Ministry of Health

National Center for HIV/AIDS, Dermatology and STDs

HIV SENTINEL SURVEYS 2010

Female entertainment workers (FEWs)
Antenatal care clinic (ANC) attendees

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UNAIDS

Ministry of Health

National Center for HIV/AIDS Dermatology and STD

Report

Estimations and Projections of HIV/AIDS in Cambodia 2010-2015

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October, 2011

Forward

The HIV/AIDS epidemic in Cambodia has been moving into its 20th year since the first case of HIV was identified in 1991. The country has successfully brought the HIV prevalence among the general population down to about 0,8% in 2010 and it is also projected that the HIV prevalence will remain stable until 2015 with the prevalence around 0,6%.

Projecting the magnitude HIV/AIDS epidemic and its impact into the future is not a simple task. It requires collective effort and commitments from all partners-government, development agencies and stakeholders, under strong leadership and ownership of the host country. It also requires the mutual collaboration between health scientists and HIV/AIDS Dermatology and STDs has successfully conducted three rounds of HIV/AIDS estimations and projections (2000, 2003 and 2007) and the estimates have been used widely.

In your hand, is the report of the HIV/AIDS estimation and projection 2011 which covers the period from 2010 to 2015, This report is also resulted from the combined efforts of all development partners, stakeholders and the National center for HIV/AIDS and STD, under the guidance of the Ministry of Health.

The Ministry of Health strongly encourages the use of the estimates given in this report in the context to improve the response to HIV/AIDS epidemic and to optimally mitigate its impact on the population.

Phnom Penh, 20 September 2012

Dr. MAM BUNHENG
MINISTER OF HEALTH

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INTRODUCTION

The HIV/AIDS epidemic in Cambodia has been moving into its 20th year since the first case of HIV was identified in 1991. The Royal Government of Cambodia, with financial and technical support from development partners and civil society organisations, has actively responded in order to contain the spread of the epidemic. Consequently, the country has successfully brought the HIV prevalence among the general population down to about 0.9% in 2006[1]. It is also projected that the HIV prevalence will remain stable until 2012 with the prevalence around 0.6%[1].

At the same time, HIV/AIDS care and treatment services have been expanded significantly in order to keep up with the increasing demand from people in need of anti-retroviral treatment (ART). As a result, the ART coverage among those in need of ART in Cambodia has increased tremendously from just less than 10% in 2003 to approximately 80% by September 2007. By June 2011, 56 Adult OI/ART sites and 33 Pediatric AIDS Care services/sites were delivering care and ART to PLHIV. Data from the clinics showed that by the end of June 2011, 40,436 adult PLHIV and 4,286 children < 15 were receiving antiretroviral therapy (ART).

The impact of the interventions would be difficult to assess if there was no HIV/AIDS related strategic information available, especially concerning the impact of HIV/AIDS interventions on the general population. When gathered, this information can be used for planning and managing a whole range of HIV/AIDS activities and programmes. However, the current HIV surveillance system only gathers data from high-risk groups and pregnant women visiting health centers for antenatal care and the Demographic Health Survey 2010 did not include an HIV testing component. Therefore, the prevalence of HIV among the general population needs to be estimated and projected based on all existing available data collected from other sub-populations.

The National Center for HIV/AIDS Dermatology and STDs has successfully conducted three previous rounds of HIV/AIDS estimations and projections (2000, 2003 and 2007), with the last HIV projections covered the period from 2006 to 2012. Therefore, there is a strong need for conducting a new round of HIV/AIDS estimations and projections for the years 2011 to 2015. These figures are expected not only by the Ministry of Health, but also by all stakeholders working in HIV/AIDS related fields and/or health sectors.

[1] HIV/AIDS consensus report 2007, NCHADS

BACKGROUND

The HIV/AIDS epidemic in Cambodia has been relatively well documented. The first HIV case was detected in 1991 and the first AIDS case was diagnosed at a national hospital in 1993. After taking into consideration the fact that it takes on average about 8 years for HIV to progress to AIDS, it is commonly believed that the HIV infection has been in Cambodia since the mid 1980s. .

The HIV/AIDS epidemic in Cambodia is believed to have originated among commercial sex workers, since the HIV prevalence among female sex workers (FSW) at the start of the epidemic was very high[2]. As a result, female sex workers were hard hit by the epidemic and through heterosexual contact, the HIV/AIDS epidemic had reached the male clients of these sex workers, then the spouses of these clients and ultimately to their new born children.

Regarding the trend of the epidemic, it is assumed that the HIV/AIDS epidemic in Cambodia peaked in 1998-1999[3]. The main mode of HIV transmission in Cambodia is still "unprotected heterosexual contact", although the rate of HIV infection among men who have sex with men (MSM) was estimated as being 5.1% in 2005[4]. The rate among Injecting Drug Users (IDU) was predicted as being even higher again with a prevalence of 25% documented in 2007[5]

HIV prevalence among different Sentinel Groups

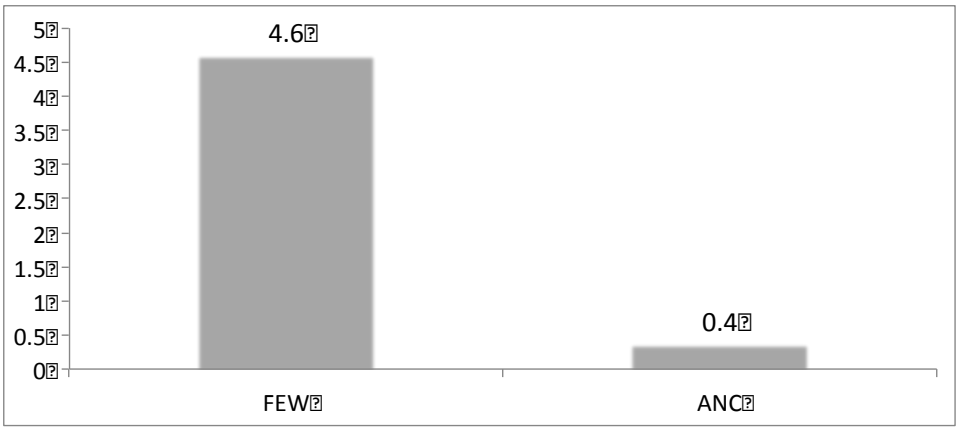
For the purpose of this estimation and projection exercise, this report presents only the results from the HIV sentinel surveillance (HSS) 2010 that recently became available at the National Center for HIV/AIDS Dermatology and STDs (NCHADS). The HSS 2010 was conducted at 22 cities/provinces in Cambodia. The two main sentinel groups presented here are Female Entertainment Workers (FEW) and pregnant women receiving AnteNatal Care (ANC).

HIV Prevalence among Female Entertainment Workers

FEW consist of different groups of female working in entertainment establishments. However, not all of them are commercial sex workers. A more detailed description of this group can be found elsewhere[6].

[2] National Center for HIV/AIDS, 1996, Report of the HIV Sentinel Survey 1996
[3] National Center for HIV/AIDS, Report of the HIV/AIDS consensus report 2007,
[4] National Center for HIV/AIDS, 2006, Report of STI survey 2005
[5] National Center for HIV/AIDS, 2007, Report of HIV prevalence among DU 2007
[6] National Center for HIV/AIDS, 2009, Standard Operation Procedure for Continuum of Prevention and Care and treatment for Female Entertainment Workers in Cambodia

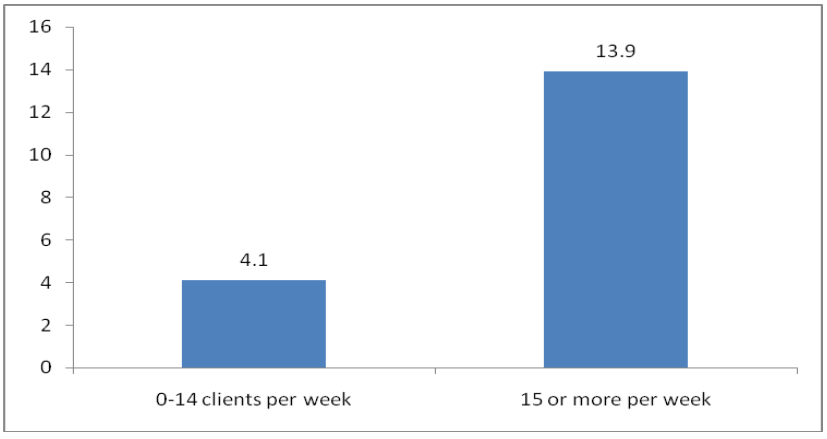
Figure 1: HIV prevalence among ANC clients and FEW in 2010



The Female Entertainment Worker population is not homogeneous; it consists of women with different level of HIV-related risks and vulnerabilities. This stems from the fact that some female entertainment workers sell sex as their main source of income generation, while others have jobs in the entertainment industry, which do not primarily involve the selling of sex - although selling sex may be an additional source of income for some. Further analysis among those who reported having more than 14 clients per week (corresponding to at least 2 partners per day) was conducted, since this group is similar to the 'direct female sex worker', a high risk group in the prior sentinel surveys. 432 women reported having more than 14 clients per week while a much higher figure of 3,390 women reported having less than 14 clients per week.

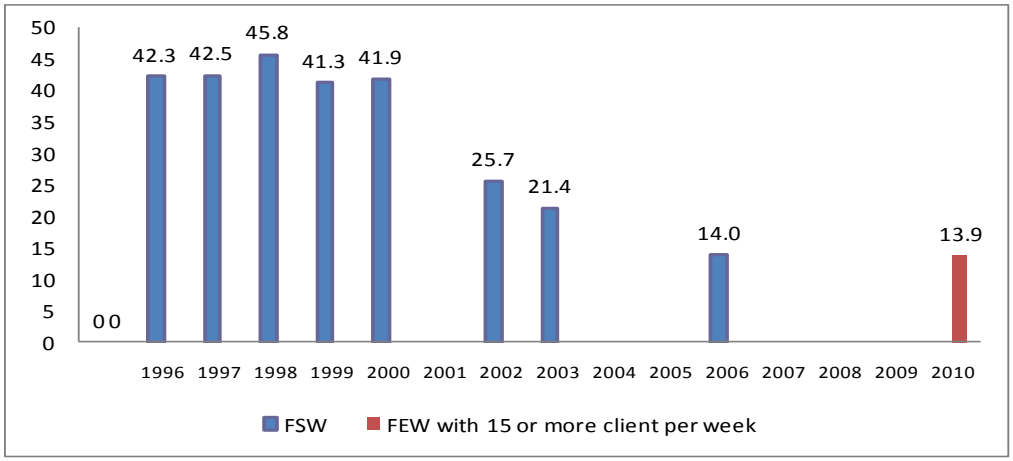
It has been found that the HIV prevalence among FEW who reported having more than 14 male clients per week was 13.9%, while the prevalence among those who reported having 14 clients or less per week was only 4.1%. It is important to note that, the HIV prevalence among those who had less than 15 clients per week did include FEW who reported never having sex with a client, these women made up about 4% of the total sample.

Figure 2: HIV prevalence among FEW, by number of sexual clients per week



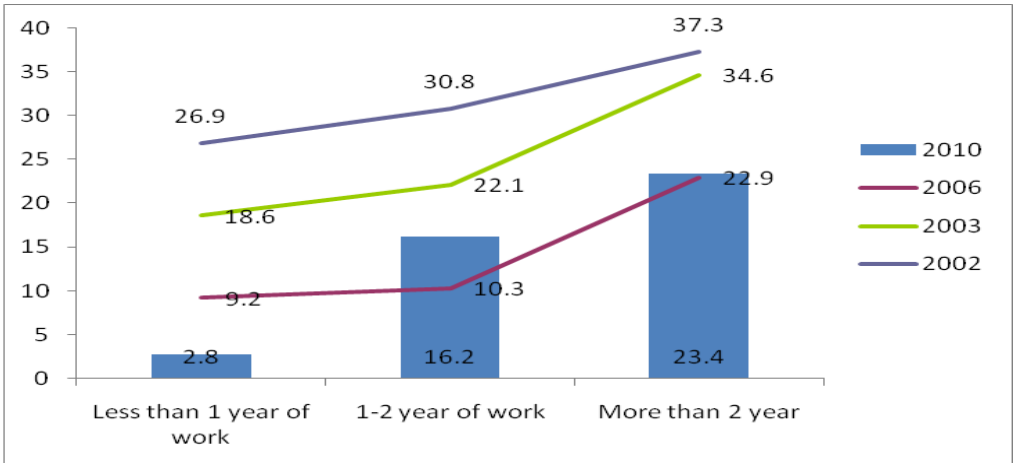
Comparing FEW who had more than 14 clients per week and brothel based female sex workers from previous surveys revealed that these two groups are very similar in terms of their HIV prevalence rates. It is possible that after the brothel crack down in 2008, many brothel based sex workers have moved to work in entertainment establishments, however, their main job is still to provide commercial sex.

Figure 3: HIV prevalence among FSW, compared to FEW who had 15 or more clients per week



In the total HSS 2010 sample, there were 2,083 FEW who had worked for less than 12 months, 1085 who had been working for between 12 months to 2 years and 755 who had worked for more than 2 years. HIV prevalence among those with multiple partners is strongly associated with the duration of time they have spent working as entertainment workers; the more years they have worked, the higher the HIV prevalence.

Figure 4: HIV Prevalence among FEW with more than 14 clients per week (2010) and FSW (2002, 2003, 2006), by number of years working



HIV prevalence among ANC clients

HIV prevalence among ANC clients has been used as the main source of data for the HIV/AIDS estimations and projections for Cambodia since 2003. In fact, women attending ANC clinics have been included in the sentinel surveys over time to establish the trend of HIV prevalence among this group.

In order to prepare the HIV prevalence data to be used in this round of HIV/AIDS estimation and projection, HIV prevalence from all rounds of HSS (including 2010) have been entered into the EPP program, so the trends could be reestablished and smoothed.

It has been found that the HIV prevalence among ANC clients dropped from 0.7% in 2006 to just 0.4% in 2010, with the peak around 1999-2000. This drop strongly suggests that the overall trend of HIV among the general population may also be declining.

Figure 5: HIV prevalence among pregnant women, by locations of ANC Clinics, in 2006 & 2010

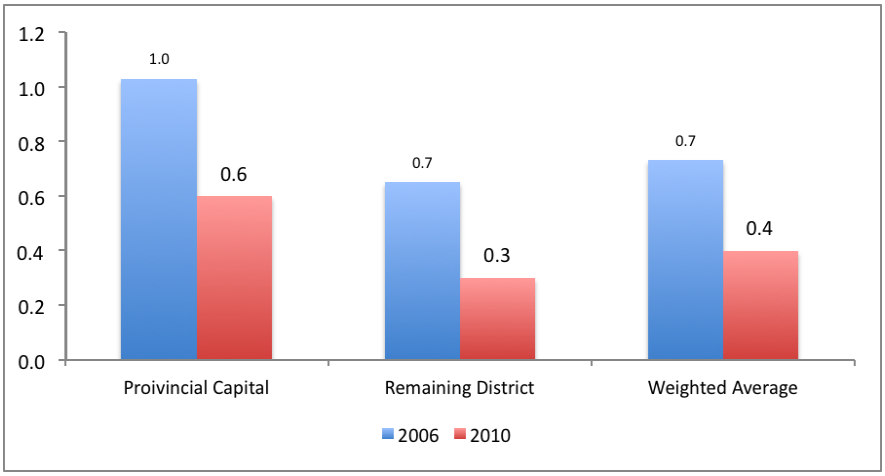
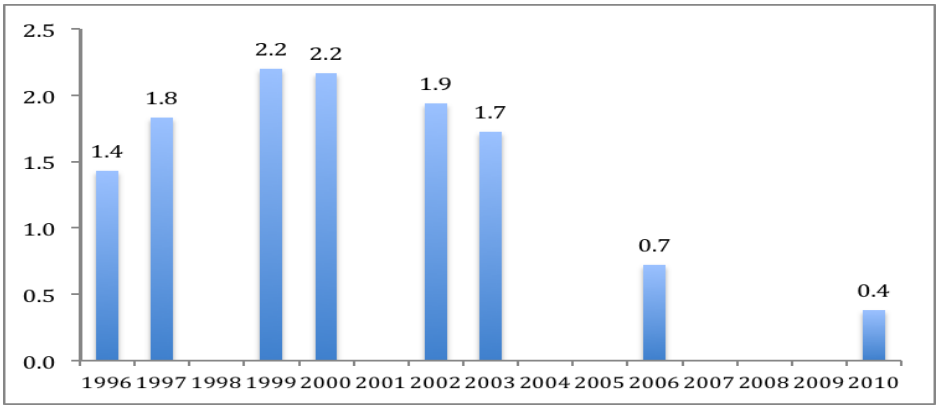


Figure 6: Population weighted* HIV prevalence among pregnant women receiving ANC (1996-2010)



In 2010, new data on HIV prevalence among men who have sex with men and other high risk men became available. This data was taken from the BROS Khmer study conducted by FHI and NCHADS outside entertainment venues in eight cities. The report of the study is available elsewhere[7]. The sub groups included in the study were men who have sex with women (MSW), men who have sex with men and women (MSMW) and men who have sex with men only (MSMO). The figure below presents the HIV prevalence among these groups.

