

Estimating National HIV Prevalence in Ghana Using Sentinel Surveillance Data

**National AIDS/STI Control Programme
Disease Control Unit
Ministry of Health
Accra**

August 1, 2001

Methodology

Sentinel surveillance systems for HIV are designed to provide information on trends to policy makers and programme planners. The data are useful for understanding the magnitude of the HIV/AIDS problem in certain geographic areas and among special populations and for monitoring the impact of interventions. These data also can be used to prepare an estimate of national HIV prevalence suitable for advocacy purposes. This paper describes the approach used in Ghana to develop an estimate of adult HIV prevalence.

The HIV sentinel surveillance system in Ghana is implemented by the National AIDS/STI Control Programme, Disease Control Unit, Ministry of Health, in collaboration with Regional and District Directors of Health Services, site supervisors and on-site laboratory staff of participating districts, and the Public Health Reference Laboratory (PHRL). Data are collected on HIV infection among pregnant women attending antenatal clinics using the unlinked anonymous method recommended by the World Health Organisation (WHO). During a period of 8 to 10 weeks each year, all women attending the selected ante-natal clinics for their first visit for their current pregnancy are selected for the sample. The standard sample size at each clinic is 500. All women attending the clinic have blood drawn for testing for anemia. After the names are removed from the blood samples, the samples are tested for HIV. This unlinked anonymous method provides an accurate unbiased estimate of HIV prevalence in the sample.

The Public Health Reference Laboratory provides a very thorough quality control system to ensure that the testing is accurate. High quality test kits are utilized. In every site, all samples that test positive for HIV are sent to PHRL in Accra for a confirmatory test. In addition, ten percent of the samples that test negative are also sent to PHRL in Accra for quality control to make sure that there are no false negative results. Finally a pre-tested set of both positive and negative blood samples are sent to each of the sites for testing to ensure that the laboratories at the sites are capable of high quality testing. The HIV sentinel surveillance system in Ghana, with a sample size of 500 at each site (many countries use a sample size of 300), and consistent reporting each year, ranks among the best sentinel surveillance systems in any African country.

This system of HIV sentinel sero-surveillance was instituted by the Ministry of Health in 1990 to complement the AIDS case reporting system. This was in response to the recognition of the limitations of AIDS case reporting. These limitations include the fact that AIDS cases do not reflect current transmission of HIV infection since the median interval between HIV infection and the onset of AIDS is between seven and ten years. Moreover, reported AIDS cases represent only a proportion of the AIDS cases that have actually occurred (the proportion of actual AIDS cases that are reported through the health system is currently estimated to be between 20 – 30%). We know that not all AIDS cases are reported. This can happen for several reasons: some people may never seek hospital care for AIDS; some doctors may not record a diagnosis of AIDS because of the stigma attached to AIDS; some people with HIV infection may die of other diseases before they are ever diagnosed as having AIDS; and some rural health care facilities may not have the capability to test for HIV infection. Therefore, the sentinel surveillance system provides the best means of measuring the current prevalence level.

Initially, only a few sentinel sites were used. In 1994, the number of sentinel sites was increased to 20 and covered all ten regions of the country. In 1999 the number was further increased to 22 to accommodate two extra sites in Greater Accra in order to reflect the diversity of population in Accra / Tema.

These HIV sentinel surveillance data in ante-natal clinics represent the best source of information available for preparing an estimate of national HIV prevalence and for preparing projections of the impact of the AIDS epidemic in Ghana. This paper presents the methodology used for preparing a national estimate.

ANC Sentinel Surveillance Data

HIV prevalence from each of the ANC sentinel surveillance sites for the years 1992 to 2000 are reported in Table 1. The National AIDS/STI Control Programme, Disease Control Unit, Ministry of Health publishes an HIV Sentinel Surveillance Report each year [Ministry of Health, 1994-2000]. These reports provide details of the test kits and reagents that are used for the testing, and the results, giving the number tested, the number testing positive for HIV, and the prevalence for each five-year age group, for each site. The reports also include information on HIV prevalence at two STD clinics, and data on prevalence of syphilis for 1999 and 2000 at each of the ANC sentinel sites.

Each region in Ghana is represented by two sentinel sites, and two additional sites are included for Greater Accra Region.. The sites are chosen to ensure that there will be a sufficiently large sample during the 8 to 10 week surveillance period. For purposes of this analysis, the average prevalence from the sites within each region are calculated to represent an estimated HIV prevalence for the region. These regional averages for each year are presented in Table 2.

