AIM

Version 4

A Computer Program for Making HIV/AIDS Projections and Examining the Social and Economic Impacts of AIDS

Spectrum System of Policy Models

By John Stover
The Futures Group International

The POLICY Project

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I. Introduction

A. Description of the Spectrum System

1. Components

POLICY and its predecessor projects have developed computer models that analyze existing information to determine the future consequences of today's development programs and policies.[1] The Spectrum Policy Modeling System consolidates previous models into an integrated package containing the following components:

Spectrum consolidates DemProj, FamPlan, Benefit-Cost, AIM, and RAPID models into an integrated package.

- **Demography (DemProj)** – A program to make population projections based on (1) the current population, and (2) fertility, mortality, and migration rates for a country or region.
- **Family Planning (FamPlan)** – A program to project family planning requirements in order to achieve national goals for meeting couple's fertility intentions.
- **Benefit-Cost** – A program for comparing the costs of implementing family planning programs, along with the benefits generated by those programs.
- **AIDS (AIDS Impact Model – AIM)** – A program to project the consequences of the AIDS epidemic including the number of people infected with HIV, AIDS deaths, the number of people needing treatment and the number of orphans.
- **Socioeconomic Impacts of High Fertility and Population Growth (RAPID)** – A program to project the social and economic consequences of high fertility and rapid population growth for sectors such as labor force, education, health, urbanization and agriculture.
- **Adolescent Reproductive Health (NewGen)** – A program to examine the effects of policies and programs on the reproductive health of adolescents, including pregnancies, HIV/AIDS, and sexually transmitted infections.

[1] The terms "model" and "module" are used interchangeably in the Spectrum manuals to refer to the separate computer programs within the system.

- **Prevention of Mother-to-Child Transmission of HIV (PMTCT)** – A program to examine the costs and benefits of different programs intended to reduce the transmission of HIV from mothers to their newborn children.

2. Software Description

Spectrum is a Windows-based system of integrated policy models. The integration is based on DemProj, which is used to create the population projections that support many of the calculations in the other components such as FamPlan, Benefit-Cost, AIM, and RAPID.

Each component has a similarly functioning interface that is easy to learn and to use. With little guidance, anyone who has a basic familiarity with Windows software will be able to navigate the models to create population projections and to estimate resource and infrastructure requirements. The accompanying manuals contain both instructions for users, and equations for those who want to know exactly how the underlying calculations are computed.

B. Uses of Spectrum Policy Models

Policy models are designed to answer a number of "what if" questions. The "what if" refers to factors that can be changed or influenced by public policy.

Policy models are designed to answer a number of "what if" questions relevant to entities as small as local providers of primary health care services and as large as international development assistance agencies. The "what if" refers to factors that can be changed or influenced by public policy.

Models are commonly computerized when analysts need to see the likely result of two or more forces that might be brought to bear on an outcome, such as a population's illness level or its degree of urbanization. Whenever at least three variables are involved (such as two forces and one outcome), a computerized modeql can both reduce the burden of manipulating those variables and present the results in an accessible way.

Some of the policy issues commonly addressed by the Spectrum set of models include:

- The utility of taking actions earlier rather than later. Modeling shows that little in a country stands still while policy decisions are stalled and that many negative outcomes can accumulate during a period of policy stasis.

- The evaluation of the costs vs. the benefits of a course of action. Modeling can show the economic efficiency of a set of actions (i.e., whether certain outcomes are achieved more effectively than under a different set of actions), or simply whether the cost of a single set of actions is acceptable for the benefits gained.
- The recognition of interrelatedness. Modeling can show how making a change in one area of population dynamics (such as migration rates) may necessitate changes in a number of other areas (such as marriage rates, timing of childbearing, etc.).
- The need to discard monolithic explanations and policy initiatives. Modeling can demonstrate that simplistic explanations may bear little relationship to how the "real world" operates.

A set of policies under consideration may not be acceptable to all stakeholders.

- The utility of "door openers." A set of policies under consideration may not be acceptable to all stakeholders. Modeling can concentrate on favored goals and objectives and demonstrate how they are assisted by the proposed policies.
- That few things in life operate in a linear fashion. A straight line rarely describes social or physical behavior. Most particularly, population growth, being exponential, is so far from linear that its results are startling. Modeling shows that all social sectors based on the size of population groups are heavily influenced by the exponential nature of growth over time.
- That a population's composition greatly influences its needs and its well being. How a population is composed—in terms of its age and sex distribution—has broad-ranging consequences for social welfare, crime rates, disease transmission, political stability, etc. Modeling demonstrates the degree to which a change in age and sex distribution can affect a range of social indicators.
- The effort required to "swim against the current." A number of factors can make the success of a particular program harder to achieve; for example, the waning of breastfeeding in a population increases the need for contraceptive coverage. Modeling can illustrate the need for extra effort—even if simply to keep running in place.

C. Organization of the Model Manuals

Each manual begins with a discussion of what the model does and why someone would want to use it. The manual also explains the data decisions and assumptions needed before the model can be run, and possible sources for the data. It defines the data inputs and outputs. The manual contains two tutorials, information on the methodology behind the model, a glossary, and a bibliography.

D. Information about the POLICY Project

The POLICY Project is a USAID-funded activity designed to create a supportive environment for family planning and reproductive health programs through the promotion of a participatory process and population policies that respond to client needs. To achieve its purpose, the project addresses the full range of policies that support the expansion of family planning and other reproductive health services, including:

- national policies as expressed in laws and in official statements and documents;
- operational policies that govern the provision of services;
- policies affecting gender roles and the status of women; and
- policies in related sectors, such as health, education and the environment, that affect populations.

The POLICY Project is implemented by the Futures Group in collaboration with Research Triangle Institute (RTI) and the Centre for Development and Population Activities (CEDPA).

More information about the Spectrum System of Policy Models and the POLICY Project are available from:

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E. What is AIM?

The AIDS Impact Model, known as AIM, is a computer program for projecting the impact of the AIDS epidemic. It can be used to project the future number of HIV infections, AIDS cases, and AIDS deaths, given an assumption about adult HIV prevalence. It can also project the demographic and social impacts of AIDS. These projections then can be used in graphic policy presentations intended to enhance knowledge of AIDS among policymakers and to build support for effective prevention and care.

The Futures Group, in collaboration with Family Health International, prepared the first version of AIM in 1991 under the AIDS Technical Support (AIDSTECH) and AIDS Control and Prevention (AIDSCAP) projects. The program has been revised a number of times since then in collaboration with the UNAIDS Reference Group on Estimates, Models and Projections.

The projection results are usually transferred to presentation software, such as PowerPoint, for presentation to leadership audiences.

AIM requires an assumption about the future course of adult HIV prevalence. Assumptions about other HIV/AIDS characteristics can also be entered for such variables as the survival period from HIV infection to AIDS death, the age and sex distribution of infections, and the perinatal transmission rate. A demographic projection must be prepared first, before AIM can be used. DemProj, one of the Spectrum system of policy models, is used to make the demographic projection; see the DemProj manual for more information. The demographic projection is modified by AIM through AIDS deaths and the impact of HIV infection on fertility. The *Epidemiology* section of AIM calculates the number of HIV infections, AIDS cases, and AIDS deaths. This information is used in the *Impacts* section to calculate various indicators of demographic and social impact.

AIM's focus is on generating information useful for policy and planning purposes.

AIM (and the entire Spectrum system of models) is designed to produce information useful for policy formulation and dialogue within a framework of computer programs that are easy to use. The focus is on generating information useful for policy and planning purposes rather than on carrying out detailed research into the underlying processes involved. For this reason, the program is designed to be used by program planners and policy analysts. AIM uses data that are readily available and requires little technical expertise beyond what can be acquired through literature review and use of this manual.

F. Why Make HIV/AIDS Projections?

HIV/AIDS projections can illustrate the magnitude of the AIDS epidemic and the demographic, social and economic consequences.

A key aspect of the policy process is recognizing that a problem exists and placing that problem on the policy agenda. HIV/AIDS projections can illustrate the magnitude of the AIDS epidemic and the demographic, social and economic consequences. This illustration also can show policymakers the impacts on other areas of development and the size of the impacts that could be expected without effective action. HIV/AIDS projections are also needed to plan the response. For example, AIM can project the number of people needing anti-retroviral therapy, which can serve as the basis for planning expanded access to treatment. It can be used to estimate the number of orphans in order to develop support programs.

For many purposes purposes, it is useful to prepare alternative HIV/AIDS projections rather than a single projection, for two reasons. Projections are based on assumptions about the future levels of HIV prevalence and other factors. Because these are uncertain assumptions, it is often wise to consider low, medium and high variants of each of these assumptions so that the range of plausible projections can be determined. When HIV/AIDS projections are used for policy dialogue, it is usually important to show how various assumptions about future rates of HIV prevalence would affect the projections. At a minimum, it is usually useful to prepare one projection that illustrates a likely future course for the epidemic and another that uses the same set of inputs but assumes that there is no AIDS epidemic. In this way, the consequences of the epidemic will be clearly demonstrated.

II. Steps in Making an HIV/AIDS Projection

There are six key steps in making most AIM projections. The amount of time spent on each step may vary, depending on the application, but most projection activities will include at least these six steps.

AIM requires a population projection prepared with DemProj. This projection should be prepared first or at the same time as the AIM projection.

1. **Prepare a demographic projection.** AIM requires a population projection prepared with DemProj. This projection should be prepared first, or at the same time as the AIM projection. The first and last years of the DemProj projection will determine the span of the AIM projection. The HIV/AIDS projections will be more accurate if the projection is started at least a year or two before the start of the AIDS epidemic. Thus, if the first year in which HIV was detected in the population was 1981, the first year of the projection should be set to 1979 or 1980. The projection can start in the middle of the epidemic, but in that case the program needs to back calculate the number and timing of HIV infections that occurred prior to the first year of the projection. This procedure will generally be less accurate than starting the projection before the first year of the epidemic. For a quick start, the EasyProj feature can be used within DemProj to create a population projection based on the estimates and projections of the United National Population Division.
2. **Collect data.** At a minimum, AIM requires an assumption about the trend of adult HIV prevalence. For many other inputs, default values provided by the program can be used, or country-specific figures can be supplied. Country-specific figures are required to calculate many of the indicators of the impacts of AIDS. Since the projection will only be as good as the data on which it is based, it is worth the effort to collect and prepare appropriate and high-quality data before starting the projection.
3. **Make assumptions.** The full range of AIM indicators requires assumptions about a number of items such as the coverage of ART and PMTCT programs. These assumptions should be carefully considered and based on reasonable selection guidelines.

4. **Enter data.** Once the base year data are collected and decisions are made about projection assumptions, AIM can be used to enter the data and make an HIV/AIDS projection.
5. **Examine projections.** Once the projection is made, it is important to examine it carefully. This examination includes consideration of the various demographic and HIV/AIDS indicators produced as well as the age and sex distribution of the projection. Careful examination of these indicators can act as a check to ensure that the base data and assumptions were understood and were entered correctly into the computer program. This careful examination is also required to ensure that the consequences of the assumptions are fully understood.

Once the base projection has been made, the program can be used to quickly generate alternative projections.

6. **Make alternative projections.** Many applications require alternative HIV/AIDS projections. Once the base projection has been made, the program can be used to quickly generate alternative projections as the result of varying one or several of the projection assumptions.

III. Projection Inputs

AIM requires data describing the characteristics of the HIV/AIDS epidemic and the response to it. Some of these data (e.g., adult HIV prevalence) must be specific for the area being studied, whereas others (e.g., the mother-to-child transmission rate) can be based either on local data or on international averages when local data are unavailable. The purpose of this chapter is to describe the inputs required and their possible sources. Recommendations are presented for default values to use when local data are not available. Each of the required variables is discussed below.

A. Demographic Projection

As noted above, AIM requires that a demographic projection first be prepared using DemProj, another model in the Spectrum system. A complete description of the use of DemProj can be found in the DemProj manual, *DemProj, Version 4, A Computer Program for Making Population Projections*. Model users should keep two key points in mind when preparing a DemProj projection for use with AIM:

Projections will be more accurate if the projection period includes the start of the epidemic.