Figure 7: HIV prevalence among MSW, MSMW, and MSMO

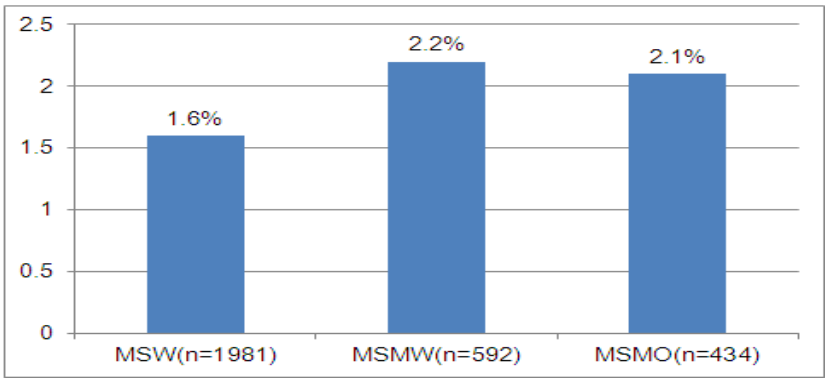
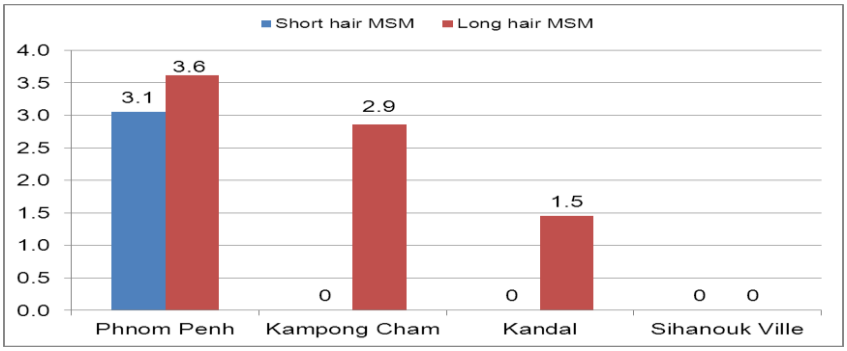


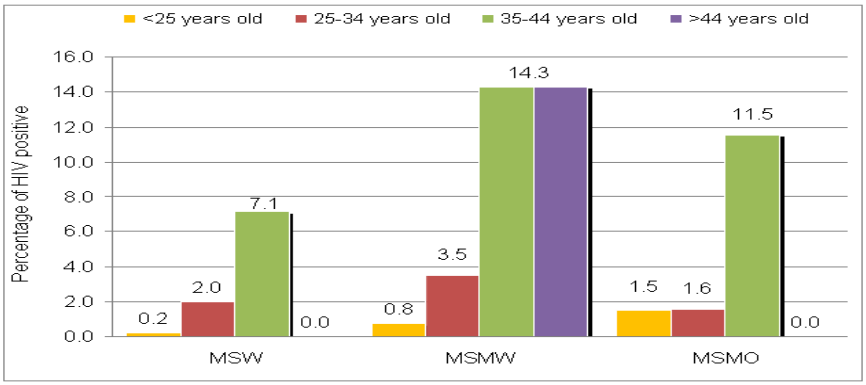
Figure 8: HIV prevalence among long and short haired MSM, by province



In addition, the HIV prevalence among long haired (transgender) MSM and short haired MSM (MSM whose physical apprence is like straight man) appeared to be different, especially in the provinces. It appears that the HIV prevalence between the two groups was different across the provinces surveyed, expcept in Sihanouk ville.

[7] FHI & NCHADS, 2010, Report on BROS Khmer Study

Figure 9: HIV prevalence among high risk men disaggregated by age group



HIV prevalence appears to be higher in the older age groups. These results strongly suggest that new HIV infection is not common among young MSM, in other words, among MSM who have recently become sexually active and have only started to engage in sexual activities.

Responses to the HIV/AIDS Epidemic in Cambodia

During the early phase of the epidemic, HIV prevention was the main strategy implemented. The primary objectives of the HIV prevention and education program were to increase knowledge about HIV/AIDS, to reduce the frequency of practices considered high risk for HIV infection and to raise awareness and commitment among policy makers about the need for multi-sectoral responses for combating the HIV/AIDS epidemic in Cambodia.

In 1998, the 100% condom use program was launched in Sihanouk Ville, and the program was scaled up very quickly to cover the whole country. The 100% condom use program aimed at increasing the level of consistent condom use in brothels. As a result, progress has been observed across all sentinel groups, especially among female direct sex workers in terms of, safer sexual practices (which is defined as always using a condom), reduction in the numbers of high risk partners, and screening and treatment for STIs.

The figure below shows that the trend of consistent condom use among the direct FSW and beer promoters (indirect sex worker) steadily increased during the period between 1997 and 2007. Unfortunately, due to the brothel crackdown in 2008, it was no longer feasible to include brothel based female sex workers in the behavioral survey in 2010. Consequently, the trend of female sex worker was not available after 2006. However, the level of consistent condom use among female entertainment workers (FEW) was used as a proxy indicator instead.

In 2010, a further analysis on the consistent condom use revealed that the level of consistent condom use was 81.5% among FEW who reported having 2 or less partners per day (corresponding to 14 or less per week –n=384) and 89.2% among FEW with more than 2 partners per day (corresponding to 15 or more partners per week –n=130).

Figure 10: Rate of consistent condom use with clients, by different groups of FEW, 1997-2010

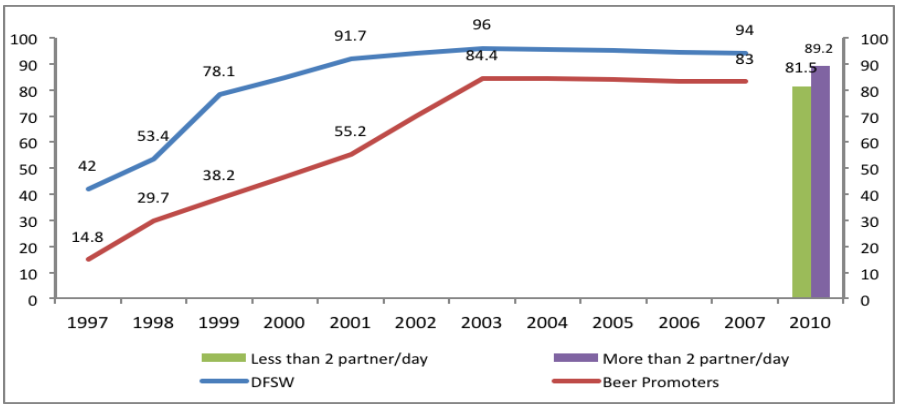
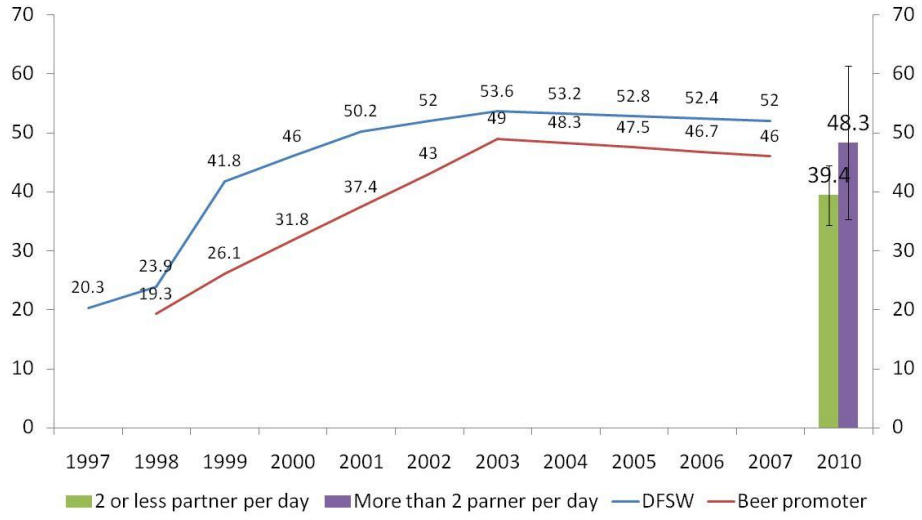
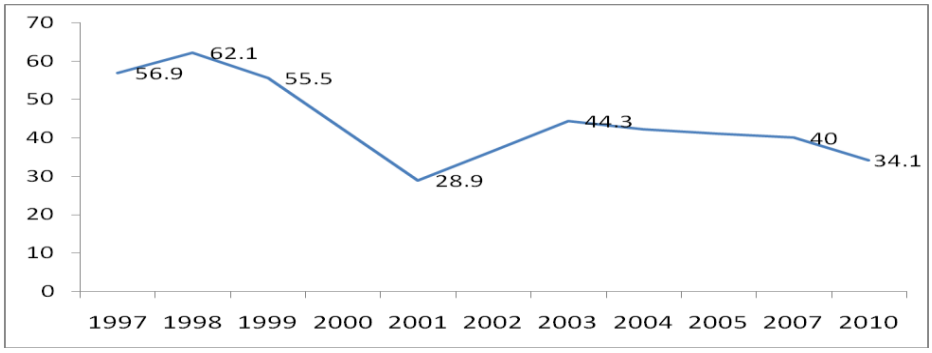


Figure 11: Rate of consistent condom use with sweethearts, by different groups of FEW, 1997-2010



The trend of consistent condom use with sweethearts, among direct sex workers and beer promoters (from 1997-2007) and among female entertainment workers with different numbers of sexual partners per day (2010), mirrors the trend of condom use with clients, although its magnitude was lower.

Figure 12 : Rate of commercial sex use in the past year among moto-taxi drivers, 1997-2010



Another aspect of behavior change has also been observed among Moto-taxi drivers who, due to the nature of their work, are bridging, in terms of HIV transmission, between female entertainment workers and married women. The percentage of moto taxi drivers who reported buying or using commercial sex declined in 2010. However, the figure does not mean that the level of sexual activity of moto- taxi drivers declined; alternatively it might be possible that they have changed to other types of sexual partners (e.g. wives, sweethearts).

Figure 13 : Rate of consistent condom use with commercial sexual partners (in the past 3 months) among moto-taxi drivers, 1997-2010

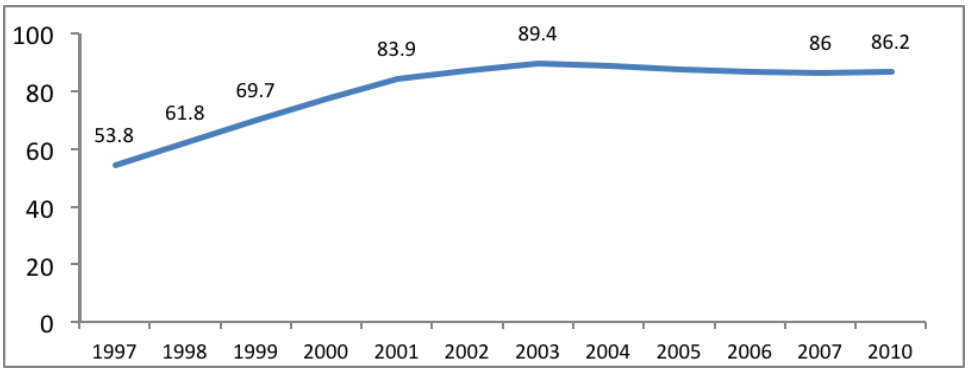


Figure 14: Rate of consistent condom use with sweethearts (in the past 3 months) among moto-taxi drivers, (1997-2010)

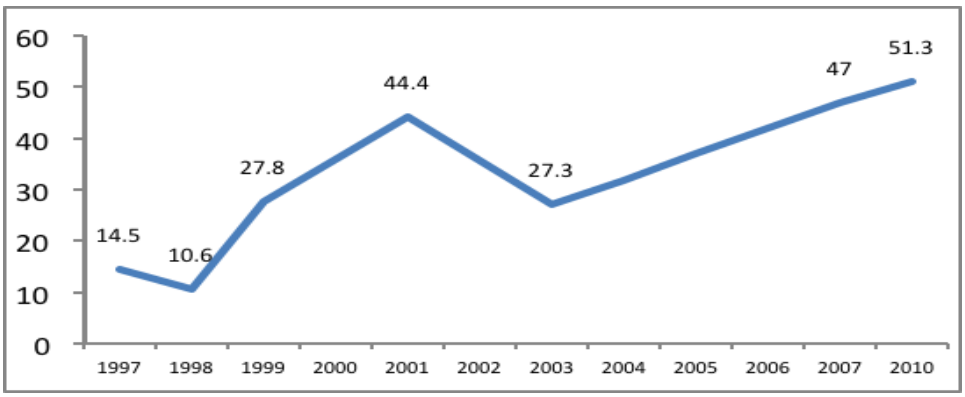


Figure 13 and 14 above illustrate the trend of condom use with commerical partners and with sweethearts. These trends were very consistent with the ones reported by female entertainment workers.

Apart from working on the prevention areas, the HIV/AIDS response in Cambodia has also focused on offering services to those who are living with HIV. For example, the number of voluntary counseling and testing centers have been scaled up nationwide, to increase access to HIV testing. At the same time, the Antiretroviral Treatment Programme was started in 2001 and has increased rapidly since 2005.

Figure 15: Reported number of patients receiving Antiretroviral Treatment and number of treatment sites

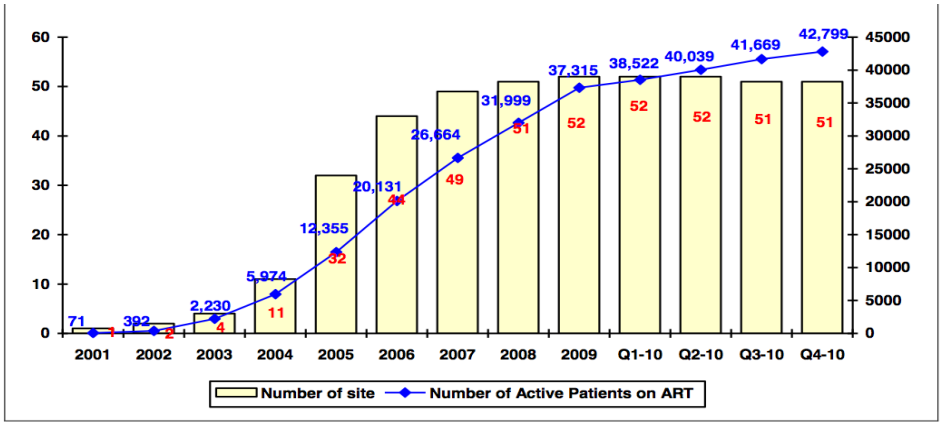
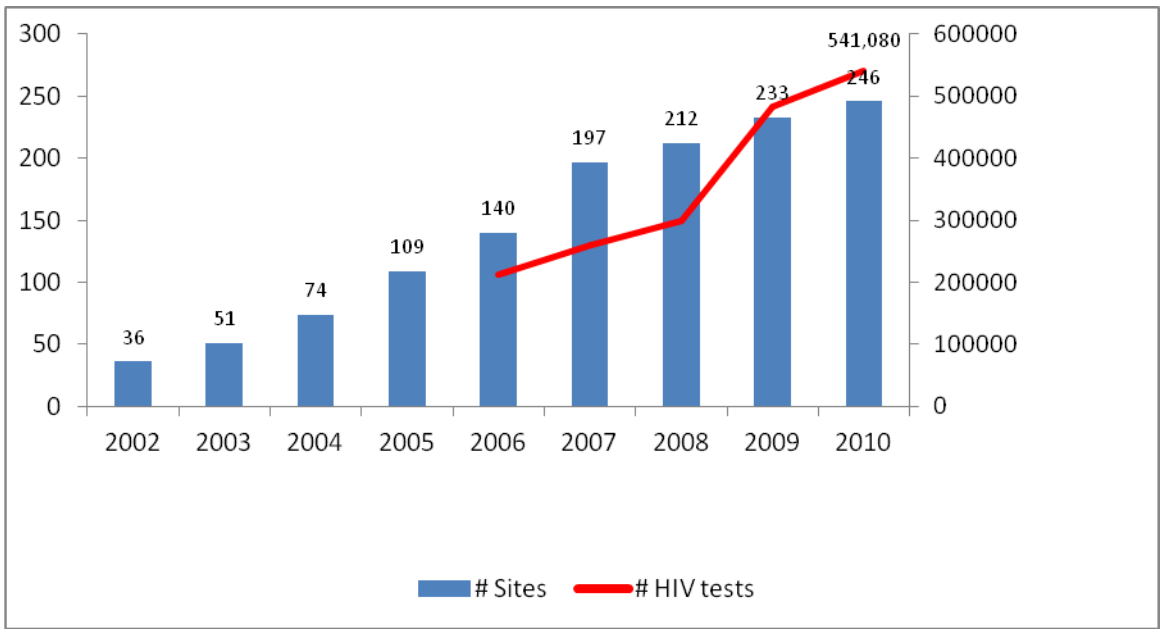


Figure 16: Number of VCCT sites and number of HIV tests performed, 2002-2010



OBJECTIVES

The main objectives of the HIV estimation and projection report were to:

- Review the data on HIV prevalence from existing sources (HSS 2010, MSM HIV prevalence study and other relevant sources that may be available).
- Determine methodology and assumptions for estimating HIV prevalence and incidence in Cambodia, with a particular emphasis on the 2010 prevalence.
- Prepare national estimates of HIV prevalence, incidence and mortality in Cambodia.
- Project the future incidence and prevalence of HIV infection.
- Project the other HIV/AIDS related indicators for program implementation.