Table 1. Ghana Sentinel Surveillance Data, 1992 – 2000

Percentage of pregnant women testing HIV positive by sentinel site

Region and Site	1992	1994	1995	1996	1997	1998	1999	2000
<u>Greater Accra Region</u>								
Korle-Bu					2.0	2.2	2.2	2.2
Adabraka	0.7		1.3	2.2	2.2	3.4	2.0	4.0
Amasaman (Rural)							2.6	2.2
Tema							2.6	3.9
<u>Ashanti Region</u>								
Kumasi	4.6	2.4	3.2	3.8	5.5	6.8	4.9	3.8
Mampong		2.0	3.6	2.0	5.2	5.0	3.4	1.6
<u>Brong Ahafo Region</u>								
Sunyani	4.0	3.0		2.2	2.0	3.4	2.8	2.1
Wenchi	4.0		3.2	2.6	2.4	2.0	2.2	1.0
<u>Central Region</u>								
Cape Coast		3.5	2.4	2.6	0.8	3.4	3.2	3.0
Assin Fosu		2.5	1.2	1.6	1.2	3.6	2.0	2.4
<u>Eastern Region</u>								
Koforidua	3.2	2.4	3.8	2.6	4.2	2.4	1.0	2.8
Agomanya	18.0	9.4	10.5	12.8	13.4	13.2	8.2	7.8

Table 1. Ghana Sentinel Surveillance Data, 1992 – 2000, continued.

Percentage of pregnant women testing HIV positive by sentinel site

Region and Site	1992	1994	1995	1996	1997	1998	1999	2000
<u>Northern Region</u>								
Tamale		1.0	1.0	1.6	1.0		0.8	1.3
Nalerigu		1.0	1.0	0.4	0.2		0.6	1.4
Bole		3.8	2.7					
<u>Upper East Region</u>								
Bolgatanga		2.0	1.6	1.0	2.8	3.0	1.6	1.0
Bawku		2.4	2.4		1.6	1.8	1.6	1.6
<u>Upper West Region</u>								
Wa	1.8	3.0	0.8	1.8	1.6	2.3	2.2	1.4
Jirapa	0.4	2.5	0.3	3.0	1.4		0.6	1.5
Nandom		2.0	2.9					
Hamile		4.3	4.2					
<u>Volta Region</u>								
Ho		2.4	2.4	2.8	3.8	4.0	5.2	4.2
Hohoe		2.3	3.2	2.1	4.2	4.2	4.4	5.0
<u>Western Region</u>								
Takoradi		1.8		4.2	3.8	3.0	4.0	3.0
Eikwe		3.0		5.7	5.8	5.8	4.8	3.2

Table 2. Ghana Sentinel Surveillance Data, 1992 - 2000
ANC Data: Regional Averages

Region	1992	1994	1995	1996	1997	1998	1999	2000
<u>Greater Accra Region</u>	0.7		1.3	2.2	2.1	2.8	2.4	3.1
<u>Ashanti Region</u>	4.6	2.2	3.4	2.9	5.4	5.9	4.2	2.7
<u>Brong Ahafo Region</u>	4.0	3.0	3.2	2.4	2.2	2.7	2.5	1.6
<u>Central Region</u>		3.0	1.8	2.1	1.0	3.5	2.6	2.7
<u>Eastern Region</u>	10.6	5.9	7.2	7.7	8.8	7.8	4.6	5.3
<u>Northern Region</u>		1.9	1.6	1.0	0.6	0.7	0.7	1.4
<u>Upper East Region</u>		2.2	2.0	1.0	2.2	2.4	1.6	1.3
<u>Upper West Region</u>	1.1	3.0	2.1	2.4	1.5	1.7	1.4	1.5
<u>Volta Region</u>		2.4	2.8	2.5	4.0	4.1	4.8	4.6
<u>Western Region</u>		2.4		5.0	4.8	4.4	4.4	3.1

UNAIDS and its international working group on monitoring the HIV/AIDS epidemic has now standardised on the **definition of adult HIV prevalence as the percentage of the adult population between the ages of 15 and 49 that is infected with HIV**. Note that in previous reports on Ghana prevalence was defined as the percentage of the adult population aged 15 years and older infected with HIV. The reason for adopting this new definition is that almost all data used for estimating prevalence comes from antenatal care data, representing women aged 15-49. However, estimates of the total number of HIV infections will still include all age groups.

There is also a consensus that the ANC data are generally representative of the adult population 15-49. There are a number of reasons to suggest that the ANC data would overestimate the prevalence in the general population. However, there are also a number of reasons to suggest that the ANC data would underestimate the prevalence in the general population. The consensus is that these factors cancel each other out, and that ANC prevalence can be broadly used to represent the general adult population. This conclusion is supported by research in a number of different settings that compared the ANC data with population-based surveys.

