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មជ្ឈមណ្ឌលជាតិប្រយុទ្ធនឹងជំងឺអេដស៍
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សូមគោរពជូន

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កម្មវត្ថុ: សំណើសុំការអនុញ្ញាតិប្រើប្រាស់តួលេខប៉ាន់ស្មានសំរាប់ជំងឺអេដស៍ នៅក្នុងប្រទេសកម្ពុជាសំរាប់ឆ្នាំ២០១២-២០១៥ ។

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ប្រធាន

វេជ្ជ មាន ឈីវុន

08.05.12

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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INTRODUCTION

The HIV/AIDS epidemic in Cambodia has been moving into its 20th year after the first case of HIV was identified in 1991. The Royal government of Cambodia, with the financial and technical support from developing partners and civil societies, 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]. And it is also projected that the HIV prevalence will remain stable till 2012 with the prevalence around 0.6%[1]

At the same time, HIV/AIDS care and treatment services have also been expanded significantly in order to keep up with the increasing demand of people in need of receiving 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 have been delivering care and ART to PLHIV. By the end of June 201140,436 adult PLHIV and 4,286 children < 15were receiving antiretroviral therapy (ART).

The impact of the interventions would be difficult to assess if there were no HIV/AIDS related strategic information available, especially the impact of HIV/AIDS interventions on the general population. This information can also be used for planning and managing all HIV/AIDS activities. However, the current HIV surveillance system provides only data among high-risk groups and pregnant women visiting health center for antenatal cares and the Demographic Health Survey 2010 did not include HIV testing component, . Therefore, the prevalence of HIV among the general population needs to be estimated and projected based on all existing data collected from other sub-populations.

National Center for HIV/AIDS Dermatology and STD has successfully conducted three rounds of HIV/AIDS estimation and projections (2000, 2003 and 2007). The last HIV projections have covered the period from 2006 to 2012. Therefore, there is a strong need for conducting a new round of HIV/AIDS estimations and projections from 2011 to 2015. These figures are expected by, apart from the Ministry of Health, 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 and it takes on average about 8 years for HIV to progress to AIDS, therefore 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 be originated among commercial sex work since the HIV prevalence among female sex worker (FSW) at the start of the epidemic was very high[2]. As result, female sex workers were hard hit by the epidemic. Through heterosexual contact, the HIV/AIDS epidemic had reached the male clients of female sex workers, then the spouses of the male clients and ultimately to their new born.

Regarding the trend of the epidemic, it is assumed that the HIV/AIDS epidemic in Cambodia peaked in 1998-1999, with the HIV prevalence among the general population of 2.8%[3]. The main mode of HIV transmission in Cambodia remain to be "unprotected heterosexual contact" although the HIV infections have been seen among men who have sex with men (MSM) with the HIV prevalence of 5.1% in 2005[4] and Injecting Drug User (IDU) with the HIV prevalence of 25% in 2007[5]

HIV prevalence among different Sentinel Groups

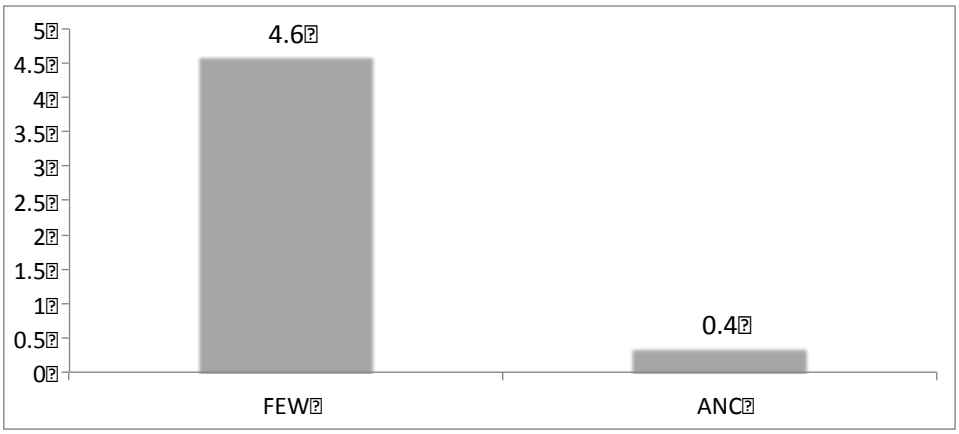
For the purpose of this estimation and projection exercise, this report presents only the result from HIV sentinel surveillance (HSS) 2010 that recently become available at the National Center for HIV/AIDS Dermatology and STDs (NCHADS). HSS 2010 were conducted at 22 cities/provinces in Cambodia. The two main sentinels group presented here are Female Entertainment Worker (FEW) and pregnant women attending antenatal clinics (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. More detail 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, 2003, Report of the HIV sentinel Survey 2003
[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 and FEW in 2010



Female Entertainment Worker population is not homogeneous; it consists of women with different level of HIV-related risks and vulnerabilities. This is because some female entertainment workers sell sex as their main source of income generation, others have jobs in the entertainment industry, which does not primarily involve the selling of sex - although selling sex may be an additional source of income for some of them. 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. Note that there are 432 and 3390 women who reported having more than 14 clients per week and less than 14 clients per week, respectively.

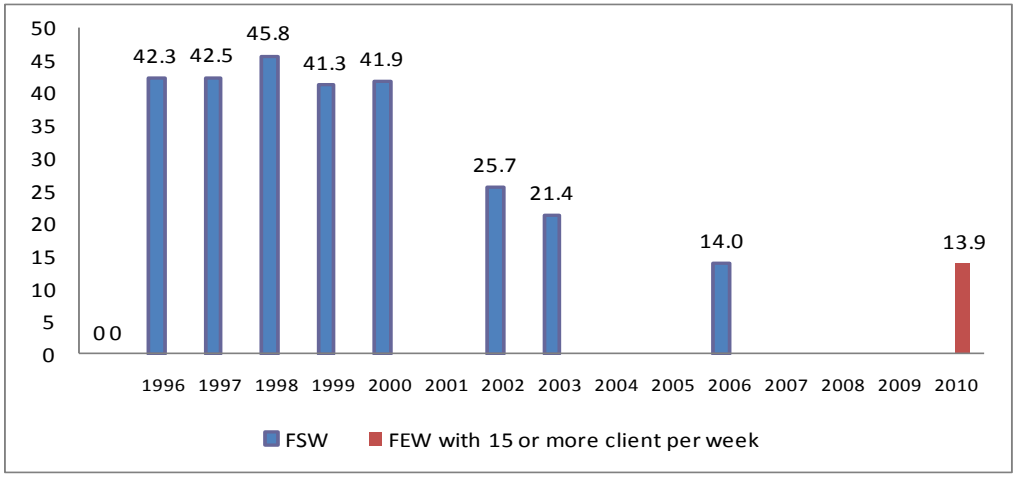
It has been found that the HIV prevalence among FEW who reported having male clients more than 14 per week was 13.9%, while those who reported having 14 or less clients per week was only 4.1%. Note that, the HIV prevalence among those who had less than 15 clients per week did include FEW who reported never had sex, which was responsible for about 4% of the total sample.