1. For accuracy, the first year of the projection should be before the starting year of the HIV/AIDS epidemic. It is possible to start the projection in a year after the beginning of the AIDS epidemic, but this type of projection will be less accurate.
2. The life expectancy assumption entered into DemProj should be the life expectancy in the absence of AIDS. AIM will calculate the number of AIDS deaths and determine a new life expectancy that incorporates the impact of AIDS. It is necessary to use this two-step process because model life tables (for specifying the age distribution of mortality) do not contain patterns of mortality that reflect the excess deaths caused by AIDS.

B. Adult HIV Prevalence

1. Base Year Estimates

Adult HIV prevalence is the percentage of adults aged 15 to 49 who are infected with HIV. Thus, this estimate of prevalence refers to the entire adult population aged 15 to 49, not just a specific risk group.

HIV prevalence data usually come from blood surveys conducted among small population groups. In some countries national surveys have been used to estimate prevalence for the entire population. There are two major sources of surveillance data:

1. **National AIDS Control Program (NACP).** Generally the National AIDS Control Program will be the best source of HIV surveillance information. In many countries, the NACP operates a sentinel surveillance system that regularly conducts surveys in a number of sites around the country. Other ad hoc surveys may be conducted among special populations.
2. **HIV/AIDS Surveillance Database.** The International Programs Center of the U.S. Bureau of the Census maintains an HIV/AIDS surveillance database that contains information from a large number of surveillance studies. The database contains information from published articles, international AIDS conferences, and other sources. The database is distributed both as hard copy and on computer diskette. For more information about the database or to obtain copies, contact:

   Health Studies Branch
   International Programs Center
   Population Division
   U.S. Census Bureau
   Washington, DC 20233-8860
   E-mail: laura.m.heaton@census.gov

Since AIM requires an estimate of HIV prevalence for the entire adult population, it is rarely possible to use surveillance data directly to make this estimate.

Surveillance information will generally refer to small populations and various risk groups. Since AIM requires an estimate of HIV prevalence for all adults, it is rarely possible to use surveillance data directly to make this estimate. UNAIDS has developed tools and procedures for making national estimates using available surveillance data. Every two years, UNAIDS works with country counterparts to prepare estimates of national HIV prevalence for most of the countries of the world. These estimates are based on careful consideration of the available surveillance data, by risk group; recent trends in HIV infection; and national population estimates (Schwartlander et al., 1999). The latest estimates are available from the UNAIDS website at http://www.unaids.org.

2. Future Projections

An AIM projection requires an estimate of future levels of HIV prevalence. Usually AIM is used to illustrate the future consequences of an epidemic. Therefore, it is not necessary to try to *predict* future prevalence. Rather, AIM can be used with plausible projections of future prevalence to show what would happen if prevalence followed the indicated path. In this case it is only necessary to have a plausible projection.

When AIM is used to stimulate policy dialogue, it is often helpful to use a conservative projection of future prevalence.

When AIM is used to stimulate policy dialogue, it is often helpful to use a conservative projection of future prevalence. This approach will avoid charges that the presentation is using the worst possible assumptions to make the case for AIDS interventions stronger and will allow the discussion to focus on other, more important issues.

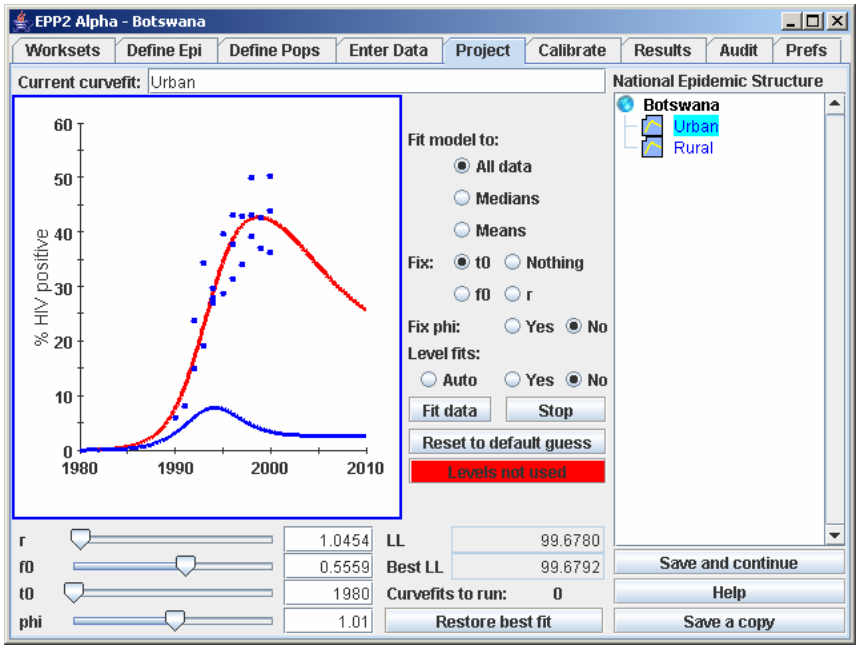
Various approaches and tools outside of the Spectrum system are available to make HIV prevalence projections. The following sections describe several of these approaches. No matter which is used, all the AIM calculations rely on the assumption of future HIV prevalence. Care should be used to develop reasonable assumptions, and the effects of alternative assumptions should be examined.

Estimation and Projection Package - EPP

UNAIDS established a Reference Group on Estimates, Models and Projections to provide advice on methods and assumptions in making national prevalence projections. In 2001 the Reference Group developed a new model, called

the UNAIDS Reference Group Model, for this purpose. This model has been implemented in a computer program called the Estimation and Projection Package (EPP). EPP replaces EpiModel, which was used previously. EPP can be used to estimate national HIV prevalence. It uses surveillance data to fit an epidemic curve for various geographic areas. These curves are then aggregated to produce a prevalence estimate for the entire country. A sample EPP fit is shown in Figure 1. The output of EPP can be read directly into Spectrum. The EPP Model is available from UNAIDS at www.UNAIDS.org. More information is provided in the manual which is also available on the UNAIDS website. EPP is primarily useful for estimating and projecting national prevalence in countries with generalized epidemics, primarily countries in sub-Saharan Africa plus a few other countries with high prevalence, such as Haiti.

Figure 1. Sample EPP Projection



For low level and concentrated epidemics a different approach is required. These are countries where HIV infection is concentrated in specific population groups, such as commercial sex workers and their clients, men who have sex with other men and injecting drug use. For these countries, the UNAIDS Reference Group has a developed a spreadsheet model to estimate and project HIV prevalence. This model uses estimates of current and future prevalence among groups at higher risk and estimates about the number of

people engaging in higher-risk behavior. The Concentrated Epidemic Spreadsheet is also available from the UNAIDS website. The prevalence estimate and projection produced with the Concentrated Epidemic Spreadsheet can be transferred directly into Spectrum.

In addition to specifying adult HIV prevalence, it is also necessary to specify the start year of the epidemic. The first year of the epidemic is the year in which the first cases of HIV occurred. This date is generally one or two years before the first AIDS cases were reported. If the AIM projection starts after the start year of the epidemic, then AIM uses this information to project in reverse the number of infections (to make an estimate of when past infections were acquired). The UN estimates of the beginning of the AIDS epidemic, by region, are shown in Table 1.

Table 1: Start of AIDS Epidemic, by Region

Region	Start of Epidemic
Sub-Saharan Africa	Late 1970s - early 1980s
South and Southeast Asia	Late 1980s
Latin America	Late 1970s - early 1980s
North America, Western Europe, Australia, New Zealand	Late 1970s - early 1980s
Caribbean	Late 1970s - early 1980s
Central Europe, Eastern Europe, Central Asia	Early 1990s
East Asia, Pacific	Late 1980s
North Africa, Middle East	Late 1980s

Source: *HIV/AIDS: The Global Epidemic,* UNAIDS and WHO, 1996.

C. Progression from HIV Infection to AIDS Death

The progression period describes the amount of time that elapses from the time a person becomes infected with HIV until he or she develops AIDS.

The progression period describes the amount of time that elapses from the time a person becomes infected with HIV until he or she dies from AIDS. AIM uses the cumulative distribution of the progression period. This distribution is defined as the cumulative proportion of people infected with HIV who will die from AIDS, by the number of years since infection. For example, it might be that for all people infected in a certain year, 1 percent will die within one year, 3 percent will die within two years, 7 percent within three years, etc. The incubation period can be specified for up to 20 years. The cumulative percentage dying from AIDS by year 20 will be the percentage that ever dies from AIDS. Thus, if this value is equal to 95 percent, it implies that 5 percent of people infected with HIV will never die from AIDS. AIM uses separate progression periods for adult men, adult women and children.

1. Adult Incubation Period

Recent reviews of the time from infection to death from AIDS in the absence of antiretroviral therapy are available for developing (Collaborative Group on AIDS Incubation and Survival) and developed countries (UNAIDS Reference Group, 2002) The progression period describes the amount of time that elapses from the time a person becomes infected with HIV until he or she dies from AIDS. AIM uses the cumulative distribution of the progression period. This distribution is defined as the cumulative proportion of people infected with HIV who will die from AIDS, by the number of years since infection. In line with these reviews, AIM has two default progression patterns available: fast (for developing countries)

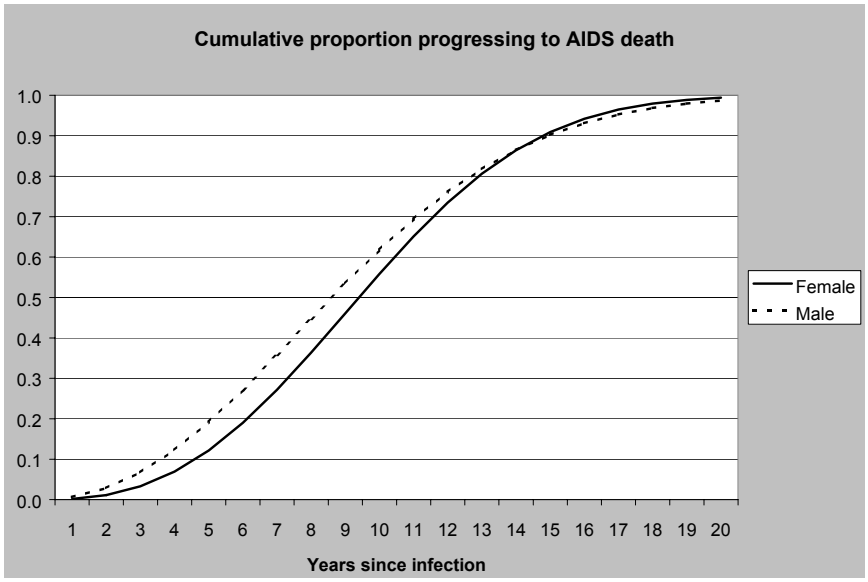
and slow (for industrialized countries). These patterns are based on the assumption that better health care leads to a somewhat longer survival period in industrialized countries. Thus, the median time from infection to death is assumed to be 9 years in developing countries (8.6 years for males and 9.4 years for females) and 11 years in industrialized countries. Survival times are assumed to follow a Weibull distribution in agreement with the available data.

These survival periods refer to people who are not receiving treatment with anti-retroviral drugs. The effects of anti-retroviral drugs are considered in a separate section. The default patterns are shown in Table 2 and Figure 2. A pattern can be selected by clicking the appropriate button, or a custom pattern can be entered directly.