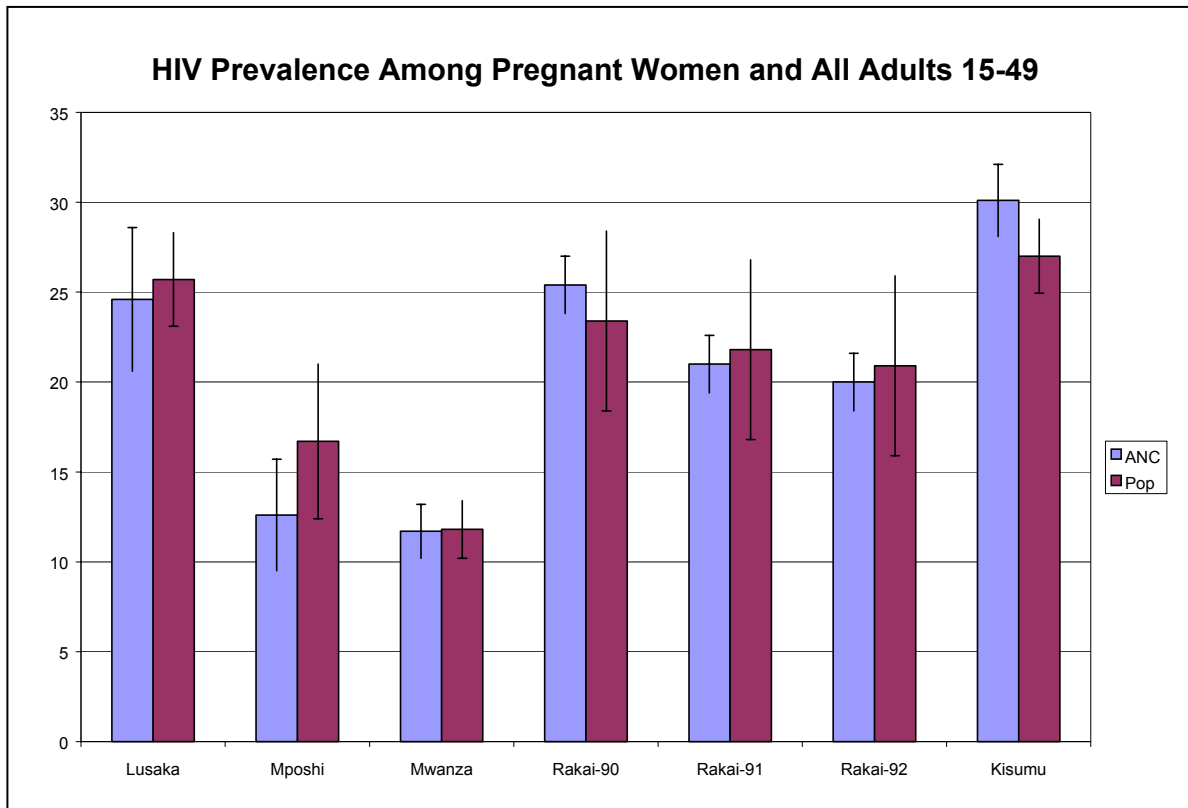
Reasons that would suggest that ANC data would overestimate prevalence in the general population include differences in the age distribution of pregnant women compared to all women 15-49, the proportion of the population 15-49 that is sexually active and differences between female and male prevalence. ANC data represent sexually active women, with fertility higher at younger ages. In addition, as the AIDS epidemic matures there is clear evidence that women are at a greater physiological risk, and are socially more vulnerable, and thus tend to have higher HIV prevalence than men. This has been true in Ghana since the beginning of the epidemic. UNAIDS is now using a female to male ratio of 1.3:1 for current HIV infections.

On the other hand, studies from several African sites have shown that women with HIV have lower fertility than those without infection, by approximately 20 percent. HIV positive women are thus less likely to be pregnant, and as a result, ANC data tend to under-estimate prevalence among all women aged 15-49.

For the 15-49 age group, these differences tend to cancel each other. **As a result, prevalence among pregnant women is widely felt to be a good indicator of prevalence among all adults 15-49, without any adjustments.** (This conclusion is only valid for the population 15-49. For some sub-populations, such as 15-19, there are significant differences in prevalence between pregnant women and all adults.) Therefore, in this analysis HIV prevalence among all ANC clients is assumed to be the same as prevalence among all adults 15-49.

This assumption is supported by a number of studies that have compared ANC data with population-based surveys in the same area (including both men and women). Data from seven studies in four African countries show clear consistency between the ANC data and the population-based surveys (see Figure 1).