METHODS

The HIV/AIDS estimation and projection project was led by NCHADS. The members of the project consisted of representatives from NCHADS (surveillance and research units), the National Institute of Statistics, the Department of Planning in the Ministry of Health, WHO, UNAIDS, CDC, CHAI, FHI and national and international consultants.

Due to the magnitude of the work, two workshops were organized. The first workshop was for the estimation of HIV in general population in 2010, while the second workshop was organized to look at the projection of HIV/AIDS from 2010 to 2015.

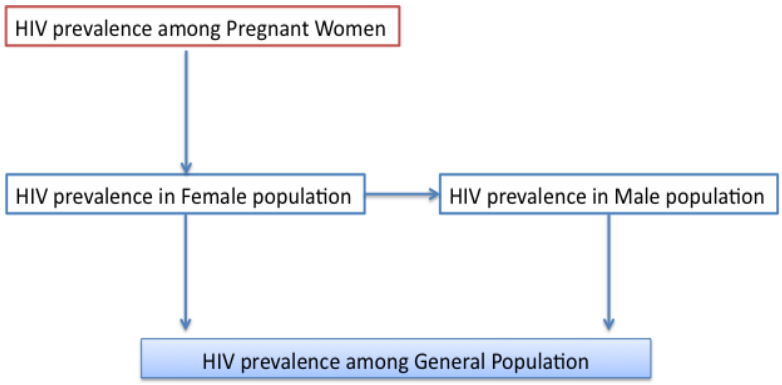
During the first 5 day workshop (27 June – 01 July 2011), the team discussed and determined the best estimate and projection methods appropriate for the Cambodian HIV/AIDS situation. The primary output for this technical workshop was to produce the HIV prevalence among the Cambodian general population in 2010.

The projection workshop was conducted from 06 to 09 September 2011. The experts who were involved in the first workshop were also invited to join the second workshop. Due to time constraints, the experts from the University of New South Wales, University of California Los Angeles, and CDC-Atlanta were not able to attend. However, all in-country experts and consultants involved in the first workshop were also present in the second workshop.

1. Estimation of HIV prevalence among the General Population

Based on the availability of the data in Cambodia, the experts reached a consensus that HIV prevalence data collected from pregnant women attending ANC services at health centers would be the most accurate, consistent and representative data to be used to estimate the HIV prevalence among the general population. The Figure below shows how the HIV prevalence among the general population was estimated.

Figure 17: Methods used for estimating HIV prevalence among the general population



1.1. Methods for Estimating HIV prevalence among the female population

Literature showed that the availability of antiretroviral treatment had a strong effect on the survival of AIDS patients. Consequently, it will significantly affect the prevalence of HIV. Therefore, experts agreed that the level of HIV/AIDS response in Cambodia could be divided into 2 phases based on the ART coverage: a low ART coverage phase and a high ART coverage phase.

Table 1: Summary of the characteristics of different ART phases in Cambodia

Low ART Coverage Phase (1990-2005)	High ART Coverage Phase (2006-2011)
Few number of patients receiving ART	Large number of patients receiving ART
Low number of people have been tested for HIV and known their HIV status	Large number of people have been tested and known their HIV status
Low proportion of HIV infected pregnant women receiving PMTCT	High proportion of HIV infected pregnant women receiving PMTCT
Low proportion of pregnant women used antenatal care service	High proportion of pregnant women used antenatal care service

The estimation of HIV prevalence among the general population requires two components; first a method for estimating HIV prevalence among the general female population and second a method for the general male population. Based on the different levels of ART coverage, HIV prevalence among the female population was estimated with two different sets of logic and formula.

1.1.1. Methods for estimating HIV prevalence among the general population in the Low ART coverage phase

The current timeframe of interest for the estimation and projection for HIV/AIDS in Cambodia was from 2010 to 2015. Therefore, this report will emphasize the methods required for the second phase of ART treatment. However, for the completeness of the report, we also offer a brief description of the method that was appropriate for estimating HIV prevalence among the general population before 2006.

In short, after reviewing the methods used for estimating HIV prevalence among the general population used in 2007, experts concluded that the method was still valid for the low ARV phase (before 2006). That is, the use of ratio of 0.75% to estimate the HIV prevalence among the general female population from pregnant women accessing antenatal care at health centers and the use of the ratio of HIV prevalence among TB patients (with a 2 year lead) were appropriate since there has been no additional

data newly available for developing a better HIV estimation method. The details of the method can be found in the HIV/AIDS Estimation and Projection report 2007[8] .

1.1.2. Methods for estimating HIV prevalence among the general population in the High ART coverage phase

The logic of estimating the HIV prevalence among the general population from the HIV prevalence among female and male populations still applied in this high ART coverage phase. However, the method used to calculate the HIV prevalence among general females from ANC was different from the one used in the period prior to 2006. However, the estimation of HIV prevalence among males from the HIV prevalence among females has remained unchanged in both phases of ART coverage.

1.1.2.1. Methods for estimating HIV prevalence among the general female population

The results from the HIV sentinel survey (HSS) 2010 were used to estimate the number of Cambodian women of child-bearing age (15-49) who were living with HIV infection in 2010. Since the HSS 2010 data was collected from health centers in both rural and provincial towns, HIV prevalence among ANC in 2010, adjusted for urban/rural with a ratio of (20/80), was used.

Mathematically, women of child-bearing age (15-49) consists of three groups;

(i) Women without HIV infection (W_N)

(ii) Women living with HIV who have been diagnosed and are receiving HIV treatment, designated (W_T). That is, HIV+ women receiving ART at the clinics

(iii) Women living with HIV who have not been diagnosed, or have been diagnosed but have not yet started treatment, designated (W_U)

The total women of childbearing age (W_A), is the sum of the three groups above.

Our goal was to estimate the HIV prevalence in women of child-bearing age = $(W_T + W_U) / (W_N + W_T + W_U)$,where $W_A=W_N+W_U+W_T$.

We could note that a good approximation would be provided by replacing W_N by W_A (all women) as there was only a 1% difference in these two figures (the HIV prevalence among general women was less than 1% in 2006)[8], and they make up 99% of the denominator in the fraction.

[8] NCHADS, 2007, HIV/AIDS estimation and Projection report

Based on reports made to the Cambodia national OI/ART database, an age-specific estimate was available of W_T , and it can be adjusted downwards, based on consensus among experts, by a figure of 10%, to take into account the risk of double counting in the routine data in the treatment cohort. The resulting estimates for 2006 and 2010 were 8,241 and 18,543 respectively.

In each of the three categories of women, proportions who were pregnant at the time of the HSS were designated p_N, p_T and p_U respectively. The corresponding proportion for all women was designated p_A .

Given that the women with HIV make up a very small proportion (under 1%) of women of child-bearing age, we assumed that $p_N = p_{A,,}$ the proportion applicable to all women in the population, and therefore could be estimated as the number of births in the year, divided by the number of women of child-bearing age in the population. The national figures for Cambodia were around 10.6% in 2006 and 9.65% in 2010[9].

We could also obtain an estimate of p_T from analyses of cohorts of women attending HIV treatment services in Cambodia. Available data from several sources indicates a best estimate for both year 2006 & 2010 of 3%[10].

We then made the assumption that every woman who was pregnant in Cambodia during the year had an equal likelihood of being included in the HSS antenatal surveys, regardless of HIV status, and geographic location. This assumption is almost certainly an oversimplification, but we have no quantitative basis for any alternative assumption about the characteristics of women included in the HSS compared to all pregnant women in Cambodia.

Under this assumption, the proportion of women in different categories in the HSS sample would correspond to the proportions among all women who were pregnant in Cambodia during 2006 and 2010.

Then the total number of women with HIV infection in the HSS can be represented by:

$$H = (p_T W_T + p_U W_U) \times F$$

Where F is the proportion of pregnant women in Cambodia in the survey year that were included in the HSS 2006 and 2010.

Using this equation, the unknown quantity, $W_{U,}$ representing the women of child-bearing age with HIV infection who are undiagnosed, can be calculated as

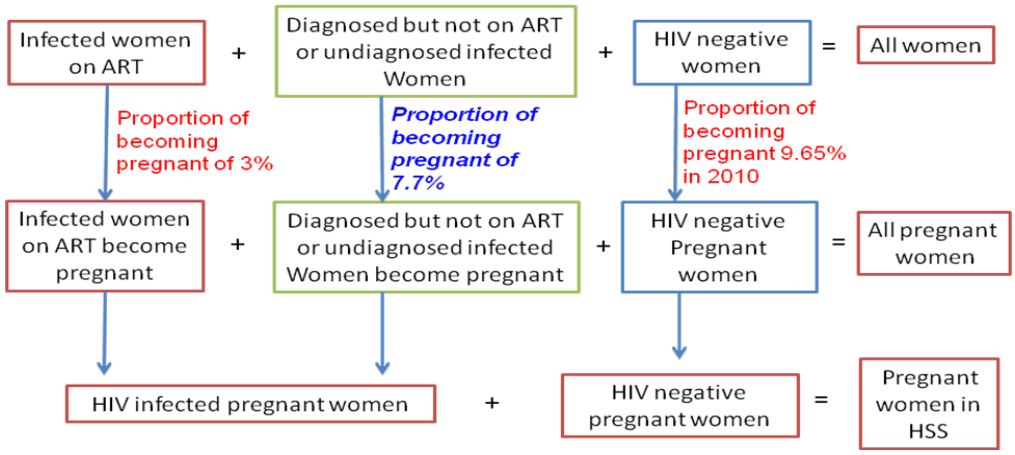
$W_U = (H/F - p_T W_T) / p_U$, where $p_T W_T$ is equal to the reported number of women receiving ART with the adjusted factor of 10% for duplication.

The one unknown quantity remaining in this equation is p_U, the proportion of women with undiagnosed HIV, or who are diagnosed but untreated, who become pregnant in the year. There has been no data

[9] CDHS 2010
[10] Informal communication with OI/ART data manager at Social Health Clinics

from Cambodia, and little data from anywhere else that can be used to estimate this proportion. In other settings, a figure of 0.8 percent of the proportion of general women who became pregnant in that particular year was used, and we have adopted it here. We also carried out sensitivity analyses, varying the figure between 0.6 and 1.2, and found that the effect on the final estimate of prevalence was a variation in absolute prevalence of about 0.1.

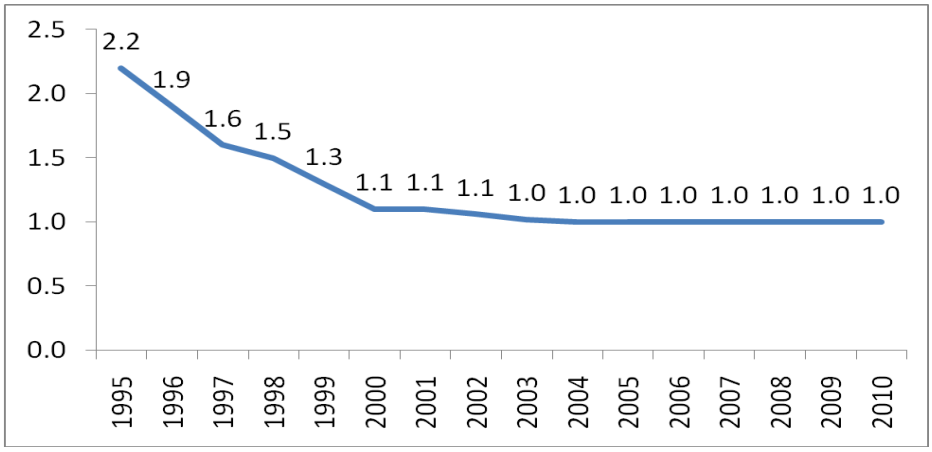
Figure 18: Method used to estimate HIV prevalence among females during the high ART coverage phase



1.2. Estimating HIV prevalence among the male population

The ratio of HIV prevalence among TB patients was used and a 2 years lead was applied. That is, the ratio of HIV prevalence among TB patients for any given year was a figure representative of the ratio of HIV among men and women 2 year before. This assumption was based on the consensus among experts attending the meeting on HIV estimation and projection conducted in 2006. That is; without ART and good standards of care, it takes 2 years on average for an HIV infected individuals to manifest with TB symptoms.

Figure 19: Ratio of HIV+ males to females among TB patients, (1995-2010)



2. Methods for HIV/AIDS Projection

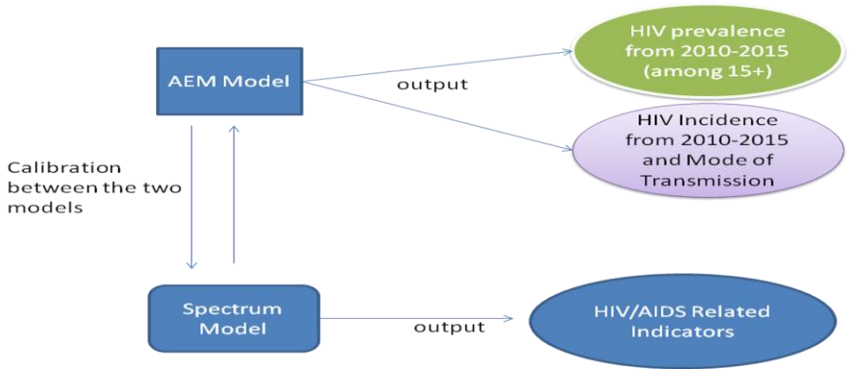
The second workshop, conducted from 05 to 09 September 2011, exclusively dealt with projecting the HIV prevalence among the general population, as well as other key indicators related to HIV/AIDS.

Two models were explored; the Asian Epidemic Model (AEM) and Spectrum. When applied to the Cambodia context, both models had their own strengths and weaknesses. While AEM produced HIV trends closer to what experts observed in the real HIV/AIDS situation in Cambodia, it cannot generate many HIV/AIDS related indicators that are required by program officers. On the other hand, Spectrum could provide many indicators that could be used to compare with many countries in the region or around the globe, but the trend of HIV prevalence among general population it produced did not comprehensively take into account the HIV/AIDS related behavioral and programmatic data among MARP sub-populations.

As result, both AEM and Spectrum were used in HIV/AIDS projection for Cambodia. The AEM model was used to produce the HIV prevalence among the general population, new HIV cases and mode of transmission among people aged 15+, while other indicators will be retrieved from the Spectrum model.

However, due to the differences between the two models, in terms of their inputs and assumptions, the models were calibrated against each other on 3 main parameters; new HIV cases, death cases and the HIV prevalence.

Figure 20: Models used for HIV/AIDS projection



2.1. Building up the Models

2.1.1. Asian Epidemic Model

Asian Epidemic Model version 3.2 was used. This model requires many different inputs relating to sexual behaviors, program coverage and HIV prevalence among different groups. For more details on the inputs see Annex 1 of this report.

2.1.2. Spectrum

Spectrum software version 4.41 was used. Details of the inputs for the model can be found in Annex 2 of this report.

2.2. Calibrating the two models

AEM was used to project the trend of HIV prevalence and new HIV cases from 2010 to 2015. However, since many HIV/AIDS related indicators cannot be produced by AEM, Spectrum was used to complement the outputs from AEM. Therefore, the experts agreed that the two models should be made similar as much as possible.

To do so, the following actions were taken to match Spectrum to the AEM model that was used to project the HIV prevalence;

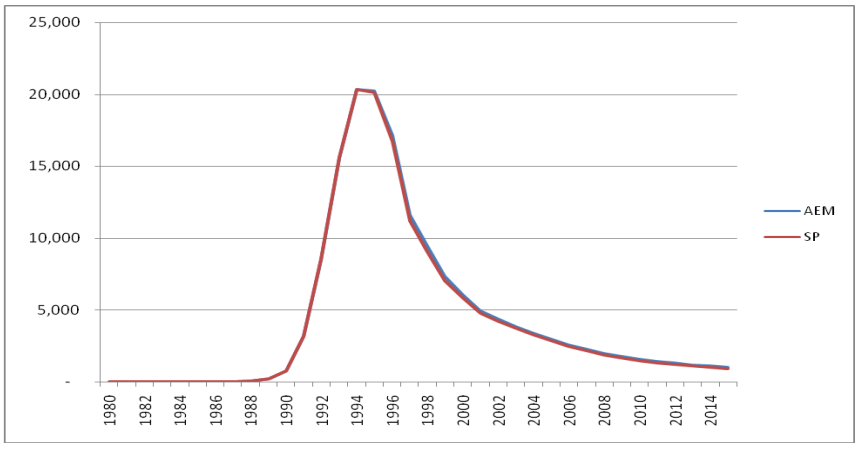
- The incidence rate which was produced by AEM had been imported into Spectrum, using a correcting factor of 1.03. The reason for using a correcting factor of 1.03 was because the Spectrum model appeared to project a lower incidence than AEM.
- The number of patients receiving ART was taken from the NCHADS reports of the OI/ART sites. This number was used in the Spectrum input regarding ART treatment among adults. Then, for each year from 2011 till 2015, it was assumed that the number of people receiving ART equaled to the number of patients receiving ART reported in 2010. Note that, it was also assumed that the reported number of patient on ART from ART sites was 10% over reported.
- The female to male ratios from AEM were used in Spectrum. These ratios were calculated based on the HIV incidence within the 15-49 age group produced by AEM.
- The CD4 cutoff for those in the need of ART in both spectrum and AEM was set to 250. This was because the fact that AEM does not allow the eligibility criteria (CD4 level) to vary over time. However, after matching the two models, the CD4 level in Spectrum was changed to 350 in 2010 to reflect the real situation of ART treatment in Cambodia.
- The survival rates in Spectrum were found to shorten the lives of AIDS patients too fast, so the experts agreed to reduce it by half in the later stage of the disease. The details of the survival rates by different level of CD4 are given in the annex of this report.