Figure 2: HIV prevalence among Female entertainment workers, by number of sexual clients per week

Comparing FEW who had more than 14 clients per week and brothel based female sex worker revealed that these two groups are very similar in term of the HIV prevalence. It is possible that after the brothel

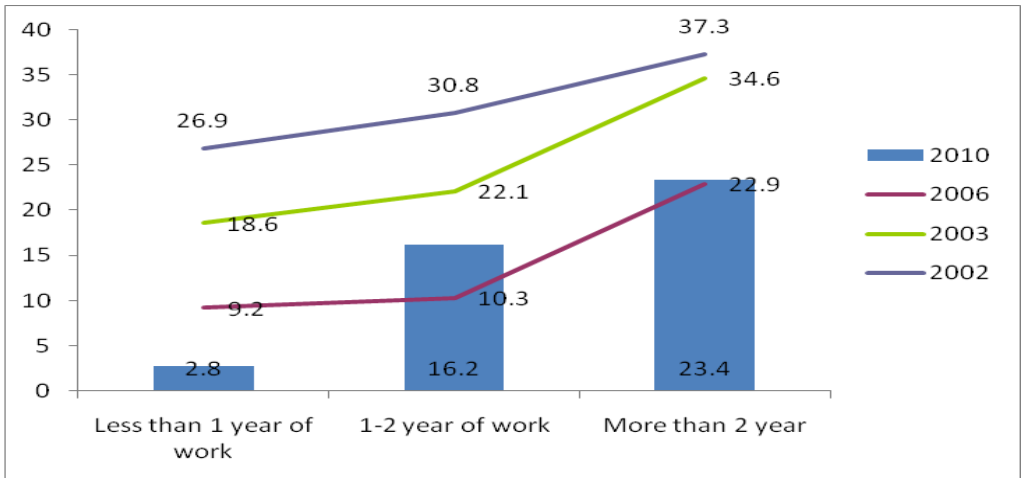
crack down in 2008, many brothel based sex workers have moved to work in establishments, however, their main job is still to provide commercial sex.

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



The total HSS 2010 sample, there were 2083 FEW who had worked for less than 12 month, 1085 for working between 12 months to 2 years and 755 had work for more than 2 years. Besides, the HIV prevalence among those with multiple partners is strongly associated with the duration of time they spent working as female 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) Compared to FSW by Duration of Work



HIV prevalence among ANC

HIV prevalence among ANC has been used as the main source for the HIV/AIDS estimation and projections for Cambodia since 2003. In fact, women attending ANC clinics have been included into 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 round of HSS (including 2010) have been entered into EPP program, so the trend could be established and smoothed. That is, the HIV trends produced in 2006, which consisted of HIV prevalence up to 2006 was not used here.

As result, it has been found that the HIV prevalence among ANC had 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

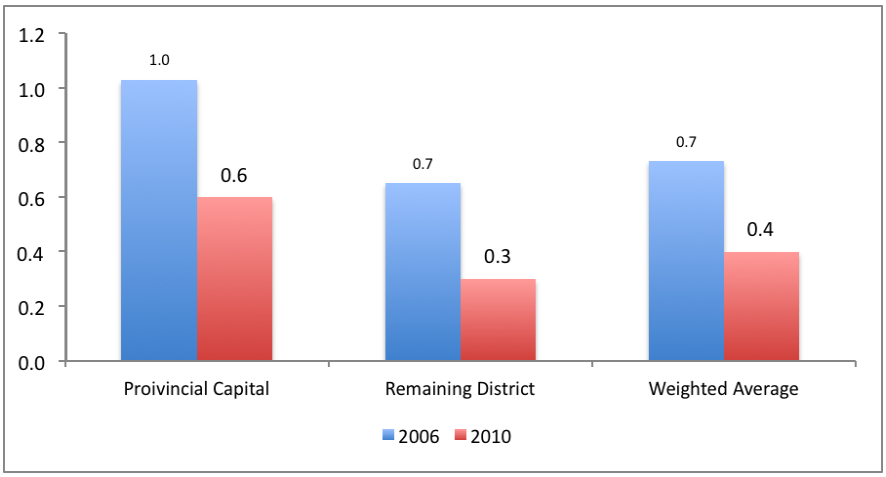
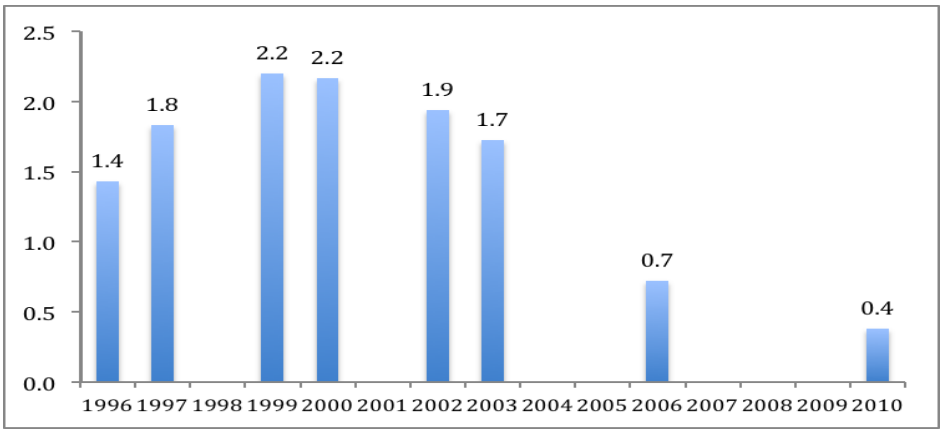
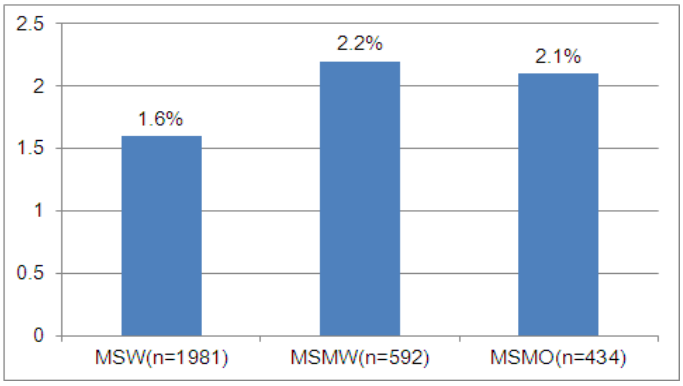