Fig. 1. Comparison of HIV prevalence among pregnant women and all adults 15-49



Sources:

Lusaka and Mposhi, Zambia: Fylkenses, et al., 1997.

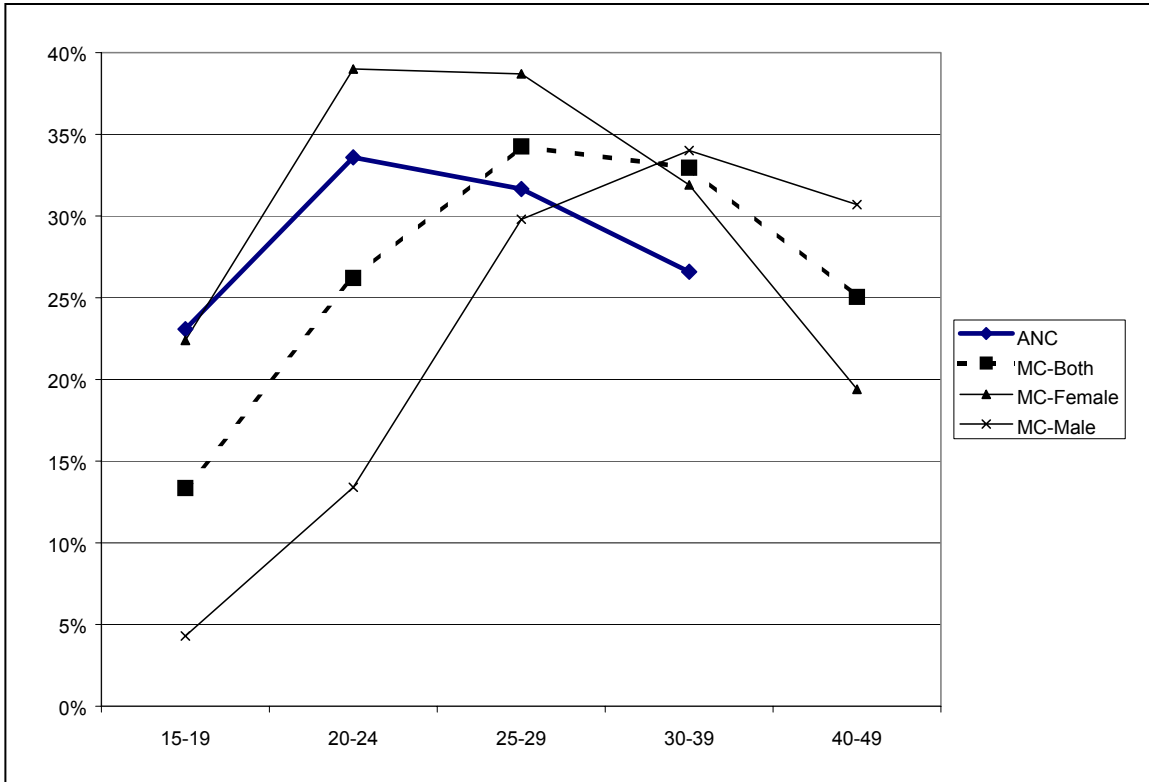
Mwanza, Tanzania: Kigadye, et al., 1993, and Barongo et al., 1992.

Rakai, Uganda: Wawer, et al., 1997.

Kisumu, Kenya: Kahindo, et al., 1998.

This important relationship is further illustrated by Figure 2 which compares age-specific prevalence data from the ANC in 1998 with data from the Multi-Centre study of Kisumu, Kenya [Kahindo, et al., 1998]. It shows that ANC data tend to under-estimate female prevalence, except at the youngest ages. The under-estimate is due to the suppressing effect of HIV infection on fertility. At the youngest ages, the fact that all ANC attendees are sexually active raises ANC prevalence relative to all females at that age. The ANC data over-estimate male prevalence, except in the over 30 age groups. For the total population, ANC data over-estimate prevalence below age 25 and under-estimate prevalence over age 25. For the entire 15-49 age group these differences cancel out. As a result, ANC prevalence is a reasonable estimate of total prevalence among males and females aged 15-49.

Figure 2. Comparison of ANC prevalence with general population prevalence for Kisumu, Kenya, 1998



Preparation of the national estimate of HIV prevalence

There are several computer models, including the Epimodel that is used by UNAIDS, that have been used to analyze sentinel surveillance data and prepare national HIV estimates. These models calculate the curve that best fits the existing data, usually for the capital city, other urban areas, and rural areas. The models then use the data points on the curve to combine the various regions to calculate a national estimate. These models are particularly useful when there are only a limited number of sentinel sites in a country.