Table 2: Cumulative Proportion Progressing from HIV Infection to Death AIDS, by Time Since Infection, for Adults

Years Since Infection	Fast Men	Fast Women	Slow Men	Slow Women
1	0.00	0.00	0.00	0.00
2	0.03	0.01	0.02	0.01
3	0.07	0.03	0.05	0.03
4	0.12	0.07	0.10	0.05
5	0.19	0.12	0.15	0.10
6	0.27	0.19	0.22	0.15
7	0.36	0.27	0.29	0.22
8	0.45	0.36	0.37	0.30
9	0.54	0.46	0.45	0.38
10	0.62	0.56	0.53	0.47
11	0.69	0.65	0.61	0.56
12	0.76	0.73	0.68	0.64
13	0.82	0.81	0.74	0.72
14	0.86	0.86	0.79	0.79
15	0.90	0.91	0.84	0.84
16	0.93	0.94	0.88	0.89
17	0.95	0.96	0.91	0.93
18	0.97	0.98	0.93	0.95
19	0.98	0.99	0.95	0.97
20	0.99	0.99	0.97	0.98

Figure 2: Cumulative Progression from HIV Infection to Death



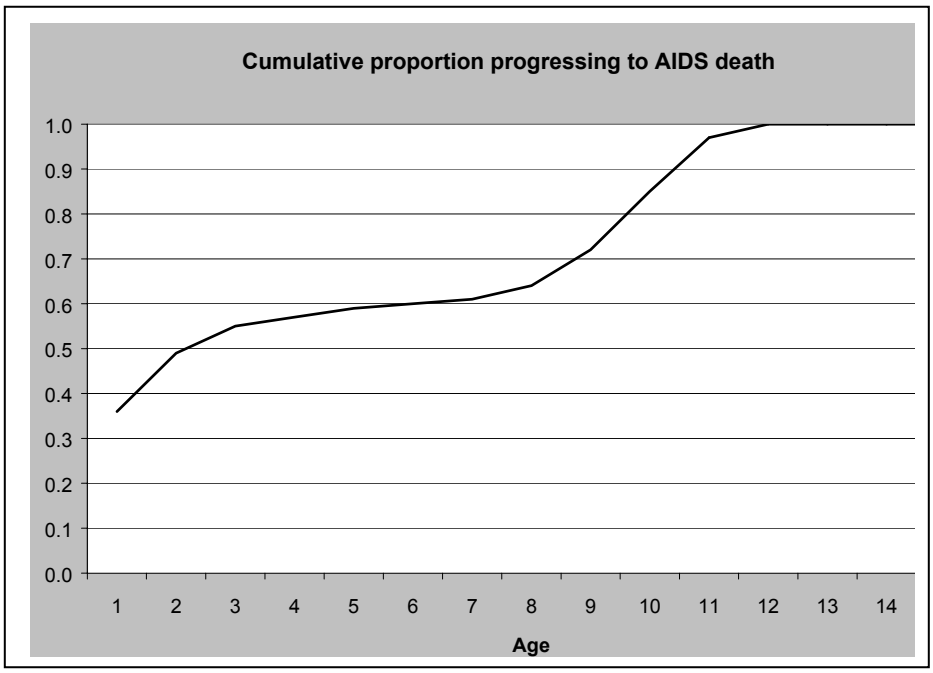
2. Child Incubation Period

Children who are infected perinatally generally progress to AIDS faster than adults. A UNAIDS review of available evidence suggests that the survival is best described by a rapid progression from infection to death for some children and much slower progression for others (UNAIDS Reference Group, 2002). The default pattern used in AIM is shown in Table 3 and Figure 3.

Table 3: Cumulative Proportion Developing AIDS, by Time Since Birth

Years Since Birth	Cumulative Proportion
1	0.36
2	0.49
3	0.55
4	0.57
5	0.59
6	0.60
7	0.61
8	0.64
9	0.72
10	0.85
11	0.97
12	1.00
13	1.00
14	1.00
15	1.00
16	1.00
17	1.00
18	1.00
19	1.00
20	1.00

Figure 3: Cumulative Progression from Birth to AIDS



D. Age and Sex Distribution of Infections

In most epidemics, there are more male than female infections early in the epidemic. As the epidemic matures, the numbers become more nearly equal.

To calculate HIV incidence from the prevalence input, AIM needs to have some information on the distribution of infection by age and sex. This information is provided through two editors, one for the ratio of prevalence at each age group to prevalence in the 25-29 age group, and one for the ratio of female to male prevalence.

AIM has two default patterns, one for generalized epidemics and one for low level and concentrated epidemics. A default pattern of the distribution of HIV infections by age for generalized epidemics has been developed from population-based surveys and reported AIDS cases (UNAIDS Reference Group, 2002) (Figure 4). Where population prevalence data are available for a particular country the observed pattern can be substituted for the default pattern. In countries with several successive population prevalence surveys the age distribution of infection shifts to older ages as the epidemic progresses.(Mbulaiteye, 2002) This is a result of the aging of those infected and changing patterns of incidence due to changes in sexual behaviour, particularly among young people. Where such data are available, Spectrum allows the age pattern of infection to change over time.

The default distributions are shown in Table 4.

Table 4: AIM Default Ratios of HIV Prevalence by Age and Sex

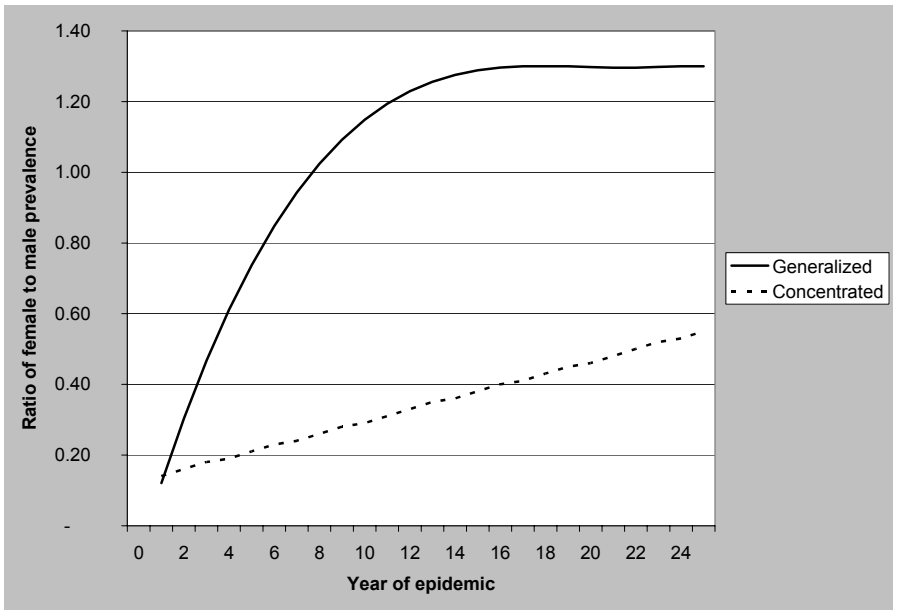
Age Group	Male	Female
0-4	0.00	0.00
5-9	0.00	0.00
10-14	0.00	0.00
15-19	0.15	0.35
20-24	0.39	0.89
25-29	1.00	1.00
30-34	1.38	0.93
35-39	1.51	0.72
40-44	1.03	0.64
45-49	0.02	0.50
50-54	0.55	0.24
55-59	0.25	0.10
60-64	0.11	0.04
65-69	0.05	0.02
70-74	0.00	0.00
75-79	0.00	0.00
80+	0.00	0.00

In most epidemics, there are more male than female infections early in the epidemic. As the epidemic matures, the

numbers become more equal and then, in heterosexual epidemics, there will eventually be more female than male infections. This pattern is especially noticeable in areas such as the Caribbean and Latin America, where the early infections were primarily among homosexual and bisexual men and the epidemic later spread to male and female heterosexuals. In many African countries today, female prevalence is significantly higher than male prevalence.

AIM has two default patterns for the ratio of female to male prevalence. The pattern for heterosexual epidemics is based on a large number of population surveys. The pattern for low level and concentrated epidemics is based on the ratio of female to male reported AIDS cases in a number of countries. These patterns are shown in Figure 4 below.

Figure 4. Default Patterns for the Ratio of Female to Male Prevalence



E. Mother-to-Child Transmission

The mother-to-child transmission rate is the percentage of babies born to HIV-infected mothers who will be infected themselves. Studies have found that this percentage ranges from about 13 to 32 percent in industrialized countries and 25 to 48 percent in developing countries (Bryson, 1996; Dabis et al., 1993). The higher rates have generally been found in studies in Africa, where a significant amount of transmission through breastfeeding may take place, and the lower figures have been found in Western Europe. AIM uses a default value

of 32 percent, typical of developing countries. If country-specific studies are available, this figure can be changed by the user. It may also be changed for future years if the country implements programs to prevent mother-to-child transmission of HIV. The effect of such programs can be included by indicating the type of program, the transmission rate for those participating in the program and the percent or number of pregnant women covered by the program. The type of program can include treatment with Nevirapine, AZT and Nevirapine or some other treatment, as well as infant feeding options (formula feeding, exclusive breastfeeding or mixed feeding).

The effect of PMTCT programs can also be explored through the use of the PMTCT module in Spectrum. The details of that module are described in that manual..

F. TFR Reduction

It is not clear how the total fertility rate might be affected by an HIV/AIDS epidemic.

It is not clear how the total fertility rate might be affected by an HIV/AIDS epidemic. Some women who find that they are infected with HIV may want to have as many children as possible while they can, in order to leave descendants behind. Others may decide to stop childbearing upon learning that they are HIV positive in order to avoid leaving motherless children behind. Since the majority of people do not know if they are infected or not, knowledge of HIV infection is not likely to have a large effect on the desired fertility rate.

Age at marriage may also be affected and could, in turn, affect fertility rates. AIDS could lead to a lower age at marriage or first union if young women and their parents seek early marriage as a protection against the young woman having premarital sex with a number of different partners. This trend, in turn, could raise fertility rates if women are exposed longer to the possibility of pregnancy. Conversely, AIDS could lead to higher age at first intercourse as the dangers of unprotected sex become known. This trend would lead to lower fertility rates.

Gregson and colleagues have examined the question of the impact of HIV on fertility by examining potential changes in the proximate determinants of fertility (Gregson, 1994; Gregson et al., 1997). They found no clear evidence either way but concluded that the most likely result is that an HIV epidemic will slightly reduce fertility.

A study in Tanzania found weak evidence that adult mortality due to AIDS leads to reduced fertility rates (Ainsworth, Filmer and Semali, 1995). Two studies in Uganda found that HIV-infected women had lower fertility rates than HIV-negative women. One of these, in rural Rakai district (Gray et al., 1997) found that age-specific fertility rates for HIV-infected women were 50 percent less than those for women who were not infected. Another study among a rural population in Masaka (Carpenter et al., 1997) found that fertility rates were 20 to 30 percent lower among HIV-infected women. Since most women did not know their sero-status, the reduced fertility rates were most likely due to biological rather than behavioral factors. This finding suggests that fertility might be 20 to 50 percent lower among HIV-infected women. In societies with substantial use of contraception, there might be a reduction in contraceptive use that would partially compensate for this effect. Fertility among young women who are HIV-positive is likely to be higher than for all women, since all HIV-positive women are sexually active but not all young women are sexually active.

The default value in AIM is that fertility among 15-19 year old women is 50 percent higher among HIV-positive women than HIV-negative women and that fertility among women 20-49 is 20 percent lower among HIV-positive women than HIV-negative women.

G. ARV Therapy

Anti-retroviral therapy (ARV) therapy can extend life and improve the quality of life for many people infected with HIV. ARV therapy has restored health to many people and continues to do so after many years. But ARV therapy does not help everyone. Some people have a good reaction initially but over time the virus becomes resistant to the drugs and the benefits diminish. Others experience such severe side effects that they cannot continue to take the drugs.

AIM can calculate the effects of ARV therapy based on an assumption about the proportion of those in need receiving ARVs. ARV therapy is assumed to delay progression to death as long as it is effective. However, some people will develop resistance to ARVs and others may have to stop treatment because of severe side effects. As a result, only a proportion of those on ARV therapy in one year continue the next year. When a person stops ARV therapy, s/he progresses to AIDS death quickly.

Since people with HIV will survive longer if they are on ARV therapy, introducing ARVs will tend to raise prevalence initially as new infections continue to occur and there are fewer deaths. In most cases the prevalence input will be derived from surveillance data collected when ARVs were not available, Thus, both the prevalence input, and the resulting incidence estimate, can be considered to represent the situation without ARV therapy. In that case, and if incidence remains the same, introducing ARVs will raise prevalence above the input projection. However, if ARVs are already being supplied to significant portions of the population, the historical surveillance data and, thus, the prevalence projection input will already include the effect of ARVs. In this case, the prevalence estimate should not be changed by ARV therapy; instead, incidence should be adjusted downward to compensate for the life-prolonging effects of ARVs.

These options are included in AIM through an input called "The effect of ARV on prevalence." When the effect is set to 0, then incidence will be reduced to ensure that prevalence remains the same as the input projection. This is the appropriate setting for countries where ARVs are already widely available, such as Argentina, Brazil, Costa Rica, Cuba and Uruguay. When the effect is set to 1, then incidence remains the same and estimated prevalence will rise over the input projection. This is the appropriate setting for most countries where ARVs are not yet available to a significant number of people, such as sub-Saharan Africa.

