THE REPUBLIC OF MALAWI

MINISTRY OF HEALTH

HIV and Syphilis Sero-Survey and National HIV Prevalence Estimates Report 2005

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National AIDS Commission

Foreword

HIV and Syphilis surveillance is a systematic and routine collection of information on the occurrence and distribution of HIV and syphilis infection as well as the factors associated with their transmission. It monitors the risk of infection among specific populations and this is done on an ongoing basis. Malawi has consistently been monitoring HIV prevalence through antenatal clinic (ANC) attendees in 19 sites since 1994.

The primary objective of the sentinel surveillance survey is to provide data on the occurrence and distribution of HIV infection among women attending antenatal clinics. HIV sentinel surveillance data are not representative of the general population and prevalence in ANC sentinel sites only presents prevalence in the respective sites. In this report, sentinel surveillance data have been used to estimate national HIV prevalence in the general population.

Overall HIV prevalence in Malawi appears to have stabilized and there has been a general decline in HIV prevalence in ANC attendees aged 15 to 24 years since 1999. However, this is not a reason to relax. There is need to scale up our intervention programs to control the HIV and AIDS epidemic in the country.

Syphilis prevalence in pregnant women attending antenatal care continues to decline in Malawi and is much lower than HIV prevalence. The decline in the syphilis prevalence may be due to effective treatment for syphilis. There is, therefore, need to continue with the programmes in the coming year that will help to sustain the low syphilis prevalence.

The HIV and Syphilis Sero-Surveys and National HIV Prevalence Estimates are done to provide data to assist with public health programme decision-making, educate the public on HIV, and guide scientific research.

I am pleased to disseminate the results of the 2005 HIV and Syphilis Sero-Survey and National HIV Prevalence Estimates as a guiding tool for decision making and programme design in the coming year.

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1.0 Executive Summary

This report presents findings from the Malawi 2005 antenatal clinic (ANC) sentinel surveillance and results of the National HIV Prevalence Estimates and Projections workshop.

The primary objective of ANC sentinel surveillance was to provide data on the occurrence and distribution of HIV infection among women attending antenatal clinics. HIV sentinel surveillance data are not representative of the general population. However, sentinel surveillance data have been used as input to develop estimates of HIV prevalence in the general population.

The 2005 ANC sentinel surveillance was carried out in nineteen sites distributed across all three regions of the country, as it has been since 1994. A total of 8,953 pregnant women were captured in the survey from 1st August 2005 through end September 2005. Over 80% of the women sampled were less than 30 years of age and about 60% aged less than 25 years. The age pattern of the women recruited in the survey is very similar to the previous surveys done since 1998.

The overall HIV prevalence for all antenatal attendees in 2005, was 16.9%. The median HIV prevalence in 2005 was 15.0%, and has declined from 2003 (17.0 %), 2001 (16.9%) and in 1999 (22.8%). Median prevalence is a better figure to compare to previous years since it is not affected by changes in site sample size, and is less effected by extreme site results.

Site-specific HIV prevalence ranged from 6.3% at Thonje Health Centre, a rural site in the central region to 27.0% at Limbe Health Centre, an urban site in the southern region of the country. HIV prevalence in the southern region (21.7%) remains higher than in the northern (14.0%) and central (14.3%) regions. Overall HIV prevalence in the urban (20.4%) areas continued to be high and significantly different from semi urban (17.0%) and rural areas (13.0%)

HIV prevalence was significantly higher among women with post secondary school education (33.3%) as compared to women with no education (17.9%) and those reporting to have gone up to std 1-5 (16.1%) and std 6-8 (15.4%).

Overall syphilis prevalence was 1.9%. Prevalence of syphilis ranged from 0% in Gawanani, Kasina Thonje and Mzuzu Health Centres to 10.8% in Nsanje. There was a direct relationship between age and syphilis infection from 15 to 44 years of age. Syphilis prevalence rates among women by age group were as follows; 15-19 (1.1%), 20-24(1.5%) 25-29 (2.3%) 30-34 (2.7%) 35-39 (3.8) and 40-44 (5.1%). The observed syphilis prevalence rates across regions are not statistically different. However, syphilis prevalence in the southern region (2.4%) remains higher than the central (1.8%) and northern (1.6%) regions. Overall, there appears to be a decline in syphilis prevalence over the years.

There was a general association between HIV and syphilis infection in the study sample. This result shows that syphilis and HIV were not occurring independently.

The 2005 sentinel surveillance survey results have been used to estimate national HIV prevalence in Malawi using internationally recommended methods; antenatal clinic data and the modeling computer software Estimation and Projection Package (EPP) and Spectrum.

The estimated HIV/AIDS prevalence in adults (15 to 49 years) in Malawi in 2005 is 14.0%, with a range from 12% to 17% giving a total of 790,000 infected adults. The analysis indicates that levels of HIV infection in the adult population of Malawi have remained constant for the last nine years. The prevalence estimate was 21.6% in urban areas and 12.1% in rural areas

The stable prevalence at 12 to 17 percent does not mean the HIV/AIDS problem has gone away. Every year at least 86,592 people are dying from AIDS and as many as 96,552 new infections occur. . The stable high prevalence could be attributed to high incidence in the younger age groups, especially adolescents (15-19 years).

Infection levels are above 10 percent in all sentinel sites except three rural sites in the Central Region. HIV prevalence is very high, 23.1 - 27 percent, in Blantyre, Mulanje and Nsanje.

The total number of people infected with HIV is estimated to be between 780,000 and 1,120,000 people in 2005. This figure includes 69,000 – 100,000 children under the age of 15 who are infected. One-third of those infected live in urban areas and two-thirds in rural areas.

A total of 187,336 people living with HIV and AIDS (PLWHA) were in need of antiretroviral therapy (ART) in 2005 and it was projected that by the end of 2010, a total of 233,675 PLWHA would be in need of ART. The estimates and projections for AIDS cases and deaths, adults and children needing ART are based on the assumptions that ART coverage will increase to 50% and prevention of mother to child transmission (PMTCT) coverage will increase to 433,000 pregnant women by 2010.

2.0 Introduction

HIV/AIDS is a major public health problem in Malawi. It is the leading cause of death in young adults, the most economically productive age group. The continuing high rates of infant and child mortality in the country have been attributed to HIV/AIDS.

HIV sentinel surveillance in pregnant women attending ANC is the main source of data for routinely monitoring HIV prevalence trends. In Malawi, this system was established in 1994 in 19 sites and these have been maintained up to now. The 2005 HIV sentinel survey was conducted for a period of up to 8 weeks starting from 1 August 2005.

Results of the HIV sentinel survey were used to estimate and project the national prevalence, incidence and impact. This was done using EPP and Spectrum modeling software developed by UNAIDS and WHO.

This report presents the findings of the 2005 HIV sentinel survey. The trends in HIV and syphilis prevalence are also presented. The report summarizes the methodology for the survey and the process for estimation and projection. National estimates for HIV prevalence and incidence, AIDS incidence and mortality and impact are also presented.

The report is expected to be used by programme managers, policy makers, academics, NGOs, UN Agencies, partners and other stakeholders involved in HIV/AIDS as a resource for monitoring and evaluation as well as advocacy.

3.0 Background

Malawi is classified as a least developed country on the UN human development index. Between the 1992 and 1998, the Gross Domestic Product (GDP) per capita decreased from US$ 200 to US$ 165[1]. The Malawi National Human Development Report, 2001[2] estimates the national poverty incidence at 65.3%, of which 66.5% and 54.9% are rural and urban poverty incidences respectively.

The projected population for 2005 according to the last Malawi Population Census is estimated at about 12.5 million, with an annual growth rate of 3.3%[3]. The Census showed that the national sex ratio was 96 males per 100 females. Malawi also has a high fertility rate of 6.2 children per woman due to early child bearing, a low contraceptive prevalence rate, high female illiteracy rates, and desire for large families[2,3]. This puts a huge stress on the country's limited land and natural resources, and social services. Most Malawians live in rural areas, though it is expected that by 2015, 44% of Malawians will be living in urban areas, a substantial increase from the 24% as was reported in 1999[2].

The HIV epidemic in Malawi started in the early 1980s and the first AIDS case was reported and confirmed in 1985, in Blantyre. Several studies were conducted in different sub populations to determine HIV and AIDS prevalence and to identify risk factors. However, the studies focussed on

[1] United Nations Development Programme/Malawi Government 2002. *The Impact of HIV/AIDS on Human Resources in the Malawi Public Sector*. Lilongwe.
[2] United Nations Development Programme 2001. *Malawi National Human Development Report 2001*. Lilongwe
[3] 1998 Malawi Population and Housing Census, Population Projections Report, 1999-2023, NSO, Malawi.

urban sub-populations. By 1990, routine data on pregnant women attending antenatal clinics (ANC) were collected in selected sites across the country.

Sentinel surveillance is the serial collection of HIV prevalence data over time and place in selected sites and groups of population in order to monitor trends in HIV infection and demographic variations in HIV prevalence. According to WHO/UNAIDS, HIV/AIDS epidemics are classified as low level, concentrated or generalised[4]. Malawi is experiencing a generalised epidemic, that is HIV prevalence among pregnant women attending ANC is consistently more than 1%. HIV is mainly transmitted through unprotected intercourse with an infected partner. In a generalised epidemic, HIV sentinel surveillance among pregnant women is the standard method for monitoring trends in HIV infection.

The HIV sentinel surveillance system was established in 1994 with data being collected from 19 sites. The sites were selected to represent the 3 regions of the country and the urban, semi-urban and rural areas. To date, nine sentinel surveys have been conducted from 1994-2000, 2001, 2003 and 2005.

4.0 Objectives

The general objective was to provide data for monitoring and evaluating HIV and AIDS programmes in Malawi.

The specific objectives were:

- To determine the HIV and syphilis prevalence among pregnant women presenting at antenatal care clinics.
- To determine trends in HIV and syphilis prevalence among pregnant women presenting antenatal care clinics.
- To estimate the national HIV and AIDS prevalence, incidence, mortality and impact.
- To project national HIV and AIDS prevalence, incidence, mortality and impact.

5.0 Methodology

5.1 Sentinel Population

All women regardless of age, attending antenatal clinic for the first visit during the current pregnancy were sampled for the study.

5.2 Sentinel Site Selection

The nineteen sites that have been used since 1994 were included in 2005. These sites are classified as urban, semi-urban and rural. Urban sites consisted of Limbe Health Centre in Blantyre, Lilongwe Bottom Hospital and Mzuzu Health Centre. Semi-urban sites comprised district and mission hospitals. Health centres away from urban or semi-urban areas are classified as rural sentinel sites. All the three urban sites were purposefully selected to get a picture of HIV prevalence in the three

[4]UNAIDS/WHO Working Group on Global HIV/AIDS and STI Surveillance,
Second Generation Surveillance for HIV

Malawian cities of Blantyre, Lilongwe and Mzuzu. On the other hand, the semi-urban and rural sites were selected through simple random sampling after stratifying by region and locality (semi-urban and rural).

5.3 Sampling

5.3.1 Sample size

The target sample sizes were 300 women in rural sites, 500 women in semi-urban sites and 800 women in urban sites. Previously, 200 women were sampled in rural sites. Routine demographic data including age, gravidity, level of education, marital status, occupation of the mother and her partner were collected before drawing blood specimens.

5.3.2 Sampling scheme

Every consecutive woman attending antenatal clinic services for the first time during the current pregnancy was enrolled throughout the survey period in all the 19 sites.

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5.3.3 Sampling Period

Sampling was done for a period of up to 8 weeks starting on 1 August 2005.

5.3.4. Inclusion and Exclusion Criteria

All women attending ANC for the first time during the current pregnancy were included in the survey. Women attending ANC for a repeat visit were excluded.

5.4 Specimen Handling and Laboratory Testing

Blood samples were collected using dried blood spots (DBS) on filter paper cards. In rural sites sample collection was conducted by mobile teams of laboratory technicians, whereas in semi-urban and urban sites procedures were carried out by technicians at the respective sentinel sites. All DBS were labelled with unique identification numbers with the corresponding data collection instrument and were transported to the Community Health Sciences Unit (CHSU) Lab for anonymous and unlinked HIV testing.

All women were screened for syphilis on site using Determine syphilis rapid tests. All reactive samples were considered to be infected with syphilis and the women were offered treatment onsite. All DBS cards were tested for HIV using Vironostika ELISA assay reference at the CHSU reference laboratory in accordance with the standard procedures. All samples reactive to this single test were regarded as HIV positive.

5.5 Quality Control and Assurance

Supervisory visits were organized during the survey period to ensure that blood samples and demographic data were collected according to protocols.

Potency of reagents, technical irregularities by different technicians and performance of ELISA reading machines were controlled for by external quality control samples as well as those provided with the test kits to standardize the results. Also, CHSU participates in external quality assurance with the CDC Laboratories in Atlanta and the WHO External Assurance programme.

5.6 Syphilis Case Management

All women reactive to the Determine rapid syphilis test on site were treated with a single 2.4 MU intramuscular injection of Benzathine Penicillin G. Women presenting with vaginal sores in addition to the rapid test result were also prescribed Erythromycin orally for five days. In cases of allergy to Penicillin, Erythromycin to be taken orally six-hourly for fifteen days was provided. Syphilis reactive women were also encouraged to bring their partners and any other contacts for treatment.

5.7 Data Management

All data were entered into an Epi Info computer database at the CHSU. Verification of data entry was done through exploratory analysis to identify inaccuracies in data entry or collection. Discrepant entries especially on HIV and syphilis test results were examined by checking all the entries using the field data collection instrument. Data entry errors were then corrected. Data analysis was also carried out in Epi Info for windows version 3.2.