Since Ghana has established a comprehensive ANC sentinel surveillance programme, with at least two sites in each region, it is possible to calculate a national estimate using a very straight-forward approach, with very few assumptions. The only adjustment that is required is to weight the ANC data by the regional population distribution so that no site is given greater weight in the national estimate.

From examination of the data in Table 1 it seems that from the beginning of the epidemic in Ghana there has been very little differential in HIV prevalence between the metropolitan areas and much smaller towns representing semi-urban /semi-rural populations. It is also evident, however, that by the early 1990s HIV had already spread to every part of the country. In many countries there is a clear differential, with urban HIV prevalence initially much higher than rural prevalence, but with the rural prevalence gradually catching up as the epidemic progresses. Since there are no truly rural sites

represented in the sentinel surveillance system in Ghana, it is important to keep in mind that no adjustment has been made for any urban/rural differential that might exist.

The method used to calculate national HIV prevalence is to use the regional HIV prevalence estimates together with data on regional population size to prepare a weighted national average. The resulting national HIV prevalence is used with DemProj, a population projections model, and AIM, an AIDS impact model, to calculate the number of current HIV infections and to make projections into the future.

There are three steps in the preparation of the national estimate of HIV prevalence.

1. Calculating Regional HIV Prevalence Rates. Regional HIV prevalence rates were calculated by averaging the results from the sentinel sites in each region. These regional averages for each year, 1992 to 2000, are reported in Table 2. For recent years, 1997 to 2000, there were only three sites where data were not reported for a particular year, all in 1998. For these three sites, Tamale and Nalerigu in Northern Region, and Jirapa in Upper West Region, the prevalence in 1997 and 1999 for the site was averaged to give the estimate for 1998. Since there were only minimal differences at any of these three sites between 1997 and 1999, it seems reasonable to use the average of these two years as an estimate for 1998.

2. Calculating the Regional Population Age 15-49. For each region, the year 2000 population was taken from the 2000 Population Census reported by the Ghana Statistical Service [GSS, 2001]. The regional total populations in 2000 are indicated in Table 3, and are included in the first column in Table 6. The total population of each region is then multiplied by the proportion aged 15-49 from the 1984 Census [Statistical Service, 1987b]. The resulting population aged 15-49 for 2000 is indicated in the second column in Table 6.

It should be noted that all previous estimates of HIV prevalence and numbers infected were based on the projected population from 1984 [Ghana Statistical Service, 1995]. The analysis presented in this paper uses the actual population count from 2000. The population for the year 2000 projected from 1984 was about 1.7 million higher than the actual count in 2000. We now know, based on the Ghana Demographic and Health Survey, 1998 [Ghana Statistical Service and Macro International Inc., 1999], that fertility has declined more rapidly than had been projected. It is also very difficult to project mortality trends so far into the future. Clearly it is better to use the actual population count in 2000. When the final Census report for the 2000 Census is published, there are likely to be only very minor adjustments for age misreporting or undercounting. The use of the 2000 Census totals, which are lower than the previously projected numbers, will result in somewhat lower estimates of the number of people infected, but these new estimates will be more accurate since they are based on the actual 2000 census data.

The age and sex distribution of the 2000 Census data are not yet available. The Ghana Statistical Service has advised that the proportion in the 15-49 year age group from the

1984 Census be used in calculating the proportion 15-49 in 2000, since the proportions change only very slowly over time, and there will have been only a minimal impact of the HIV epidemic on the age structure in Ghana up to now, although it will become more significant in the future as the number of AIDS deaths continue to increase. The proportions age 15-49 for each region are indicated in Table 4 [from Statistical Service, 1987b]. These proportions are multiplied by the population in the first column in Table 6 to give the population age 15-49 in 2000, reported in the second column of Table 6.

3. Calculating the National HIV Prevalence Estimates. The national HIV prevalence estimate weighted for the regional population distribution is calculated as follows. For each region, the population 15-49 is multiplied by the regional HIV prevalence (15-49) to give the number of adult (15-49) infections. The regional prevalence is given in the third column of Table 6, and the number of adult infections (15-49) is given in the fourth column of Table 6. The regional infection numbers (age 15-49) are added to give a national total. The total infections (15-49) are then divided by the total population (15-49) to give the national prevalence.

Similar calculations have been carried out to calculate national HIV prevalence estimates for 1998 to 2000. These are reported in Table 6. To get the total population for each region in 1999 and 1998, the total population from the 2000 Census for the region is projected backward using the intercensal (1984-2000) annual population growth rates for each region, which have also been provided by the Ghana Statistical Service [2001]. These intercensal annual population growth rates are given in Table 5.