Figure 6: Population Weighted* HIV Prevalence among Pregnant Women Attending ANC over years



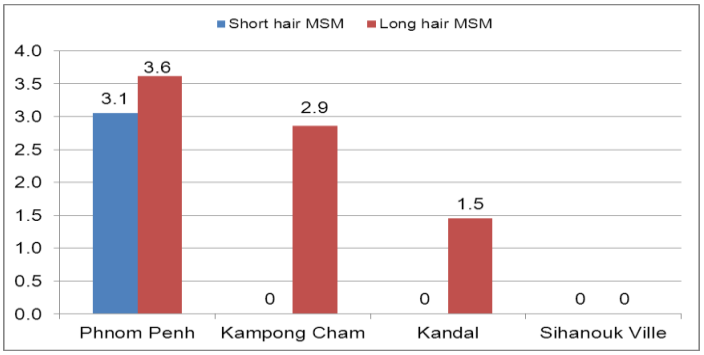
In 2010, the new HIV prevalence among men who have sex with men and other high risk men become available. These data were taken from the BROS Khmer study conducted by FHI and NCHADS outside entertainment venues in eight cities. The report of the study is available elsewhere[7]. The sub groups included 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



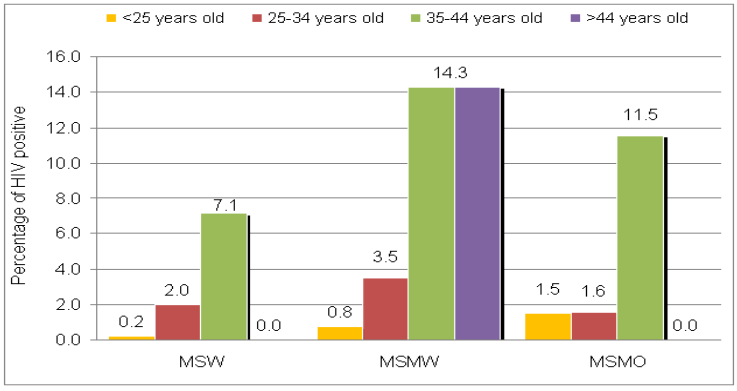
[7] FHI & NCHADS, 2010, Report on BROS Khmer Study

Figure 8: HIV Prevalence among Long and Short hair MSM, by provinces



Besides, the HIV prevalence among long hair (trangender) and short hair MSM (MSM whose physical apprence is like straight man) appeared to be different, especially in the province. It seems that the HIV prevalence between the two groups were different across provinces, expcept in Sihanouk ville.

Figure 9: HIV Prevalence among Different age groups



The HIV prevalence were higher in the older age groups. This result is strong evidence suggesting that the new HIV infection is not common among those young MSM, in other words, among MSM who have recently become sexually active and engage in sexual activities.

Responses to HIV/AIDS Epidemic in Cambodia

At the early phase of the epidemic, HIV prevention was the main strategy implemented. The main objectives of the HIV prevention and education program were to increase the knowledge about HIV/AIDS, to reduce the risk behaviors for HIV infection and to raise awareness and commitment among policy makers about the need for multi-sectoral responses for combating 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 the result, safer sexual practices, which defined as always use

condom, reduction number of high risk partners, screening and treatment for STI, has been observed across all sentinel groups, especially among female direct sex workers.

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 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 levels of consistent condom use were 81.5% and 89.2% among FEW who reported having 2 or less partners per day (corresponding to 14 or less per week –n=384) and FEW with more than 2 partners per day (corresponding to 15 or more partners per week –n=130), respectively.