Confidence intervals were calculated using the exact binomial method. Chi-square statistics were used to assess associations in 2 by 2 tables. Fisher's exact test was used for 2 by 2 tables with small 'expected frequencies'. Chi-square for trends was used to assess linear trends for HIV and syphilis sero-prevalence**.**

5.8 Estimation and Projection

To prepare HIV and AIDS national estimates, seven major steps were implemented. The steps were:

1. **Curve fitting**. The Estimation and Projections Package (EPP)[5] developed by UNAIDS/WHO, was used to fit epidemic curves to the time trend prevalence data for each sentinel site. These curves smooth the inherent annual fluctuations and provide a picture of the entire course of the epidemic from the start to today and can be used to project a short time into the future. More information on curve fitting methodology and results is presented in Annex 4.

2. **Assigning sites to districts without sentinel sites**. Only 19 districts have a sentinel site, either urban, semi-urban or rural. Hence, one of the 19 sentinel surveillance sites was selected to represent the urban population of each district and one was selected to represent the rural population for each district in the country. The assignment was based on geographical, cultural, socio-economic similarities between the sentinel sites and those districts they represent. See tables 1 and 2**.**

3. **Estimating the size of the adult population**. The adult population was obtained from the population projection for 2005, from the National Statistics Office[3]. These data were used to estimate the size of the urban and rural populations in each district, by year, from 1982 to 2010. The population 15-49 by district was calculated from the proportion of the total 15-49 population in the 1998 census.

4. **Estimating the number of adults infected in each district.** The number of people living with HIV and AIDS in each district was estimated separately for urban and rural populations.

[5] The EPP program is available free of charge. The program and manual can be downloaded from the internet at www.unaids.org.

The number of people infected was calculated by multiplying the population between the ages of 15 and 49 by the estimated and projected HIV prevalence.

5. **Estimating national adult HIV prevalence.** HIV prevalence among adults was calculated by dividing the number of people infected with HIV by the size of the population between the ages of 15 and 49. These results were input into Spectrum program. Assumptions on survival, fertility, HIV age-sex ratios, ART and PMTCT coverage were input to provide a full demographic projection. Spectrum was also used to estimate additional indicators including HIV and AIDS incidence, AIDS mortality, ART needs and number of AIDS and non-AIDS orphans.

Table 1 shows the districts and the sentinel sites (columns 2 and 3) that were chosen to represent them . The reasons for the assignments are presented in Table 2. In some cases, no single site was appropriate to represent a district, so two sites were selected and the average prevalence of the two sites was used.

Table 1. Districts and sentinel sites used to represent them

Region	*District*	*Urban site*	*Rural site*
North	Chitipa	Kaporo	Mbalachanda-Kaporo
	Karonga	Nkhata Bay	Kaporo
	Rumphi	Rumphi	Mbalachanda
	Nkhata Bay	Nkhata Bay	Mbalachanda-Kaporo
	Mzimba	Rumphi	Mbalachanda
	Mzuzu City	St. John's	
	Likoma	Nkhata Bay-Kaporo	Nkhata Bay-Kaporo
Central	Kasungu	Mchinji	Kamboni
	Nkhotakota	Nkhotakota	Kamboni
	Ntchisi	Thonje-Mchinji	Thonje
	Dowa	Mchinji	Thonje
	Salima	Mchinji-Nkhotakota	Nkhata Bay-Kaporo
	Lilongwe	Lilongwe	Kasina
	Mchinji	Mchinji	Kamboni
	Dedza	Ntcheu	Kasina
	Ntcheu	Ntcheu	Kasina
South	Mangochi	Mangochi	Gawanani
	Machinga	Mangochi	Gawanani
	Balaka	Mangochi-Ntcheu	Gawanani
	Zomba	Blantyre	Gawanani-Milepa
	Chiradzulu	Mulanje	Milepa
	Blantyre	Blantyre	Milepa-Mianga
	Mwanza	Mchinji	Gawanani
	Thyolo	Mulanje	Mianga
	Mulanje	Mulanje	Mianga
	Phalombe	Milepa	Milepa
	Chikwawa	Nsanje	Milepa-Mianga
	Nsanje	Nsanje	Milepa-Mianga

Table 2. Characteristics used in assigning sentinel sites to represent districts

Geographic proximity
Socio-cultural factors (practices, rites)
Development levels (infrastructure, schools, shops, etc.)
Access to major transportation routes (main highways, lake, railroad)
Economic aspects (agriculture, estates, commercial centers, cross-border trade)
Migration (migrant farmers/laborers, cross-border migration, economic opportunity)
Commercial sex-workers networks
History
HIV prevalence of surveillance sites

5.9 Limitations

Sentinel surveillance data are derived from convenience samples and some sites were purposefully selected. Therefore, the data do not represent the general population but only reflect HIV and syphilis prevalence from specific sites. Sentinel surveillance data are, however, used to estimate national HIV prevalence. There are several sources of potential error involved in preparing these estimates. Firstly, prevalence estimates at ANC sites have an error of plus or minus 5 percentage points for rural sites with sample sizes of about 300 women to plus or minus 3 percent in urban sites with sample sizes of around 800 women. Secondly, there are uncertainties in finding the best fitting curves for each site and in equating prevalence from ante-natal clinics to the general adult population.

Another source of error of unknown size is the use of 19 sentinel sites to represent the entire country. The assignment of sentinel sites to each district was based on the best judgment of the participants during the 2001 prevalence estimation workshop. The assignment of sites has an element of subjectivity.

Given these limitations, UNAIDS has recommended that the error range around national estimates in generalized epidemics with good surveillance systems, such as Malawi, is plus or minus 20 percent[6].

[6] UNAIDS Reference Group on Estimates, Modelling and Projections. "Improved methods and assumptions of the HIV/AIDS epidemic and its impact: Recommendations of the UNAIDS Reference Group on Estimates, Modelling and Projections" *AIDS* 2002. **14**:W1-W16.

6.0 Results

6.1 Demographic Distribution of the Sample

6.1.1 Number of Women enrolled by site

A total of 8,953 women attending antenatal clinics were included in the analysis. While most sites collected slightly more than the target number of samples, Kamboni, Thonje and Nsanje fell short of the desired sample sizes. Refer to Table 3 showing the distribution of women sampled by site.

Table 3: Number of women sampled by sentinel site

Sentinel Site	Region	Locality	Desired sample size	Total Sampled	%of Total
Kaporo Health Centre	North	Rural	300	307	3.43
Mbalachanda Health Centre	North	Rural	300	312	3.48
Rumphi District Hospital	North	Semi-urban	500	539	6.02
Nkhata-Bay District Hospital	North	Semi-urban	500	520	5.81
Mzuzu Health Centre	North	Urban	800	849	9.48
Kamboni Health Centre	Central	Rural	300	297	3.32
Thonje Health Centre	Central	Rural	300	205	2.29
Kasina Health Centre	Central	Rural	300	300	3.35
Mchinji District Hospital	Central	Semi-Urban	500	522	5.83
St. Anne's Mission Hospital	Central	Semi-Urban	500	500	5.58
Ntcheu District Hospital	Central	Semi-Urban	500	500	5.58
Lilongwe Bottom Hospital	Central	Urban	800	867	9.68
Gawanani Health Centre	South	Rural	300	301	3.36
Milepa Health Centre	South	Rural	300	311	3.47
Mianga Health Centre	South	Rural	300	321	3.59
Mangochi District Hospital	South	Semi-Urban	500	502	5.61
Mulanje Mission Hospital	South	Semi-Urban	500	524	5.81
Nsanje District Hospital	South	Semi-Urban	500	429	4.79
Limbe Health Centre	South	Urban	800	847	9.46
Total				**8,953**	**100**

6.1.2 Number of Women enrolled by locality

The distribution of women enrolled by locality (rural – urban) is shown in Table 4 below.

Table 4:Number of women sampled by Locality

Location	Total Sampled	% of Total
Urban	2,563	28.6
Semi-Urban	4,036	45.1
Rural	2,354	26.3
Total	**8,953**	**100**

6.1.3 Number of Women enrolled by region

The sample size in the northern region is smaller with fewer sites and is reflective of the smaller population size in the northern region. The distribution of women enrolled by region is shown in Table 5.

Table 5 : Number of women sampled by Region

Region	Total Sampled	% of Total
North	2,527	28.2
Centre	3,191	35.6
South	3,235	36.1
Total	**8,953**	**100.0**

6.1.3 Number of Women enrolled by age-group

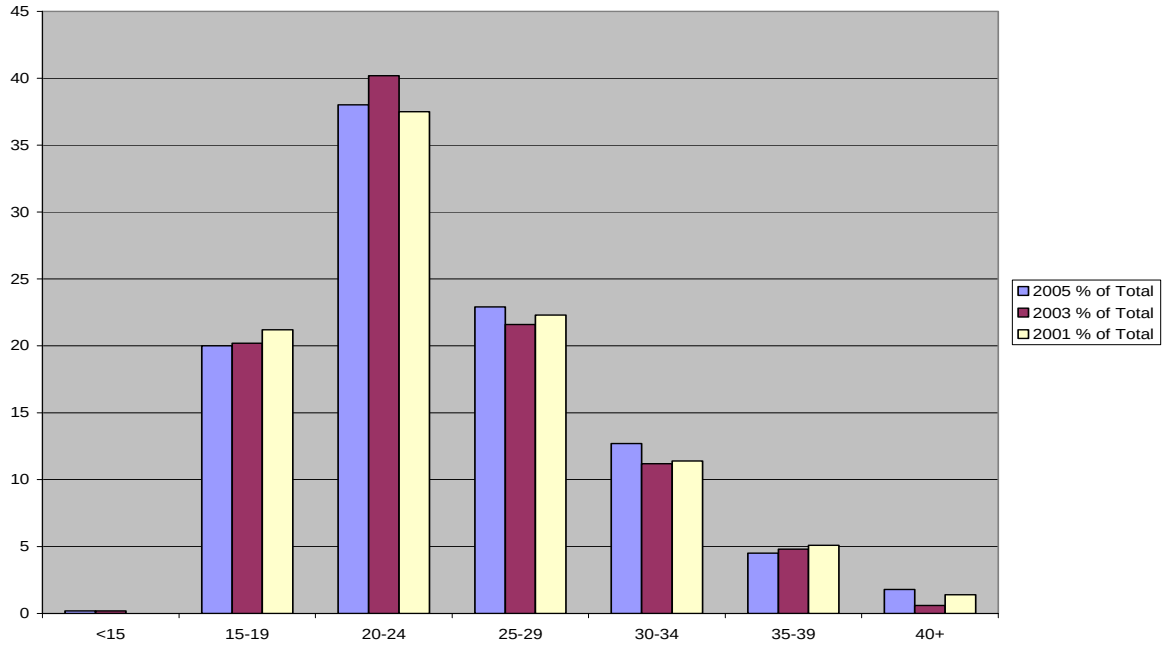
The sample comprised relatively young women in their prime years of sexual activity. Over 90% of the women were aged less than 30 years and almost 60% aged less than 25 years as shown in Table 6.

Table 6: Number of Women enrolled by age-group

Age group	Total Sampled	% of Total
<15	16	0.2
15-19	1780	19.9
20-24	3,380	37.8
25-29	2,035	22.7
30-34	1133	12.7
35-39	397	4.4
40-44	117	1.8
45-49	31	0.3
50+	11	0.1
Total	**8,953**	**100**

The age pattern of the women recruited in the survey is similar to the previous three surveys as shown in Figure 1.

Figure 1: Age patterns of women at sentinel sites in the three most recent surveys



6.2 HIV Prevalence

6.2.1 HIV Prevalence by Site

HIV prevalence ranged from 6.3% in Thonje HC to 27.0% in Limbe HC (Blantyre). The median prevalence was 15.0%. Table 7 shows the HIV prevalence by site. The sites in the major cities; Limbe HC in Blantyre, Lilongwe Bottom Hospital and Mzuzu HC had HIV prevalence rates of 27.0%, 18.6% and 15.5% respectively.

Table 7: HIV Prevalence by Site

Sentinel Site	Region	Locality	Total Sampled	HIV+	% HIV+	95% CI
Kaporo Health Centre	North	Rural	307	39	12.7	9.3-17.1
Mbalachanda Health Centre	North	Rural	312	45	14.4	10.8-18.9
Rumphi District Hospital	North	Semi-urban	539	73	13.5	10.8-16.8
Nkhata-Bay District Hospital	North	Semi-urban	520	64	12.3	9.7-15.5
Mzuzu Health Centre	North	Urban	849	132	15.5	13.2-18.2
Kamboni Health Centre	Centre	Rural	297	19	6.4	3.9-9.8
Thonje Health Centre	Centre	Rural	205	13	6.3	3.4-10.6
Kasina Health Centre	Centre	Rural	300	25	8.3	5.5-12.1
Mchinji District Hospital	Centre	Semi-Urban	522	77	14.8	11.9-18.2
St. Anne's Mission Hospital	Centre	Semi-Urban	500	61	12.2	9.5-15.5
Ntcheu District Hospital	Centre	Semi-Urban	500	110	22.0	16.8-24.0
Lilongwe Bottom Hospital	Centre	Urban	867	161	18.6	16.1-21.4
Gawanani Health Centre	South	Rural	301	45	15.0	11.2-19.6
Milepa Health centre	South	Rural	311	58	18.6	14.6-23.5
Mianga Health centre	South	Rural	321	62	19.3	15.2-24.2
Mangochi District Hospital	South	Semi-Urban	502	87	17.3	14.2-21.0
Mulanje Mission Hospital	South	Semi-Urban	524	123	23.5	20.0-27.4
Nsanje District Hospital	South	Semi-Urban	429	99	23.1	19.2-27.4
Limbe Health Centre	South	Urban	847	229	27.0	24.1-30.2
Total			**8,953**	**1,513**	**16.9**	
Median					**15.0**	

6.2.2 HIV Prevalence by Locality

Prevalence was highest in urban areas at 20.4% followed by semi-urban areas where prevalence was 17.0%. Rural areas had the lowest prevalence of 13%, as shown in Table 8.