Table 3. Total Population by Region, 2000

REGION	2000 Population
Western	1,842,878
Central	1,580,047
Greater Accra	2,909,643
Eastern	2,108,852
Volta	1,612,299
Ashanti	3,187,601
Brong Ahafo	1,842,822
Northern	1,854,994
Upper West	573,860
Upper East	917,251
Total Country	18,412,247

Source: Ghana Statistical Service, 2001

Table 4. Proportion Age 15-49, by Region, 1984

REGION	Proportion 15-49
Western	.4561
Central	.4299
Greater Accra	.5029
Eastern	.4427
Volta	.4269
Ashanti	.4489
Brong Ahafo	.4429
Northern	.4175
Upper West	.4157
Upper East	.4333
Total Country	.4454

Source: Statistical Service, 1987

Table 5. Intercensal (1984-2000) Annual Population Growth Rate by Region, 2000

REGION	Intercensal PGR (%)
Western	2.9
Central	2.0
Greater Accra	4.4
Eastern	1.4
Volta	1.8
Ashanti	2.6
Brong Ahafo	2.6
Northern	2.9
Upper West	1.7
Upper East	1.1
Total Country	2.5

Source: Ghana Statistical Service, 2001

Results. The results of applying this methodology to the sentinel surveillance data are shown in Table 6, which shows HIV prevalence among adults aged 15 and 49.

National adult HIV prevalence in 2000 is estimated to be 3 percent. The estimated number of infections in Table 6 refers only to the adult population age 15-49. In order to

estimate the total number of infections in the population, the AIM model, described below, is used to calculate infections among children (0-14) and older adults (age 50 +). The AIM model then adds the infections among the three groups (0-14, 15-49, and 50+) to give an estimate of the total number of people infected with HIV. **For the year 2000, the model estimates that about 350,000 Ghanaians are infected with HIV.**

Between 1998 and 2000 the sentinel surveillance data seem to give an indication of some stabilization or even a slight decline, after a period of gradual increase from 1994 to 1997. However, many cities and regions have shown evidence of reaching a plateau only to record further increases in prevalence in subsequent years (this happened, for example, in Kisumu Municipality in Kenya and in KwaZulu-Natal Province in South Africa). This shows the importance of continuing to monitor the trends over a number of years before it will be possible to make any clear statements about stabilization of the prevalence rates. It should also be noted that when HIV prevalence stabilizes, or reaches a plateau, this means that the number of AIDS deaths is now equal to the number of new infections; it does not mean that the rate of new infections has declined.

Table 6. HIV Prevalence Estimates 1998 – 2000

HIV Prevalence Estimate for 2000

Region	Population	Pop, 15-49	Regional Average Prevalence	Number Infected 15-49	
Western	1,842,878	840,537	3.1	26,057	
Central	1,580,047	679,262	2.7	18,340	
Gt. Accra	2,909,643	1,463,259	3.1	44,995	
Eastern	2,108,852	933,589	5.3	49,480	
Volta	1,612,299	688,290	4.6	31,661	
Ashanti	3,187,601	1,430,914	2.7	38,635	
Brong Ahafo	1,824,822	808,214	1.6	12,527	
Northern	1,854,994	774,460	1.4	10,455	
Upper West	573,860	238,554	1.5	3,459	
Upper East	917,251	397,445	1.3	5,167	
Total	18,412,247	8,254,524		240,777	
					3%
					Estimated National Prevalence, 2000

HIV Prevalence Estimate for 1999

Region	Population	Pop, 15-49	Regional Average Prevalence	Number Infected 15-49
---------------	-------------------	-------------------	------------------------------------	------------------------------

Western	1,790,941	816,848	4.4	35,941
Central	1,549,066	665,943	2.6	17,315
Gt. Accra	2,787,014	1,401,590	2.4	32,937
Eastern	2,079,736	920,699	4.6	42,352
Volta	1,583,791	676,120	4.8	32,454
Ashanti	3,106,824	1,394,653	4.2	57,878
Brong Ahafo	1,778,579	787,733	2.5	19,693
Northern	1,802,715	752,634	0.7	5,268
Upper West	564,267	234,566	1.4	3,284
Upper East	907,271	393,121	1.6	6,290
Total	17,950,204	8,043,906		253,413