- The fertility ratio of HIV infected women to HIV uninfected women was about 0.45 for those aged 20-24, 0.35 for those aged 25 to 39yr and 0.30 for those aged 40 to 45 years old.
- In AEM, the ARV coverage was based on report data of 45% in 2010, with the assumption of increasing triple therapy over the years. The 45% coverage was calculated by the MTCT team using Pediatric and the PMTCT Impact model and assumed that, with the current pace of implementation, the PMTCT coverage would increase to 50% in 2015.
- Again, in AEM the probability of MTC among mothers on ARV was estimated based on 300 HIV+ pregnant women in 2007 (with the rate of 27%), and this rate was assumed to be 18% in 2010. In contrast, the rate of MTC was 28% in 2010 based on the calculation of MTCT model (2010-produced by Clinton Health Access Initiative, Cambodia)
- It was assumed that the rate of progression to death among children getting infected in the peri-natal period to be equaled to those who got infected during the post natal (0-180 days after birth), although in other settings they die faster.

After calibrating the models, the three key indicators - incidence, prevalence and mortality among the population aged 15+, from both models were put on the same graph to detect the differences, however, a statistical test was not performed. Moreover, it has been argued that it was not necessary to overlay the indicator related to HIV/AIDS death produced by the two models because of the complexity of the model build-in assumptions.

2.3. AEM and Spectrum after the Calibration

Figure 21: Trends of HIV incidence projected by both models



After calibration, the number of new HIV infection cases and the HIV prevalence produced by the two models were very similar. This suggests that the Spectrum model was ready to be used in projecting other parameters which could not be projected by AEM.

Figure 22: Trends of HIV prevalence projected by both models

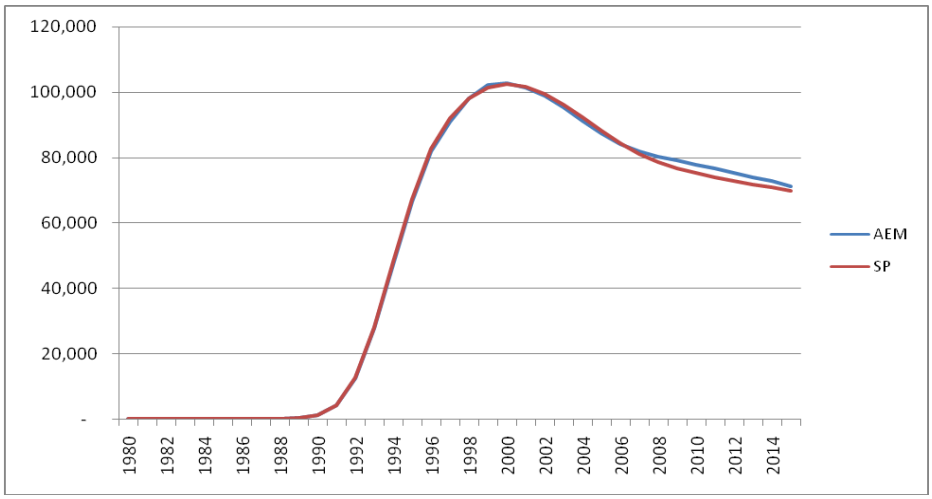
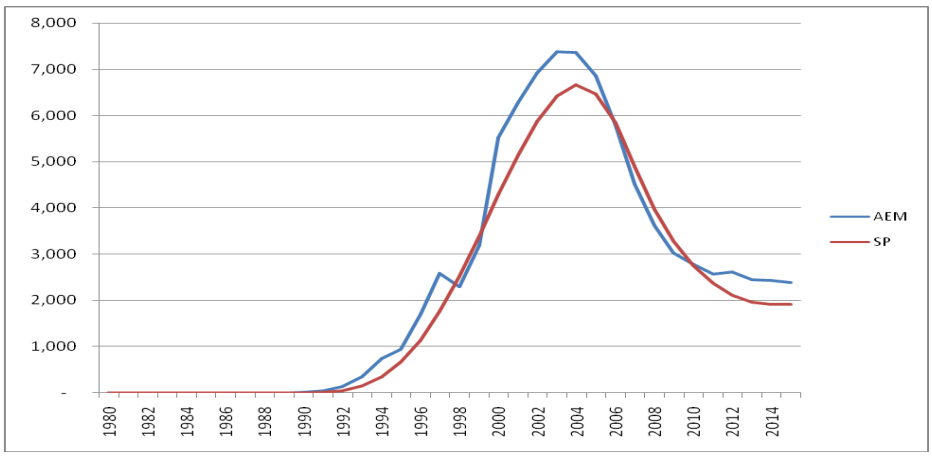


Figure 23: Trends of HIV deaths projected by both models



2.4. Final fitting of the Spectrum model

After successfully matching Spectrum to AEM models, the Spectrum model was refined further on a few more parameters. These parameters were not required by the AEM model, and it did not have any effect on the incidence, prevalence or the number of death among population aged 15+, but it had an effect on indicators relating to children aged 0-14 years old. Those parameters were;

- It had been agreed to change the progression rate among children in need of treatment. That is, among children, it should take a longer time to progress to AIDS (in need of ART) especially among those who have CD4>500. This change would affect mainly the estimated number of children in need of ART. The details of years within each CD4 category are in the annex of this report.
- Similarly, in spectrum, the survival of the HIV+ general population on ART, which is used to estimate number of orphans, was also revised. It had been assumed that the percentage of death among HIV+ individuals in low risk groups was only 50% of the survival rate used by the default in Spectrum model. Without doing so, Spectrum will generate more deaths than the program data. This results in decreasing the number of deaths related to HIV/AIDS and ultimately the number of AIDS orphans.
- The assumption regarding the criteria for 'in need of ART' among HIV infected adult patients was changed to 350 from 2010-2015, while the CD4 before 2010 was set to 250. This change would affect the number of adults in need of ART.
- Based on the new policy on HIV/AIDS care and treatment in Cambodia, ARV treatment must be offered to all HIV infected children aged less than 24 months regardless of their CD4 level. This policy was reflected in the model starting from the year 2011.

3. Assumptions for HIV/AIDS projections

At this stage, the Spectrum model for Cambodia was ready for projecting the indicators of interest for the year 2011 to 2015. However, due to the uncertainty of the future, this projection would not be possible without several hidden assumptions. Those assumptions were:

- The current level of AIDS response, in terms of its coverage, would remain unchanged till 2015
- The quality of any programs implemented was good. For example, women would have to receive all services offered by the MTCT program to be counted as covered by MTCT programs.
- It is assumed that the new HIV treatment guideline for HIV infected adults (CD4<350) had been implemented country wide in 2010, although the guidelines were disseminated in late 2011, and new treatment guideline for the children (giving ART to those aged less than 2 years old) had been implemented in 2012.

4. Limitations of the HIV/AIDS projections

The interpretation of the results from the estimations and projections should be put in the context of the below limitations:

- This is a projection exercise using generic projection tools. Some parameters were estimated using expert opinions or based on default values which might not be correct for Cambodia.
- Due to the use of different models (Spectrum and AEM) for estimation and projection, there might be small variations in terms of the magnitude of the estimated indicators produced by each model.
- It is not guaranteed that the future projections would be perfectly reproduced the trend with the same magnitudes of the indicators produced in this round of estimation and projection, since newly available data or new version of estimation and projection tools would help us making the estimates better.
- The information regarding injecting drug users was very limited, so it was assumed that the HIV prevalence among IDU will remain stable at 25% from 2007 to 2015. This is a big assumption and it may have a strong impact on the modes of transmission that were produced by the model.

Results

1. HIV prevalence among women aged 15-49 years old in High ART coverage phase

The HIV prevalence among the general population age 15 to 49 years old was calculated using the spreadsheet below. This calculation was based on the HIV prevalence among pregnant women included in the HIV sentinel Surveys of 2006 and 2011.

The results showed the HIV prevalence among the general female population aged 15 to 49 years old was 1% and 0.8% in 2006 and 2010, respectively.

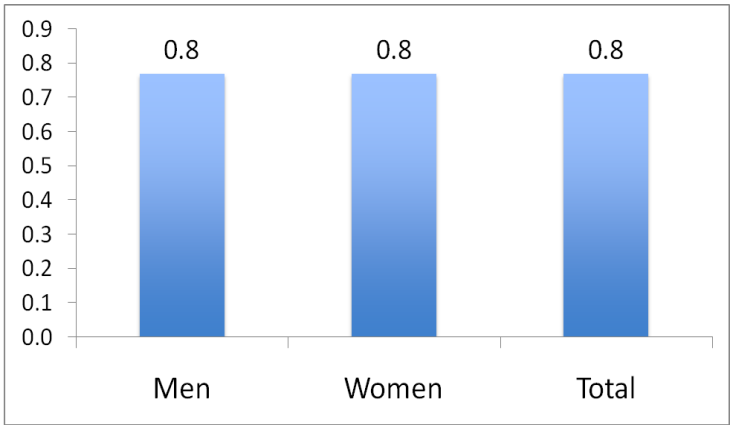
Table 2: Summary of data for estimating HIV the infection rate, for the general female population, during the high ART coverage stage. 2006 and 2010

	2006	**2010**
Number women 15-49 (Wtotal)	3,558,126	3,782,421
Number of delivery in 2010 (total pregnancy)	382,499	365,004
% HIV+ pregnant women (from HSS2010) (adjusted for QC and urban rural)	0.73%	0.36%
Number of HIV+ pregnant women (ftWt+FuWu)	2,776.94	1,314.01
% of HIV+ women on ART before they get pregnant	10%	40%
% of HIV+ women not on ART before they get pregnant	90%	60%
Number of HIV+ pregnant women not on ART (FtWt)	2,499.25	788.41
Pregnancy rate per 100 women (Fn)	10.75%	9.65%
Pregnancy reduction factor	0.8	0.8
Pregnancy rate per 100 women HIV+ (Fu)	8.6%	7.72%
Number of general women age 15-49 HIV+ not on ART (Wu)	29,061	10,213
Number HIV+ women on ART (Wt)	9,157	20,603
Number HIV+ women on ART adjusted for duplication 10% (Wt)	8,241	18,543
Total women HIV+ (Wt+Wu)	37,302	28,755
% of HIV+ among general women	**1.0%**	**0.8%**

- Note: % HIV+ who were on ART before they got pregnant and % HIV+ who were not on ART before they got pregnant were assumed based on the consensus. However, these percentages were set in such a way as to ensure that they will produce the proportion of HIV+ pregnant women on ART divided by total number of women on ART equal to about 3%. In other words, 3% of HIV+ women become pregnant at any given year.
- It was assumed that the number of ART patients from ART clinics were 10% over reported (due to duplication)
- The pregnancy reduction factor of 0.8 was used based on the consensus among the technical team based on international studies of reduced pregnancy and birth rates among HIV infected women.

Based on the ratio of HIV among women to men was 1 to 1, the HIV among male population, as well as, the HIV prevalence among the general population was 0.8%.

Figure 24: Estimated HIV prevalence among the general population, aged 15-49, in 2010



2. *Projections of HIV prevalence among the general population aged 15 to 49 years old*

The HIV prevalence among general population aged 15-49 years old could not be estimated by using AEM model, so we used Spectrum model to project this parameter. However, for the HIV prevalence among 15+ groups, the results were taken from the AEM model.

Figure 25: HIV prevalence among general population, aged 15 to 49 years old, 1990-2015 (from Spectrum)

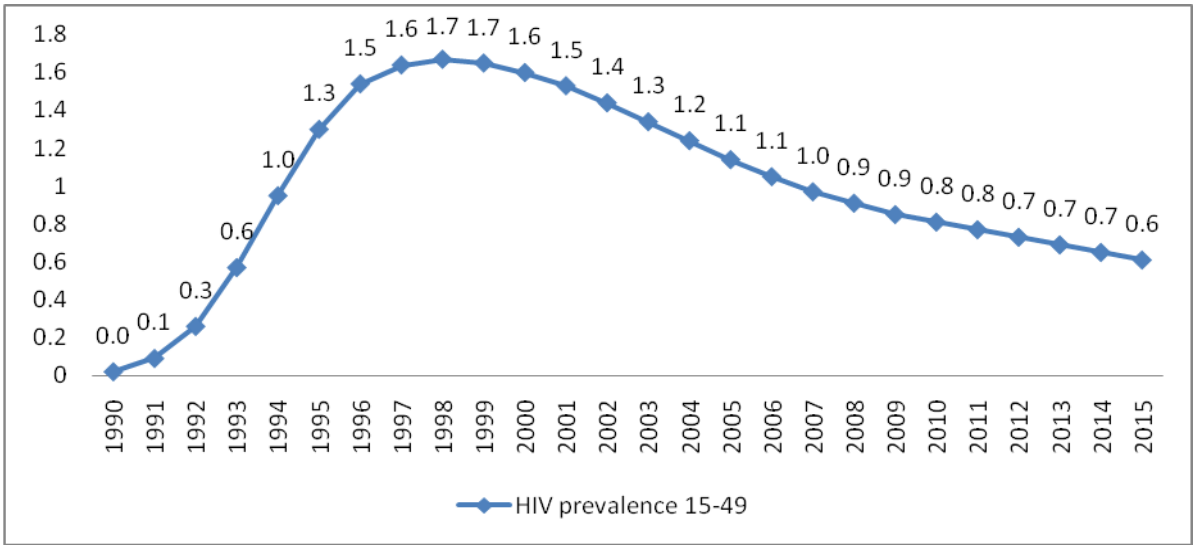
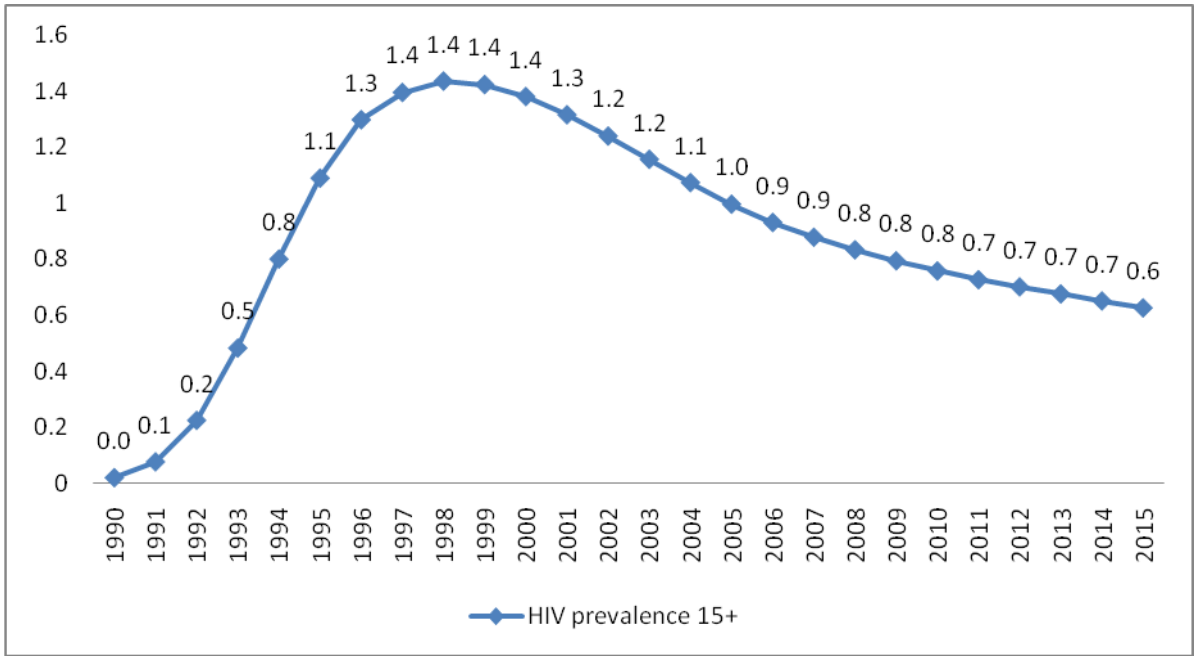


Figure 26: HIV prevalence among the general population, aged 15+, 1990-2015 (from AEM)



It is projected that the HIV prevalence would keep declining, although with a slower rate of decline, from 0.8% in 2010 to about 0.6% in 2015. Interestingly, the 2015 the HIV prevalence among general population aged 15+ and aged 15-49 would meet at 0.6%.