Table 8: HIV Prevalence by Locality

Location	Total Sampled	HIV+	% HIV+	95% CI
Urban	2,563	522	20.4	18.8-20.0
Semi-Urban	4,036	685	17.0	15.8-18.2
Rural	2,354	306	13.0	11.7-14.4
Total	**8,953**	**1,513**	**16.9**	

6.2.3 HIV Prevalence by Region

The Southern region had the highest prevalence at 21.7%. Prevalence was similar for Centre and South regions at, 14.3% and 14.0% respectively (Table 9).

Table 9: HIV Prevalence by Region

Region	Total Sampled	HIV+	% HIV+	95% CI
North	2,527	353	14.0	12.7-15.4
Centre	3,191	457	14.3	13.1-15.6
South	3,235	703	21.7	20.3-23.2
Total	**8,953**	**1,513**	**16.9**	

6.2.4 HIV Prevalence by Age-Group

Prevalence increased with age, peaking in the 25-29 year age group. HIV prevalence in young women (15-24) was significantly lower than in the older women (Table10).

Table 10: HIV Prevalence by Age-Group

Age group	Total Sampled	HIV+	% HIV+	95% CI
15-19	1780	183	10.3	8.9-11.8
20-24	3,380	554	16.4	15.2-17.7
25-29	2,035	439	21.6	19.8-23.4
30-34	1133	233	20.6	18.3-23.1
35-39	397	70	17.6	14.1-21.8
40-44	117	15	12.8	7.4-20.3
45-49	31	7	22.6	9.6-41.1
Total	**8874**	**1,513**	**16.9**	

6.2.5 HIV Prevalence by Level of Education Attained

As has been seen before, prevalence was higher among women with higher levels of education attainment as observed among those who have gone up to secondary school level (Table11).

Table 11: HIV Prevalence by Level of Education Attained

Education	Total Sampled	HIV+	% HIV+	95% CI
None	1102	197	17.9	15.7-20.3
Std 1-5	2600	418	16.1	14.7-17.6
Std 6-8	3161	487	15.4	14.2-16.7
Form 1-2	856	167	19.5	16.9-22.4
Form 3-4	675	143	21.2	18.2-24.5
Post Secondary	18	6	33.3	13.3-59.0
Other	6	1	16.7	0.4-64.1
TOTAL	**8418**	**1419**	**16.9**	

6.2.6 HIV Prevalence by Occupation

Prevalence by occupation is shown in Table 12. Subsistence farmers have lower prevalence rates than other occupational categories.

Table 12: HIV Prevalence by Occupation

Occupation	Total Sampled	HIV+	% HIV+	95% CI	
None	63	11	17.5	9.1	29.1
Unskilled	218	42	19.3	14.3	25.1
Housewife	5273	964	18.3	17.3	19.4
Subsistence farmer	2170	244	11.2	10.0	12.70
Small scale business	391	75	19.2	15.5	23.5
Skilled	127	26	20.5	13.8	28.5
Driver	30	10	33.3	17.3	52.8
Professional	90	29	32.2	22.8	42.9
Security agent	26	6	23.1	9.0	43.6
Student	61	9	14.8	7.0	26.20
Fishermen	19	4	21.1	6.1	45.60
Military/police	6	2	33.3	4.3	77.7
Missing	463	85	18.4	15	22.3
Other	17	6	35.3	14.2	61.7
TOTAL	8954	1513	16.9	16.1	17.7

6.3 Syphilis Prevalence

6.3.1 Syphilis Prevalence by Site

Syphilis prevalence ranged from 0% in Gawanani, Kasina, Mzuzu, Thonje to 10.8% in Nsanje (Table 13).

Table 13: Syphilis Prevalence by Site

Sentinel Site	Total Sampled	Syphilis +	% Syphilis +	95% CI
Bottom Hospital	866	12	1.4	0.8-2.5
Gawanani HC	299	0	0.0	0.0-1.2
Kamboni HC	294	1	0.3	0.0-1.9
Kaporo HC	304	8	2.6	1.2-5.3
Kasina HC	298	0	0.0	0.0-1.2
Limbe HC	841	12	1.4	0.8-2.6
Mangochi District Hospital	498	1	0.2	0.0-1.3
Mbalachanda HC	311	3	1.0	0.2-3.0
Mchinji District Hospital	521	15	2.9	1.7-4.8
Mianga HC	318	1	0.3	0.0-2.0
Milepa HC	308	13	4.2	2.4-7.3
Mulanje Mission Hospital	523	2	0.4	0.1-1.5
Mzuzu HC	836	0	0.0	0.0-0.6
Nkhata Bay District Hospital	514	21	4.1	2.6- 6.3
Nsanje District Hospital	427	46	10.8	8.1-14.2
Ntcheu District Hospital	498	24	4.8	3.2-7.2
Rumphi District Hospital	538	8	1.5	0.7-3.0
St Annes Hospital	500	3	0.6	0.2-1.9
Thonje HC	203	0	0.0	0.0-1.8
TOTAL	**8897**	**170**	**1.9**	**1.7-2.2**

6.3.2 Syphilis Prevalence by Age

Syphilis prevalence increased with age, though not significantly (Table 14).

Table 14: Syphilis Prevalence by Age-group

Age group	Total Sampled	Syphilis +	% Syphilis +	95% CI
15-19	1778	20	1.1	0.7-1.8
20-24	3379	51	1.5	1.1-2.0
25-29	2035	47	2.3	1.7-3.1
30-34	1133	31	2.7	1.9-3.9
35-39	397	15	3.8	2.2-6.3
40-44	117	6	5.1	1.9-10.8
45-49	31	0	0.0	0.0-11.2
TOTAL	**8870**	**170**	**1.9**	**1.7-2.2**

6.3.3 Syphilis Prevalence by Region

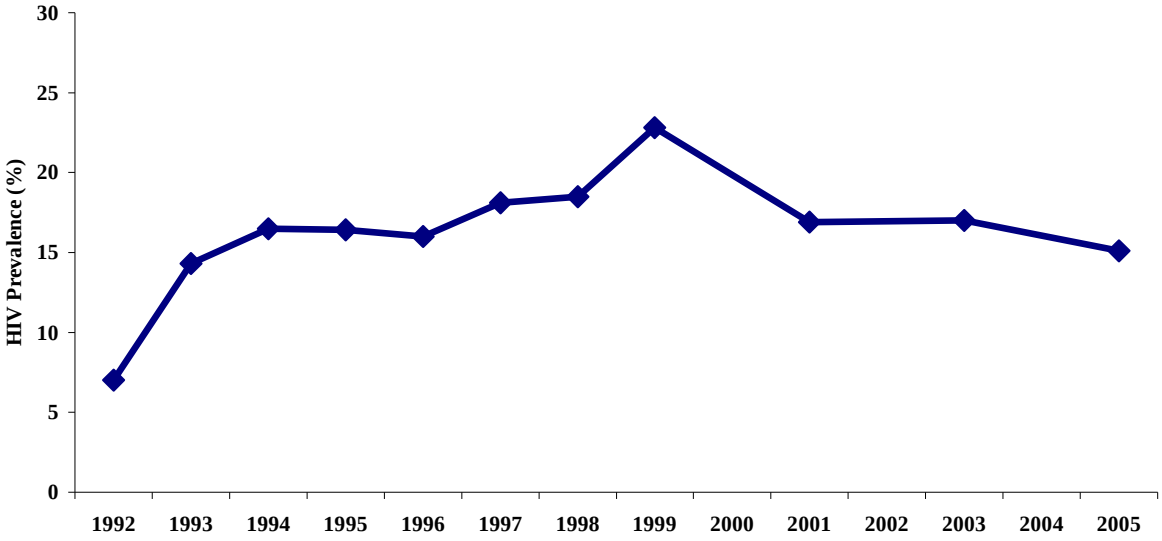
Syphilis prevalence is highest in the south, though again not significantly (Table 15).

Table 15: Syphilis Prevalence by Region

Region	Total Sampled	Syphilis +	% Syphilis +	95% CI
Center	3191	56	1.8	1.3-2.3
North	2528	40	1.6	1.1-2.2
South	3235	77	2.4	1.9-3.0
TOTAL	8954	173	1.9	

6.4 HIV and Syphilis Trends

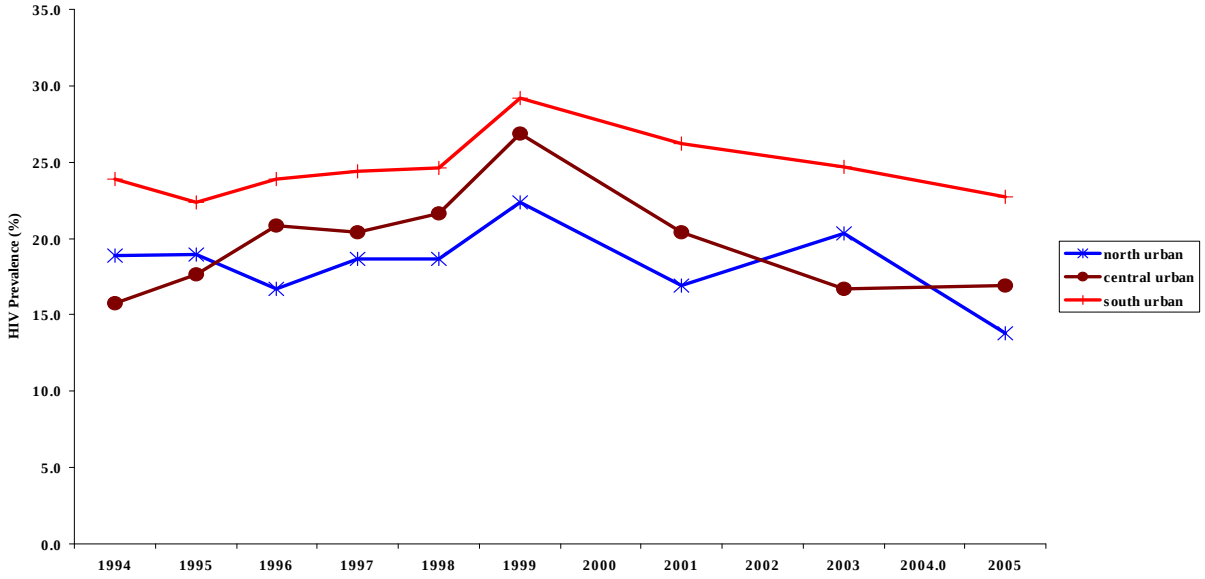
Figure 2: Trend in Median HIV prevalence, 1992-2005



The median HIV prevalence for sentinel sites increased from 1992 to 1999, after which prevalence declined and stabilized. Median site HIV prevalence has been stable since 1994 (Figure 2). Median HIV prevalence has been used to monitor the trend because it is a better indicator than overall prevalence when non-probability sampling is used. Overall prevalence is also affected by changes in sample size. Furthermore, the median is less sensitive to extreme values.

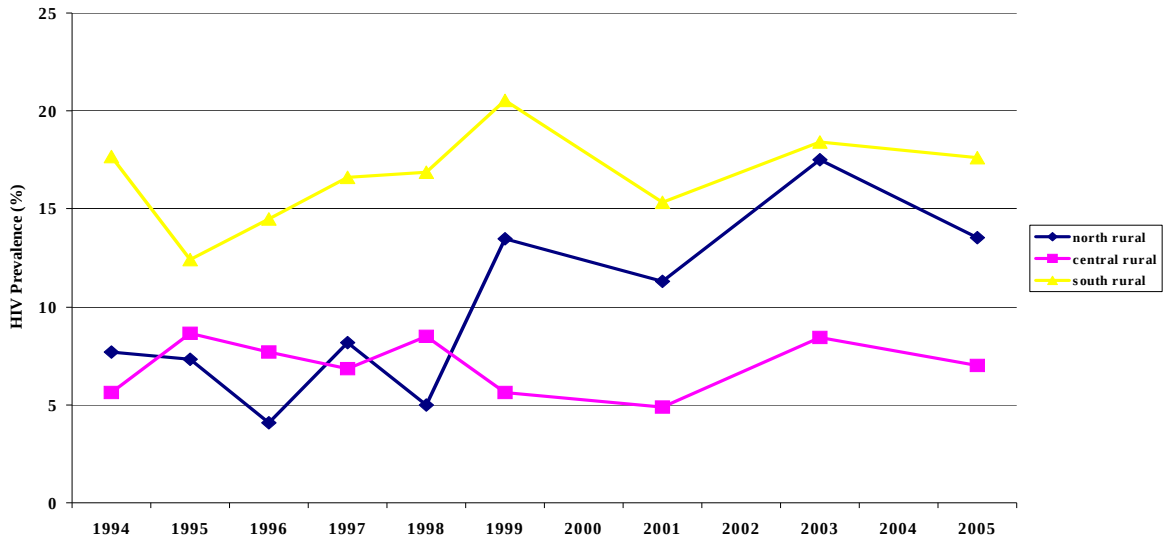
A comparison of 2003 and 2005 survey results show that 5 sites (Kasina HC, St Anne's Mission Hospital, Lilongwe Bottom Hospital, Milepa HC and Mangochi District Hospital) experienced an increase in prevalence rates while it was the same at Ncheu District Hospital and prevalence decreased at the rest of the sites (13 sites).