H. Orphans

AIM will estimate the number of AIDS and non-AIDS orphans caused by adult deaths. An orphan is defined as a child under the age of 18 who has lost at least one parent. These estimates are based on the time history of fertility and the age at death. AIM will estimate maternal orphans (children whose mother has died), paternal orphans (children whose father has died), and dual orphans (children whose father and mother have both died). AIDS orphans are children who have lost at least one parent to AIDS. To estimate double AIDS orphans, AIM needs to estimate the proportion of couples with both parents infected with HIV. This estimation is based on a regression equation using data from national population surveys in sub-Saharan Africa. To make the estimate more

precise, two additional pieces of information are required: the percentage of women aged 15-19 who have not married, and the percentage of married women who are in monogamous unions. Both of these parameters are available from national population surveys for most countries. Table 5 shows values for these two indicators from various DHS reports.

Table 5. Percent of Women 15-19 Never Married and Percent of Married Women in Monogamous Unions from Various DHS Reports

Country	Percent 15-19 never married	Percent of married women in monogamous unions
Benin 2001	76.1	54.2
Botswana 1988	93.9	
Burkina Faso 1998/99	65.2	45.3
Burundi 1987	93.2	88.3
Cameroon 1998	64.2	66.9
CAR 1994/95	57.7	71.5
Chad 1996/97	51.4	60.8
Comoros 1996	88.5	74.7
Cote d'Ivoire 1998/99	74.6	65.0
Eritrea 1995	62.4	92.9
Ethiopia 2000	70.0	86.4
Gabon 2000	77.6	78.0
Ghana 1998	83.6	77.3
Guinea 1999	53.9	46.3
Kenya 1998	83.3	83.7
Liberia 1986	64.0	61.9
Madagascar 1997	66.3	96.0
Malawi 2000	63.2	
Mali 1995/1996	50.3	55.7
Mauritania 2000/01	72.3	88.4
Mozambique 1997	52.9	71.5
Namibia 1992	92.3	74.6
Niger 1998	38.1	62.2
Nigeria 1999	72.5	64.3
Rwanda 1992	90.2	85.6
Senegal 1997	71.0	51.4
Sudan 1990	84.1	79.6
Tanzania 1999	72.8	
Togo 1998	80.1	57.2
Uganda 2000/01	67.7	67.3
Zambia 1996	72.7	82.9
Zimbabwe 1999	77.3	

I. Health Sector Impacts

In addition to projecting the number of infections, AIDS cases, and deaths, AIM can also calculate some of the additional impacts of AIDS. In this section you can display the number of young adults deaths (15-49) and the number of expected cases of tuberculosis. TB cases are projected on the basis of three inputs.

- **TB incidence with HIV (%):** The proportion of people with both TB infection and HIV infection who develop TB each year. Estimated to be 2.3 to 13.3 percent (Cantwell and Binkin, 1997).
- **TB incidence without HIV (%):** The expected adult incidence (per thousand) of tuberculosis each year in the absence of HIV infection. Estimated to be about 2.4 per thousand in Africa.
- **Percent of the population with latent TB.** This is the percentage of the population that has a latent TB infection. It is usually estimated to be around 50% in sub-Saharan Africa.

IV. Projection Outputs

AIM will calculate and display a number of indicators grouped under the headings E*pidemiology, Impacts* and *Orphans*. A complete list of indicators available and their definitions is given below.

A. Epidemiology

Prevalence

- **Number infected with HIV:** The total number of people who are alive and infected with HIV.
- **Adult HIV prevalence:** The percentage of adults (population aged 15 to 49) who are infected with HIV.
- **HIV age distribution:** The number of infected people, by age and sex. This information can be displayed as a table or a pyramid chart.
- **Number of HIV+ pregnant women.** The number of pregnant women who are infected with HIV.

Incidence

- **Number of new HIV infections.** The total number of new HIV infections each year.
- **Adult HIV incidence:** The percentage of uninfected adults who become infected in each year.
- **New infections by age.** The number of new infections by age and sex and incidence by age and sex.

AIDS

- **New AIDS Cases.** The number of people progressing to AIDS each year.
- **AIDS age distribution:** The number of people alive with AIDS, by age and sex. This information can be displayed as a table or a pyramid chart.

AIDS deaths

- **AIDS deaths:** The annual number of deaths due to AIDS.
- **Cumulative AIDS deaths:** The cumulative number of AIDS deaths since the beginning of the projection.

- **AIDS deaths by age.** The number of AIDS deaths each year by age and sex.

Anti-retroviral therapu

- **Number newly needing ARV therapy.** The number of people progressing to the stage where they need ARV therapy. The is estimated as those within two years of AIDS death if they do not receive ARV therapy.
- **Number on ARV therapy.** The number of people receiving ARV therapy.
- **Total number needing ARV therapy.** The total number of people needing ARV therapy. This includes those newly needing therapy and those who continue successfully on therapy from the previous year.

Summary tables

- **HIV/AIDS summary:** A table with a selection of indicators shown for a selection of years. Input assumptions are also shown on this table.
- **Adults 15-49 summary:** A table showing indicators just for adults 15-49.
- **Child summary:** A table showing indicators just for children under the age of 15.
- **Regional summary.** If the prevalence trend is read from a file produced by EPP or the Concentrated Epidemic Spreadsheet and this file includes prevalence by region, then AIM will display key indicators by region for any year between 2000 and 2010. The regions are those included in the EPP or spreadsheet file.
- **Ranges summary.** This is a table of key indicators with lower and upper plausibility bounds. This table can only be displayed for the current year or the past two years. The ranges depend on the type of epidemic (generalized, low level or concentrated) and the trend in prevalence (rising, stable or declining).

B. Impacts

- **TB cases:** The annual number of new tuberculosis cases.
- **Young adult (15-49) deaths:** The total number of annual deaths occurring to adults between the ages of 15 and 49, inclusive.

C. Orphans

- **Maternal AIDS orphans**. Children under the age of 15 who have lost their mother to AIDS.
- **Paternal AIDS orphans**. Children under the age of 15 who have lost their father to AIDS.
- **Dual AIDS orphans**. Children under the age of 15 who have lost both parents to AIDS.
- **All AIDS orphans**. Children under the age of 15 who have lost one or both parents to AIDS.
- **Maternal non-AIDS orphans**. Children under the age of 15 who have lost their mother due to causes other than AIDS.
- **Paternal non-AIDS orphans**. Children under the age of 15 who have lost their father due to causes other than AIDS.
- **Dual non-AIDS orphans**. Children under the age of 15 who have lost both their parents due to causes other than AIDS.
- **All non-AIDS orphans**. Children under the age of 15 who have lost one or both parents due to causes other than AIDS.
- **Maternal orphans**. Children under the age of 15 who have lost their mothers due to any cause.
- **Paternal orphans**. Children under the age of 15 who have lost their father due to any cause.
- **Dual orphans**. Children under the age of 15 who have lost both their parents due to any cause.
- **Total orphans**. Children under the age of 15 who have lost one or both parents due to any cause.
- **Summary by age**. A table showing orphans by type and single age.
- **Summary table**. A table showing all orphans by type and year.

V. Program Tutorial

This tutorial covers the key steps in installing and running Spectrum and AIM.[2] It assumes you have a computer running Windows 98 or higher and that you are familiar with the basic operation of Windows programs and terminology.

A. Before You Get Started

You will need to collect data and make certain decisions before running the model. At a minimum you will need an estimate and projection of adult HIV prevalence. This may come from EPP or the Projections Workbook or some other source. You should also have information on the current coverage of PMTCT and ART programs. For other data needs Spectrum provides default patterns that you can use if you do not have information, but you should review these default patterns to make sure they are appropriate for your application.

B. Installing the Spectrum Program

The Spectrum program is distributed on floppy diskettes, CD-ROMS or through the Internet at http://www.FuturesGroup.com. It must be installed on a hard disk before it can be used. Spectrum will operate on any computer running Windows 98 or later version. It requires about 10MB of hard disk space.

0To install the Spectrum program, follow the directions below. [3]

Installing from floppy diskettes: Insert the first diskette into your disk drive. Select "Start" from the task bar. Then select "Run" from the pop-up menu. In the dialogue box that appears, type the file name "a:\SpecInstall.exe" and press

[2] There are two versions of AIM: Spectrum and Excel. The Excel spreadsheet permits the user to customize equations and variables as appropriate for the country and region. A brief tutorial follows in Chapter 6.

[3] To remove the Spectrum program from your hard disk, run the unwise.exe program located in the Spectrum directory.

"Ok." (If the install disk is in floppy disk drive b, then use the file name "b:\SpecInstall.exe".) Follow the instructions on the screen to complete the installation.

Installing from a CD-ROM. Insert the CD-ROM into your CD-ROM drive. The installation program should start automatically. If it does not, Select "Start" from the task bar, then select "Run" from the pop-up menu. In the dialogue box that appears, click on Browse, and find the file SpecInstall.exe. Then press "Ok."

Installing from the internet. Start your internet browser and go to www.FuturesGroup.com. Click on "Software" and then "Spectrum". Next click on "Spectrum download (single executable file). From the dialogue box that appears next, select "Save". Select a location for the file. Once the file has been downloaded, click on that file and the follow the instructions.

C. Creating a New Projection

1. Starting the Spectrum Program

To start Spectrum:

1. Click the "Start" button on the task bar.
2. Select "Programs" from the pop-up menu.
3. Select "Spectrum" from the program menu. Alternatively, you can use Windows Explorer to locate the directory c:\spectrum" and double click on the file named spectrum.exe."

2. Opening a Demographic Projection

Before using AIM, you should use DemProj to prepare a demographic projection. DemProj is part of the Spectrum System of Policy Models; for more information, consult its manual.

AIM in Spectrum requires a demographic projection prepared with DemProj. In a typical AIM application, the demographic projection calculates all the normal demographic processes (births, deaths, migration, aging). AIM influences the demographic projection by adding a number of AIDS deaths and, possibly, specifying a lower fertility rate because of the effects of HIV infection. All the population figures required by AIM (e.g., size of the adult population) are provided by DemProj. Therefore, before using AIM you should prepare a demographic projection using DemProj. For more information on DemProj, consult the DemProj Manual for Spectrum that is a companion to this one, *DemProj: A Computer Program for Making Population Projections*. One easy way to create a demographic projection is to use the EasyProj feature of DemProj. To use this feature, follow these steps:

1. Select "File" and "New projection" from the Spectrum menu.
2. In the "New projection" dialogue box, fill in the projection title, the first year of the projection and the last year of the projection. It is a good idea to set the first year of the projection to one or two years before the start of the HIV/AIDS epidemic.
3. Check the box next to "AIDS (AIM)" to include the AIM module.
4. Click the "File name" button and enter a file name for this projection.
5. Click the "EasyProj" button and select your country from the country list. This will read the demographic data from a file based on the population estimates and

projections from the United Nations Population Division.

6. Click "OK" to return to the dialogue box and click "OK" once more to complete the set-up process.

7. Select "File" and "Save as" from the Spectrum menu to save this projection.

The first step in preparing the AIM projection is to open the demographic projection. To do this,

1. Select "File" from the menu bar.

2. From the pull-down menu that appears, select "Open projection."

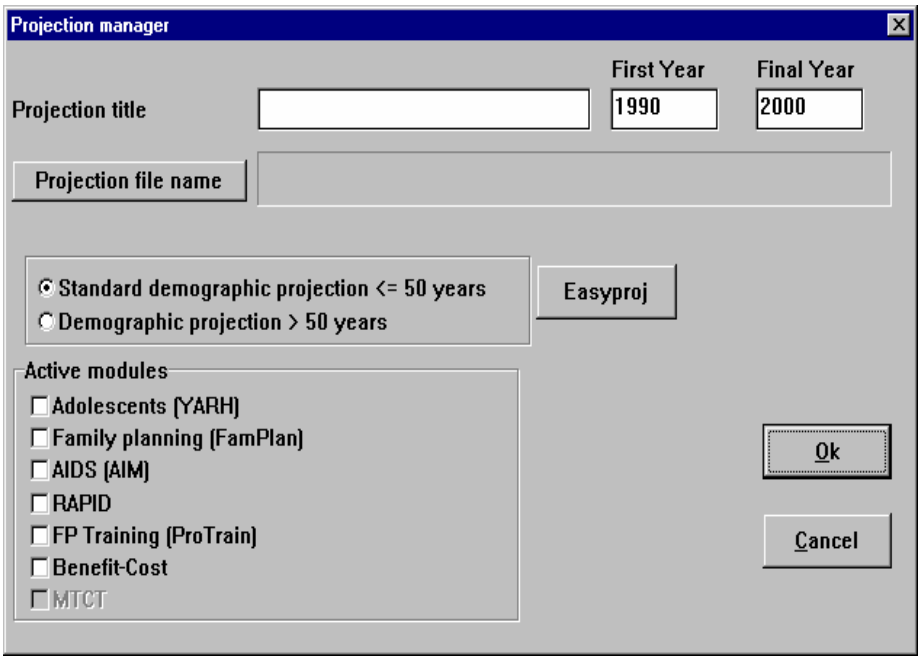
3. Select the projection file from the "Open" dialogue box and press "Ok." All pre-existing projections that can be loaded will be listed here.