Figure 27: HIV prevalence among the general population by age groups 15+ and 15-49, 1990-2015

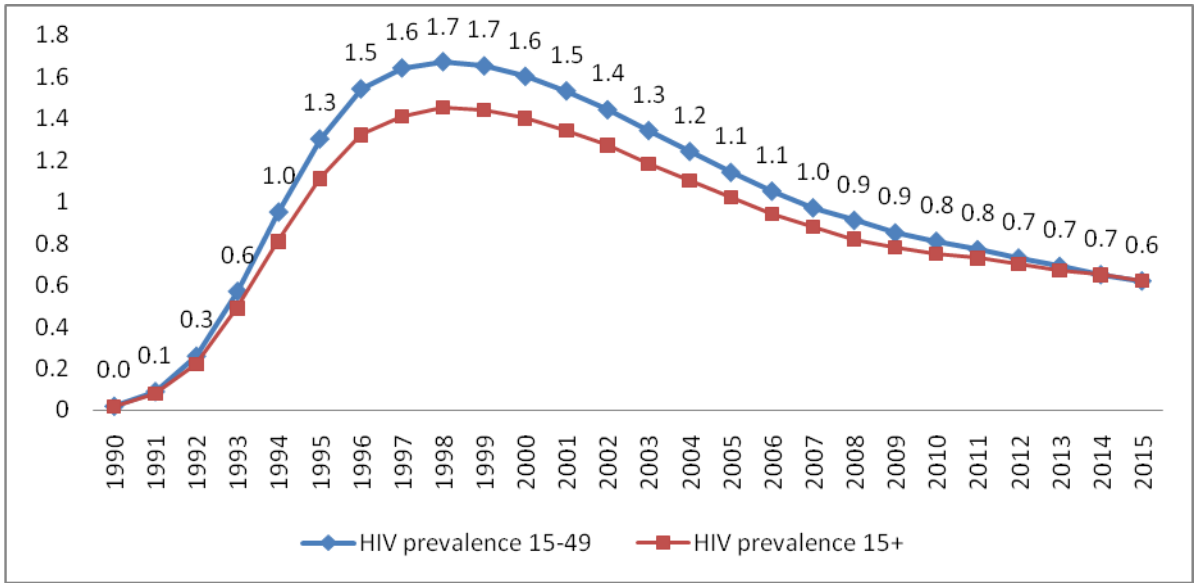
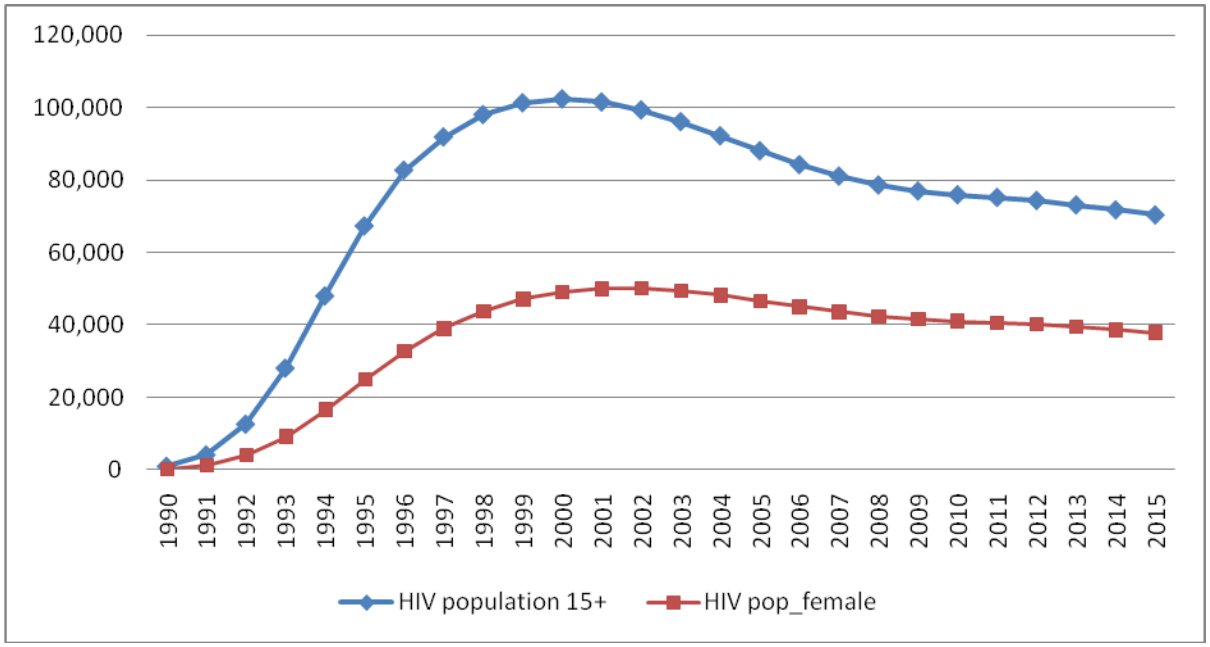


Figure 28: Number of individuals and females infected with HIV aged 15+, 1990-2015 (from Spectrum)



The number of people living with HIV in 2010 was estimated to be 75,900 and this figure is expected to fall further to reach 70,400 in 2015.

Figure 29: Number of individuals and females infected with HIV aged 15+, 2000-2015 (from Spectrum)

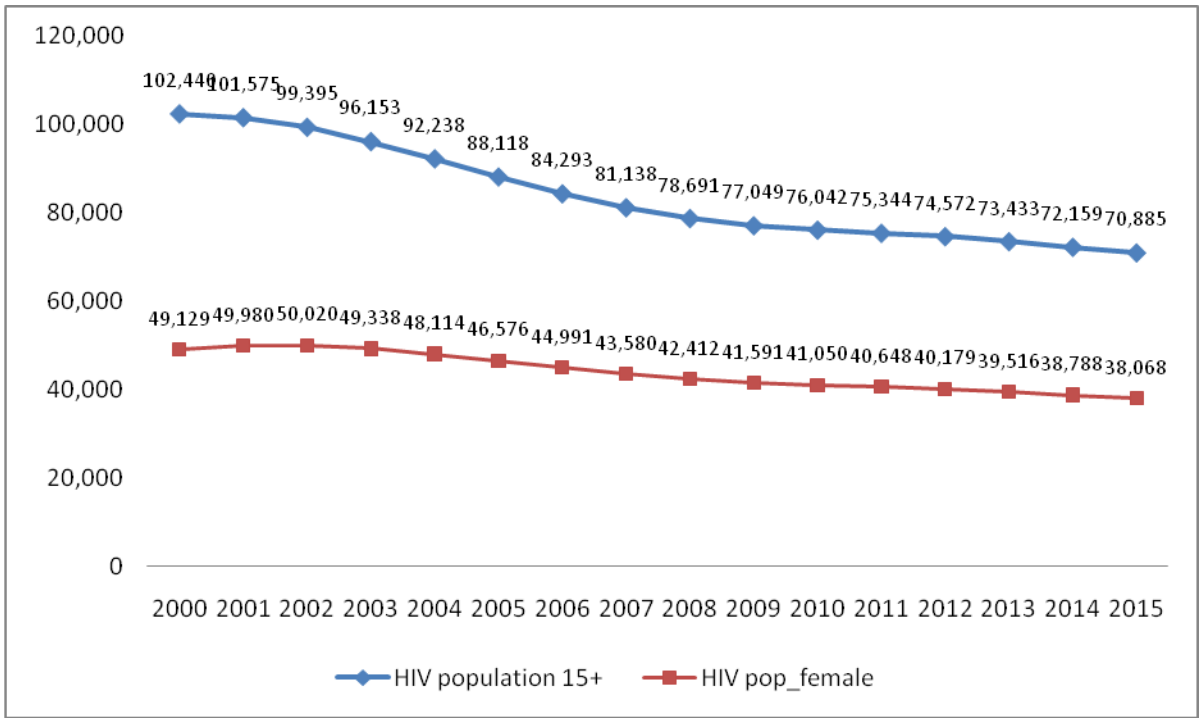
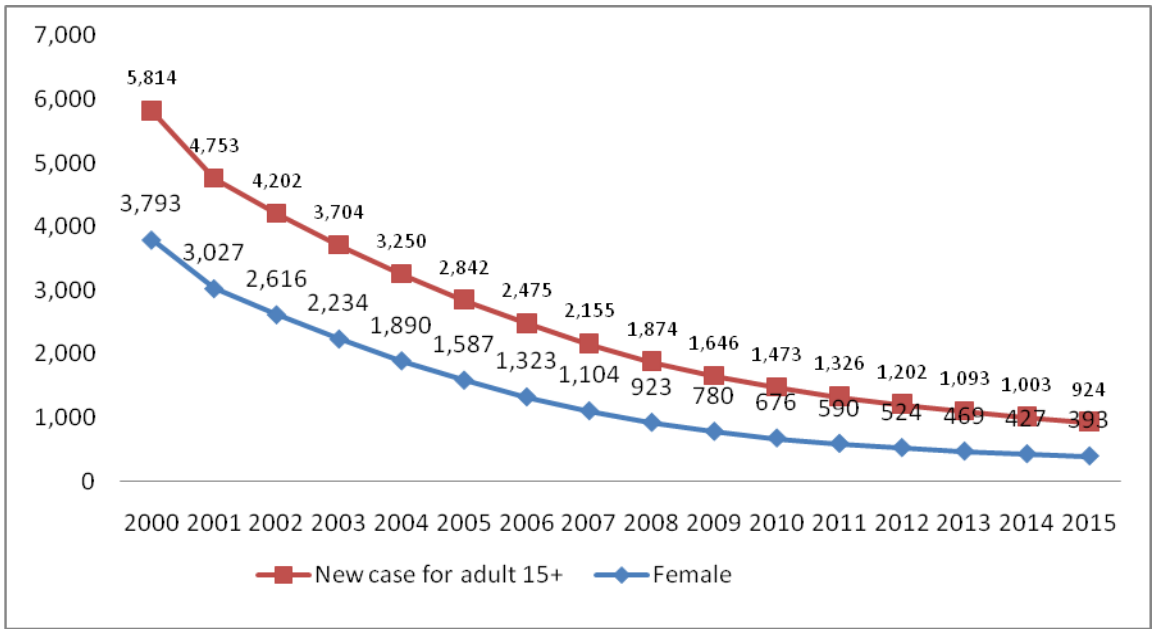
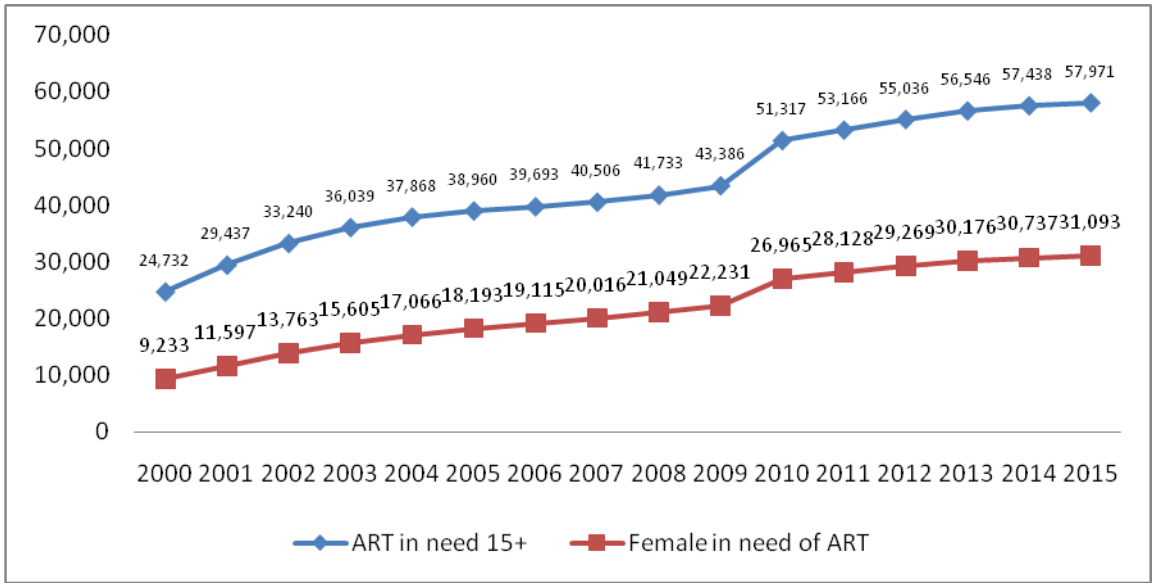


Figure 30: Number of individuals and females aged 15+ newly infected with HIV 2000-2015 (from Spectrum)



The projected number of new HIV cases among population aged 15+ was 1,473 in 2010, which was corresponding to about 4 newly infected per day. In 2015, there will be less than 3 people newly infected per day.

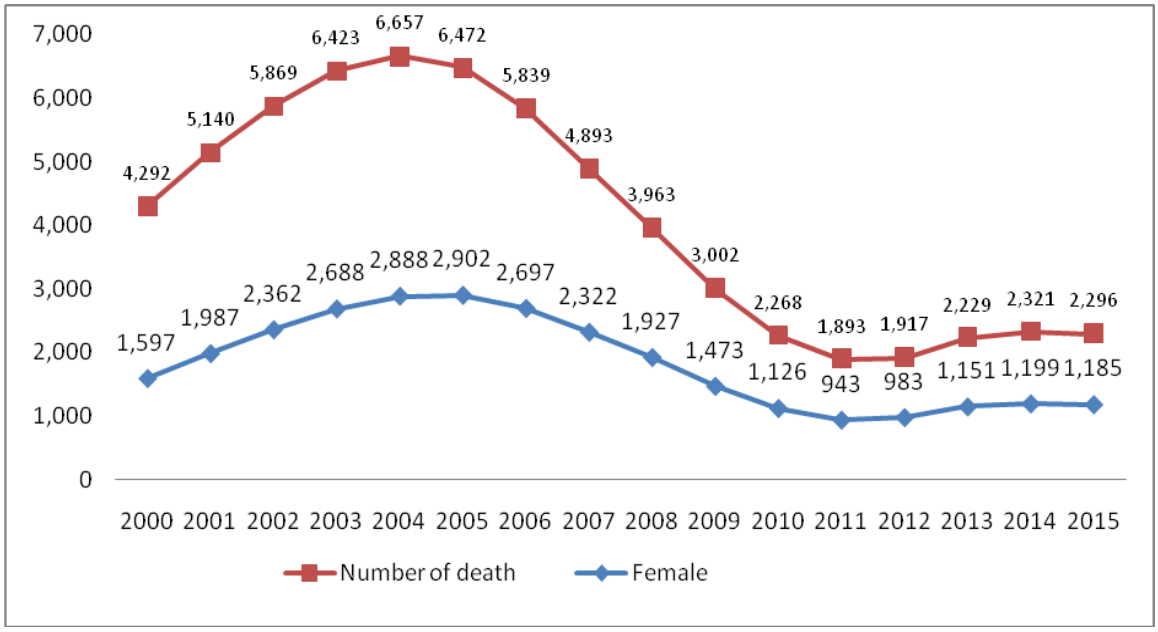
Figure 31: Number of AIDS patients in need of ART aged 15+, 2000-2015 (from Spectrum)



The change of CD4 level from 250 to 350 for the eligibility for ART in 2010 resulted in a significant increase of the projected number of people in need of ART treatment in 2010 and beyond. The

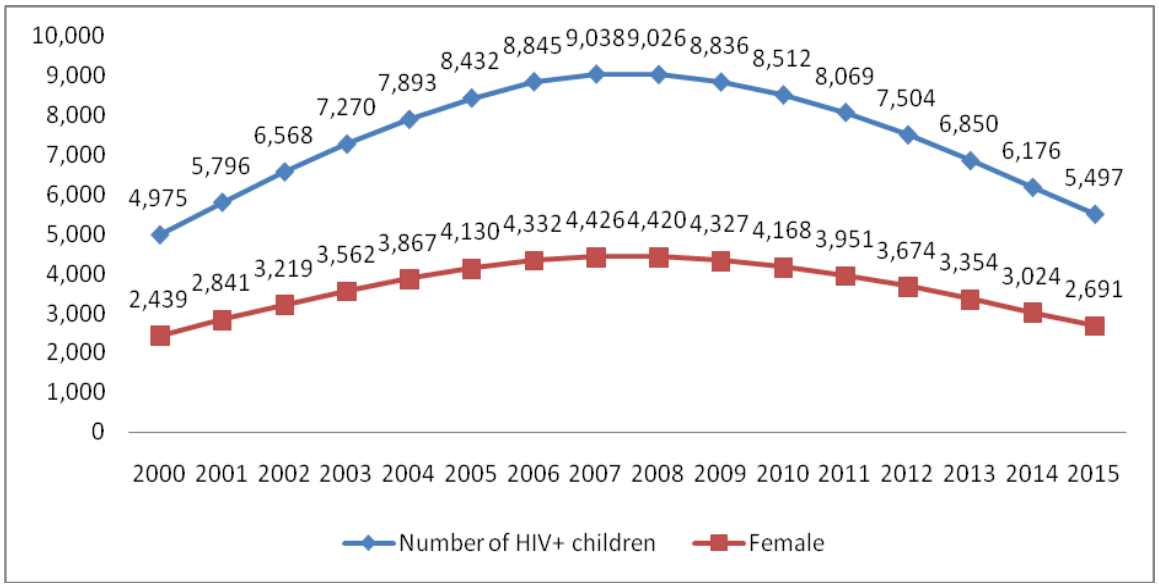
projection showed that the number of people in need of ART increased from 51,255 in 2010 to 57,410 in 2015.