Figure 3: HIV Prevalence in Urban Areas by Region



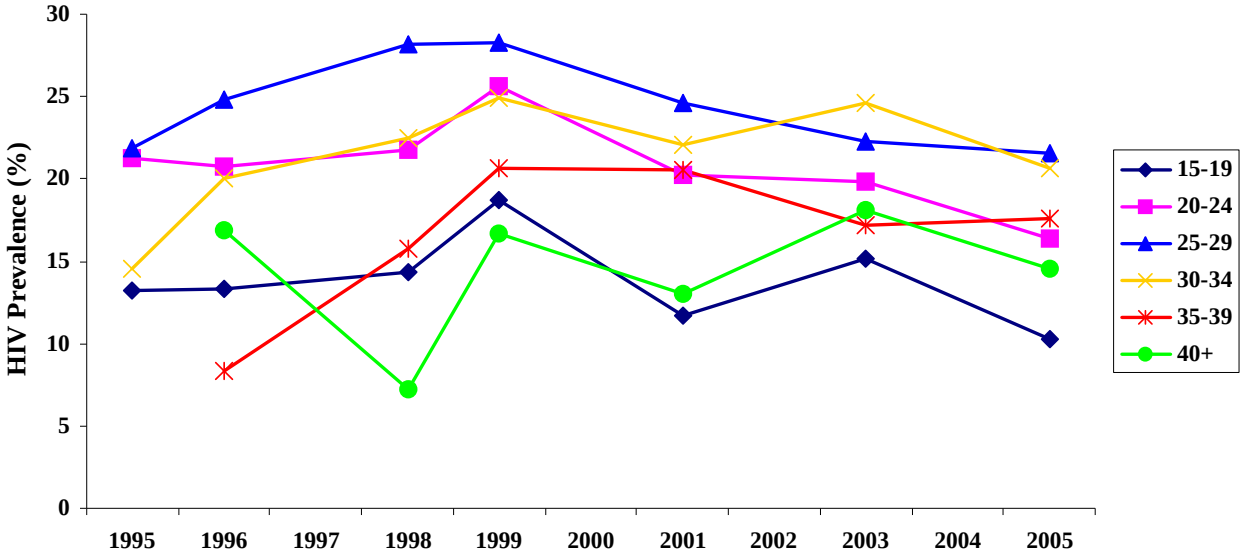
There is a general downward trend in the urban sites from 1999 to 2005 in all regions. The decline is most pronounced in the Central Region (Figure 3).

Figure 4: HIV Prevalence in Rural Areas by Region



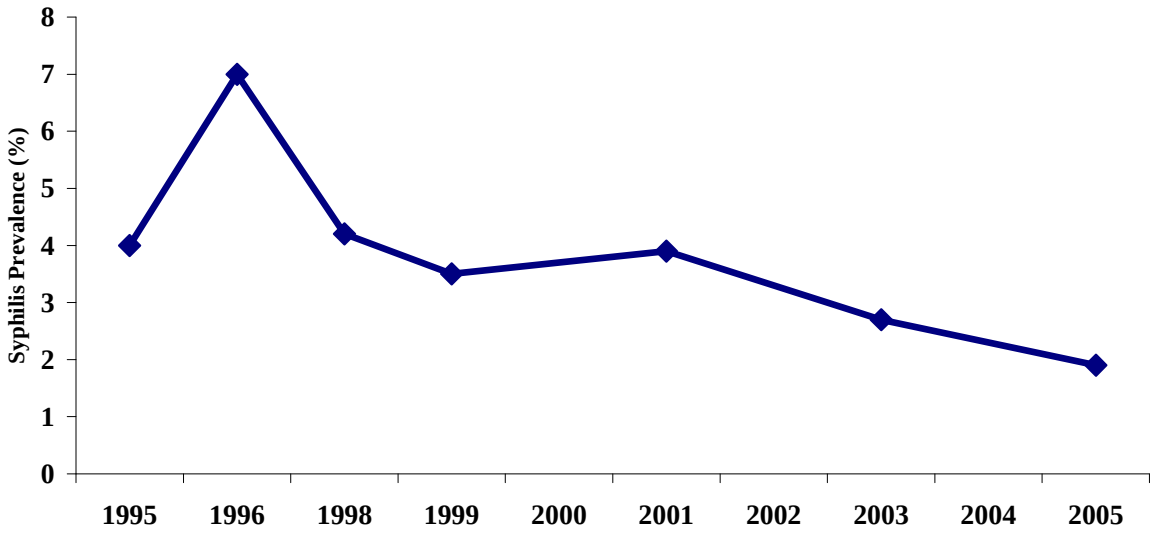
There is an upward trend in prevalence in rural sites in the Northern Region. Prevalence in the Southern and Central Region rural sites is stable (Figure 4).

Figure 5: HIV prevalence trend by age-group



HIV prevalence in younger age-groups is declining while in older women it appears stable. Prevalence generally decreased between 1999 and 2005 in the 15-19, 20-24 and 25-29 age-groups (Figure 5).

Figure 6: Syphilis Trends



The prevalence of syphilis in pregnant women has been decreasing since 2001 (Figure 6).

6.5 Estimates and Projections

6.5.1 National HIV Prevalence Estimates

In 2005, the estimated adult national prevalence was 14.02% giving a total of 790,000 infected adults. In the total population, there were an estimated 930,000 persons living with HIV/AIDS in 2005. The estimated prevalence was 21.6% in urban areas and 12.1% in rural areas. Table 16 below shows the indicators for HIV prevalence in 2005.

Table 16: National HIV Prevalence Estimates, 2005

Indicator	Value	Low	High
National adult prevalence(15-49)	14.0%	12%	17%
Number of infected adults	790,000	660,000	950,000
Number of infected adult women (15-49)	440,000	370,000	530,000
Urban adult prevalence	21.6%	18%	26%
Number of infected urban adults	240,000	200,000	290,000
Rural adult prevalence	12.1%	10%	15%
Number of infected rural adults	550,000	458,000	660,000
Number of infected children (0-14)	83,000	69,000	100,000
Number infected over age 50	59,000	49,000	71,000
Total HIV+ population	930,000	780,000	1,120,000

Applying the UNAIDS certainty recommendation of 20% to the point estimate for prevalence of 14%, generates the certainty range around that estimate of 12% to 17%. Ranges for estimates are presented in Table 16.

6.5.2 AIDS Incidence, Mortality and ART Needs

Table 17 below shows the 2005 estimates for AIDS incidence, mortality and ART needs, as well as the projections up to 2010. A total of 187,336 PLWHA were in need of ART in 2005 and it was projected that by the end of 2010, a total of 233,675 PLWHA would be in need of ART.

Table 17: AIDS Incidence, Mortality and ART Needs Estimates and Projections

Indicator	2005	2006	2007	2008	2009	2010
New AIDS Cases (15-49)	67,082	67,452	68,035	68,884	70,147	71,861
New AIDS Cases (0-14)	21,735	21,754	21,214	20,273	19,430	18,803
New AIDS Cases	96,552	97,004	97,089	96,996	97,454	98,632
Annual AIDS Deaths (15-49)	57,814	60,119	60,067	59,702	59,276	58,870
Annual AIDS Deaths (0-14)	21,118	19,288	17,516	15,967	13,472	12,219
Annual AIDS Deaths	86,592	87,574	85,855	83,958	81,000	79,284
Adults needing ART	137,371	145,166	151,312	158,236	166,619	176,933
Children (0-14) needing ART	49,965	50,910	51,007	51,992	53,906	56,742
Adults newly needing ART	67,082	67,452	68,035	68,884	70,147	71,861

The projections for AIDS cases and AIDS-related deaths, and adults and children needing ART are based on the assumptions that both ART coverage will increase to 50% and PMTCT coverage will increase to 433,000 pregnant women by 2010.

7.0 Discussion

The results of the HIV sentinel survey indicated an HIV prevalence rate ranging from 6.3% to 27.0%, with a median prevalence of 15.0% and an overall prevalence of 16.9 percent. The median prevalence is a better reflection of HIV prevalence in pregnant women in the country for several reasons.

Overall, HIV prevalence in Malawi appears to be stabilized. While HIV prevalence declined in 13 of the 19 sites, the decline in 9 of these sites did not appear to be significant. The median HIV prevalence fluctuated between 15.0% and 17.0% between 2001 and 2005. The differences in median HIV prevalence between 2005 and previous years may be due to increased sample size in the rural sites, where prevalence is generally lower. During the 2005 survey, rural sites collected a sample size of 300 compared to the 200 samples collected in the previous surveys. Therefore, it is not possible to meaningfully compare the overall prevalence between this year and prior years.

HIV prevalence in urban areas remains higher than in the semi-urban and rural areas. This is consistent with the pattern observed in most countries in Africa. Trend analysis for HIV prevalence by locality shows that although prevalence is coming down in urban areas, it remains higher than in rural areas. Overall, prevalence appeared to be stable in the Southern and Central Regions but increasing in the North. This is driven by a trend of increasing prevalence in rural sites in the North since 1998.

Monitoring HIV prevalence in the 15-19, 20-24 and 15-24 year age groups is important because infection in younger women (associated with more recent infections) is a surrogate for incidence trends, since these women are more likely to have only recently become sexually active. For this reason, HIV prevalence in the 15-24 year age group is a national indicator as well as a Millennium Development Goals indicator. Prevalence in the 15-19, 20-24 and 15-24 was 10.3%, 16.4% and 14.3% respectively, and is significantly lower than in older women. As HIV positive individuals live an estimated 8 years[6], HIV prevalence is expected to be higher in older women. In both the 15-19 and 20-24 year age groups, prevalence declined between 2003 and 2005. Further, there has been a general decline in HIV prevalence in the younger age-groups since 1999. This may be attributed to HIV prevention efforts targeted at the youth. Program evaluation should therefore be a focus in the coming year.

The decline in prevalence seen in Lilongwe in 2003 was not sustained in 2005. However, prevalence rates did remain low in Lilongwe suggesting that continued focus on the capital would be beneficial to the program development nationally.

Syphilis prevalence in pregnant women attending antenatal care clinics continues to decline in Malawi. Prevalence declined from 3.9% in 2001, 3.7% in 2003 and 1.9% in 2005. The syphilis prevalence is also much lower than HIV prevalence. The decline in the syphilis prevalence in women attending antenatal care may be due to an effective treatment programme for syphilis.

The estimated adult HIV prevalence was 14.0% with a low and high estimate of 12% and 17% respectively. This translates to 790,000 infected adults and 930,000 persons living with HIV/AIDS in the total population. The projection describes a stable prevalence since the mid 1990's of 14% to 15%. There may be a slight decline in prevalence since 1999. This observation is supported by ANC sentinel results where 13 of the 19 sites saw declines. However, this slight decline is expected in generalized epidemics that have reached a peak prevalence and then see a slight decline, mainly due to deaths of those persons infected during the rapid increase in prevalence. (See graph of Adult HIV prevalence in Annex 6.)

The 2005 estimates compare well with those projected for 2005 in the 2003 estimation and projection exercise. In 2003, it had been projected that in 2005 the 760,000 adults infected with HIV and 870,000 children and adults will be infected. However, it should be noted that some modifications were made to the estimation software between 2003 and 2005. Consequently, care should be taken in comparing figures developed in 2003 with new figures from 2005.

Annual AIDS-related deaths are projected to increase from 86,592 in 2005 to 87,574 in 2006 then gradually decline to 79,284 in 2010. These projections are based on modest ART coverage targets. (Annex 5) More ambitious targets for ART coverage would result in more drastic declines in AIDS deaths.

8.0 Conclusion and Recommendations

While overall the HIV prevalence in Malawi is stable, prevalence is declining in urban areas but increasing in rural areas. This continued increase is particularly apparent in the North. Consequently, there is need to intensify HIV prevention activities especially in rural areas. Although prevalence declines are being noted in young women, the prevalence is still high and there is need to increase the coverage of prevention services targeted at the youth to sustain and accelerate the declines.

Lessons from districts that are experiencing declines should be applied to districts where this was not seen, particularly in the area of prevention. There is also a need to increase access to ART and PMTCT services for persons living with HIV/AIDS; which would have an impact on the AIDS-related deaths and hence less orphans.

As one of the sources of error of unknown size is the use of 19 sentinel sites to represent the entire country, there is need to conduct district based HIV sentinel surveillance. Each district will have one or two sites (one in rural and the other in urban setting).

Glossary

Chi-square test

The statistical test used to test the null hypothesis that proportions are equal or equivalently, the factors or characteristic are independent or associated

Confidence interval

The interval computed from sample data that has a given probability that an unknown parameter, such as the proportion is contained within the interval. Common confidence intervals are 95%, meaning that the probability that the unknown parameter lies in the interval is 0.95.

If confidence intervals for groups which are being compared do not overlap, then there is a statistical difference.

Generalised epidemic

It is when HIV prevalence among pregnant women attending ANC is consistently more than 1%.

Incidence

Number of new cases in a defined population and period of time.

Median

The middle value in a distribution of values, half the scores are above the median and half the scores are below.

Null hypothesis

The hypothesis being tested about a population. Null generally means “no difference” and as a result refers to a situation where no difference exists. E.g. prevalence rates between rural and urban.

Overall (prevalence)

The percent of all HIV positive women at all sites divided by all the women sampled at all sites.