3. Adding the AIM Module to the Projection

Once the demographic projection is open, you need to change the configuration to indicate that the AIDS module will be used as well. To do this, select "Edit" from the menu bar and "Projection" from the pull-down menu.

You will see the "Projection manager" dialogue box. It will look similar to the display shown below.

If a box is shown in gray, you will not be able to change its contents. It means that a projection has been loaded, and the data must remain the same. If you want to create an entirely new projection, you should close the other projections, using "File" and "Close," and then select "File" and "New." Users may want to have several projections open in order to examine the effects of changing assumptions.



The following information is displayed.

Once all the information is entered for this dialogue box, click on the "Ok" button. You can always return to this screen and change some of the information by selecting "Edit" from the menu bar and then "Projection" from the pull-down menu.

If you want to change the projection file name, the years, or the demographic projection interval, you will need to do so in DemProj. The options in the Projection manager were set when the demographic projection was created with DemProj.

Projection title: This title will be printed at the top of all printed output and will be used to identify the projection if more than one projection is loaded at a time. You can change the title to reflect the projection you are about to prepare.

Projection file name: This is the name that will be used to store all data files associated with this projection. You cannot change the file name here. You can change it if you select "File" and "Save projection as" to save the projection to a new name.

First year: This is the first year of the projection.

Final year: This is the final year of the projection.

Demography. The radio button labeled "standard demographic projection <= 50 years" will be selected by default. You cannot change this here because the demography module is required to make the AIDS projection.

Active modules. The check boxes let you select other modules that will be used with the population projection. Initially none of them will be selected. You should select the "AIDS" module by clicking on the check box next to the name. This step will allow you to include the AIDS module in the projection.

Once all the information is entered for this dialogue box, click on the "Ok" button. You can always return to this screen and change some of the information later by selecting "Edit" from the menu bar and "Projection" from the pull-down menu.

EasyProj. EasyProj is a special feature that allows you to use data prepared by the United Nations Population Division and published in *World Population Prospects*. If you click on the EasyProj button, the program will prompt you to select a country and ask whether you want to use the UN low, medium, or high projection assumptions. Once you click "Ok," the program will load the base year population, the total fertility rate, and the male and female life expectancy from the United Nations estimates and projections.

D. Entering the Projection Assumptions

For readers who feel they need additional review or explanations of the terms found in this section, Chapter III and the glossary of this manual may be useful.

1. About the Editors

Both editors in AIM are similar. At the very top of the screen, the variable name appears. At the bottom of the screen are the special edit keys. "Duplicate" allows you to copy information from one cell, column, or row to another; "Interpolate" to enter a beginning and ending number and have the computer calculate the numbers for the intervening intervals; "Multiply" to multiply a cell, column or row by a specific number; and "Source" to write notes indicating the source of the data for future reference.

To use the "Duplicate" button,

1. Highlight (select) the range (column, row, or cells to be affected). The first cell in the range should be the value you want to copy.

2. Extend the range to the last year by using the mouse (hold down the left button and drag the range) or the keyboard (hold down the shift key and use the arrow keys).

3. Click on the "Duplicate" key to copy the value at the beginning of the range to all the other cells in the range.

To use the "Interpolate" button,

1. Enter the beginning and ending values in the appropriate cells.

2. Highlight the entire range from beginning to end.

3. Click on the "Interpolate" key to have the values interpolated and entered into each of the empty cells.

To use the "Multiply" button,

1. Highlight the range (column, row, or cells to be affected).

2. Enter the multiplier in the dialogue box.

3. Click "Ok" to accept. The entire range will be multiplied by the designated number.

To use the "Source" button,

1. Click on the "Source" button to open a small word processor window.

2. Enter the source of the data and make any special comments about the assumptions.

3. Click on “Close” to return to the editor.

This feature allows you to keep a record of the data sources and assumptions as you make the projections. This source information will be maintained with the data file and printed whenever you print the projection summary. It is **strongly** recommended that you use this feature to avoid later confusion.

When you have finished entering all the necessary data for the component into the editor,

1. Click the “Ok” button to return to the “AIDS” dialogue box.

2. Click the “Close” button to complete the editing process.

The “Cancel” button allows you to exit the editor without making any changes to the data.

2. Epidemiology

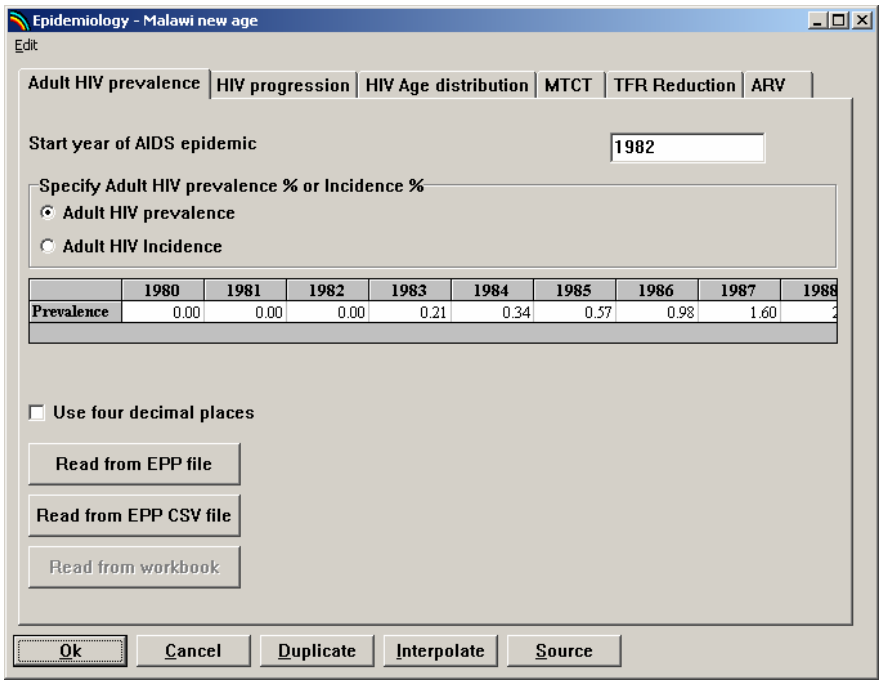
To enter the assumptions for the AIDS projection,

1. Choose “Edit” from the menu bar.

2. Choose “AIDS (AIM)” from the pull-down menu.

3. Choose “Epidemiology” from the “AIDS” dialogue box. This step will display an editor like the one shown below.

For each of the inputs required for the projection, there is a tab near the top of the screen.



1. To enter data for any of these assumptions, click on the appropriate tab to display the editor for that variable.

2. Then click anywhere inside the editor to make it active.

Adult HIV Prevalence

This editor allows you to enter the adult HIV prevalence or adult HIV incidence. If you are entering prevalence, it can be done in several ways:

A. **Enter the prevalence manually** by typing the values in the editor. You can copy a value to several years by selecting the value and the years to copy to and pressing the "Duplicate" button. You can interpolate between two years by outlining the range, including the first and last year, and pressing the "Interpolate" button.

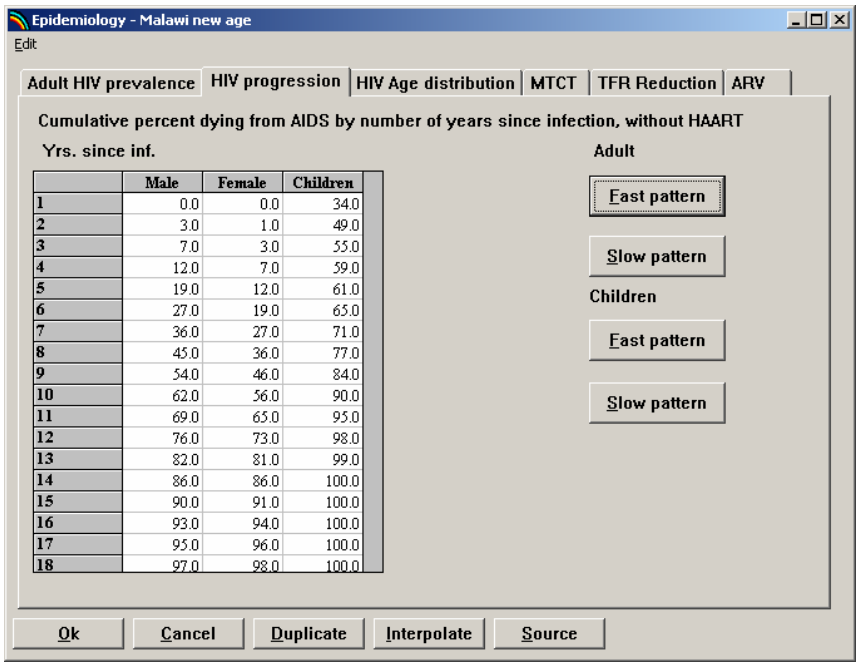
B. **Read the prevalence estimate and projection from EPP**. Click the button "Read from EPP file". This will display a "file open" dialog box. Navigate to the directory where your EPP file is stored (for example C:\Program files\EPP2\eppout), select the appropriate file and click "Open" to complete this step. The prevalence projection from this file will be read into Spectrum and displayed in the editor. If you have made regional projections for your country (i.e. urban/rural or by province), then you can also read this information. You must have saved your EPP data as a CSV file first. Click the button "Read from EPP CSV file". This will display

a “file open” dialog box. Navigate to the directory where your EPP is stored, select the appropriate file and click “Open”. This regional projection from this file will be read into Spectrum.

C. **Read the prevalence from the Projections Workbook**. Click the button “Read from workbook”. This will display a “file open” dialog box. Navigate to the directory where your Workbook file is stored (for example C:\Country files\projection), select the appropriate file and click “Open” to complete this step. The prevalence projection from this file will be read into Spectrum and displayed in the editor.

When you have entered the information on adult HIV prevalence, click the “HIV/AIDS parameters” tab to move to the next editor.

HIV Progression



	Male	Female	Children
1	0.0	0.0	34.0
2	3.0	1.0	49.0
3	7.0	3.0	55.0
4	12.0	7.0	59.0
5	19.0	12.0	61.0
6	27.0	19.0	65.0
7	36.0	27.0	71.0
8	45.0	36.0	77.0
9	54.0	46.0	84.0
10	62.0	56.0	90.0
11	69.0	65.0	95.0
12	76.0	73.0	98.0
13	82.0	81.0	99.0
14	86.0	86.0	100.0
15	90.0	91.0	100.0
16	93.0	94.0	100.0
17	95.0	96.0	100.0
18	97.0	98.0	100.0

AIM requires a distribution of the progression period, described as the cumulative percentage of HIV-infected individuals dying from AIDS by the number of years since they acquired the infection. The editor for this data entry is shown below.