Figure 32: Number of AIDS deaths among the adult population aged 15+, 2000-2015 (from Spectrum)



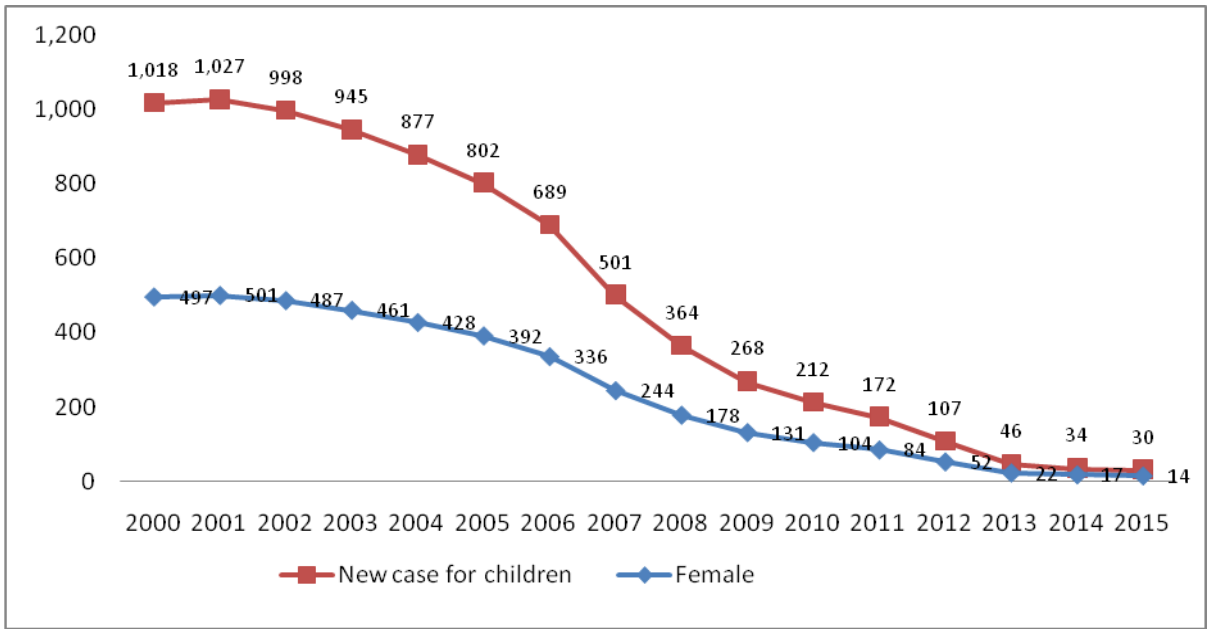
It is assumed that the current expansion of ART coverage will be continued (with annual scale up of 1,400 patients per year) from 2010 to 2015, however the annual number of HIV deaths among the population aged 15+ is expected to rise by about 20 percent between 2011 and 2015. One possible explanation for this increase in deaths could be that the people who have been on ART since the drugs were made widely available in 2005/6 could now be becoming resistant to the drugs and require a new treatment regime.

Figure 33: Number of HIV+ children aged 0-14 years, 2000-2015 (from Spectrum)



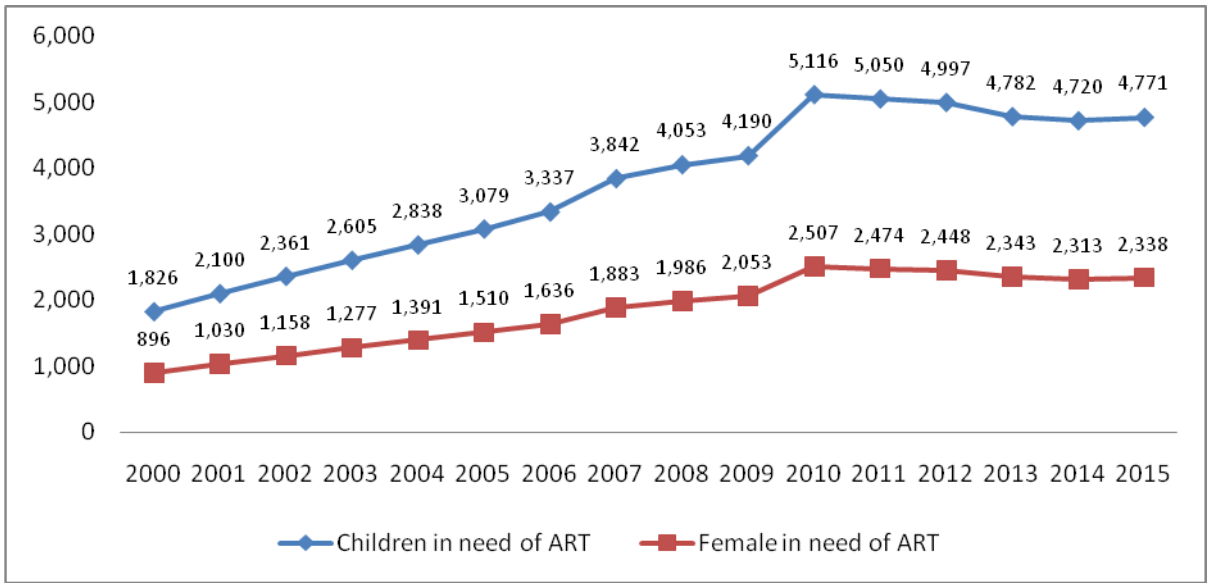
From Spectrum model, the number of HIV+ children age 0-14 was also estimated and projected. In 2010, there were 8,512 children living with HIV; however, this figure is expected to continue to decrease steadily and by 2015 the figure is expected to be down to 5,497.

Figure 34: Number of new HIV cases among children aged 0-14 years, 2000-2015 (from Spectrum)



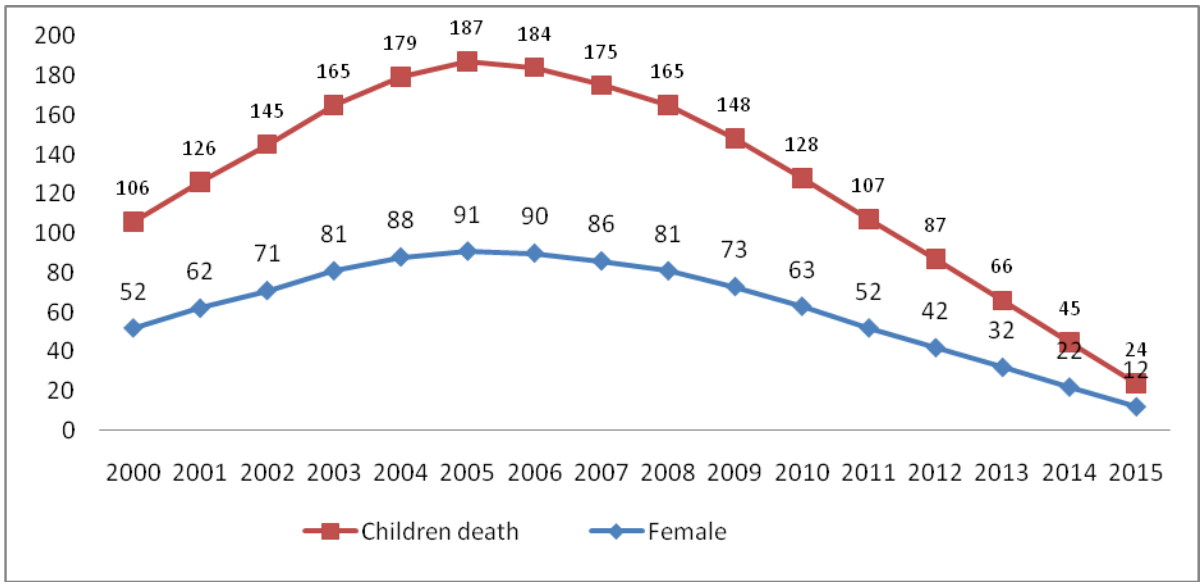
It had been projected that the number of new HIV cases among children would significantly drop from 2010 to 2015.

Figure 35: Number of children aged 0-14 years in need of ART. 2000-2015 (from Spectrum)



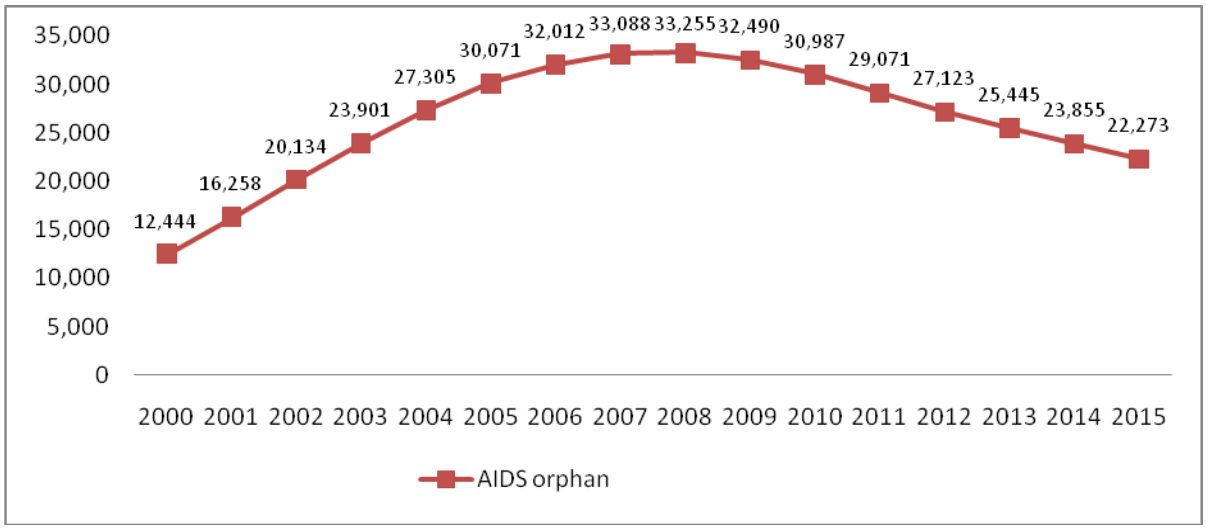
The number of children in need of ART would stabilize from 2010 to 2015, while the number of deaths would decline. It is projected that the number of children in need of ART would be about 4,770 by 2015.

Figure 36: Number of AIDS deaths among children aged 0-14 years, 2000-2015 (from Spectrum)



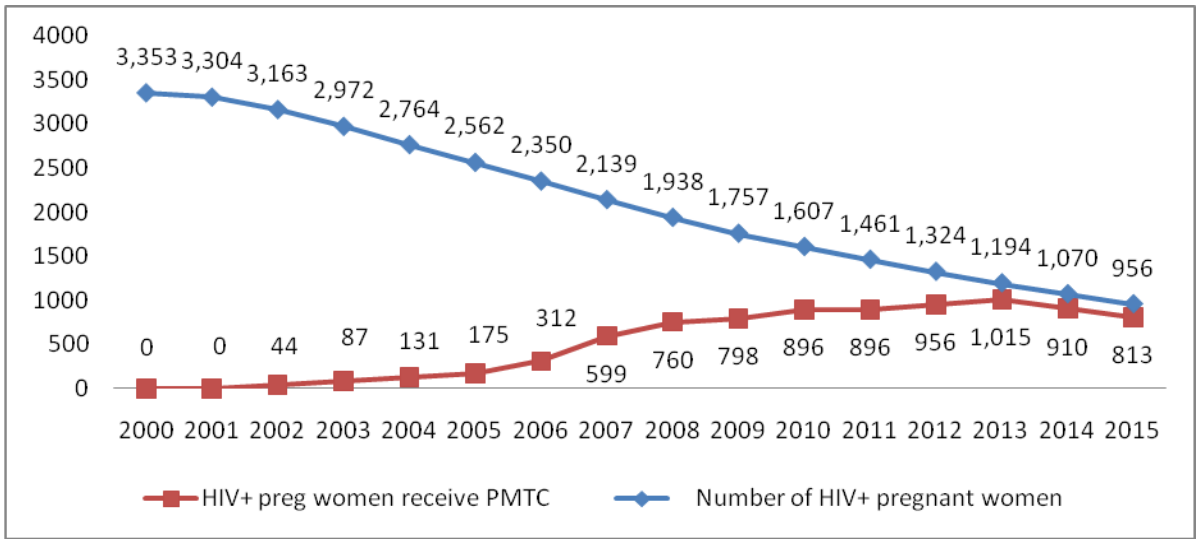
The number of AIDS orphan is newly estimated in this round of HIV/AIDS estimation and projection. It has been found that the number of total AIDS orphans would drop from about 30, 987 in 2010 to 22,273 in 2015.

Figure 37: Number of total AIDS orphans, 2000-2015 (from Spectrum)



In addition to the number of total AIDS orphans, the number of HIV+ pregnant women and the number of HIV+ pregnant women receiving PMTCT were also estimated.

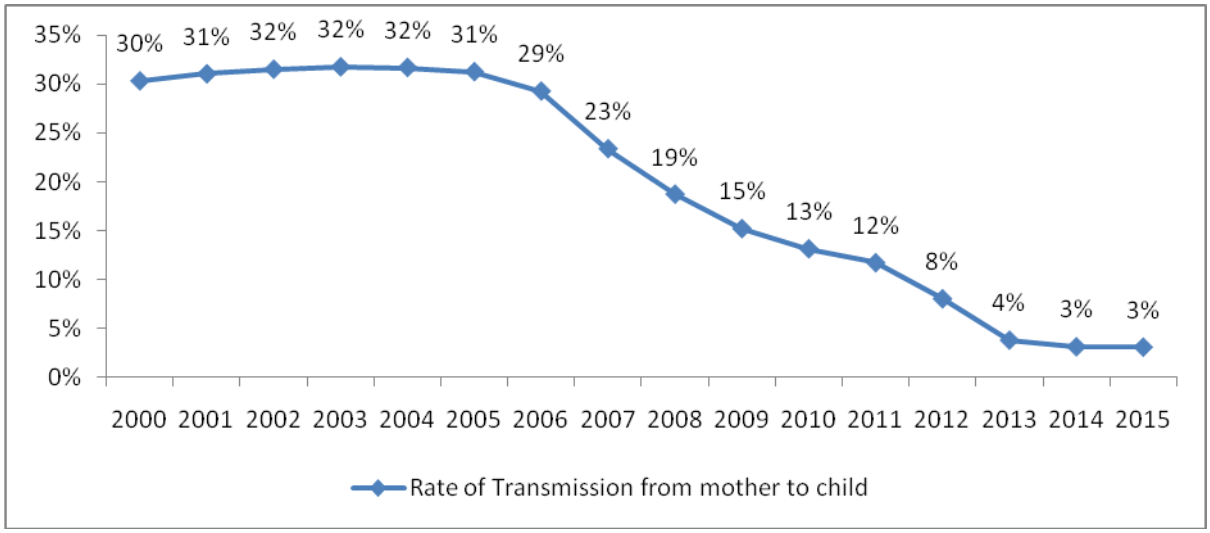
Figure 38: Estimated Number of HIV+ pregnant women & HIV+ pregnant women receiving PMTCT, 2000-2015 (from Spectrum)



Further estimation was made for the modeled mother-to-child transmission rate[11]. The moderator was the estimated number of children age 0-14 newly infected and the denominator was the estimated number of HIV positive women. Both numerator and denominator were taken from the output of the spectrum model. It has been found that the rate of mother to child transmission in Cambodia was about 13% in 2010 and it will drop to just 3% in 2014.

[11] Monitoring and Evaluating the prevalence of mother to child transmission of HIV: A guide for national programmes, preliminary version for AIDS 2010 (WHO & Unicef)

Figure 39: Estimated transmission probability from mother to child, 2000-2015 (from Spectrum)



The mode of transmission, which was an output from the AEM model, is presented below. This mode of transmission was estimated based on the projected number of new HIV cases for each year. Note that, the absolute value of new cases by different groups is different from the number estimated from spectrum, since the two models took into account different subsections of the population.