Prevalence

Total number of individuals who have a disease during a particular period divided by the population at risk of having the disease during the period.

P value

This is the probability of observing a result, as extreme as or more extreme than the one actually observed from chance alone. Usually, when the p value is less than 0.05, one rejects the null hypothesis, one concludes that there is a statistical difference or an association.

Sentinel surveillance

Is the serial collection of HIV prevalence data over time and place in selected sites and groups of population in order to monitor trends in HIV infection and demographic variations in HIV prevalence.

Statistical significance

Generally interpreted as a result that would occur by chance, for example 1 time in 20 with a p-value of 0.05. There is statistical significance when null hypothesis is rejected.

Variable

Any quantity that varies is a variable. Any attribute, phenomenon or event that can have different values is a variable.

Annex 1

SECOND GENERATION SURVEILLANCE

In July 2000, the World Health Organisation (WHO) and other partners released the guidelines for conducting second-generation surveillance studies. The concept of second generation HIV/AIDS/STD surveillance systems sets out to achieve the following objectives: to better understand trends; to understand the behaviours driving the epidemic; to provide a system that is more focused on sub-populations at higher risk of infection; to provide a system that is flexible and moves with the needs and state of the epidemic; and finally to provide a system that will enable better use of data so as to maximise opportunities to plan for prevention and care.

Second generation HIV/AIDS/STD surveillance systems are meant to be appropriate to the epidemic, dynamic, use resources where they will generate the most useful information, compare biological and behavioural data for maximum explanation power, integrate information from other sources and use data produced to improve and increase the national response.

In Malawi, second generation surveillance may include strengthening surveillance in the age group 15-24 years. The epidemic in Malawi is well-established "a generalized epidemic". Surveillance efforts in generalized epidemics should focus on new infections because it is difficult to interpret changes in prevalence. Although it is difficult to measure HIV incidence, resources can be concentrated on the youth since their infections are likely to be relatively recent hence not biased by reduced fertility. Behaviour surveillance among young people is very critical. Establishing safer behaviour from the beginning of young people's sexual lives could be more effectual in changing the course of the epidemic than changing behaviour in older groups.

Malawi should put in place behaviour surveillance through repeat cross-sectional household surveys, preferably annually. The following biological data should also be analysed annually to validate sentinel surveillance findings: 1. blood donors' data, 2. VCT data, 3. PMTCT data, 4. STI data, 5. TB data, and 6. AIDS cases data

Annex 2

ANTENATAL SEROPREVALENCE STUDY
Ministry of Health
Data collection form

PART A: For site result

Date ___/___/_____ **Clinic Site**: _____

Client name:

Education level:
1. None 2. Std 1-5 3. Std 6-8 4. Form 1-2
5. Form 3-4 6. Post Secondary 7. Other

SYPHILIS RESULT

Non-Reactive
Reactive

Instructions: Enter the Syphilis results and demographic information below

Cut Here

ANTENATAL SEROPREVALENCE STUDY
Ministry of Health
Data collection form

PART B: For Reference Lab **Put label Here:**

Date ___/___/_____ **Clinic Site**: _____

Age in years : **Gravida:**

Education level:
(circle)
1. **None 2. Std 1-5 3. Std 6-8 4. Form 1-2**
5. Form 3-4 6. Post Secondary 7. Other

SYPHILIS RESULT

Non-Reactive
Reactive

Marital status: 1. Married 2.Single 3.Divorced 4.Widowed 5.Separated 6.Cohabiting

HIV SEROLOGY

Occupation: Partner:
(see reverse for code)

Mother:

Non-Reactive
Reactive

Demographic and syphilis results should be filled during antenatal clinic

Put numbered labels on this part of form and DBS cards bag. Send this part of form and DBS bag to Reference Lab

Occupation categorization

Occupation	Comments
1. Unskilled	Labourers/manual workers or jobs that do not require special skills or education eg cleaner, messenger, piece works *"Ganyu"*
2 Business	Owners of shops, hawkers, bakers, vendors, vegetable sellers etc.
3. Skilled	Occupations that need technical skills e.g. mechanics, builders, carpenters, electricians, welders, etc
4. Professional	Jobs requiring professional/academic qualifications e.g. clerks, secretaries, administrator, manager, teacher, banker e.t.c.
5. Military/police	Army and police
6. Security agent	Guards, watchmen
7. Student	Primary school, secondary school, college and university students
8. fishermen	People who catch fish and those who sell the fish at the lake
9.Subsistence farmer	Unemployed villagers relying on subsistence farming
10. House wife	Unemployed married women
11. none	Jobless people staying in urban and semi urban areas
12. driver	Any type of drivers working for government, private sector, NGOs and all kinds of vehicles taxis, minibuses, trucks etc
13.other	Any other occupation not specified above

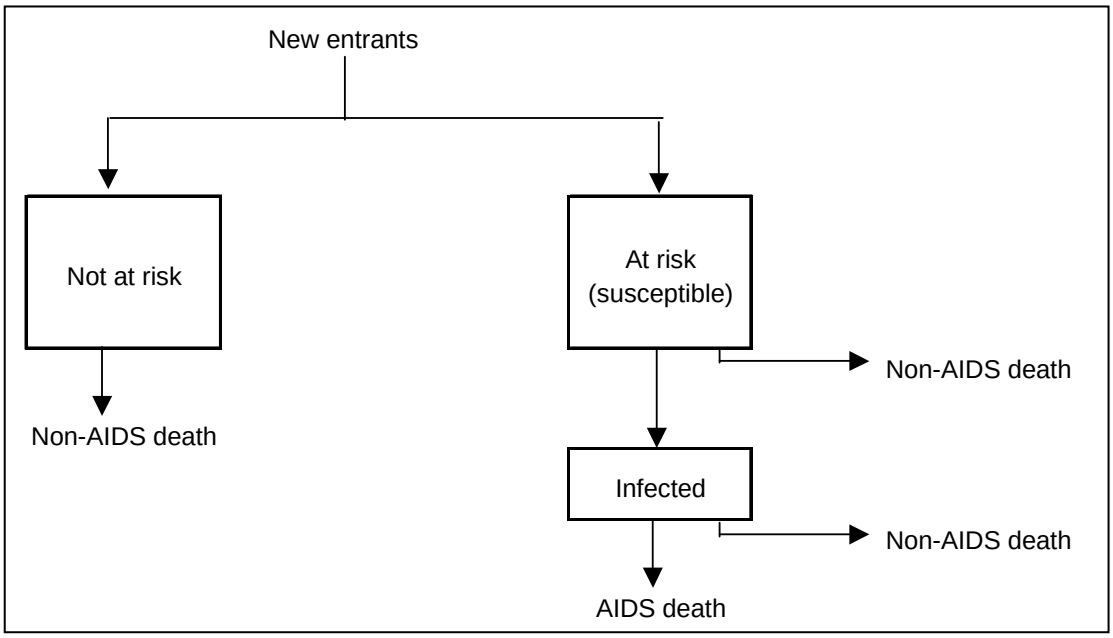
Annex 3

Curve Fitting

For most sites, surveillance data are available annually from 1994. For some sites, data are available for years prior to 1994. The average sample size is about 800 in urban sites, 500 for the semi-urban sites and about 200 for rural sites. To smooth the fluctuations resulting from small sample sizes, a curve is fit to the sentinel data. The curve indicates the trend through the available data points. Values from these curves (rather than the actual sentinel site point estimates) are used to estimate national prevalence.

The curve fits were done using a model prepared by the UNAIDS Reference Group on Estimates, Models and Projections, called the Estimation and Projection Package (EPP). EPP is a simple epidemiological model that produces the basic epidemic curve shapes found in most HIV epidemics. The model structure is shown below.

The population is initially divided into two parts, those who are not at risk of HIV infection and those who are at risk. People would not be at higher risk if they are not sexually active, if they have only one partner who has no outside partners, or if they successfully use condoms all the time. New entrants are children reaching the age of 15. They can enter either population group. Some of those who are at risk will become infected and progress to AIDS-related death. All population groups are subject to this risk of dying from causes other than AIDS.



The dynamics of this model are described by four parameters:

- $\mathbf{t_o}$ – The initial year of the epidemic.
- $\mathbf{f_o}$ – The initial proportion of the population that is in the at-risk category.
- **r** – The force of infection. This governs the rate at which people in the susceptible population become infected.
- $\boldsymbol{\phi}$ – A parameter that affects the distribution of new entrants to the not at-risk and at-risk categories.

The model is defined as follows:

Z = at-risk population
X = not at-risk population
Y = infected
$N = X + Y + Z$

$$\frac{dX}{dt} = (1 - f(X/N)).E_t - \mu X$$

$$\frac{dZ}{dt} = f(X/N).E_t - (\mu + rY/N + \iota)Z$$

$$\frac{dY}{dt} = (rY/N + \iota)Z - \int_0^t (rY_x/N_x + \iota_x).Z_x.g(t-x)\mathrm{dx}$$

where $f(X/N)$ is the fraction of those individuals entering the adult population (E_t) who enter the at-risk group *Z*, and is given by

$$f(X/N) = \frac{\exp\left[\phi(\frac{X}{N} - (1 - f_0))\right]}{\exp\left[\phi(\frac{X}{N} - (1 - f_0))\right] + \frac{1}{f_0} - 1}$$

μ = the non-AIDS death rate
ι = 1 for the first year of the epidemic and 0 for all other years
g = function describing the proportion progressing to AIDS-related death by the number of years since HIV infection

The population not at risk (X) is increased by new entrants and reduced by non-AIDS related deaths (μX). The population at risk (Z) is increased by new entrants and reduced by non-AIDS deaths and new HIV infections (rY/N). The infected population (Y) is increased by new infections (rY/N and ι) and decreased by progression to AIDS related death.

The function *f*(X/N) determines the proportion of new entrants to the adult population that enter the at-risk population. Initially, this proportion is set by *f*o. As the epidemic progresses, those in the at-risk category become infected with HIV and die. Since the death rate will be higher in the at-risk category than among those not at risk, the proportion of the population at risk will gradually decline. This will produce a prevalence curve that rises to a peak value and then declines rapidly to low levels. In many epidemics, however, prevalence stabilizes at or near its peak value. This can be simulated by directing more entrants to the at-risk category as the proportion of the population in the at-risk category declines. The parameter ϕ determines the size of this effect. At high values of ϕ, new entrants will join the at-risk category in large enough numbers so that the proportion of the total population in the at-risk category remains nearly constant. When ϕ is zero, the proportion of entrants going to the at-risk category does not change from its initial value. Negative values of ϕ cause the proportion of entrants to the at-risk category to drop as AIDS related deaths increase.

These equations can produce a prevalence curve that can fit a wide variety of epidemic shapes by adjusting the four parameters: **t_o**, **f_o**, **r**, and **phi**.

EPP uses this model to find prevalence curves that fit available surveillance data. The parameter μ (the non-AIDS related death rate) is estimated for each country from the population estimates and projections of the United Nations Population Division. The progression to AIDS related death (g) is assumed to be constant throughout the projection. It is a weibull function that has been fitted to available information on survival times. The progression pattern used in EPP is discussed below.

New entrants to the adult population at time *t*, E_t are calculated from the births of HIV negative children B^-_{t-15} occurring 15 years previously and the probability of surviving to age 15, *l*. The number of births is simply the birth rate multiplied by the size of the adult population. However, some children will be born infected. It is assumed that they do not survive to age 15. Thus, the number of children born without HIV infection is determined by calculating births to HIV-negative adults (b(X+Z)) and HIV-negative births to HIV-positive adults (b'Y(1-v) where v is the perinatal transmission rate and b' is the birth rate adjusted for the reduction in fertility caused by HIV infection, ε.

$$E_t = B^-_{t-15} \cdot l$$

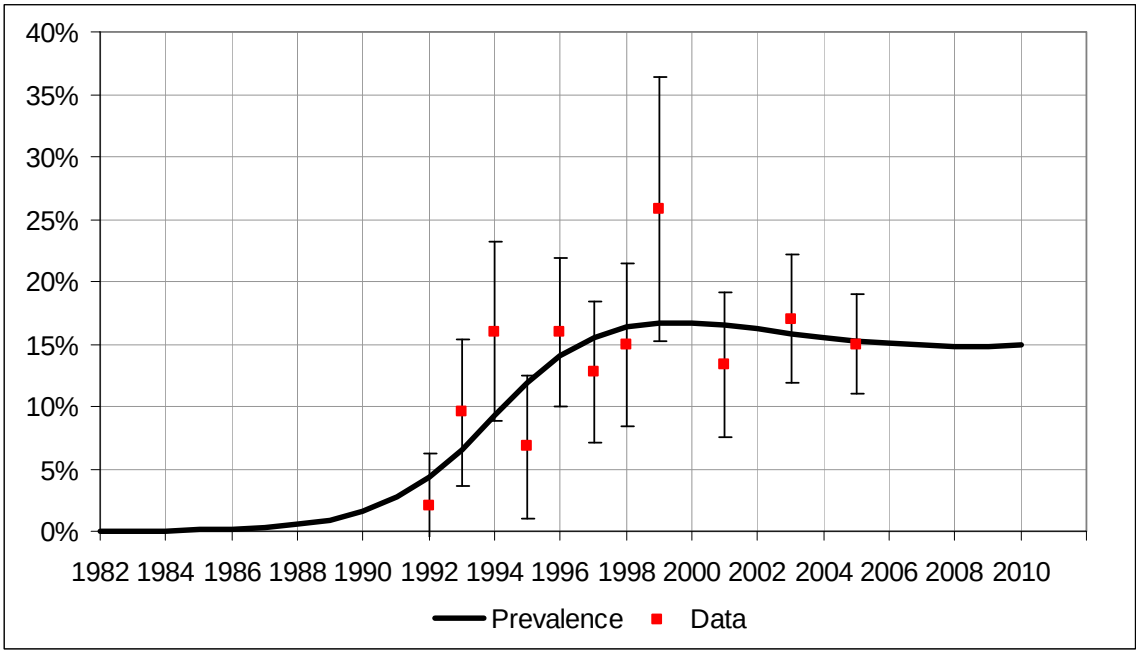
$$B^-_{t-15} = b \cdot \left[X_{t-15} + Z_{t-15} + (1-\nu) \cdot \varepsilon \cdot Y_{t-15} \right]$$

This approach is implemented in the EPP model by assuming that the parameters l (survival to age 15), b (birth rate), ε (fertility reduction caused by HIV), v (perinatal transmission rate) and the distribution g (progression from infection to AIDS death) are fixed. The initial values of the population size, survival to age 15 and the birth rate are derived from the population estimates of the United Nations Population Division.