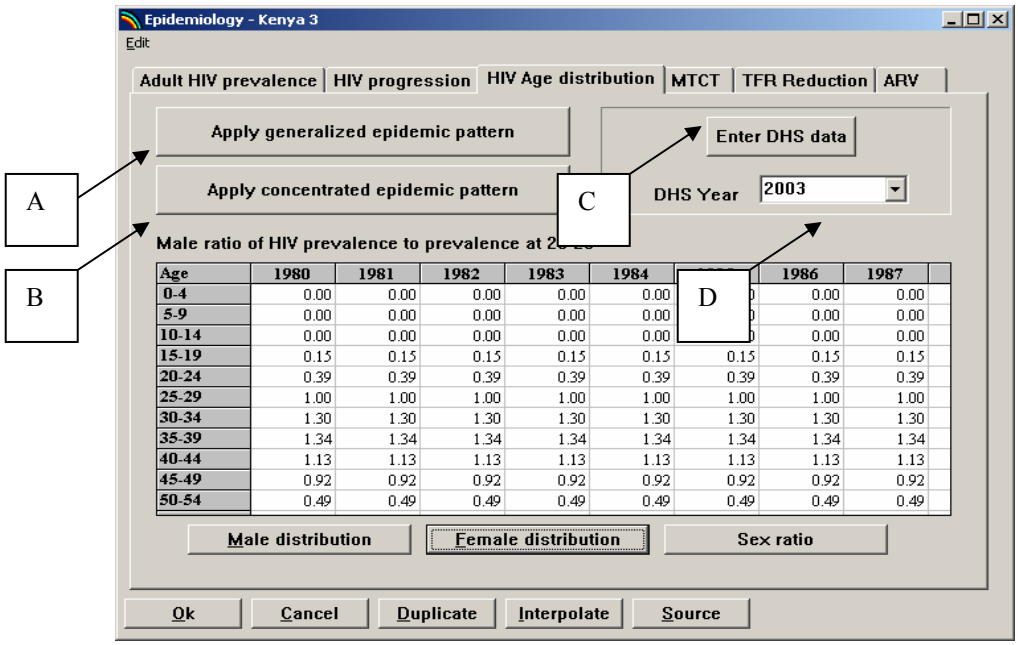
You may enter your own data or choose from the default patterns to the right of the editor. These buttons provide several default distributions for both adults and children. Click

on the desired option, and the corresponding distribution will be entered into the editor.

When you have entered the information on the HIV incubation period, click the "HIV age distribution" tab to move to the next editor.

\Age Distribution of HIV Prevalence

Select the tab "HIV Age distribution" and the following screen will appear. This editor shows the age distribution of prevalence for males and females and the ratio of female to male prevalence over time.



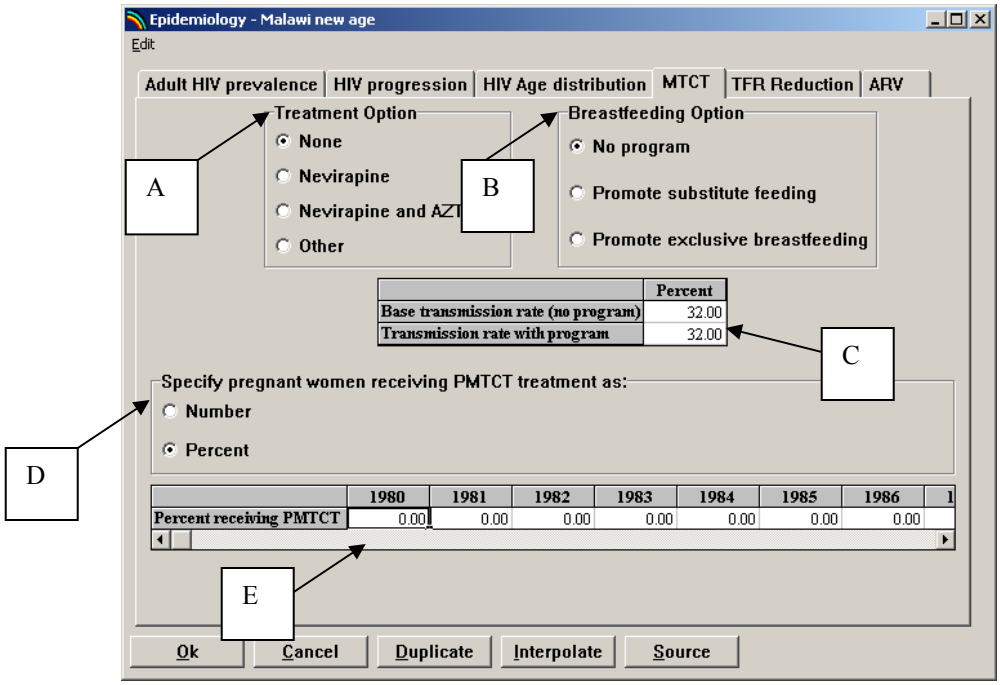
Age	1980	1981	1982	1983	1984		1986	1987
0-4	0.00	0.00	0.00	0.00	0.00		0.00	0.00
5-9	0.00	0.00	0.00	0.00	0.00		0.00	0.00
10-14	0.00	0.00	0.00	0.00	0.00		0.00	0.00
15-19	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20-24	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
25-29	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
30-34	1.30	1.30	1.30	1.30	1.30	1.30	1.30	1.30
35-39	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34
40-44	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
45-49	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
50-54	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49

Here you have three options.

A. If your country has a generalized epidemic you should click the button "Apply generalized epidemic pattern". This will insert the default age and sex pattern for generalized epidemics.
B. If your country has a low lever or concentrated epidemic, you should click the button, "Apply concentrated epidemic pattern". This will insert the default age and sex pattern for low level and concentrated epidemics.
C. If you have had a recent DHS or other general population survey that reported HIV prevalence by age and sex, then you can enter this information by clicking the "Enter DHS data button". Enter the prevalence by age and sex and specify the year of the survey [D]. The program will automatically adjust the pattern in the editors to match the survey data in that year. Data for all other years will be adjusted proportionately.

MTCT

Select the tab "MTCT" and the following screen will appear:

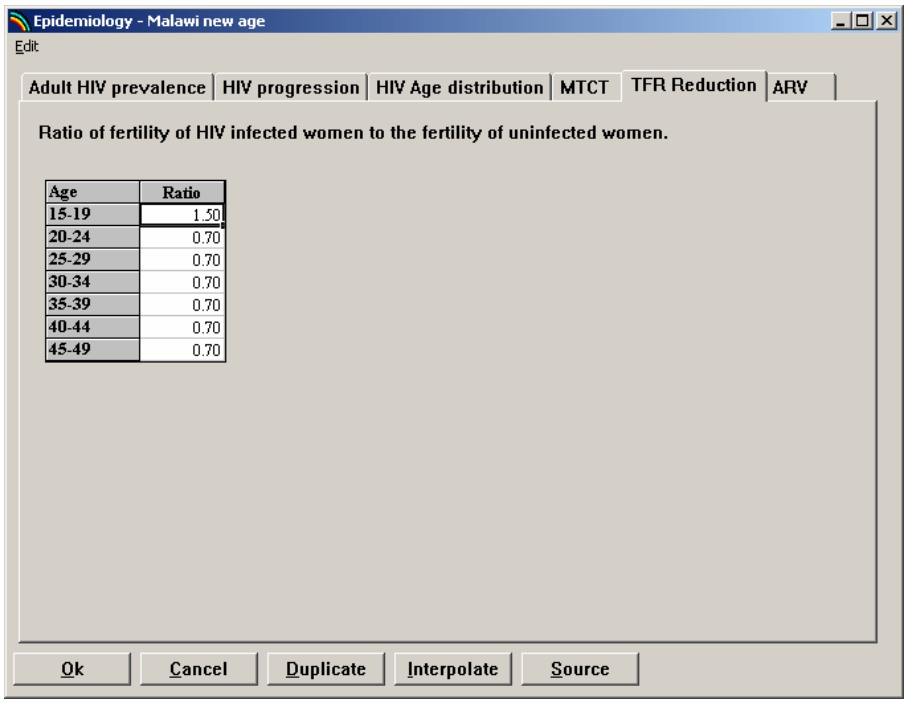


If there is no program to prevent mother-to-child transmission in your country then you can just accept the default values in this screen. However, most countries have such programs. You need to specify the type and scope of the program.

A. **Select the treatment option**. Select the radio button that most closely describes the treatment available.
B. **Select the infant feeding option**. Select the type of infant feeding promoted by the program.
C. **Set the transmission rate**. The mother-to-child transmission rate with no program is set to 32% by default. If you have information about this rate in your country you can change this value. If you selected one of the pre-set treatment options (Nevirapine or Nevirapine plus AZT) then the program will enter a default transmission rate for those participating in the program in the cell labelled "Transmission rate with program". You can change this rate if you have better information.
D. **Set the program scope**. You can define the scope of the program either as the number of women receiving PMTCT services or as the percentage of pregnant women receiving services.
E. **Enter the scope**. Specify the number or percent of pregnant women receiving PMTCT services each year of the projection.

TFR reduction

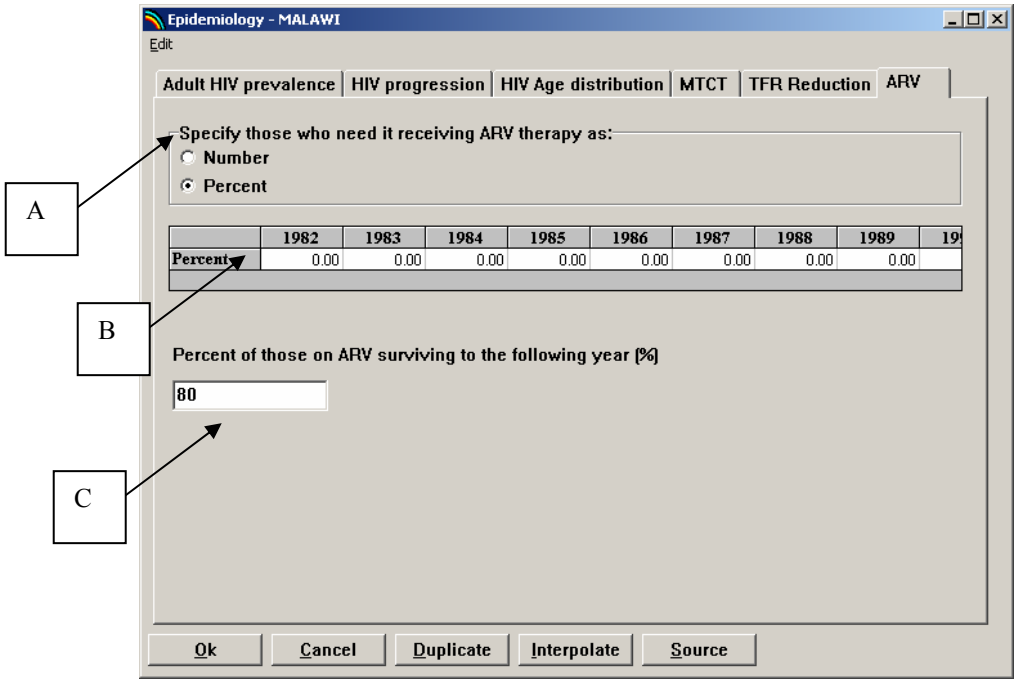
The next editor specifies the ratio of fertility among women who are HIV-positive to those who are HIV-negative. The default values are a 50 percent increase for women 15-19 (due to a higher proportion of HIV-positive women being sexually active) and a 20 percent reduction for all other women.



Age	Ratio
15-19	1.50
20-24	0.70
25-29	0.70
30-34	0.70
35-39	0.70
40-44	0.70
45-49	0.70

ARV Therapy

Select the ART tab and you will see a screen that looks like the on below. Here you can describe the scope of antiretroviral treatment.



A. **Set the program scope.** You can describe the scope of the ART program either as the number of people receiving ART or the percent of those who need it.