Figure 10: Percentage of Consistent Condom Use with Clients, by groups

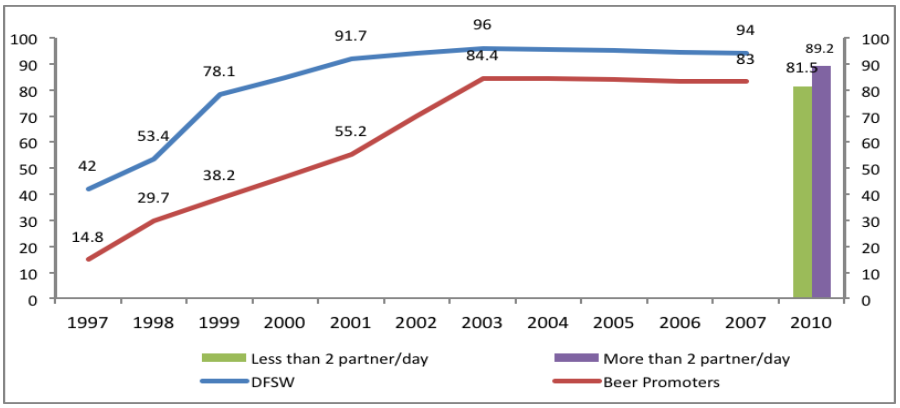
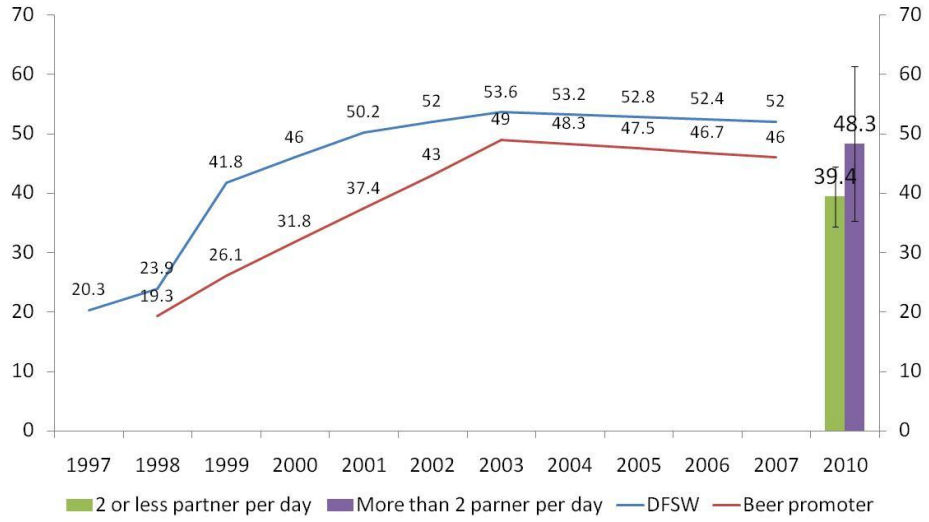
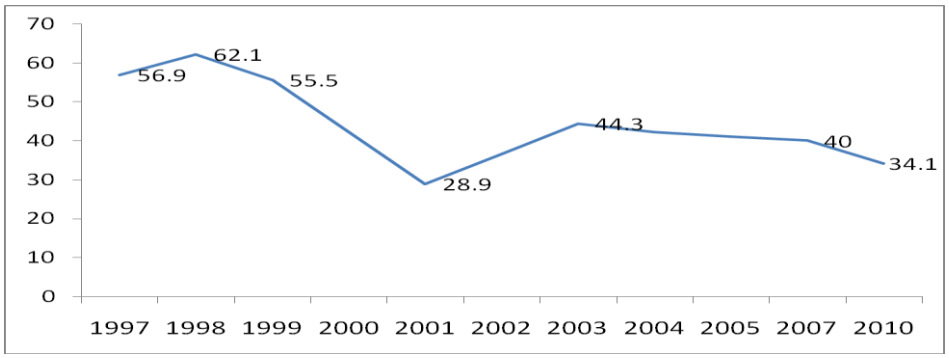


Figure 11: Trend of Percent of Consistent Condom Use with Sweethearts, by groups



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 : Percent of Commercial Sex Use in the Past Year among Moto-taxi driver



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

Figure 13 : Percent Consistent Condom Use with Commercial Partner (in the past 3 months) among Moto-taxi driver

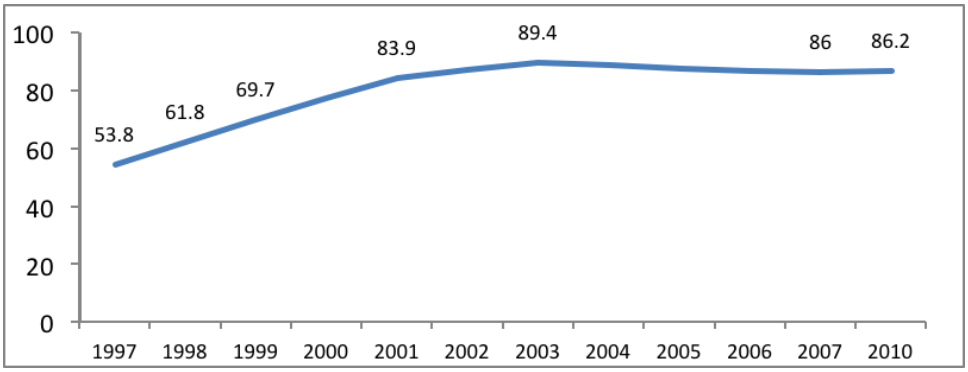


Figure 14: Percent of Consistent Condom Use with Sweethearts (in the past 3 months) among Moto-taxi driver

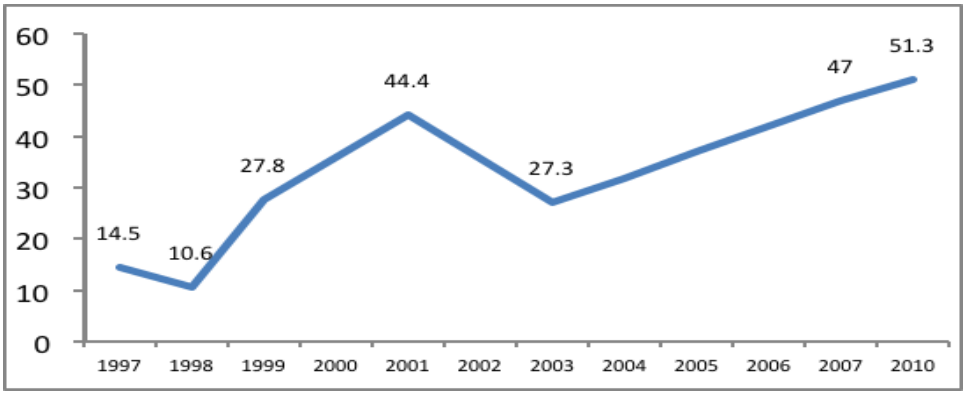


Figure 13 and 14 above showed the trend of condom use with commerical partners and with sweetheart. These trends were very consistent with the ones reported by female entertainment workers.

Apart from working on the prevention areas, the HIV/AIDS response in Cambodia has also focussed on offering services to those who are living with HIV. For example, 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 was started in 2001 and increased rapidly from 2005.