EPP searches for the best values of the four remaining parameters $\mathbf{t_0}$ (start year), $\mathbf{f_0}$ (fraction at-risk), **r** (force of infection and **phi** (adjustment for AIDS deaths). The best values are defined as those that produce the prevalence curve that best fits the surveillance data. The best fit is determined by minimizing the sum of the squared errors (the differences between the model curve and the surveillance estimates in each year).

An example of fitting a curve to surveillance data using EPP is shown in Figure 7 for Gawanani Rural Hospital in Machinga District. The projection of these curves to 2012 is meant to indicate the future situation, if past trends continue. These projections are not a prediction of what we expect to happen, since it is expected that prevention programs will eventually lead to a reduction in HIV prevalence.

Figure 7. Curve fit to surveillance data for Gawanani Rural Hospital



These curves have been fit to the data in all 19 sites. In some cases, the EPP program is able to determine the best fitting curve, in other cases this does not happen and the curve is fit manually. Many of the manual curve fits were required because the sites have few data points describing the early phases of the epidemic. In these cases, the model could not determine when prevalence reached a plateau.

Table 18 shows the parameters used to fit each site. The value of $\mathbf{f_o}$ represents the proportion of the population at risk of infection early in the epidemic. The value of **phi** indicates to what extent people with high risk behaviors who die from AIDS are replaced by others adopting high risk behaviors. High values of **phi,** above 50, indicate a high degree of replacement. Low values, near zero, indicate very little replacement. The **r** value is the force of infection. It determines how steeply the epidemic rises during the explosive phase. Since **r** depends on $\mathbf{f_o}$ it is not possible to compare these values of one site with another unless they have the same value of $\mathbf{f_o}$**.** The start year of the epidemic is indicated by $\mathbf{t_o}$. It is set to 1982 in almost all cases.

Table 18. Curve Fit Parameters by Sentinel Site

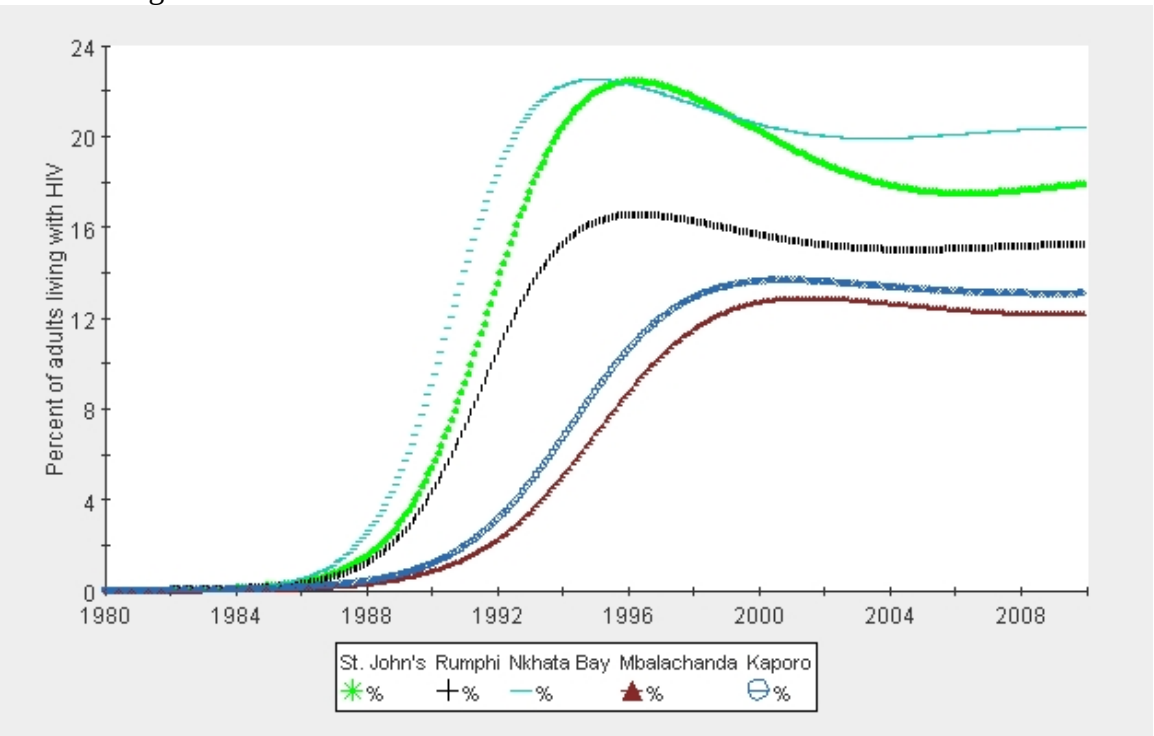
Table 18. Curve Fit Parameters by Sentinel Site *Site*	*Region*	*Type*	*r*	f_o	*Phi*	t_o	*Fit*
Mzuzu	North	Urban	2.90	0.270	25	1982	Custom
Rumphi	North	Semi-urban	4.10	0.195	100	1982	Custom
Nkhata Bay	North	Semi-urban	3.40	0.260	65	1984	Custom
Mbalanchanda	North	Rural	3.60	0.164	200	1982	Custom
Kaporo/Kasoba	North	Rural	3.77	0.166	999	1982	Model
Lilongwe Bottom	Centre	Urban	3.30	0.300	13	1982	Custom
Mchinji	Centre	Semi-urban	3.00	0.240	65	1982	Custom
St. Anne's	Centre	Semi-urban	4.00	0.215	37	1982	Custom
Ntcheu	Centre	Semi-urban	3.30	0.266	200	1982	Custom
Thonje	Centre	Rural	6.60	0.100	200	1982	Custom
Kamboni	Centre	Rural	7.46	0.099	65	1982	Model
Kasina	Centre	Rural	10.00	0.092	70	1982	Custom
Blantyre (Limbe)	South	Urban	2.30	0.370	40	1980	Custom
Mulanje	South	Semi-urban	2.60	0.340	27	1982	Custom
Mangochi	South	Semi-urban	4.00	0.220	65	1982	Custom
Nsanje	South	Semi-urban	1.30	0.420	200	1982	Custom
Milepa	South	Rural	3.88	0.212	100	1982	Model
Gawanani	South	Rural	3.00	0.212	60	1982	Custom
Mianga	South	Rural	3.23	0.227	649	1982	Model

Note: The last column indicates "Model" if the best fitting model curve was used and "Custom" if the parameters values were modified from those of the best fit.

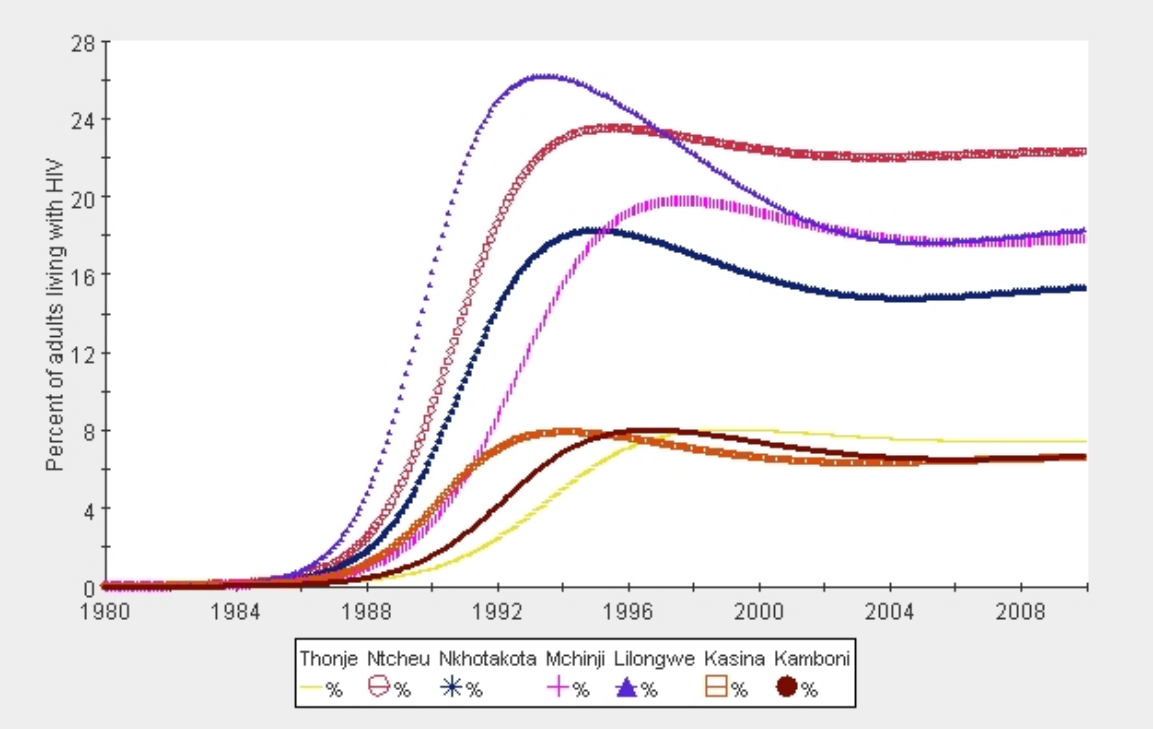
The curve fits for the individual sites by region are shown in Figure 8 below.

Figure 8. Prevalence curves fit to each sentinel site by region

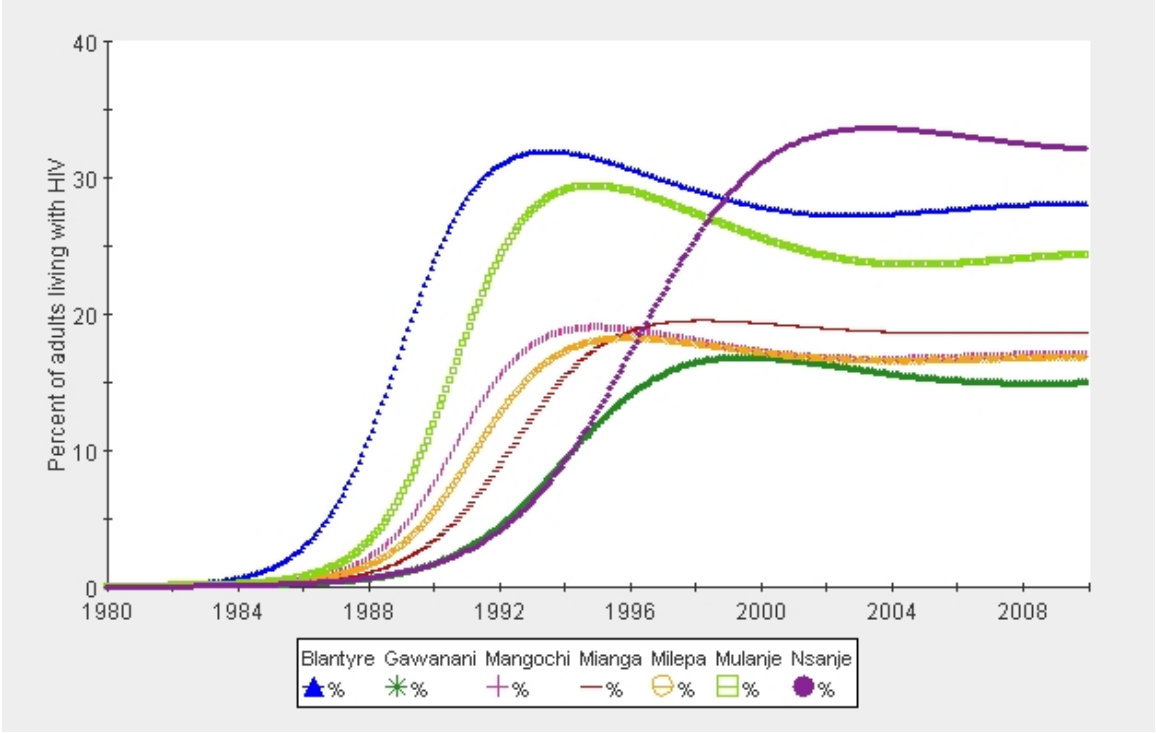
Northern region



Central region



Southern region


Percent of adults living with HIV
40
30
20
10
0
1980
1984
1988
1992
1996
2000
2004
2008
Blantyre
Gawanani
Mangochi
Mianga
Milepa
Mulanje
Nsanje
%
%
%
%
%
%
%

Annex 4

PMTCT and ART coverage targets used in the Spectrum model.

