precise estimates to be developed. Nonetheless, case reporting is unlikely to capture people living with HIV who were recently infected, and who therefore present no symptoms of infection. For these reasons, case reports can only indicate the minimum number of people living with HIV.

On the other hand, reliance on *sentinel surveillance* of at-risk groups can lead to overestimation of HIV prevalence in these groups. This is because such surveillance in some cases detects HIV infection rates among individuals who are at highest risk of HIV infection. For example, sentinel surveillance among sex workers or their clients often focuses on those who seek treatment at sexually transmitted infection clinics—and who, by definition, have had unprotected sex. However, other sex workers and clients who *do* practise safe sex—and who therefore tend not to present at these clinics with sexually transmitted infections—generally are not captured in this surveillance.

10. How are the HIV/AIDS estimates arrived at?

UNAIDS and WHO, in close consultation with countries, employ a six-step method to obtain estimates of HIV prevalence for men and women. An increasing number of countries have adopted these methods to develop national estimates.

Different approaches are used for *generalized* epidemics (where adult HIV prevalence exceeds 1% and transmission is mostly heterosexual) and *low-level* or *concentrated* epidemics (where HIV is concentrated in groups with behaviours that expose them to a high risk of HIV infection).

This is how the six-step process works for countries with a *generalized* epidemic:

Step One ... All available surveillance data gathered from HIV-tested blood samples of pregnant women attending antenatal clinics are entered into ...

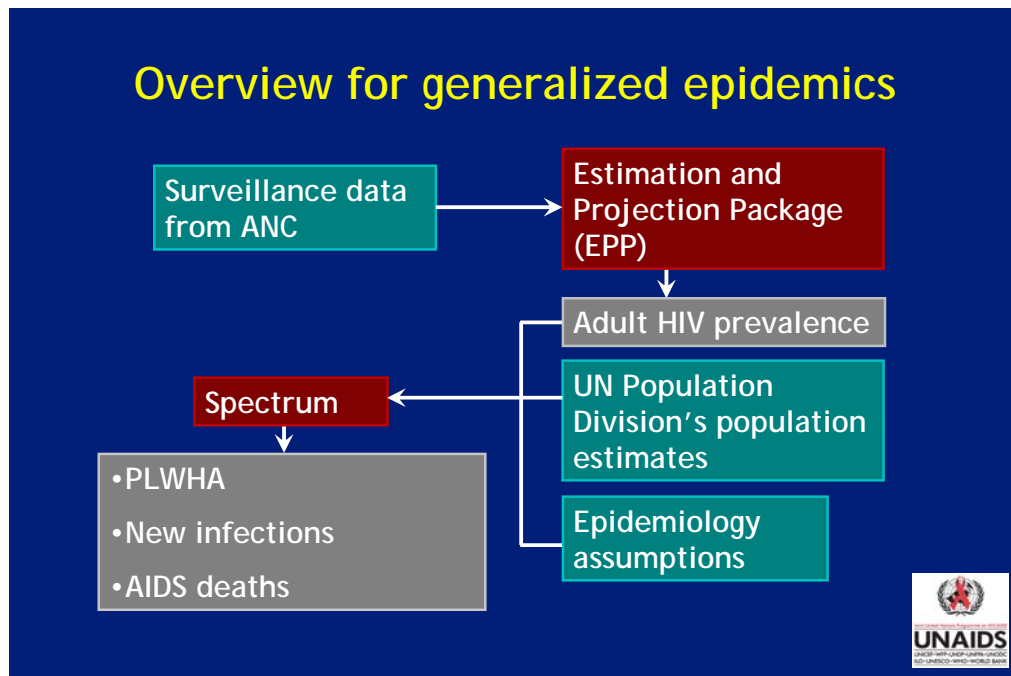
Step Two ... a specialized software programme (called the “Estimation and Projection Package”). This programme generates a curve that describes the evolution of ...

Step Three ... adult HIV prevalence rates over time. This adult prevalence curve, along with the ...

Step Four ... national population estimates obtained from the UN Population Division, along with ART coverage and ...

Step Five ... various epidemiological assumptions (fertility rates, male/female ratios, survival time after HIV infection, etc.) are then entered into the ...

Step Six ... Spectrum software programme which calculates the number of adults and children infected, new infections and deaths.



For countries with a low-level or *concentrated* epidemic, estimates emerge from this process:

Step One -- Surveillance data are gathered for populations at high risk (sex workers, men who have sex with men and injecting drug users). Estimates are made of the size of those populations, and of populations that are at lower but significant risk (for example, the

partners of sex workers and their clients, injecting drug users, etc.). That information is then entered into ...