Figure 15: Reported Number of Patients Receiving Antiretroviral Treatment

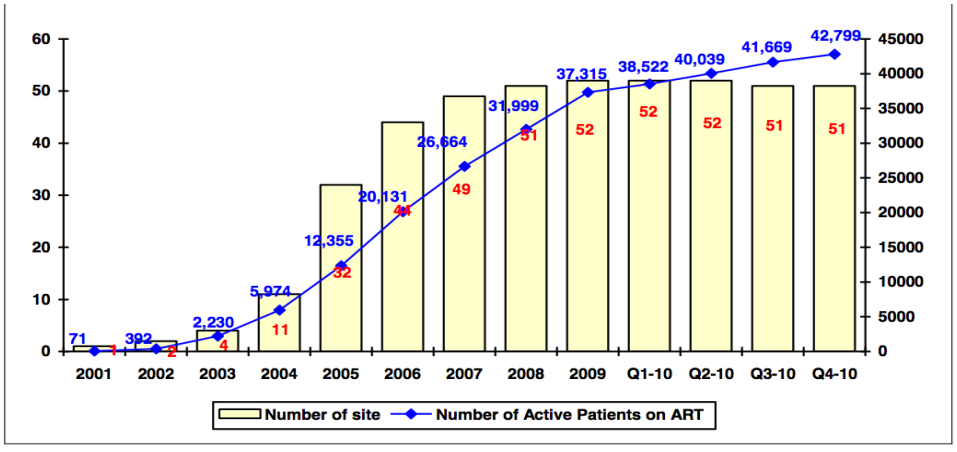
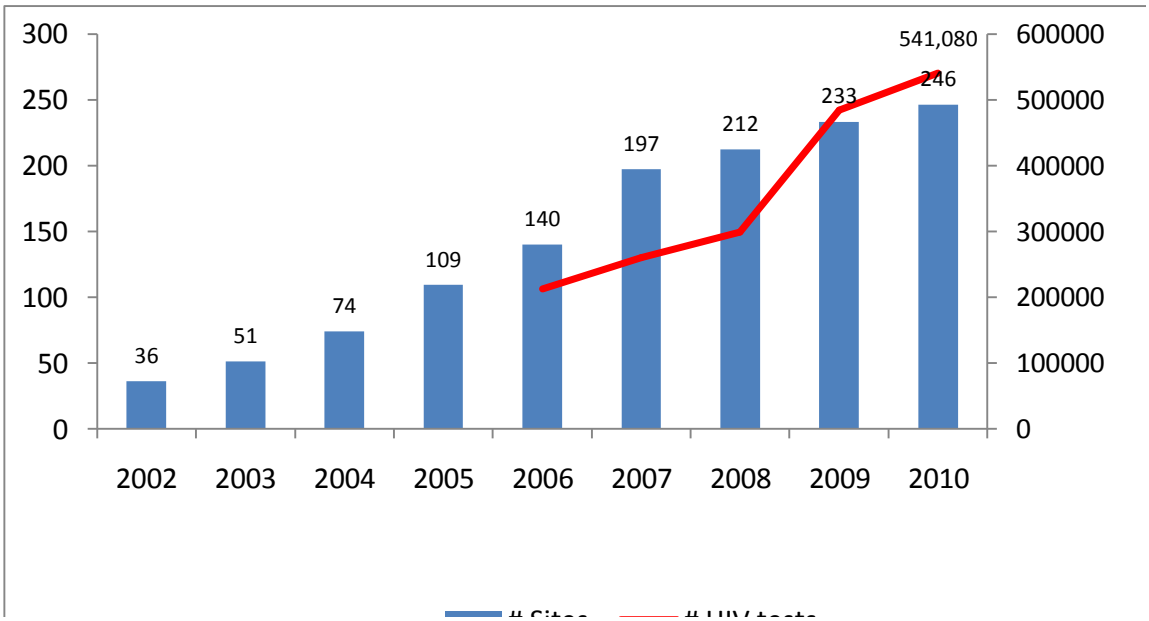


Figure 16: Number of VCCT sites and number of HIV test performed Over Years



OBJECTIVES

The main objectives of the HIV estimation and projection 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 implementations

METHODS

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

Due to the magnitudes 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.

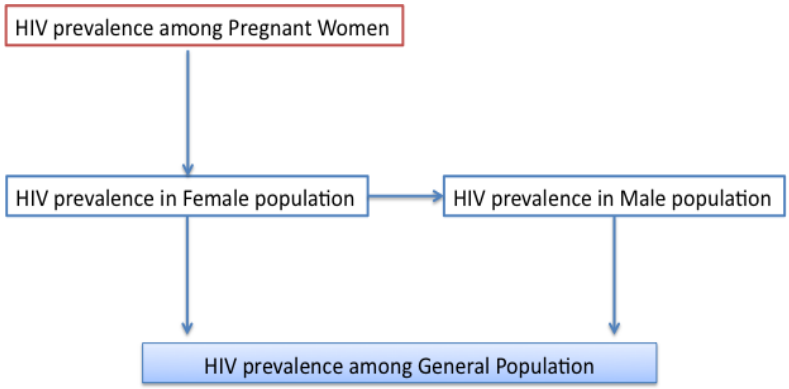
During the first 5 day workshop (27 June – 01 July 2011), the team discussed and determined the best estimate and projection methods appropriate for Cambodia HIV/AIDS situation. The main output for this technical workshop was to produce the HIV prevalence among the Cambodian general population in 2010.

The projection workshop was conducted from 06 to 09 September 2011. The experts who involved in the first workshop were also invited to join the second workshop. Due to time constraint, 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 presented in the second workshop.

1. Estimation of HIV prevalence among General Population

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

Figure 17: Methods used for Estimating HIV prevalence among general population



1.1. Methods for Estimating HIV prevalence among female population

Literature showed that the availability of antiretroviral treatment had strong effect on the survival of AIDS patients. Consequently, it will significantly affect the prevalence of the 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 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

Actually, 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 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 offered a brief description of the method that was appropriate for estimating HIV prevalence among 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 female general population from pregnant women using antenatal care at health centers (ANC) and the use of the ratio of HIV prevalence among TB patients (with a 2 year lead) were appropriate since there have 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 general population in the High ART coverage phase

The logic of estimating the HIV prevalence among general population from the HIV prevalence among female and male population still applied in this high ART coverage phase. However, the method to calculate the HIV prevalence among general female 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 remained unchanged in both phases of ART coverage.

1.1.2.1. Methods for estimating HIV prevalence among general female population

The result from 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 were collected from health center 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 had 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 had not been diagnosed, or had been diagnosed but not yet started treatment, designated (W_U)

The total women of childbearing ages (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 be 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.

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.

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

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 the 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 the pregnant women in Cambodia in the survey year who 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 adjusting factor of 10% for duplication.