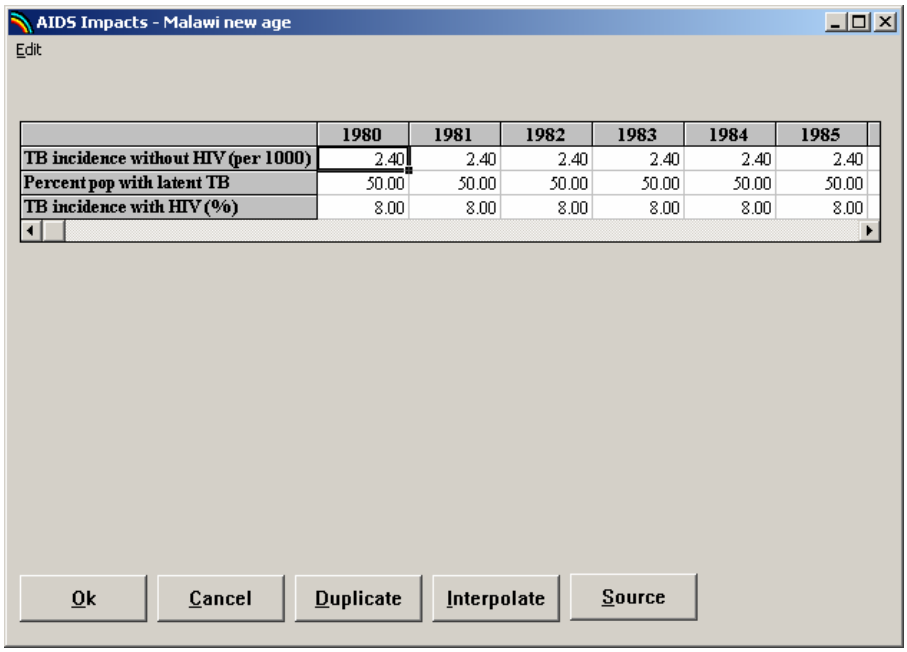
B. **Enter the scope.** Enter the number or percent of people receiving ART for each year in the projection.

C. **Define effectiveness.** Enter the effective of ART treatment in terms of the percentage of those on ART who successfully continue on it the following year.

3. Impacts

To enter the impact assumptions for the AIDS projection,

1. Choose "Edit" from the menu bar.
2. Choose "AIDS (AIM)" from the pull-down menu.
3. Select "Impacts" from the "AIDS" dialogue box. This step will display an editor like the one shown below.



	1980	1981	1982	1983	1984	1985
TB incidence without HIV (per 1000)	2.40	2.40	2.40	2.40	2.40	2.40
Percent pop with latent TB	50.00	50.00	50.00	50.00	50.00	50.00
TB incidence with HIV (%)	8.00	8.00	8.00	8.00	8.00	8.00

This screen contains a single section with all the assumptions displayed at once. Default values can be changed if better information is available

1. Click somewhere inside the editor to make the scroll bar appear.
2. Scroll to the right or left to see all the years and enter the data.

4. Orphans

AIM needs two additional parameters to calculate AIDS orphans. These are the percentage of women 15-19 that have never been married and the percentage of married women 15-49 that are in monogamous unions. These parameters are required to estimate dual AIDS orphans. For

many countries they can be obtained from DHS reports. Values for many countries are given in Table 4.

5. Leaving the Editors

Once you have entered all the necessary information,

1. Leave the editors by clicking on the "Ok" button. When you click the "Ok" button, the program will record your changes and return to the "AIDS" dialogue box.

2. Click on "Close" to keep your work, and you will return to the main program. If you decide that you do not want to keep the changes you have just made, click the "Cancel" button in any editor. This action will exit the AIDS editors and restore all inputs to their values before you entered the AIDS editors. Any changes you made during the current editing session will be lost.

6. Saving the Input Data

Once you have entered the projection assumptions, it is a good idea to save the data onto your hard disk. To do this, select "File" from the menu bar and "Save projection" from the pull-down menu. The data will be saved using the file name you specified earlier.

E. Making the Projection

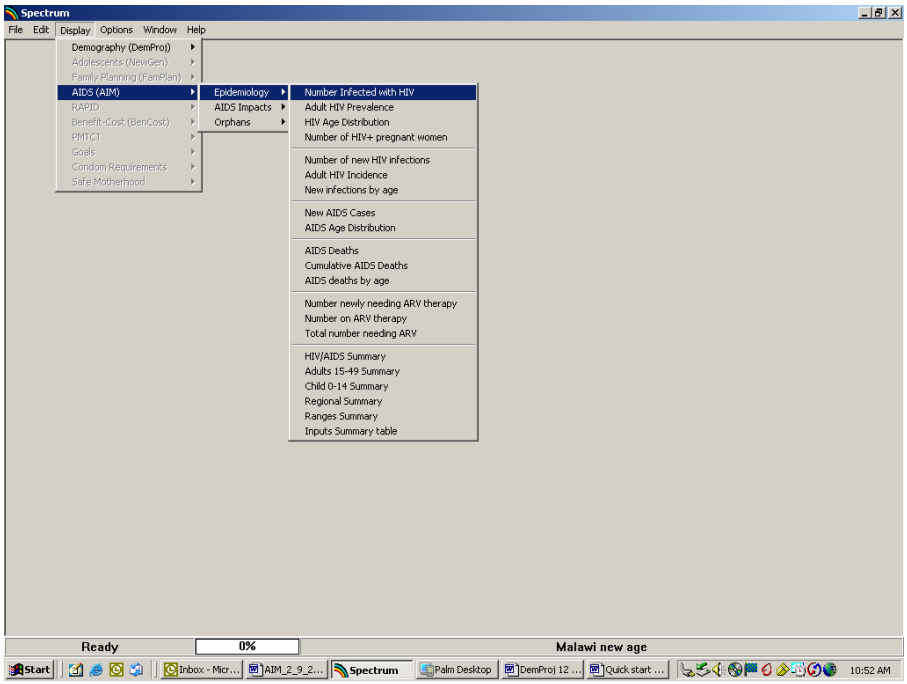
Whenever you enter data for a new projection or edit the assumptions, Spectrum will note that the data have been changed. The next time you try to display an indicator, it will inform you that the data may have changed and ask if you want to recalculate the projection. Normally, you should answer "Yes" to this question. Spectrum will then make the projection. This step may take only a few seconds or much longer, depending on the length of the projection and the number of modules being used. Once the projection is made, you will not be asked if you want to project the population again, unless you edit the assumptions.

F. Examining the Output

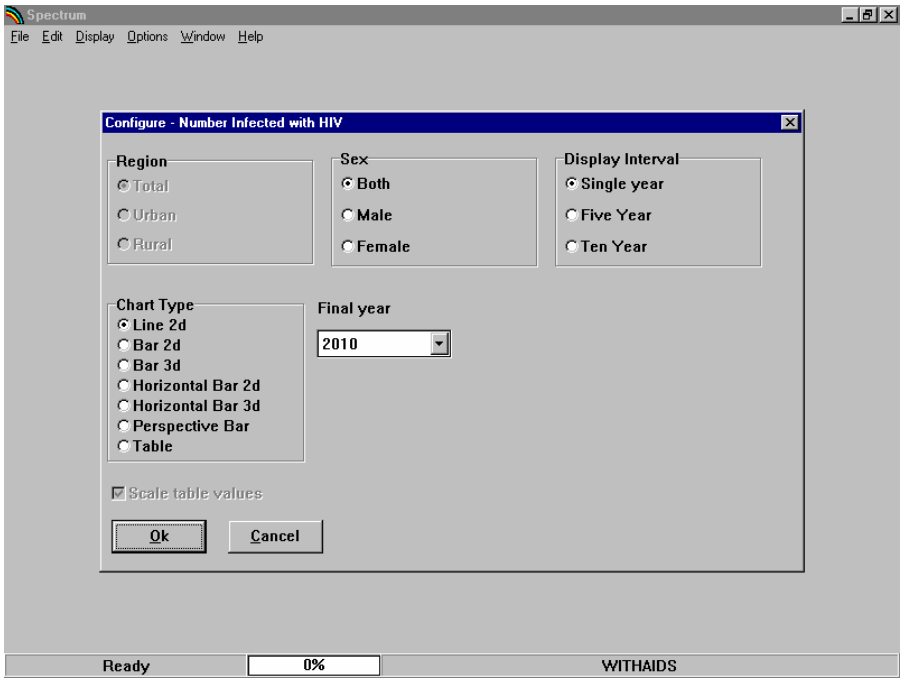
To see the results of the projection, select "Display" from the menu bar. From the pull-down menu select "AIDS." You will then see another menu showing the three categories of indicators available:

- Epidemiology

- AIDS Impacts
- Orphans

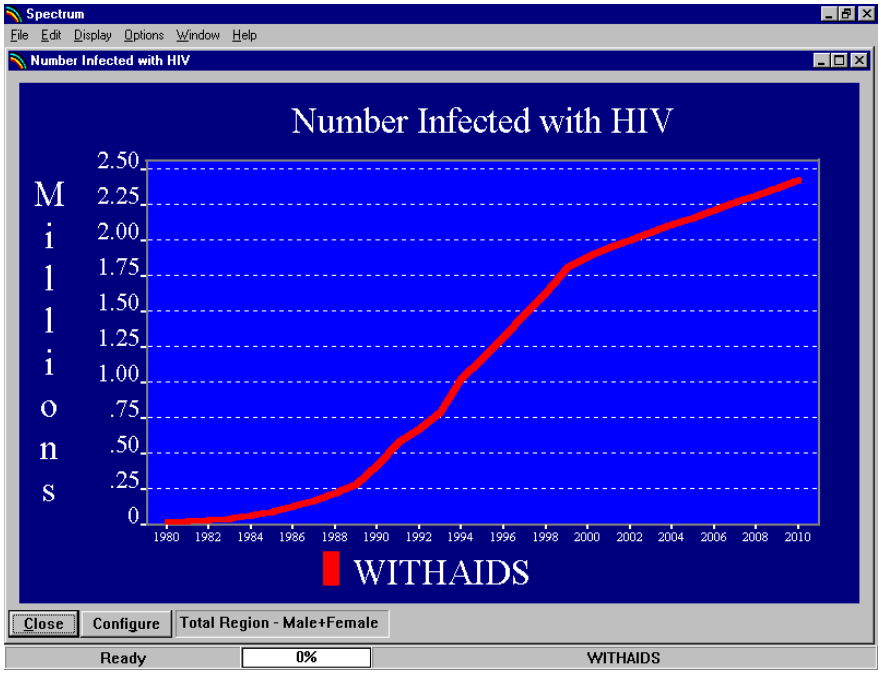


Choose one of these categories (the Epidemiology screen is shown above) and you will see one final menu listing the indicators available in that category. Select one of the indicators. Then you will see the display dialogue box. It will look similar to the one shown below.



The exact choices available will depend on the indicator you have selected. For "Number infected with HIV," sex can be set to "Both," "Male," or "Female." The display will normally be in single years but you can change it to display every five or ten years if desired. The chart type is also set through this dialogue box. Click on the button next to the type of display you want. Normally the display will show all the years in the projection. However, if you want to see only part of the projection, you can change the final year by selecting a new final display year from the "Final year" list box.

Once you are satisfied with the type of display, click the "Ok" button and the display will appear. It will look similar to the display shown below.



All the projections that are currently in use will be displayed on the same graph.

You can change the configuration of the display by clicking the "Configure" button. You can also change the type of display by placing the mouse pointer anywhere inside the chart and clicking with the right mouse button.

To close the display, click on the "Close" button. You do not have to close the display immediately. You can choose to display another indicator and it will appear on top of the first display. The first display will be covered but it will still be there. You can return to any previous display that you have not closed by choosing "Window" from the menu bar and selecting the name of the display from the pull-down menu. From the "Window" selection you can also choose to tile or cascade all the existing display windows.

1. Graphs and Bar Charts

Spectrum will display a variety of graphs and bar charts, including:

- Line charts
- Two- and three-dimensional bar charts (column charts)
- Two- and three-dimensional horizontal bar charts
- Two- and three-dimensional overlap bar charts (bars for multiple projections are shown on top of one another)
- Three-dimensional perspective bar charts.

To print the active chart, select "File" from the menu bar and "Print" from the pull-down menu.

2. Tables

Spectrum will also display data in the form of tables. In tables, each projection that is in use will be displayed in a separate column. You can scroll through the table to see all the years by using the PgUp and PgDn keys or by using the mouse.

To print a table, select "File" from the menu bar and "Print" from the pull-down menu.

3. Displaying All Age Groups

If you wish to see the number of people with AIDS by age and sex, choose "Display," "AIDS (AIM)," "Epidemiology," and then "AIDS age distribution."

You can display the information as a table, "Summary table," or as a population pyramid showing either numbers of people ("Pyramid (numbers),")or the percent distribution by age and sex ("Pyramid (percent)").

The pyramid display always shows two pyramids. If you are using a single projection, then the pyramids on both the left and the right will be for the base year. You can change the year for the pyramid on the right by clicking one of the buttons at the bottom of the screen to advance the pyramid one year ("Next"), show the previous year ("Previous"), show the first year ("First year"), or show the last year ("Last year").