Program	Year								
	2002	2003	2004	2005	2006	2007	2008	2009	2010
PMTCT (#)	5,059	26,791	42,345	60,000	109,350	200,295	306,935	382,588	433,000
ART (%)	0	0	7.00	18.80	25.04	31.28	37.52	43.76	50.00

Annex 5

Additional estimates and projections

Total HIV positive by Age and Sex, 2005

	Total	Males	Females
0-4	58,760	28,711	30,049
5-9	23,515	11,048	12,467
10-14	746	278	468
15-19	53,243	17,537	35,706
20-24	114,483	29,582	84,902
25-29	165,134	58,444	106,690
30-34	179,699	93,503	86,195
35-39	141,140	74,544	66,596
40-44	81,503	38,861	42,643
45-49	50,805	30,074	20,731
50-54	33,355	19,434	13,921
55-59	15,210	7,274	7,936
60-64	7,186	3,911	3,275
65-69	2,970	1,809	1,161
70-74	484	246	238
75-79	48	16	32
80+	4	4	0
Total	928,286	415,276	513,010

Annual new HIV infections by Age and Sex, 2005

Age	Total	Male	Female
0-4	24,860	12,492	12,368
5-9	0	0	0
10-14	0	0	0
15-19	18,462	4,004	8,023
20-24	14,464	5,005	14,913
25-29	26,921	11,083	15,648
30-34	18,011	14,968	6,826
35-39	7,171	5,637	5,020
40-44	2,143	0	934
45-49	5,642	1,845	0
50-54	2,718	1,599	795
55-59	872	0	508
60-64	260	0	0
65-69	0	0	0
70-74	0	0	0
75-79	0	0	0
80+	0	0	00
Total	121,525	56,532	64,993

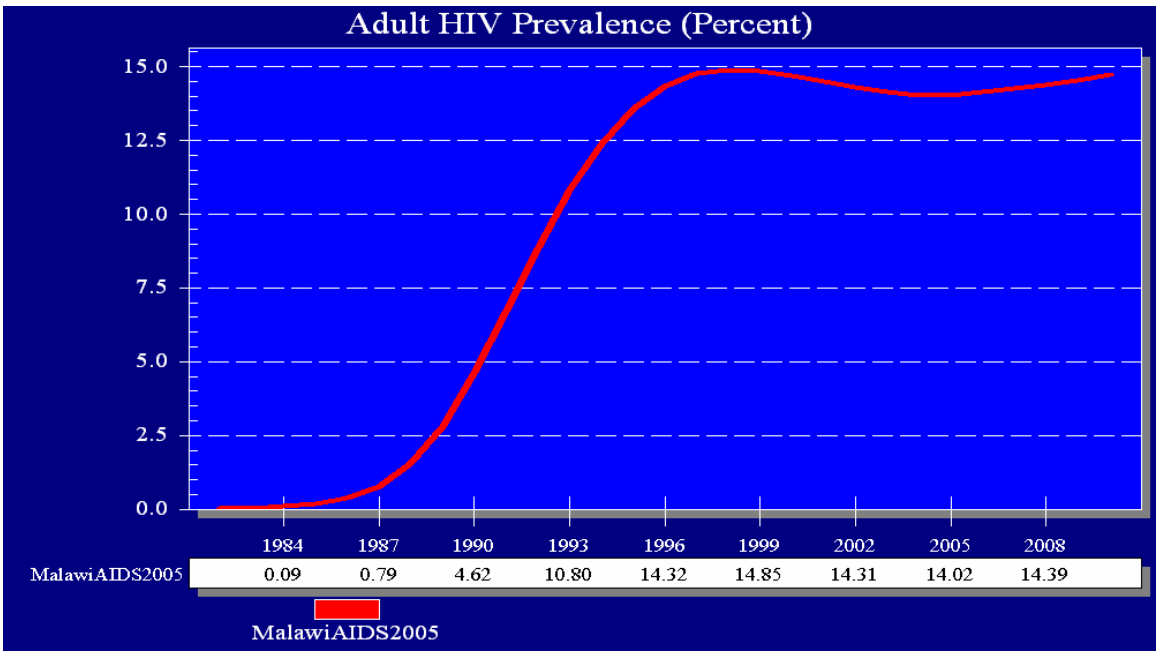
New AIDS Cases by Age and Sex, 2005

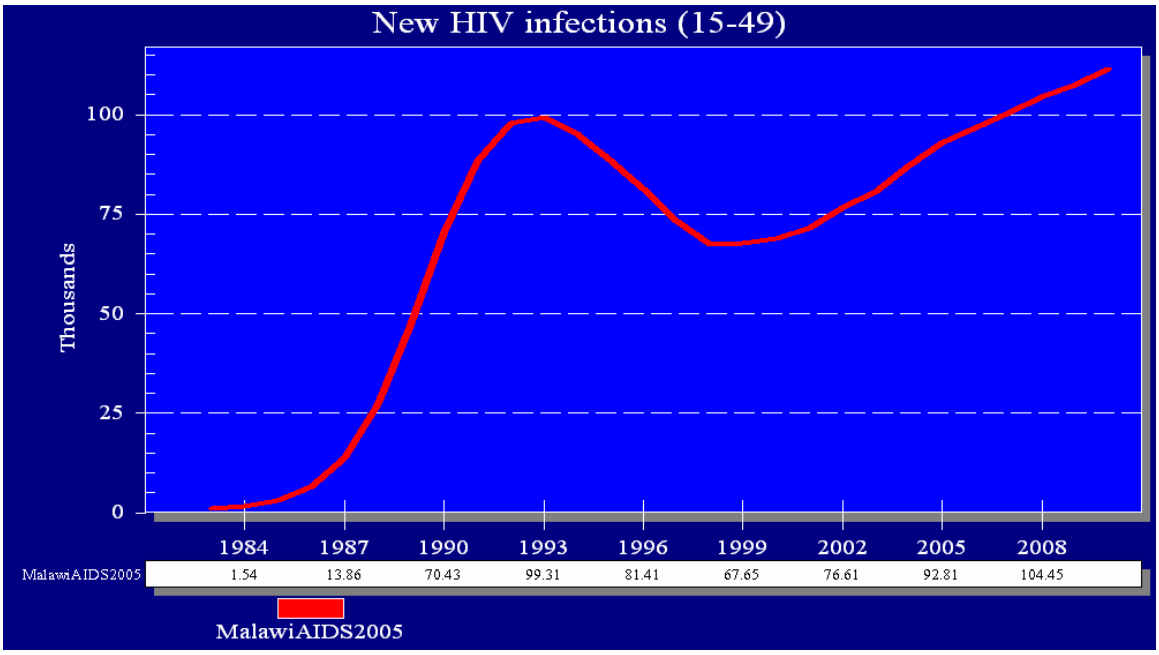
Age	Total	Male	Female
0-4	14,415	7,163	7,252
5-9	5,811	2,793	3,018
10-14	1,508	725	784
15-19	1,004	473	531
20-24	6,193	2,157	4,035
25-29	11,507	3,504	8,003
30-34	15,014	6,244	8,770
35-39	15,685	8,187	7,497
40-44	11,173	5,615	5,558
45-49	6,507	3,017	3,490
50-54	3,920	2,527	1,393
55-59	2,081	1,020	1,061
60-64	1,019	541	477
65-69	553	319	234
70-74	139	71	68
75-79	20	6	14
80+	3	3	0
Total	96,552	44,367	52,185

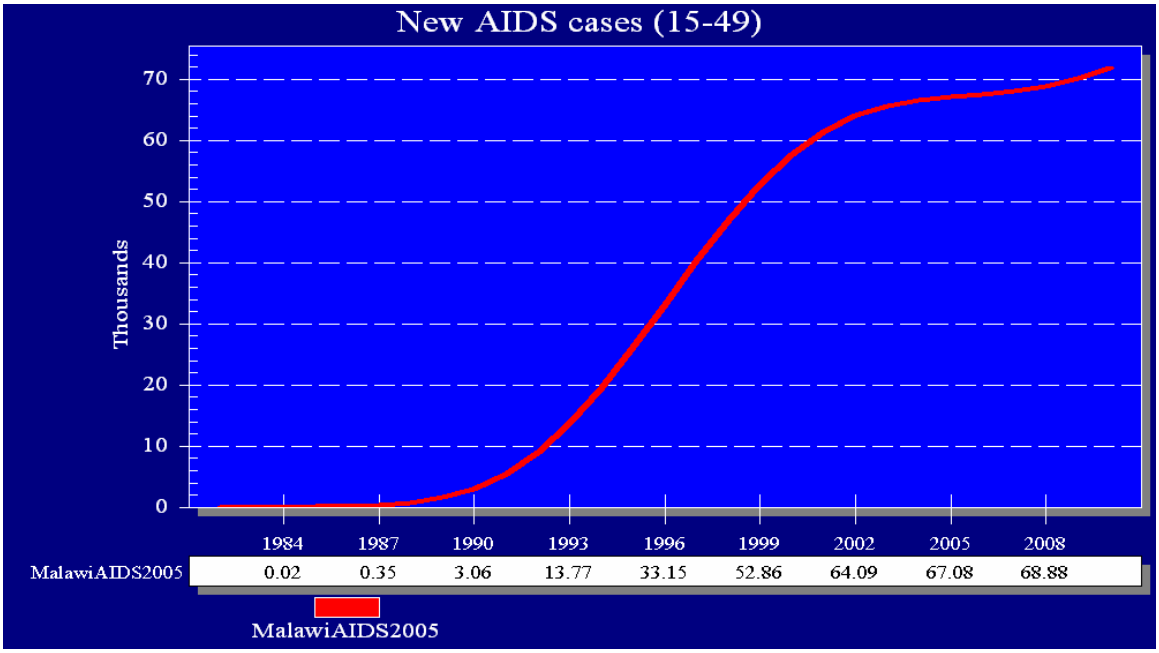
AIDS Deaths by Age and Sex, 2005

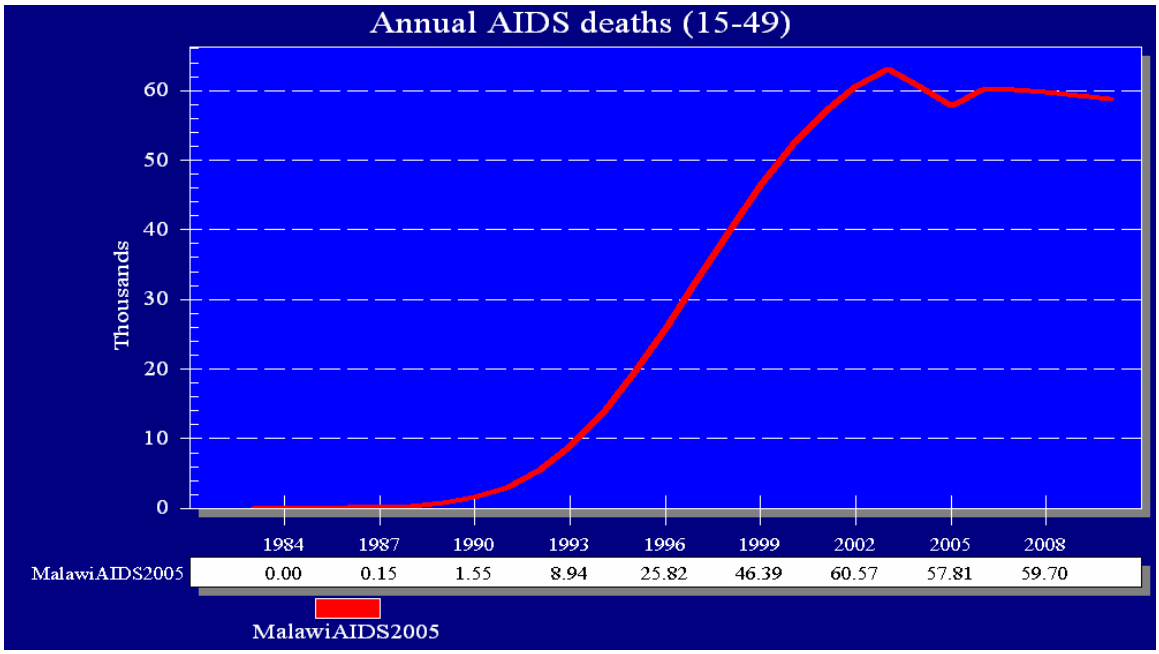
Age	Total	Male	Female
0-4	13,873	6,842	7,031
5-9	5,751	2,763	2,988
10-14	1,493	717	776
15-19	428	215	214
20-24	4,255	1,597	2,658
25-29	9,194	2,739	6,455
30-34	12,437	4,759	7,678
35-39	14,228	7,146	7,082
40-44	10,870	5,554	5,316
45-49	6,402	2,842	3,560
50-54	3,793	2,394	1,399
55-59	2,064	1,056	1,008
60-64	1,028	540	489
65-69	582	331	251
70-74	163	83	80
75-79	26	8	18
80+	4	4	1
Total	86,592	39,588	47,004