Figure 40: Number of new HIV infections by mode of transmission 1996-2015

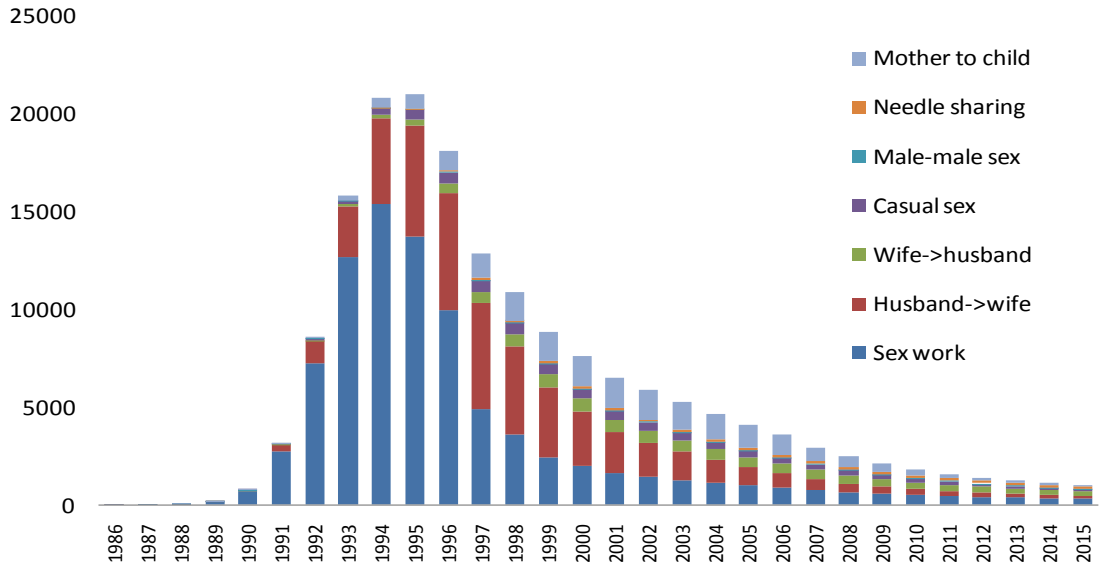
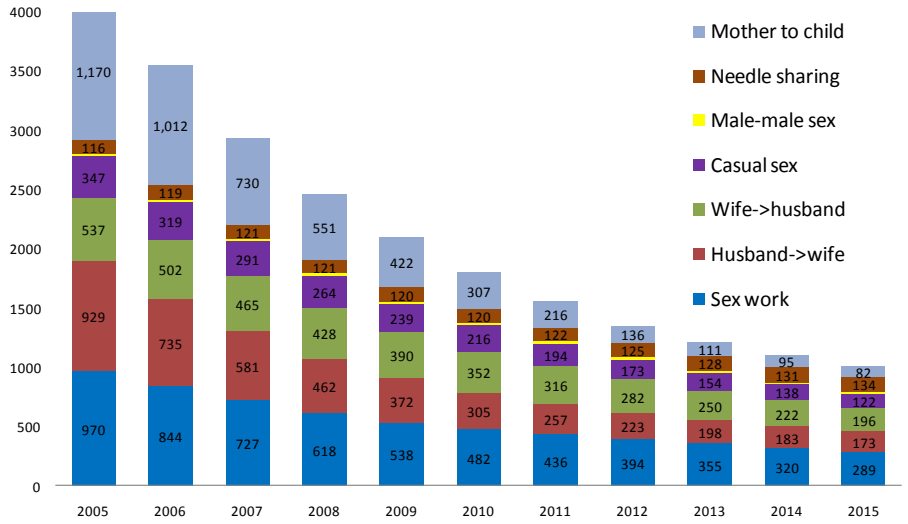
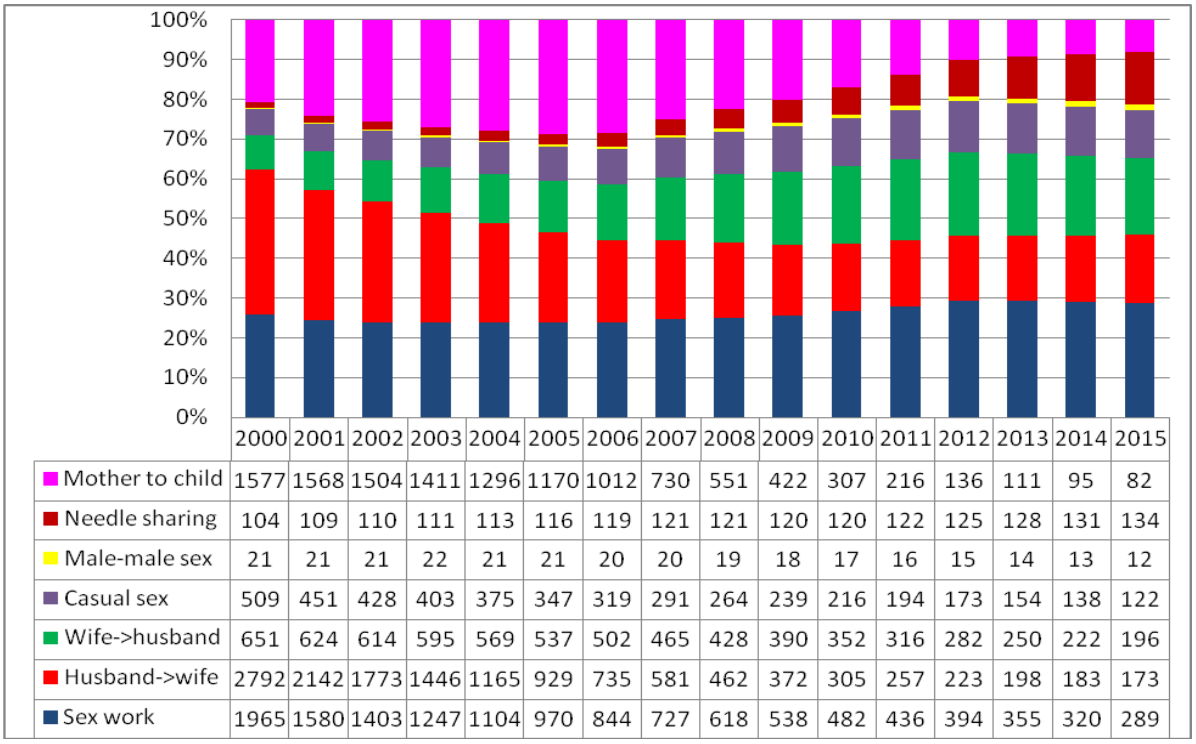


Figure 41: Number of new HIV infections by mode of transmission 2005-2015



Based on the mode of transmission, sex work and transmission from husband to wife and from wife to husband will be responsible for most of new HIV cases projected from 2010 to 2015. In addition, needle sharing could also be considered as one of the main modes of HIV transmission in the Cambodian context. In contrast, if current effort is at least maintained, the proportion of mother to child transmission would go down quite significantly year by year.

Figure 42: Proportion of new HIV cases by different modes of transmission. 2000-2015



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Mother to child	1577	1568	1504	1411	1296	1170	1012	730	551	422	307	216	136	111	95	82
Needle sharing	104	109	110	111	113	116	119	121	121	120	120	122	125	128	131	134
Male-male sex	21	21	21	22	21	21	20	20	19	18	17	16	15	14	13	12
Casual sex	509	451	428	403	375	347	319	291	264	239	216	194	173	154	138	122
Wife->husband	651	624	614	595	569	537	502	465	428	390	352	316	282	250	222	196
Husband->wife	2792	2142	1773	1446	1165	929	735	581	462	372	305	257	223	198	183	173
Sex work	1965	1580	1403	1247	1104	970	844	727	618	538	482	436	394	355	320	289

DISCUSSION

The trend of HIV prevalence estimated in this project is similar to the trend of HIV prevalence produced by other estimation and projection exercises conducted in the past. The main similarities between all the estimation and projection projects on the HIV/AIDS situation in Cambodia over time are; the year that the epidemic reached its peak and its overall trend. For instance, the HIV epidemic reached its peak around 1998-1999 and the overall trend confirmed that the spread of the HIV infection is slowing down. However, the slopes of the projected epidemic curves are not similar.

It has been argued that there are two other important determinants of the slope of each curve. Those determinants are the magnitudes of the estimated HIV prevalence and the effect of OI/ART treatment on AIDS patients. For example, with higher coverage of ART, AIDS patients who would have died survived longer and contributed to stabilizing the number of people living with HIV infection. This explains the fact that in 2006, a similar workshop was conducted and found that the HIV prevalence was 0.9% in 2006. However, if we back calculated the HIV prevalence in 2006 using the latest data available up to 2010, the HIV prevalence in 2006 was around 1%. The low estimate found by the 2006 estimation and projection workshop was due to the fact that during that time the impact of ART on the survival of

AIDS patients was not well documented and was not extensively used in the model built for the estimation and projection in that particular year.

Furthermore, factors that affect the magnitude of the HIV prevalence differ from one estimation exercise to another; improvement of the models led to the model developers increasing the capacity of their model account, to include more variables affecting actual HIV prevalence. In addition, changes in the program coverage; such as; antiretroviral treatment, VCT and PMTCT also influence the course of the epidemic and the trends of the prevalence.

The decline in HIV prevalence can be a result of a combination of several factors. The decline of HIV prevalence in the early stage of the epidemic might be due to the death of HIV infected individuals and also due to the success of the HIV prevention and behavioral changes, which resulted in having fewer numbers of new cases added to the pool of HIV infected individuals. In the last 3-4 years, the number of deaths due to HIV/AIDS has reduced considerably, thanks to the wide expansion of the ART program and its good service quality. Consequently, HIV infected individuals are staying alive longer which, in turn, results in the number of people living with HIV stabilizing. Further, ART also reduces the infectiousness of HIV+ individuals, which may lead to a reduction in the number of new cases transmitted by HIV+ individuals.

The estimated modes of transmission revealed that a high proportion of new HIV cases still are still resulting from sex work. However, HIV infection between casual partners will take an increasingly significant share of the total number of new HIV infections from 2010 to 2015.

CONCLUSIONS

The trend of HIV prevalence will continue to decline up until 2015. The decline that occurred between 2006 and 2015, is due to 1) increasing coverage of ART, leading to decreasing infectiousness of HIV infected individuals, 2) successful implementation of targeted HIV prevention activities (condom program, VCCT, PMTCT/linked response, 3Is, STI care, outreach programs, etc) and 3) decreasing number of new HIV infections.

The projections for 2010 to 2015 show a decline in both HIV prevalence and HIV incidence. However, the rate of the decline is decreasing. This is due to a lower mortality rate of HIV infected individuals, who are currently receiving treatment for opportunistic infections or are accessing ARV treatment at one of the 56 OI/ART sites across the country.

Despite the decline of HIV prevalence and incidence, the numbers of people in need of ART (both adult and children) are on the rise at least until 2015. The budget for care and treatment for HIV/AIDS patients will become the largest expense in HIV/AIDS response programs. The Cambodian government and development partners should identify sufficient resources and a sustainable mechanism to ensure that care and treatment will be available to those in needs despite the economic downturn.

Annexes

Table 3: Inputs of high risk groups into AEM model

Heterosexual Behaviors and STI

Behavioral inputs to AEM for heterosexual populations

	2000	2005	2010	2015
Female Sex Workers (FSWs) / population in thousands	16.047	18.736	21.675	24.203
Sex workers - General				
Percent of females age 15-49 who are sex workers	0.5%	0.5%	0.5%	0.5%
Percent of sex workers who are higher frequency	50.7%	37.5%	27.0%	27.0%
High frequency to low frequency movement each year	10.0%	10.0%	10.0%	10.0%
Sex workers - Higher frequency group / numbers (in '000s)	8.138	7.033	5.852	6.535
Number of clients per day - higher frequency SW	3.184	3.184	3.184	3.184
Days worked per week - higher frequency sex workers	7.000	7.000	7.000	7.000
Percent condom use with clients - higher frequency SW	86.1%	86.1%	86.1%	86.1%
Average duration for higher frequency sex workers (years)	2.500	2.500	2.500	2.500
Percent higher frequency SW with STI	25.9%	22.7%	22.7%	22.7%
Sex workers - Lower frequency group / numbers (in '000s)	7.909	11.702	15.823	17.668
Number of clients per day - lower frequency SW	0.100	0.100	0.100	0.100
Days worked per week - lower frequency sex workers	3.000	3.000	3.000	3.000
Percent condom use with clients - lower frequency SW	63.1%	63.1%	63.1%	63.1%
Average duration for lower frequency sex workers (years)	2.500	2.500	2.500	2.500
Percent lower frequency SW with STI	8.6%	7.6%	7.6%	7.6%

Clients of Female Sex Workers (Clients) / population in '000s	298.565	363.793	428.208	483.899
Clients of sex workers				
Percent of males age 15-49 visiting sex workers in last year	10.8%	10.9%	10.9%	10.9%
Average duration of being a client (years)	7.874	7.874	7.874	7.874
Percentage of adult males circumcised	3.0%	3.0%	3.0%	3.0%
Casual Sex (non-commercial, non-regular partner) / '000s	343.740	411.499	484.326	545.565
Males engaging in casual sex / numbers in thousands	248.029	299.382	354.273	400.348
Female engaging in casual sex / numbers in thousands	95.710	112.117	130.053	145.217
Percentage of males having casual sex in last year	9.0%	9.0%	9.0%	9.0%
Percentage of females having casual sex in last year	3.0%	3.0%	3.0%	3.0%
Percent condom use in casual sex	35.8%	35.8%	35.8%	35.8%
Average number of casual contacts in last year (male)	16.110	16.110	16.110	16.110
Spouses and Regular Partners				
Sex with spouses or regular partners (RP)				
Number of sexual contacts with spouse or RP (per week)	1.000	1.000	1.000	1.000
Percent condom use with spouses or regular partners	2.0%	2.0%	2.0%	2.0%
Percent adult population with STI	3.4%	2.8%	2.8%	2.8%

Table 4: Inputs for injecting drug users (AEM)

Injecting Drug Use Behavior

Behavioral inputs to AEM for IDUs & injecting sex workers

	2000	2005	2010	2015
Male Injecting Drug Users (IDUs) / population in thousands	1.491	2.534	3.346	3.781
Injecting behaviors				
Percent of adult males 15-49 years of age who inject	0.1%	0.1%	0.1%	0.1%
Percent in high risk networks	40.0%	40.0%	40.0%	40.0%
IDU mortality (additional mortality per year in percent)	1.0%	1.0%	1.0%	1.0%
Percent of IDUs sharing	50.0%	50.0%	50.0%	50.0%
Percent of all injections shared (by those in sharing group)	70.0%	70.0%	70.0%	70.0%
Number of injections each day	2.000	2.000	2.000	2.000
Average duration of injecting (years)	3.000	6.500	10.000	10.000
Sharing to non-sharing movement in a year	10.0%	10.0%	10.0%	10.0%
Sexual behaviors				
Percent visiting female sex workers	50.0%	50.0%	50.0%	50.0%
Percent condom use with higher frequency sex workers	86.1%	86.1%	86.1%	86.1%
Percent condom use with lower frequency sex workers	63.1%	63.1%	63.1%	63.1%
Percent condom use with spouse or regular partner	2.0%	25.6%	35.0%	35.0%
Number of contacts with regular partners (per week)	25.0%	25.0%	25.0%	25.0%
Female Injecting Drug Users (IDUs) / population in thousands	0.0%	0.0%	0.0%	0.0%
Injecting behaviors for female IDU				
Percent of adult females 15-49 years of age who inject	0.0%	0.0%	0.0%	0.0%
Percent female IDU in high risk networks	60.0%	55.0%	50.0%	50.0%

Percent of female IDUs sharing	67.0%	53.5%	40.0%	40.0%
Percent of all injections shared (by those female IDU in sharing group)	60.0%	46.5%	33.0%	33.0%
Number of injections each day for female IDU	2.500	1.750	1.000	1.000
Average duration of injecting for female IDU (years)	10.000	10.000	10.000	10.000
Sharing to non-sharing movement in a year	10.0%	10.0%	10.0%	10.0%
Sexual behaviors for female IDU				
Percent regular partners that are male IDUs	60.0%	60.0%	60.0%	60.0%
Percent condom use with spouse or regular partner	10.0%	10.0%	10.0%	10.0%
Number of contacts with regular partners (per week)	1.000	1.000	1.000	1.000
Injecting sex workers (ISW) / population in thousands	0.0%	0.0%	0.0%	0.0%
Higher frequency injecting SWs / population in thousands	0.0%	0.0%	0.0%	0.0%
Percent of higher frequency sex workers who inject	0.0%	0.0%	0.0%	0.0%
Percent of higher frequency ISW in high risk networks	60.0%	60.0%	60.0%	60.0%
Percent of higher frequency ISW sharing	67.0%	67.0%	67.0%	67.0%
Percent of all injections shared (Sharing hi frequency SW)	60.0%	60.0%	60.0%	60.0%
Number of daily injections for higher frequency ISW	2.500	2.500	2.500	2.500
Average duration of injecting for higher freq ISW (years)	5.000	5.000	5.000	5.000
Percent condom use with clients (hi frequency ISWs)	30.0%	30.0%	30.0%	30.0%
Lower frequency injecting SWs / population in thousands	0.0%	0.0%	0.0%	0.0%
Percent of lower frequency sex workers who inject	0.0%	0.0%	0.0%	0.0%
Percent of lower frequency ISW in high risk networks	60.0%	60.0%	60.0%	60.0%
Percent of lower frequency ISW sharing	67.0%	67.0%	67.0%	67.0%
Percent of all injections shared (Sharing low frequency SW)	60.0%	60.0%	60.0%	60.0%
Number of daily injections for lower frequency ISW	2.500	2.500	2.500	2.500
Average duration of injecting for lower freq ISW (years)	5.000	5.000	5.000	5.000

Percent condom use with clients (low frequency ISWs)	30.0%	60.0%	60.0%	60.0%

Table 5: Inputs for male same sex behaviors (AEM)