3.2%
**Estimated National
Prevalence, 1999**

HIV Prevalence Estimate for 1998

Region	Population	Pop, 15-49	Regional Average Prevalence	Number Infected 15-49
Western	1,740,467	793,827	4.4	34,928
Central	1,518,692	652,886	3.5	22,851
Gt. Accra	2,669,554	1,342,519	2.8	37,591
Eastern	2,051,021	907,987	7.8	70,823
Volta	1,555,787	664,165	4.1	27,231
Ashanti	3,028,093	1,359,311	5.9	80,199
Brong Ahafo	1,733,508	767,771	2.7	20,730
Northern	1,751,910	731,422	0.7	4,754
Upper West	554,835	230,645	1.7	3,806
Upper East	897,400	388,843	2.4	9,332
Total	17,501,267	7,839,376		312,245

4.0%
**Estimated National
Prevalence, 1998**

Regional populations for 1998 and 1999 in Table 6 have been projected backward from 2000 using regional population growth rates from the 2000 Census. All sentinel surveillance data are from NACP.

What conclusions can be drawn from this analysis?

The sentinel surveillance data in Ghana seem to show that HIV prevalence in Ghana during the past few years has been fairly stable in the range of 3 to 4 percent of the adult population age 15-49. Although there is no evidence of a rapid increase in HIV prevalence in Ghana during the past few years, most of the neighboring countries have experienced such an increase. It will require several more years of careful monitoring before any definitive statements could be made about stabilization or decline in HIV prevalence in Ghana. And there is certainly a danger that prevalence in Ghana could increase in the future as it has in neighboring countries because of several factors including the worldwide epidemic in other sexually transmitted infections such as genital herpes. It is more important than ever that Ghana mount an expanded response to the epidemic, especially to prevent the spread of HIV among vulnerable groups including adolescents and young adults. It is also clear that the number of AIDS cases and deaths will inevitably be increasing over the coming years as the 350,000 Ghanaians who are currently infected begin to develop the symptoms of AIDS. An expanded programme of care and support will be required to provide the medical care required for those with AIDS and to mitigate the social and economic impacts of AIDS on families and communities.

Where did the previous estimate of 4.6 percent come from?

The estimate of 4.6 percent adult HIV prevalence that has been quoted in several reports was based on 1997 sentinel surveillance data adjusted for several factors. In 1997, the standard practice was to define adult HIV prevalence as prevalence among the population age 15 and over. It was also standard scientific practice at that time to adjust the ANC data to account for the lower fertility of HIV-positive women. The ANC data were reduced to account for the lower prevalence among older adults, and increased to account for lower fertility of HIV-positive women.

The 1997 adjustments were calculated as follows:

In 1997, the sentinel surveillance data weighted for regional population distribution provided an adult HIV prevalence for adults 15-49 of 4.0.

The adjustment factors were .918 (for older adults) and 1.25 (for the fertility factor). The calculations were: $4.0 \times .918 \times 1.25 = 4.59$. This was rounded to 4.6 percent. This was the standard scientific approach for making national estimates at that time. As indicated in the first section of this paper, new evidence has shown that ANC data can be used directly to represent prevalence in the adult population, with no adjustments required.

Calculating the number of infections

The HIV prevalence estimates have been used with the Spectrum model to project the consequences of these figures [Stover, 1999 and Stover and Kirmeyer, 1999]. Two

modules of Spectrum have been used, DemProj and AIM (AIDS Impact Model). DemProj projects the population by age and sex and displays a full range of demographic indicators while AIM calculates the number of people infected with HIV, AIDS cases, AIDS deaths, AIDS orphans and other consequences of AIDS. The AIM model includes a calculation of infected children. The model calculates the number of infected children from the age-specific infection rates among women, the age-specific fertility rates, the perinatal transmission rate, the non-AIDS age-specific death rates and the distribution of the time from birth to AIDS death for infected new-borns.

In preparing the population projections, the size of the adult population by age and sex in 1984 is taken from the 1984 population census [Statistical Service, 1987]. The population is projected forward from 1984 using the Spectrum model. The fertility and mortality assumptions have been adjusted so that the population projected for the year 2000 matches the 2000 figure from the *2000 Population Census of Ghana* [Ghana Statistical Service, 2001]. First the total fertility rate was adjusted to reflect the total fertility rates from the 1988, 1993 and 1998 Ghana Demographic and Health Surveys. The future trends in fertility were based on the assumption of reaching the National Population Policy goal of a total fertility rate of 4.0 in 2010 and 3.0 by 2020. Then the mortality assumptions (based on Life Expectancy) were adjusted until the year 2000 population exactly matched that of the 2000 Population Census.

The model calculates that in the year 2000 a total of about 350,000 Ghanaians are infected with HIV.

Future projections

A third edition of the booklet *“HIV/AIDS in Ghana”* is currently being prepared. The assumptions about future trends in HIV prevalence will take the form of two scenarios.