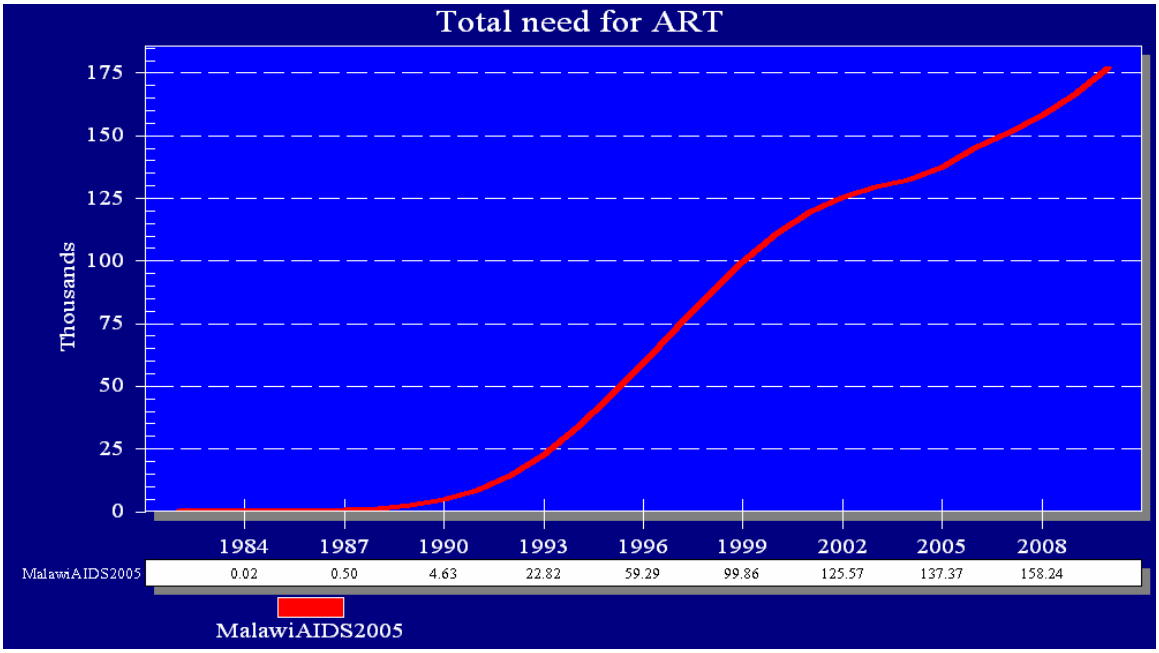
Spectrum estimate graphs

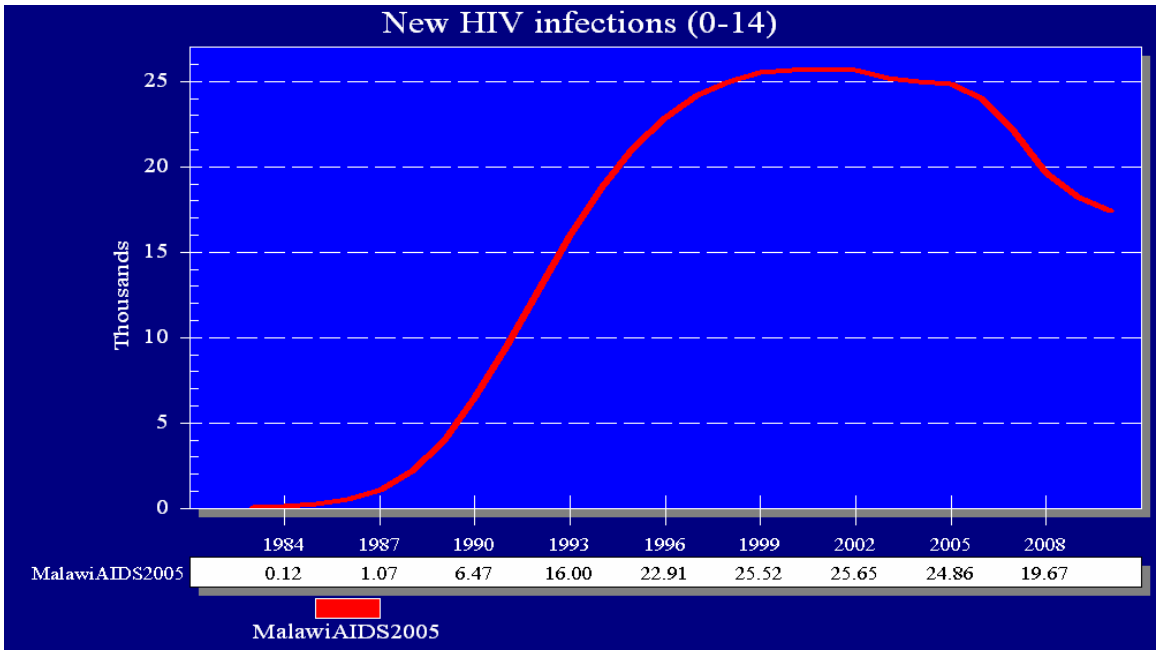


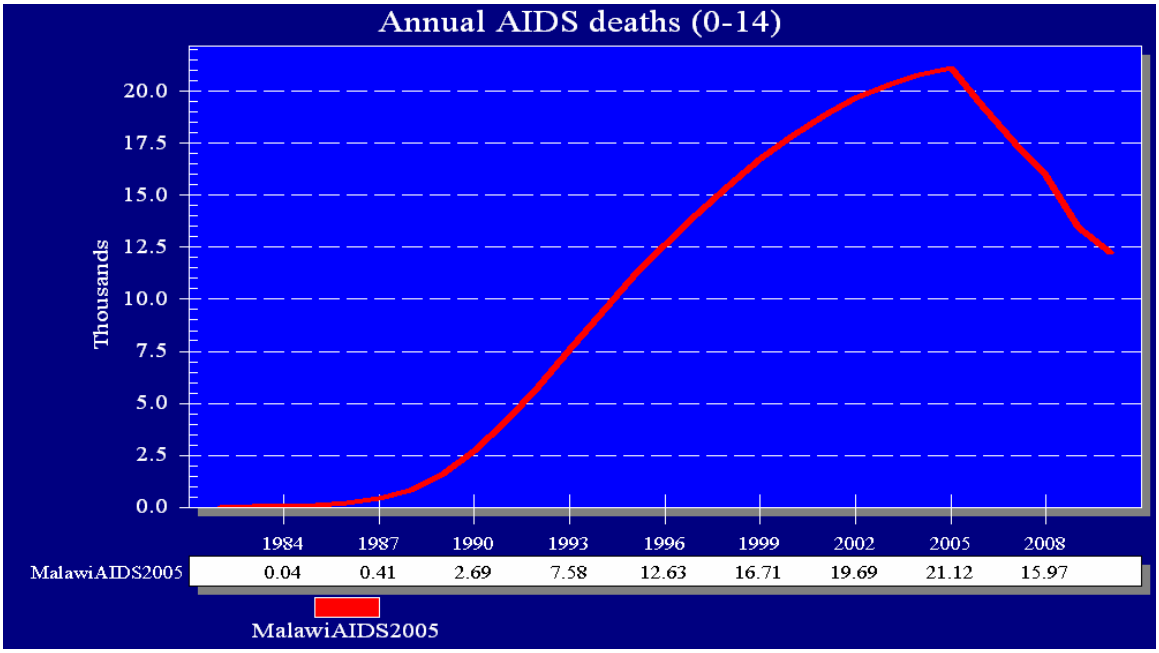



New AIDS cases (15-49)
Thousands
70
60
50
40
30
20
10
0
1984 1987 1990 1993 1996 1999 2002 2005 2008
MalawiAIDS2005 0.02 0.35 3.06 13.77 33.15 52.86 64.09 67.08 68.88
MalawiAIDS2005


Annual AIDS deaths (15-49)
Thousands
60
50
40
30
20
10
0
1984 1987 1990 1993 1996 1999 2002 2005 2008
MalawiAIDS2005 0.00 0.15 1.55 8.94 25.82 46.39 60.57 57.81 59.70
MalawiAIDS2005


Total need for ART
Thousands
175
150
125
100
75
50
25
0
1984 1987 1990 1993 1996 1999 2002 2005 2008
MalawiAIDS2005 0.02 0.50 4.63 22.82 59.29 99.86 125.57 137.37 158.24
MalawiAIDS2005


New HIV infections (0-14)
Thousands
25
20
15
10
5
0
1984 1987 1990 1993 1996 1999 2002 2005 2008
MalawiAIDS2005 0.12 1.07 6.47 16.00 22.91 25.52 25.65 24.86 19.67
MalawiAIDS2005


Annual AIDS deaths (0-14)
Thousands
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
1984
1987
1990
1993
1996
1999
2002
2005
2008
MalawiAIDS2005
0.04
0.41
2.69
7.58
12.63
16.71
19.69
21.12
15.97
MalawiAIDS2005

Spectrum estimate tables

- Total (Spectrum)

	1985	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
HIV population														
Total	5,738	166,306	576,526	723,544	732,589	741,731	751,063	764,666	786,008	813,542	842,163	874,458	909,937	949,489
Males	3,567	79,606	250,402	314,373	318,399	322,527	326,989	332,943	342,545	354,677	367,426	381,313	397,034	414,300
Females	2,171	86,700	326,124	409,171	414,190	419,204	424,074	431,723	443,463	458,865	474,736	493,146	512,903	535,189
Adult prev	0	5	14	15	15	14	14	14	14	14	14	14	15	15
New HIV infections														
Total	3,169	70,425	88,745	68,834	71,521	76,606	80,619	87,277	92,814	96,619	100,423	104,447	107,572	111,448
Males	1,831	32,680	38,130	33,980	34,897	36,805	38,175	40,222	42,541	43,914	45,637	47,347	48,985	50,509
Females	1,343	37,858	51,231	36,602	38,619	41,905	44,410	48,628	51,364	53,199	54,784	57,313	57,926	59,882
Adult HIV Incidence	0	2	2	2	2	2	2	2	2	2	2	2	2	2
New AIDS cases														
Total	63	3,056	26,140	57,759	61,484	64,087	65,714	66,615	67,082	67,452	68,035	68,884	70,147	71,861
Males	52	1,986	13,557	25,615	26,846	27,714	28,323	28,789	29,197	29,636	30,178	30,836	31,569	32,469
Females	11	1,069	12,583	32,143	34,638	36,373	37,391	37,826	37,885	37,816	37,857	38,048	38,578	39,392
Annual AIDS deaths														
Total	21	1,550	19,316	52,148	56,945	60,566	63,095	60,626	57,814	60,119	60,067	59,702	59,276	58,870
Males	18	1,048	10,394	23,460	25,058	26,238	27,087	25,970	24,851	26,019	26,231	26,307	26,342	26,312
Females	3	502	8,923	28,688	31,887	34,328	36,008	34,656	32,963	34,100	33,835	33,395	32,933	32,559
Adults newly needing ART														
Total	63	3,056	26,140	57,759	61,484	64,087	65,714	66,615	67,082	67,452	68,035	68,884	70,147	71,861
Males	52	1,986	13,557	25,615	26,846	27,714	28,323	28,789	29,197	29,636	30,178	30,836	31,569	32,469
Females	11	1,069	12,583	32,143	34,638	36,373	37,391	37,826	37,885	37,816	37,857	38,048	38,578	39,392
Number receiving ART														
Total	0	0	0	0	0	0	0	9,263	25,826	36,350	47,330	59,370	72,912	88,467
Total need for ART														
Total	84	4,626	45,696	110,619	119,243	125,571	129,801	132,329	137,371	145,166	151,312	158,236	166,619	176,933
Unmet need for ART														
Total	84	4,626	45,696	110,619	119,243	125,571	129,801	123,066	111,545	108,816	103,981	98,866	93,707	88,467
Adult population 15-49														
Total	3,079,203	3,598,791	4,257,621	4,920,759	5,051,231	5,183,020	5,317,310	5,458,166	5,605,567	5,754,267	5,911,688	6,078,401	6,255,559	6,443,396
Male	1,469,067	1,726,150	2,050,033	2,378,557	2,444,583	2,511,650	2,579,995	2,651,022	2,724,466	2,797,981	2,875,031	2,956,070	3,041,782	3,132,332
Female	1,610,136	1,872,641	2,207,588	2,542,202	2,606,648	2,671,371	2,737,315	2,807,144	2,881,101	2,956,285	3,036,656	3,122,331	3,213,778	3,311,063

Orphans, (Spectrum)

	1985	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Maternal Orphans														
AIDS	0	1,420	35,872	181,603	220,732	259,670	297,566	327,955	351,505	375,856	399,282	420,298	435,437	445,228
Non-AIDS	0	209,352	190,622	166,243	161,383	156,541	151,843	147,452	143,382	139,627	136,162	132,987	130,109	127,436
Total	0	210,772	226,493	347,846	382,115	416,211	449,409	475,408	494,887	515,483	535,444	553,285	565,546	572,665
Paternal Orphans														
AIDS	0	3,193	44,499	168,825	198,936	228,930	259,540	284,858	305,735	330,283	358,980	387,997	410,234	426,064
Non-AIDS	0	350,366	333,933	325,457	323,297	320,726	318,142	315,521	312,985	310,922	309,675	308,888	308,256	307,602
Total	0	353,559	378,432	494,282	522,234	549,656	577,682	600,380	618,720	641,205	668,655	696,885	718,490	733,666
Dual Orphans														
AIDS	0	753	22,103	93,187	112,334	131,759	151,404	167,084	178,998	192,434	207,273	221,423	230,582	234,898
Non-AIDS	0	63,208	46,709	36,146	34,008	31,950	29,964	28,115	26,408	24,867	23,494	22,248	21,097	20,053
Total	0	63,962	68,813	129,333	146,342	163,709	181,368	195,199	205,406	217,301	230,767	243,671	251,679	254,951
Total Orphans	0	500,369	536,113	712,795	758,007	802,157	845,723	880,588	908,201	939,388	973,332	1,006,499	1,032,357	1,051,380
All AIDS orphans	0	4,123	62,302	272,398	324,879	376,560	427,374	468,696	501,963	538,240	576,340	612,880	641,309	662,463