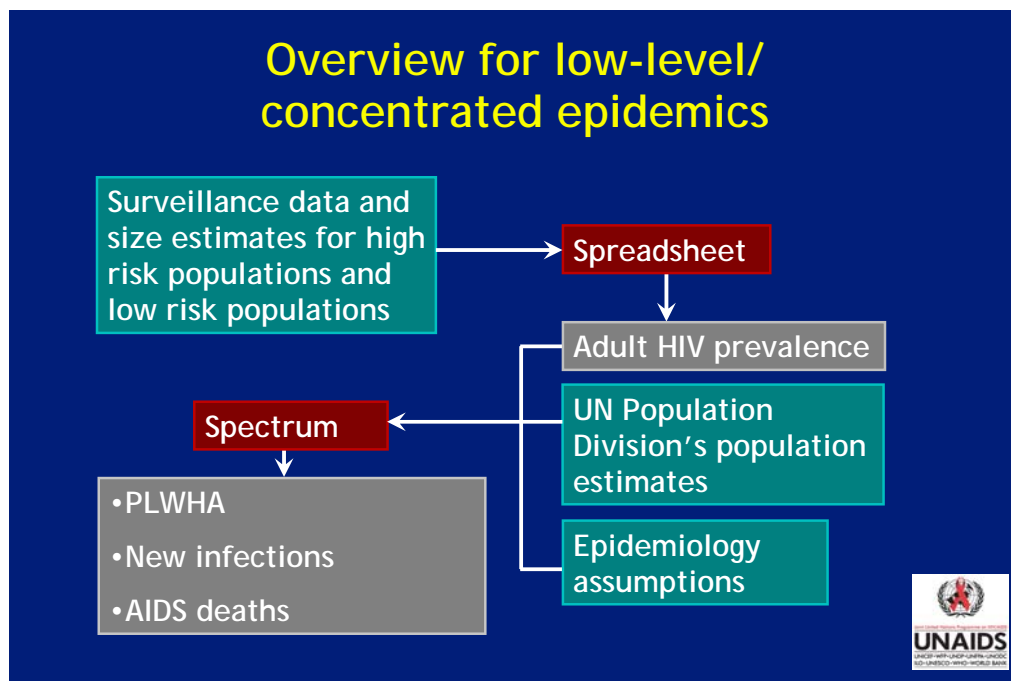
Step Two ... spreadsheet models to produce curves that describe the evolution of ...

Step Three ... adult HIV prevalence rates over time. This adult prevalence curve, along with the ...

Step Four ... national population estimates obtained from the UN Population Division along with ART coverage and ...

Step Five ... various epidemiological assumptions (fertility rates, male/female ratios, survival time after HIV infection, etc.) are then entered into the ...

Step Six ... Spectrum software programme which calculates the number of adults and children infected, new infections and deaths.



11. What is being done to improve HIV estimates?

New and different sources of data, such as national household surveys, are enabling more accurate estimates and more refined understandings of the epidemic's trends.

Importantly, the roles of national AIDS programmes have changed significantly since the first set of UNAIDS/WHO estimates was produced in 1997. Initially, countries were requested to comment on provisional estimates. The extent of their involvement has increased subsequently.

In the past several years, for example, UNAIDS and WHO, along with their technical partners (including East-West Center, Family Health International, The Futures Group, the US Census Bureau and the US Centers for Disease Control and Prevention), carried out a series of regional training workshops in which epidemiologists from over 140 countries were trained in the HIV estimation process.

Such efforts have led to much greater involvement by national programmes, national statistics offices and other government and academic organizations in the production of

estimates. The result has been better quality estimates, due to the use of additional data and the application of local knowledge.

UNAIDS and WHO continue to work with countries, partner organizations and experts to improve data collection. These efforts will ensure that the best possible estimates are available to assist governments, non-governmental organizations and others in gauging the status of the epidemic and monitoring the effectiveness of prevention and care efforts.

Additional sources of information:

For a technical description of the processes used to arrive at the estimates and further explanation on the quality of HIV, please see:

Walker N, Grassly NC, Garnett GP, Stanecki KA, Ghys PD (2004) Estimating the global burden of HIV/AIDS: What do we really know about the HIV pandemic? *Lancet* 2004;336, 26 June 2004.

For a detailed description of the methods, software, quality of data and development of ranges, please see the series of seven articles published in the journal *Sexually Transmitted Infections* the second week of July 2004. The articles can be downloaded for free from their website at www.Sti.bmjjournal.com.

More information on the UNAIDS Reference Group on Estimates, Modelling and Projections can be found at www.epidem.org.