If you have two projections loaded, then the pyramid on the left will display the first projection and the one on the right will show the second projection. Both pyramids will display the same year.

If you have more than two projections loaded, you will be asked to choose which two pyramids should be shown before the pyramids appear.

4. Summary Tables

The final choice in each section is a summary table showing all the indicators and input assumptions. You can scroll through this page to see all the output. If you have more than one projection loaded, the indicators for the second projection will immediately follow the first. To print a table, select "File" from the menu bar and "Print" from the pull-down menu.

G. Saving the Projection

It is always a good idea to save the projection whenever you make a change to any assumptions. To save the projection without changing the name, choose "File" from the menu bar and "Save projection" from the pull-down menu.

To save the projection with a different name, choose "File" from the menu bar and "Save projection as" from the pull-down menu. You will then have a chance to specify a new file name for the projection. Normally when you save the projection with a new name, you should also change the projection title. This step will avoid confusion if you have both projections loaded at the same time.

H. Opening an Existing Projection

If you have already created an AIM projection or are using a projection provided by someone else, you can immediately load that projection.

1. Select "File" from the menu bar.

2. Select "Open projection" from the pull-down menu.

3. Select the file you wish to use and click the "Ok" button to open the projection.

You can open more than one projection at a time. Simply repeat these steps to load a second or third projection. When you have more than one projection loaded, all projections will be displayed in the graphs and tables. The number of projections you can load at any one time is determined by the amount of available memory in your computer.

When you have more than one projection loaded, you will be asked to choose a projection when performing certain tasks, such as editing assumptions. The program will display a list of the projection names and you may choose the appropriate one from the list.

I. Closing a Projection

To close a projection that has already been opened,

1. Choose "File" from the menu bar and

2. "Close projection" from the pull-down menu. If you have more than one projection loaded, you will be asked to select which projection should be closed.

Closing a projection merely removes it from the computer's memory; it does not erase it from the hard disk. You can open that projection again at any time.

VI. Methodology

A. Epidemiology

The AIDS projections in AIM are based on an approach suggested by James Chin and Jonathan Mann of the Global Programme on AIDS, WHO (Chin and Lwanga, 1989) and adapted for spreadsheet calculations by David Sokal of Family Health International and John Stover of the Futures Group. The approach is based on the fact that a certain proportion of those infected with HIV at time *t* are assumed to develop AIDS by time *t+n*. Thus, if we know the number of people infected by year and we know the proportion progressing to AIDS by time since infection, we can determine the number of new AIDS cases each year. This methodology has been adapted age-specific calculations and includes a more exact calculation of AIDS deaths and non-AIDS deaths. The complete methodology is described below.

It is important to note that AIM starts with adult HIV prevalence as the input and estimates the other indicators to be consistent with this input. This is the reverse of most simulation models which would estimate incidence and then calculate prevalence as a result.

1. Adult Population

The number of adults is the sum of the population aged 15 to 49.

$$adults_t = \sum_{a,s} Pop_{a,s,t} \ ,$$

where

a = 15 to 49

s = males, females

2. HIV-infected Adults

The number of adults infected with HIV is the sum of the infected population for each age from 15 to 49.

$$HIV\_adults_t = \sum_{a,s} HIV\_Pop_{a,s,t}$$

where

a = 15 to 49

s = males, females

3. Target Number of HIV-Prevalent Cases

The number of HIV-infected adults at time *t* that matches the assumed prevalence level is the number of adults multiplied by the assumed prevalence:

$$Target\_HIV_t = adults_t \bullet prevalence_t.$$

4. New Adult HIV Infections

The number of new adult HIV infections in any year is calculated as the target number minus the number of adults already infected:

$$New\_adult\_HIV_t = Target\_HIV_t - HIV\_adults_t.$$

If some new infections (that are not acquired perinatally) are assumed to occur to children under the age of 15, then given the assumed level of adult prevalence, the number of new infections among adults needs to be increased by the proportion of new infections that will occur to children:

$$New\_adult\_HIV_t = (Target\_HIV_t - HIV\_adults_t) / Percent\_New\_HIV\_Under15.$$

5. New HIV Infections by Age and Sex

The new HIV infections are distributed by age and sex according to the distribution entered as an input assumption:

$$New\_HIV_{a,s,t} = New\_adult\_HIV_t \bullet Percent\_new\_infections_{a,s,t}.$$

6. Surviving HIV Infections

Some number of persons with new infections at time *t* who survive into future years will be subject to death due to AIDS and death due to non-AIDS causes. The number surviving is first adjusted by non-AIDS deaths:

$$HIV\_infection_{a,s,t,y} = HIV\_infection_{a-1,s,t-1,t} \bullet (1 - mortality\_rate_{a,s,t}),$$

where

$HIV\_infection_{a,s,t,y}$ = the number of persons who survive HIV infections in age group *a*, of sex *s*, at time *t*, who were initially infected in year *y*.

Survivors of HIV infections are further reduced by the number of people who die due to AIDS:

$$HIV\_infection_{a,s,t,y} = HIV\_infection_{a,s,t,y} - AIDS\_deaths_{a,s,t,y}.$$

The total number surviving with HIV in any year is the sum of those surviving to that year from cohorts of infection from all previous years:

$$HIV\_infection_{a,s,t} = \sum_{y} HIV\_infection_{a,s,t,y}.$$

7. New AIDS Cases

The number of new AIDS cases in time *t* is calculated as the sum of the number of people progressing to AIDS in time *t* who were infected in the 20 years before time *t*.

$$New\_AIDS_{a,s,t} = \sum_{y} NewHIV_{a,s,y} \bullet Prop\_progressing\_to\_AIDS_{t-y},$$

where *y* varies from *t*-20 to *t*.

8. AIDS Deaths

AIDS deaths are simply the number of new AIDS cases lagged by the life expectancy after AIDS:

$$AIDS\_deaths_{a,s,t} = New\_AIDS_{a,s,t-ALE}.$$

If the AIDS life expectancy (ALE) is not entered as an integer number of years, then the deaths are distributed between the two years proportionally. For example, if the life expectancy

after AIDS were assumed to be 1.5 years, then half of the new AIDS cases would be assumed to die one year later and half two years later.

9. Perinatal Infections

The number of infected children is determined by the number of infected babies born. The number of infected babies is a function of the perinatal transmission rate (PTR), fertility, and the percentage of mothers who are infected:

$$HIV\_births_t = PTR \bullet TFR_t \bullet \sum_a ASFP_{a,t} \bullet HIV\_infection_{a,f,t},$$

where

HIV_births_t	=	the number of infected births at time *t*
PTR	=	perinatal transmission rate
TFR_t	=	total fertility rate at time *t*
$ASFP_{a,t}$	=	the age-specific fertility proportion, or the proportion of lifetime births that occur during age *a* and at time *t*
$HIV\_infection_{a,f,t}$	=	the number of infected females at age *a* and time *t*

Children progress from HIV to AIDS to death in a manner similar to adults; however, the time to progress from HIV to AIDS is much shorter for children.

B. Health

1. Number of Cases of Non-HIV Tuberculosis

$$Non\_HIV\ TB_t = Tbincidence \bullet \sum_{a=15}^{80+} Pop_{at} \ ,$$

where

Non-HIV TB_t	=	The annual number of cases of tuberculosis (TB)that are not related to HIV infection, at time *t*
TBincidence	=	The normal incidence of TB cases in the adult population.

2. Number of Cases of HIV-Related Tuberculosis

$$HIV\_TB_1 = PercTB \bullet HIV\_Tbincidence \bullet \sum_{a=15}^{80+} HIV\_Pop_{a,s,t} \ ,$$

where

HIV_TB_t	=	The annual number of TB cases that are related to HIV infection, at time *t*
PercTB	=	The percentage of the adult population with latent TB infection
HIV_TBincidence	=	The proportion of HIV- positive individuals developing TB each year.

D. Orphans

The orphan calculations are based on estimates of the number of surviving children of adults who die from AIDS or other causes. The program calculates the expected number of children that were born to an adult before his or her death, and estimates how many are still alive and their age. The same approach is used for AIDS and non-AIDS orphans and for maternal and paternal orphans. For dual AIDS orphans the program uses a regression equation to estimate the proportion of children who are likely to have both parents die from AIDS given that one parent has died. This equation has been developed using data from Africa and may not be appropriate for other regions of the world. Full details of the methodology used here are provided in Grassly *et al.,* 2003.

IX. References

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X. Glossary of Terms

Most of the definitions were obtained from the United Nations World Wide Web site: http://www.unaids.org/

Click on the ribbon to enter the site, then *Human Interest,* then *ABC's of HIV/AIDS.*

Adult. In AIM, an adult is defined as a person aged 15 or older.

AIDS. The abbreviation for the acquired immune deficiency syndrome, a disabling and fatal disease caused by the human immunodeficiency virus (HIV).

Epidemiology. The study of the incidence, distribution, and determinants of an infection, disease, or other health-related event in a population. Epidemiology can be thought of in terms of who, where, when, what, and why. That is, who has the infection/disease, where are they located geographically and in relation to each other, when is the infection/disease occurring, what is the cause, and why did it occur?

HIV. The human immunodeficiency virus is the virus that causes AIDS. Two types of HIV are currently known: HIV-1 and HIV-2. Worldwide, the predominant virus is HIV-1. Both types of virus are transmitted by sexual contact, through blood, and from mother to child, and they appear to cause clinically indistinguishable AIDS. However, HIV-2 is less easily transmitted, and the period between initial infection and illness is longer in the case of HIV-2.

HIV Infection. Infection with the human immunodeficiency virus (HIV). HIV infection is primarily a sexually transmitted infection, passed on through unprotected penetrative sex. The virus can also be transmitted through blood transfusions, through the use of unsterilized injection equipment or cutting instruments, and from an infected woman to her fetus or nursing infant.

HIV Sentinel Surveillance. The systematic collection and testing of blood from selected populations at specific sites—for example, pregnant women attending prenatal clinics—for the purpose of identifying trends in HIV prevalence over time and place.

Incubation Period. The time interval between infection and the onset of AIDS.

Interpolation. Given two numbers that serve as boundary points, it is possible to estimate the values that lie at intervals between the two points. For example, if the HIV prevalence rate for a country or region was actually measured only in 1985 and in 1995, by assuming even increments from year to year, it is possible to interpolate a TFR for each intervening year. Spectrum uses a linear form of interpolation so that the difference between each annual value is the same. Other nonlinear forms of interpolation are also possible but are not used in Spectrum.

Life Expectancy. The average number of years a newborn can expect to live, based on the mortality and conditions of the time.

Model. Computer system designed to demonstrate the probable effect of two or more variables that might be brought to bear on an outcome. Such models can reduce the effort required to manipulate these factors and present the results in an accessible format.

Module. Synonym for "model."

Orphan. In this manual, an orphan is defined as a child under the age of 15 whose mother has died of AIDS. It is assumed that if the mother has AIDS, the father will have the fatal disease as well.

Perinatal and Perinatal Transmission. Pertaining to or occurring during the periods before, during, or shortly after the time of birth; that is, before delivery from the 28th week of gestation through to the first seven days after delivery. The transmission of HIV from an infected woman to her fetus or newborn child is referred to as perinatal transmission.

Prevalence. The proportion of a defined population with the infection, disease, or other health-related event of interest at a given point or period of time.

Seroprevalence (HIV, STD). The percentage of a population from whom blood has been collected that is found, on the basis of serology, to be positive for HIV or other STD agents at any given time.

Sentinel Surveillance. See HIV Sentinel Surveillance.

XI. Acronyms and Abbreviations

AIDS	acquired immune deficiency syndrome
AIDSCAP	AIDS Control and Prevention Project (USAID-funded)
AIDSTECH	AIDS Technical Support Project (USAID-funded)
AIM	AIDS Impact Model
CDC	U.S. Centers for Disease Control and Prevention
FHI	Family Health International
GDP	gross domestic product
GNP	gross national product
HIV	human immunodeficiency virus
ILO	International Labor Organization
MOH	Ministry of Health
NACP	national AIDS control program
PTR	perinatal transmission rate
STD	sexually transmitted disease
TFR	total fertility rate
TB	tuberculosis
UNAIDS	Joint United Nations Programme on HIV/AIDS
USAID	United States Agency for International Development