Male Same Sex Behaviors and STIs

Behavioral inputs to AEM for men having sex with men

	2000	2005	2010	2015
Men who have sex with men (MSM)	12.401	14.969	17.714	20.017
Higher risk MSM (Hi MSM) size and sexual behavior	12.401	14.969	17.714	20.017
Percent of males age 15-49 engaging in higher risk same-sex behavior	0.5%	0.5%	0.5%	0.5%
Percent of Hi MSM reporting anal sex in last year	90.0%	90.0%	90.0%	90.0%
Number anal sex contacts last week (for MSM w/anal sex)	1.500	1.500	1.500	1.500
Average duration of same-sex behavior (years)	20.000	20.000	20.000	20.000
Shift from Hi MSM to Lo MSM	0.0%	0.0%	0.0%	0.0%
Percent of Hi MSM with other female partners	60.0%	60.0%	60.0%	60.0%
Percent condom use in anal sex with other Hi MSM	74.4%	74.4%	74.4%	74.4%
Percent Hi MSM with anal STI	5.0%	5.0%	5.0%	5.0%
Lower risk MSM (Lo MSM) size and sexual behavior	0.000	0.000	0.000	0.000
Percent of males age 15-49 engaging in lower risk same-sex behavior	0.000	0.000	0.000	0.000
Percent of Lo MSM reporting anal sex in last year	0.700	0.700	0.700	0.700
Number anal sex contacts last week (for MSM w/anal sex)	0.600	0.600	0.600	0.600
Average duration of same-sex behavior (years)	20.000	20.000	20.000	20.000
Percent of Lo MSM with other female partners	0.250	0.250	0.250	0.250
Percent condom use in anal sex with other Lo MSM	0.500	0.500	0.500	0.500
Percent Lo MSM with anal STI	0.006	0.006	0.006	0.006

MSM sexual behavior with commercial partners				
Percent of Hi MSM visiting male sex workers	0.000	0.000	0.000	0.000
Percent of Lo MSM visiting male sex workers	0.000	0.000	0.000	0.000
Ratio of frequency of visiting MSW (Lo MSM/Hi MSM)	0.100	0.100	0.100	0.100
Percent of Hi MSM visiting female sex workers	0.500	0.500	0.500	0.500
Percent of Lo MSM visiting female sex workers	0.000	0.000	0.000	0.000
Percent condom use in anal sex with male sex workers	0.150	0.150	0.150	0.150
Percent condom use with higher frequency female SW	0.861	0.861	0.861	0.861
Percent condom use with lower frequency female SW	0.631	0.631	0.631	0.631
Male sex workers (MSW)	0.000	0.000	0.000	0.000
MSW size and duration				
Percent of males age 15-49 who are male sex workers	0.000	0.000	0.000	0.000
Average duration of male sex work (years)	1.000	1.000	1.000	1.000
Shifts from Hi MSM to MSW	0.010	0.010	0.010	0.010
Shifts from Lo MSM to MSW	0.010	0.010	0.010	0.010
Sexual behaviors and STI with clients				
Percent of MSW reporting anal sex with clients in last year	0.800	0.800	0.800	0.800
Number anal sex contacts last week (for MSW w/anal sex)	3.000	3.000	3.000	3.000
Percent MSW with anal STI	0.100	0.100	0.100	0.100
Female partners of MSW				
Percent MSW visiting female sex workers in last year	0.100	0.100	0.100	0.100
Percent MSW with other female partners in last year	0.300	0.300	0.300	0.300

Table 6: Inputs for mother to child transmissions (AEM)

Note that the parameter for mother to child transmission in AEM was based on assumptions. This assumption has been refined further in the Spectum model where the HIV epidemic among children age 0-14 years old was estimated.

Mother to Child Transmission Parameters

Year	Prob. MTCT without ARV	Prob. MTCT with ARV	ARV Coverage	%Reduction of fertilty for HIV+
2000	30%	27%	0%	20%
2001	30%	27%	0%	20%
2002	30%	27%	2%	20%
2003	30%	27%	3%	20%
2004	30%	27%	5%	20%
2005	30%	27%	8%	20%
2006	30%	25%	15%	20%
2007	29%	23%	23%	20%
2008	29%	22%	31%	20%
2009	28%	20%	38%	20%
2010	28%	18%	45%	20%
2011	28%	18%	46%	20%
2012	28%	18%	47%	20%
2013	28%	18%	48%	20%
2014	28%	18%	49%	20%
2015	28%	18%	50%	20%

Table 7: Input HIV prevalence among the general population based on previous projections (AEM)

HIV General population males		HIV General population females	
Month-year	%HIV+	Month-year	%HIV+
1995	1.6%	1995	0.7%
1996	2.6%	1996	1.4%
1997	2.9%	1997	1.8%
1998	2.9%	1998	2.0%
1999	2.5%	1999	1.9%
2000	2.0%	2000	1.9%
2001	1.9%	2001	1.8%
2002	1.7%	2002	1.6%
2003	1.5%	2003	1.5%
2004	1.4%	2004	1.4%
2005	1.2%	2005	1.2%
2006	1.1%	2006	1.1%
2007	1.0%	2007	1.0%
2008	0.9%	2008	0.9%
2009	0.8%	2009	0.8%
2010	0.8%	2010	0.8%

Note: these figures were EPP smoothed from the estimation of the past trends (low and high ART coverage)

Table 8: Input for MTCT in Spectrum model

AIM - Program statistics - (350 CD4)HIV estimation and projection 2011 to 2015_26Jan2012_update
PMTC

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Prenatal prophylaxis											
Single dose nevirapine	175	276	265	222	162	224	224	191	216	302	372
Dual ARV	0	0	93	186	139	134	134	96	0	0	0
Option A - maternal	0	0	0	0	0	0	0	0	0	0	0
Option B - triple prophylaxis from 14 weeks	0	0	0	0	0	179	179	191	216	227	186
Triple ART started before current pregnancy	0	36	241	352	482	144	144	239	388	639	911
Triple ART started during current pregnancy	0	0	0	0	15	215	215	239	259	344	390
Total	175	312	599	760	798	896	896	956	1,079	1,512	1,859
Postnatal prophylaxis (among women not on ART)											
Option A	0	0	0	0	0	0	0	0	0	0	0
Option B	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	0	0	0
Monthly drop-out rate of postnatal prophylaxis											
Option A	0	0	0	0	0	0	0	0	0	0	0
Option B	0	0	0	0	0	0	0	0	0	0	0

Table 9: Inputs for ART coverage used in Spectrum

AIM - Program statistics - (350 CD4)HIV estimation and projection 2011 to 2015_26Jan2012_update PMTC

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of adults receiving ART	17,957	23,924	31,999	37,315	42,799	41,500	42,900	44,300	45,700	47,100
Percent of adults in need receiving ART	0	0	0	0	0	0	0	0	0	0
Migration from first to second line (% per year)	0	0	0	0	0	0	0	0	0	0

AIM - Program statistics - (350 CD4)HIV estimation and projection 2011 to 2015_26Jan2012_update PMTC

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number receiving cotrimoxazole	0	0	0	0	0	0	0	0	0	0
Percent receiving cotrimoxazole	0	0	0	0	0	0	0	0	0	0
Number Receiving ART	1,938	2,541	3,067	3,638	4,102	4,400	4,500	4,600	4,700	4,700
Percent Receiving ART	0	0	0	0	0	0	0	0	0	0

AIM - Program statistics - (350 CD4)HIV estimation and projection 2011 to 2015_26Jan2012_update PMTC

	1 year	2 years	3 years	4 years	5 years	6 years	7 years	8 years	9 years	10 years
Reduction in mortality with no ART	0.33	0.33	0.33	0.33	0.33	0	0	0	0	0
Reduction in mortality with ART	0.33	0.16	0.08	0.04	0.02	0	0	0	0	0

Table 10: Input for the Eligibility Criteria for spectrum model

AIM - Eligibility for treatment - (350 CD4)HIV estimation and projection 2011 to 2015_26Jan2012_update PMTC

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
CD4 count threshold for eligibility	250	250	250	250	250	350	350	350	350	350	350

AIM - Eligibility for treatment - (350 CD4)HIV estimation and projection 2011 to 2015_26Jan2012_update PMTC

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Age below which all HIV+ children should be on treatment (months)	0	0	12	12	12	12	12	24	24	24	24
CD4 count threshold for eligibility											
Age < 11 months	1,500	1,500	1,500	1,500	1,500	750	750	750	750	750	750
Age 12-35 months	750	750	750	750	750	750	750	750	750	750	750
Age 35-59 months	350	350	350	350	350	750	750	750	750	750	750
Age >= 5 years	200	200	200	200	200	350	350	350	350	350	350
CD4 percent threshold for eligibility											
Age < 11 months	25	25	25	25	25	25	25	25	25	25	25
Age 12-35 months	25	25	25	25	25	25	25	25	25	25	25
Age 35-59 months	25	25	25	25	25	25	25	25	25	25	25
Age >= 5 years	15	15	15	15	15	15	15	15	15	15	15

Table 11: Inputs of the HIV incidence (15-49) for spectrum

These incidence were calculated from AEM model, however, a factor of 1.03 was used to calibrate the both models.

AIM - Incidence - (350 CD4)HIV estimation and projection 2011 to 2015_26Jan2012_update PMTC

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Incidence (15-49)	0.0173	0.0687	0.1817	0.3251	0.4151	0.4044	0.3301	0.2152	0.1677	0.1253	0.0996	0.0784	0.0668

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Incidence (15-49)	0.0568	0.0481	0.0407	0.0343	0.0289	0.0243	0.0207	0.018	0.0158	0.014	0.0124	0.0112	0.0101

Table 12: Estimating HIV incidence ratio from AEM

Data from AEM Baseline 09 Sep 2011
Calculating HIV incidence age 15-49 years old
Calculating incidence ratio female to male

	1995	2000	2005	2010	2015
Population male 15-49	2,381,770	2,921,115	3,518,975	4,124,788	4,604,427
Population female 15-49	2,626,196	3,107,401	3,634,950	4,159,689	4,561,581
Total 15-49	5,007,966	6,028,516	7,153,925	8,284,477	9,166,008

New Male HIV Age Distributions over time

Age\Year	1995	2000	2005	2010	2015
15 - 19	1681	300	184	116	76
20 - 24	4100	733	450	282	186
25 - 29	3060	547	336	211	139
30 - 34	1464	262	161	101	67
35 - 39	623	111	68	43	28
40 - 44	270	48	30	19	12
45 - 49	131	23	14	9	6

New Female HIV Age Distributions
over time
Age\Year

	1995	2000	2005	2010	2015
15 - 19	2823	1290	536	226	130
20 - 24	2972	1358	564	238	137
25 - 29	1557	711	296	125	72
30 - 34	634	290	120	51	29
35 - 39	235	107	45	19	11
40 - 44	77	35	15	6	4
45 - 49	35	16	7	3	2
new case male (15-49)	11329	2024	1243	781	514
new case female (15-49)	8333	3807	1583	668	385
new case Total incidence 15-49	19662	5831	2826	1449	899
female/male case ratio	0.7355459	1.8809289	1.2735318	0.8553137	0.7490272
% incidence male	0.00476	0.00069	0.00035	0.00019	0.00011
% incidence female	0.00317	0.00123	0.00044	0.00016	0.00008
% incidence age 15-49	0.3926	0.0967	0.0395	0.0175	0.0098

Table 13: Years in CD4 count categories

AIM - Transition parameters - (350 CD4)HIV estimation and projection 2011 to 2015_26Jan2012_update PMTC

Average number of year in CD4 categories

	Male				Female			
	15 - 24	25 - 34	35 - 44	45 -54	15 - 24	25 - 34	35 - 44	45 -54
> 500	8.51	7.45	4.46	2.83	8.51	7.45	4.46	2.83
350 - 499	3.35	2.43	1.53	0.86	3.35	2.43	1.53	0.86
250 - 349	2.23	1.62	1.02	0.59	2.23	1.62	1.02	0.59
200 - 249	1.12	0.81	0.51	0.36	1.12	0.81	0.51	0.36
100 - 199	1.73	1.12	0.52	0.44	1.73	1.12	0.52	0.44
50 - 99	1.12	0.81	0.51	0.2	1.12	0.81	0.51	0.2

Median time from HIV infection to Death

AIM - Transition parameters - (350 CD4)HIV estimation and projection 2011 to 2015_26Jan2012_update PMTC

	Male				Female			
	15 - 24	25 - 34	35 - 44	45 -54	15 - 24	25 - 34	35 - 44	45 -54
Median	16.1	13.3	9.5	7.1	16.1	13.3	9.5	7.1

Proportion of HIV infection at CD4 count categories 350-499

AIM - Transition parameters - (350 CD4)HIV estimation and projection 2011 to 2015_26Jan2012_update PMTC

	Male				Female			
	15 - 24	25 - 34	35 - 44	45 -54	15 - 24	25 - 34	35 - 44	45 -54
Proportion	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Table 14: HIV Mortality without ARV

AIM - Transition parameters - (350 CD4)HIV estimation and projection 2011 to 2015_26Jan2012_update PMTC

	Male				Female			
	15 - 24	25 - 34	35 - 44	45 -54	15 - 24	25 - 34	35 - 44	45 -54
> 500	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
350 - 499	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
250 - 349	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
200 - 249	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
100 - 199	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
50 - 99	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
< 50	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27

Table 15: HIV mortality with ARV

AIM - Transition parameters - (350 CD4)HIV estimation and projection 2011 to 2015_26Jan2012_update PMTC

	Male				Female			
	15 - 24	25 - 34	35 - 44	45 -54	15 - 24	25 - 34	35 - 44	45 -54
0-6 months on treatment								
> 500	0.058	0.044	0.039	0.044	0.042	0.032	0.028	0.032
350 - 499	0.105	0.08	0.07	0.079	0.076	0.058	0.051	0.057
250 - 349	0.143	0.108	0.096	0.108	0.103	0.078	0.069	0.078
200 - 249	0.111	0.084	0.074	0.084	0.08	0.061	0.054	0.061
100 - 199	0.128	0.097	0.086	0.096	0.092	0.07	0.062	0.07
50 - 99	0.227	0.172	0.152	0.171	0.164	0.124	0.11	0.124
< 50	0.417	0.316	0.279	0.314	0.301	0.228	0.201	0.227
7-12 months on treatment								
> 500	0.018	0.012	0.012	0.014	0.012	0.008	0.008	0.01
350 - 499	0.024	0.016	0.016	0.019	0.016	0.01	0.011	0.013
250 - 349	0.022	0.014	0.015	0.017	0.014	0.01	0.01	0.012
200 - 249	0.017	0.011	0.012	0.014	0.011	0.008	0.008	0.009
100 - 199	0.021	0.014	0.014	0.017	0.014	0.009	0.01	0.011
50 - 99	0.027	0.018	0.018	0.022	0.018	0.012	0.012	0.015
< 50	0.034	0.023	0.023	0.028	0.023	0.015	0.016	0.019
Greater than 12 months on treatment								
> 500	0.011	0.007	0.007	0.009	0.007	0.005	0.005	0.006
350 - 499	0.015	0.01	0.01	0.012	0.01	0.006	0.007	0.008
250 - 349	0.013	0.009	0.009	0.011	0.009	0.006	0.006	0.007
200 - 249	0.011	0.007	0.007	0.009	0.007	0.005	0.005	0.006
100 - 199	0.013	0.009	0.009	0.011	0.009	0.006	0.006	0.007
50 - 99	0.017	0.011	0.011	0.013	0.011	0.007	0.008	0.009
< 50	0.021	0.014	0.014	0.017	0.014	0.009	0.01	0.011

Table 16: Progression from HIV to AIDS death among Children without ART (Spectrum)

AIM - Transition parameters - (350 CD4)HIV estimation and projection 2011 to 2015_26Jan2012_update PMTC

	Perinatal	Post-natal 0-180 days	Post-natal 181-365 days	Post-natal 365+ days
0	0	7.32	7.32	7.32
1	1	24.39	24.39	24.39
2	2	25.82	25.82	25.82
3	3	26.97	26.97	26.97

4	4	28.57	28.57	28.57
5	5	30.6	30.6	30.6
6	6	33.05	33.05	33.05
7	7	35.88	35.88	35.88
8	8	39.05	39.05	39.05
9	9	42.51	42.51	42.51
10	10	46.2	46.2	46.2
11	11	50.05	50.05	50.05
12	12	54.01	54.01	54.01
13	13	58	58	58
14	14	61.97	61.97	61.97
15	15	65.86	65.86	65.86
16	16	69.61	69.61	69.61
17	17	73.19	73.19	73.19
18	18	76.56	76.56	76.56
19	19	79.68	79.68	79.68
20	20	82.55	82.55	82.55
21	21	85.16	85.16	85.16
22	22	87.49	87.49	87.49
23	23	89.55	89.55	89.55
24	24	91.35	91.35	91.35
25	25	92.91	92.91	92.91
26	26	94.25	94.25	94.25
27	27	95.38	95.38	95.38
28	28	96.32	96.32	96.32
29	29	97.1	97.1	97.1
30	30	97.73	97.73	97.73

Table 17: Ratio of the fertility of infected women to fertility of uninfected women

AIM - Transition parameters - (350 CD4)HIV estimation and projection 2011 to 2015_26Jan2012_update PMTC

Age	Ratio
15-19	1
20-24	0.45
25-29	0.35
30-34	0.35
35-39	0.35
40-44	0.3
45-49	0.3

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