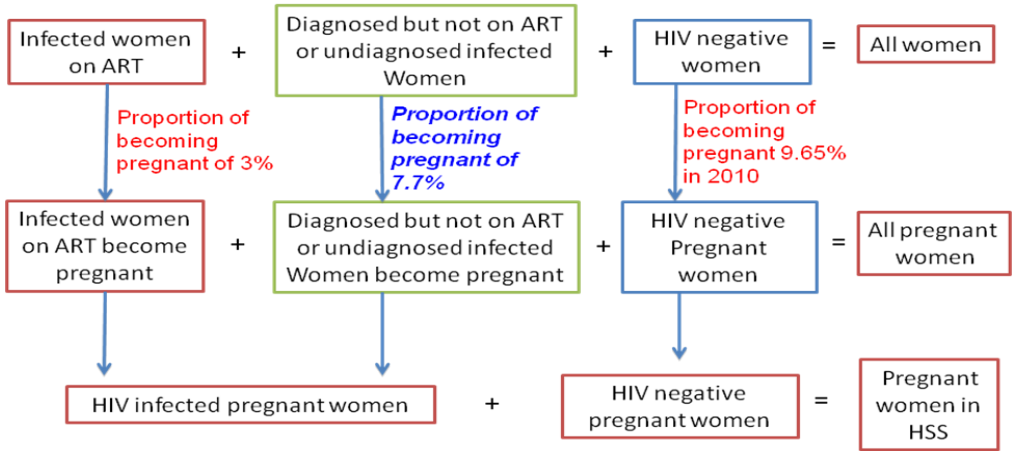
The one unknown quantity remaining in this equation is p_U, the proportion of women with undiagnosed HIV or diagnosed but untreated who become pregnant in the year. There have been no data from Cambodia, and few data from anywhere else that be used to estimate this proportion. In other settings, a figure of 0.8 of the proportion of general women become pregnant in that particular year has been used, and we have adopted it here. We also carried out sensitivity analyses, varying the figure between

[9] CDHS 2010

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

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.

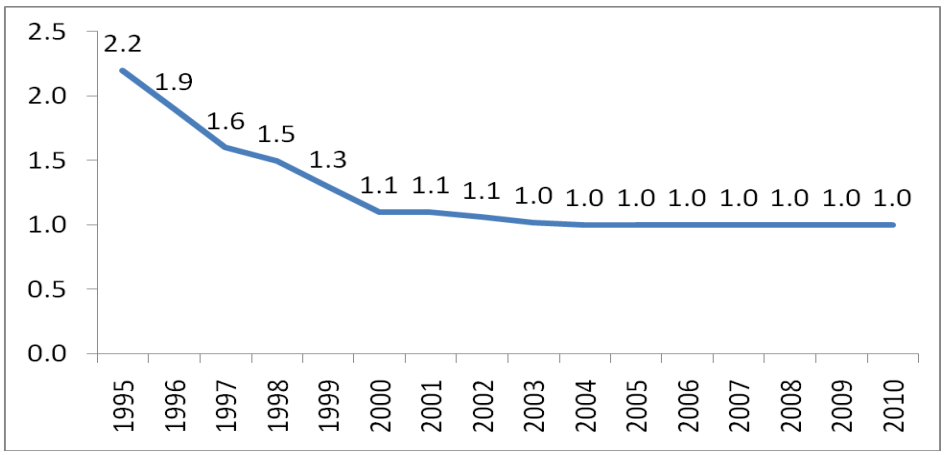
Figure 18: Diagram of the method used to estimate HIV prevalence among female in high ART coverage



1.2. Estimating HIV prevalence among 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 for any given year was a figure representing 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 standard of care, it takes 2 years on average for an HIV infected individuals to manifest with TB symptoms.

Figure 19: Ratio HIV + male to female among TB patients



2. Methods for HIV/AIDS Projections

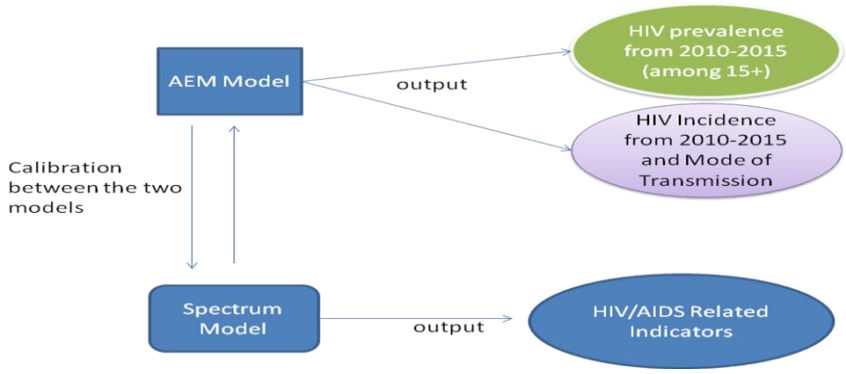
The second workshop, conducted from 05 to 09 September 2011, exclusively dealt with projecting the HIV prevalence among general population, as well as other key indicators related to HIV/AIDS.

Two models were explored; Asian Epidemic Model (AEM) and Spectrum. When applying 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. AEM model will be used to produce the HIV prevalence among 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 term of its inputs and assumptions, the models were calibrated against each other on 3 mains 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 related to sexual behaviors, program coverage and HIV prevalence among different groups. More detail inputs are attached as the Annex 1 of the reports.

2.1.2. Spectrum

Spectrum software version 4.41 was used. The detail inputs of the model were given 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 to 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 used to project the HIV prevalence;

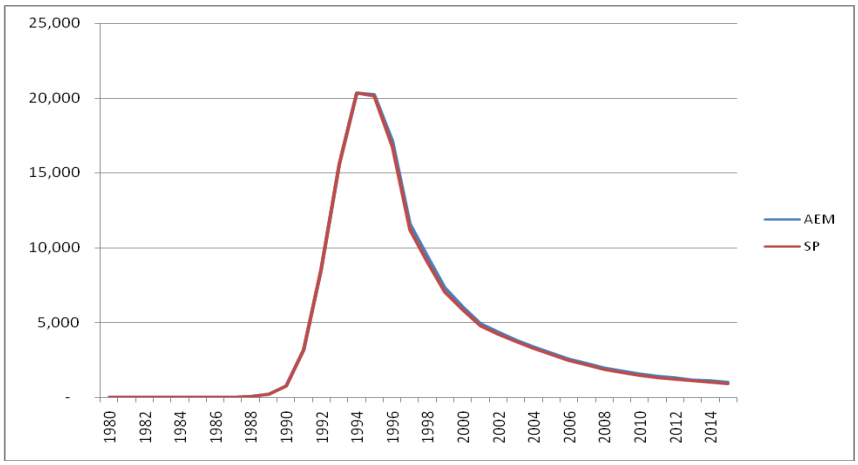
- The incidence rate which was produced by AEM had been imported into Spectrum, using a correcting factor of 1.03. The reason for using a correcting factor of 1.03 was because the Spectrum model appeared to project a lower incidence than AEM.
- The number of patients receiving ART was taken from the NCHADS reports of the OI/ART sites. This number was used in the Spectrum input regarding to ARV treatment among adult. 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 assume that the reported number of patient on ART from ART sites was 10% over reported.
- The female to male ratio from AEM were used in Spectrum. These ratios were calculated based on the HIV incidence within 15-49 age group produced by AEM.
- The CD4 cutoff for those in the need of ART in both spectrum and AEM were 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 life of AIDS patients too fast, so the experts agreed to reduce it by half in the later stage of the disease. The detail of the survival rate by different level of CD4 was given in the annex of the report.