In the first scenario HIV prevalence will increase from the current 3.0 percent to 9.0 percent in the year 2014. This reflects trends in neighboring countries, several of which have already reached that level.

The second scenario assumes that the trend in HIV will remain fairly stable, with a prevalence of 4.0 percent in the year 2014.

Analysis of these two scenarios will show the dramatic difference in impact of these two scenarios and the importance of mounting an expanded and effective response.

Ghana has prepared a National AIDS Policy, has formed the Ghana AIDS Commission, and is actively pursuing a multisectoral programme of HIV/AIDS prevention and care. The results reported here demonstrate the urgent need both to ensure the sustainability of the surveillance system and to continue building a revitalized and greatly expanded HIV/AIDS programme of prevention and care.

Note: This report has been prepared by Dr. Kwaku Yeboah and Dr. Agnes Dzokoto, National AIDS/STI Control Programme, Ministry of Health, Accra and Alan Johnston, Dr. Benedicta Ababio, Dr. Phyllis Antwi and David Logan of the USAID-POLICY Project, Ghana.

References

- Barongo et al. 1992. "The epidemiology of HIV-1 infection in urban areas, roadside settlements and rural villages in Mwanza Region, Tanzania." *AIDS* 6:1521-1528.
- Fylkenses, K., Mubanga-Musonda, M., Kasumba, K., Ndhlova, Z., Mluanda, F., Kaetano, L., Chipialia, C. 1997. "The HIV epidemic in Zambia: socio-demographic prevalence patterns and indications of trends among childbearing women." *AIDS* 11:339-345.
- Ghana Statistical Service (GSS) and Macro International Inc. (MI). 1999. *Ghana Demographic and Health Survey, 1998*. Calverton, Maryland: GSS and MI.
- Ghana Statistical Service. 1995. *Analysis of Demographic Data: Volume 1, Preliminary Analysis Reports*. GSS, Accra, Ghana.
- Ghana Statistical Service. 2001. *2000 Population Census of Ghana: Preliminary Report*. GSS, Accra, Ghana.
- Government of Ghana. 1994. *National Population Policy (Revised Edition, 1994)*. Accra: National Population Council.
- Kahindo, M., Nyang, J., Chege, J. 1998. "Multicentre study on factors determining the differential spread of HIV in Africa - Preliminary results of the Kisumu study site." 2nd National Conference on HIV/AIDS in Kenya, 28-30 October 1998, Nairobi, Kenya and sentinel data from the National AIDS and STDs Control Programme, Nairobi.
- Kigadye, RM., Klokke, A., Nicoll, A., Nyamuryekunh'e, KM., Borgdorff, M., Barongo, L., Laukamm-Josten, U., Lisekie, F., Grosskurth, H., and Kigadye, F. 1993. "Sentinel surveillance for HIV-1 among pregnant women in a developing country: 3 years' experience and comparison with a population serosurvey." *AIDS* 7:849-855.
- Ministry of Health, Disease Control Unit. *HIV Sentinel Surveillance Reports, 1994-2000*.
- Ministry of Health, National AIDS/STD Control. 1995. *AIDS in Ghana: Background, Projections, Impacts and Interventions*. Accra, Ministry of Health.
- Ministry of Health, National AIDS/STD Control. 1999. *HIV/AIDS in Ghana: Background, Projections, Impacts and Interventions*. Second Edition. Accra, Ministry of Health.

National AIDS and STDs Control Programme, Nairobi, Kenya. 2000. "Estimating National HIV Prevalence in Kenya from Sentinel Surveillance Data." June 2000.

Statistical Service. 1987. *1984 Population Census of Ghana, Demographic and Economic Characteristics: Total Country*. Statistical Service, Accra.

Statistical Service. 1987b. *1984 Population Census of Ghana, Demographic and Economic Characteristics: Regional Reports*. Statistical Service, Accra.

Stover, John. 1999. *AIM, Version 4: A Computer Program for Making HIV/AIDS Projections and Examining the Social and Economic Impact of AIDS*. The Policy Project, The Futures Group International: Washington, DC.

Stover, John and Sharon Kirmeyer. 1999. *DemProj, Version 4: A Computer Program for Making Population Projections*. The Policy Project, The Futures Group International: Washington, DC.

Wawer, J.M., Serwadda, D., Gray, R.H., Swankambo, N., Chuanjun, L., Nalugoda F., Lutalo, T., Konde-Lule, J.K. 1997. "Trends in HIV-1 prevalence may not reflect trends in incidence in mature epidemics: data from the Rakai population-based cohort, Uganda." *AIDS* **11**:1023-1030.