- The fertility ratio of HIV infected women to HIV uninfected women to about 0.45 for those aged 20-24, 0.35 for aged from 25 to 39yr and 0.30 for age 40 to 45years 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 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 mother 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 peri-natal period to be equaled to those who got infected during the post natal (0-180 days after birth), although in other setting they die faster.

After the calibrating the models, the three key indicators - incidence cases, prevalence and mortality among population aged 15+, from both model were put on the same graph to detect the differences, however, 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 Projected incidence cases produced by both models



After the 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

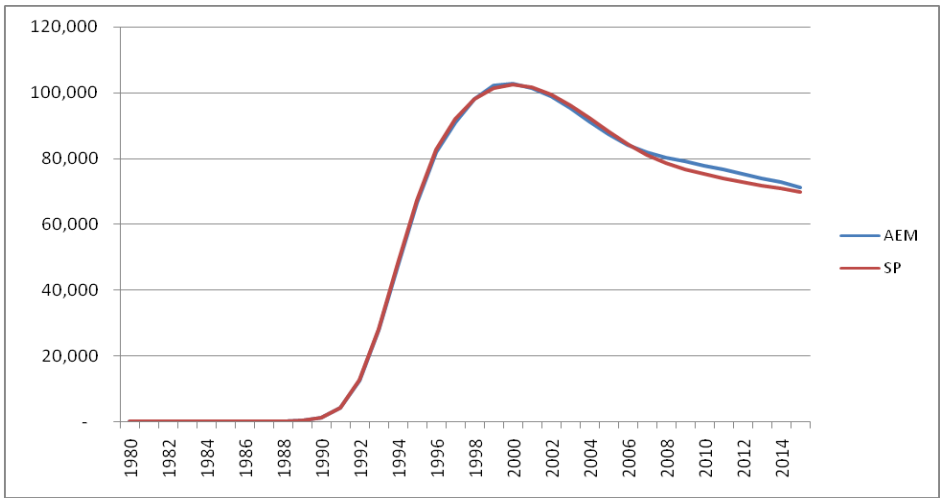
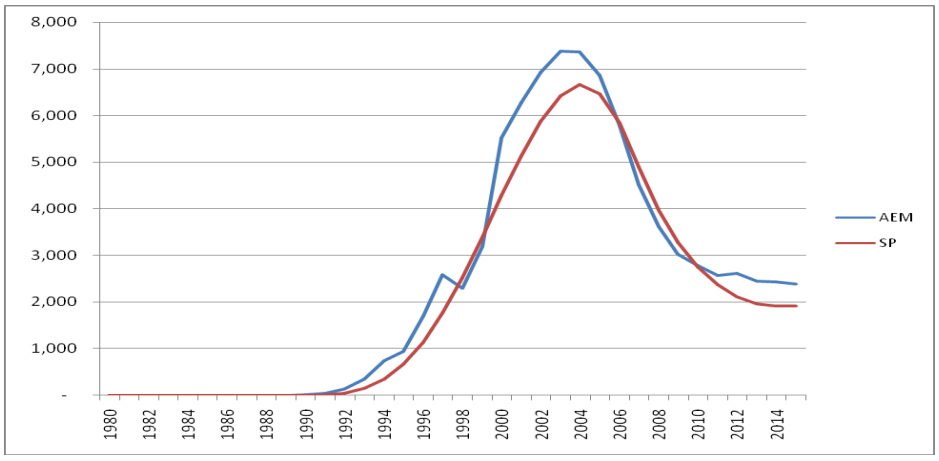


Figure 23: Trend of HIV deaths projected by the two models



2.4. Final fitting the Spectrum model

After successfully matching Spectrum to AEM models, the Spectrum model was refined further on 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 effect on indicators related to children aged 0-14 years old. Those parameters were;

- It had been agreed to change the progression rate among children in need of the treatment. That is, among children, it should take 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 the changes are in the annex of this report.
- Similarly, in spectrum, the survival of HIV+ general population on ART, which is used to estimate number of orphan, was also revised. It had been assumed that the percentage of death among HIV+ individual in low risk group 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. Consequently, this resulting in decreasing number death 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 were set to 250. This change would affect the number of adult in need of ART.
- Base 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 started 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 interested for the year 2011 to 2015. However, due the uncertainty of the future, this projection would not be possible without several hidden assumptions. Those assumptions were:

- The current level of AIDS responses, 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 policy related to PMTCT, HIV treatment guideline for HIV infected adult (CD4<350) had been implemented country-wide in 2010, although guideline was disseminated in late 2011, and 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 estimation and projection 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 the 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 term 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 user were very limited. So, it was assumed that the HIV prevalence among IDU has s remained stable at 25% from 2007 to 2015. This is a big assumptions and it may have strong impact in the mode of transmission that produced by the model.
- Should we also add that risk behaviors and HIV prevalence might change in certain MARPs groups over the projected 5 year period, but we assume that historical trends in behaviors and HIV prevalence will continue over this time period? (I'm thinking about the MSM epidemics in Thailand and Myanmar.)

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 HIV sentinel Survey 2006 and 2011.

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

Table 2: Summary of data for estimating HIV for general women in high ART coverage

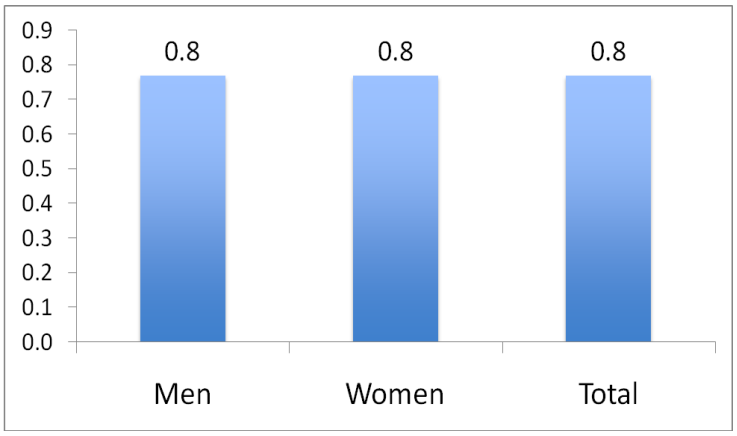
	2006	**2010**
Number women 15-49 (Wtotal)	3,558,126	3,782,421
Number of delivery in 2010 (total pregnancy)	382,499	365,004
% HIV+ pregnant women (from HSS2010) (adjusted for QC and urban rural)	0.73%	0.36%
Number of HIV+ pregnant women (ftWt+FuWu)	2,776.94	1,314.01
% of HIV+ who on ART before they get pregnant	10%	40%
% of HIV+ who not on ART before 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 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 adjust 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 on ART before they get pregnant and % HIV+ who not on ART before they get pregnant were assumed based on the consensus. However, these percentages were set in way to ensure that it 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: Estimate HIV prevalence among 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 (from AEM)

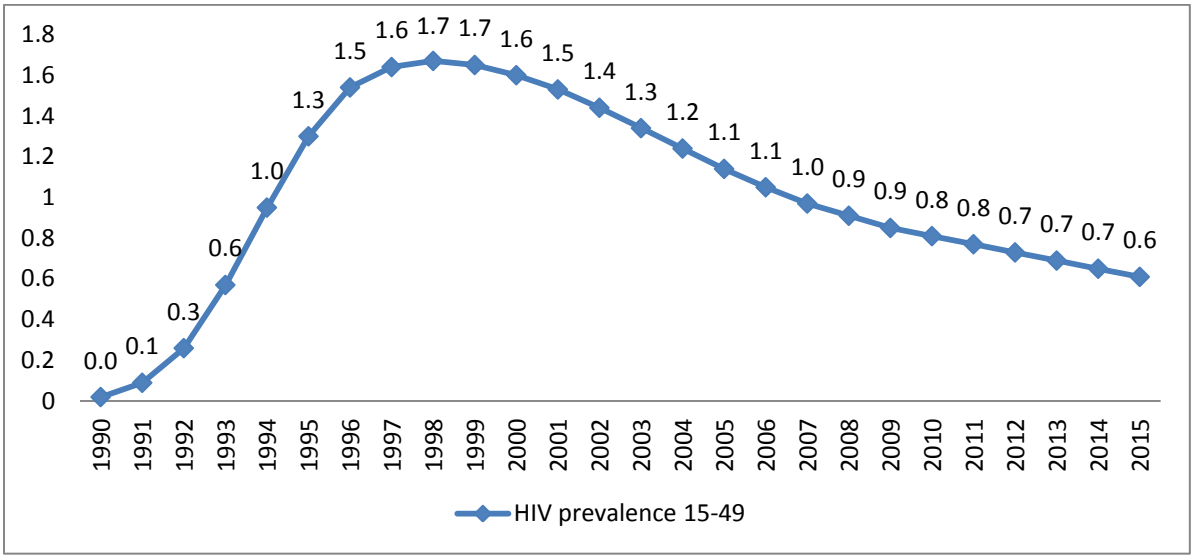
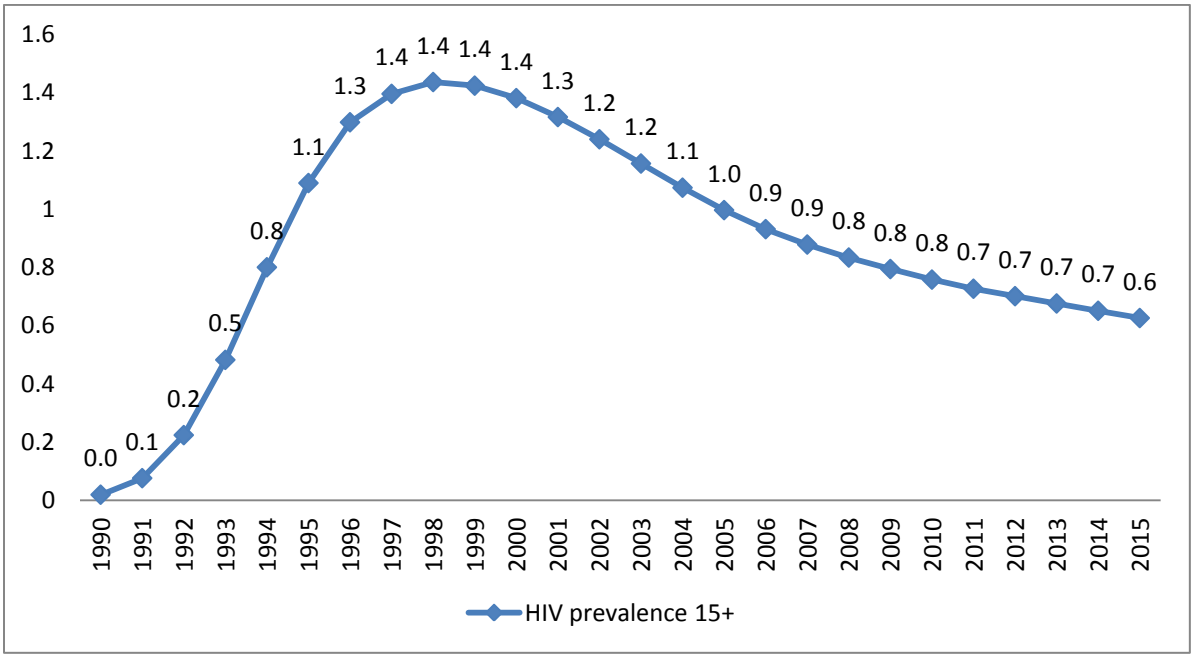


Figure 26: HIV prevalence among general population aged 15+ (from Spectrum)



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 general population by different age groups

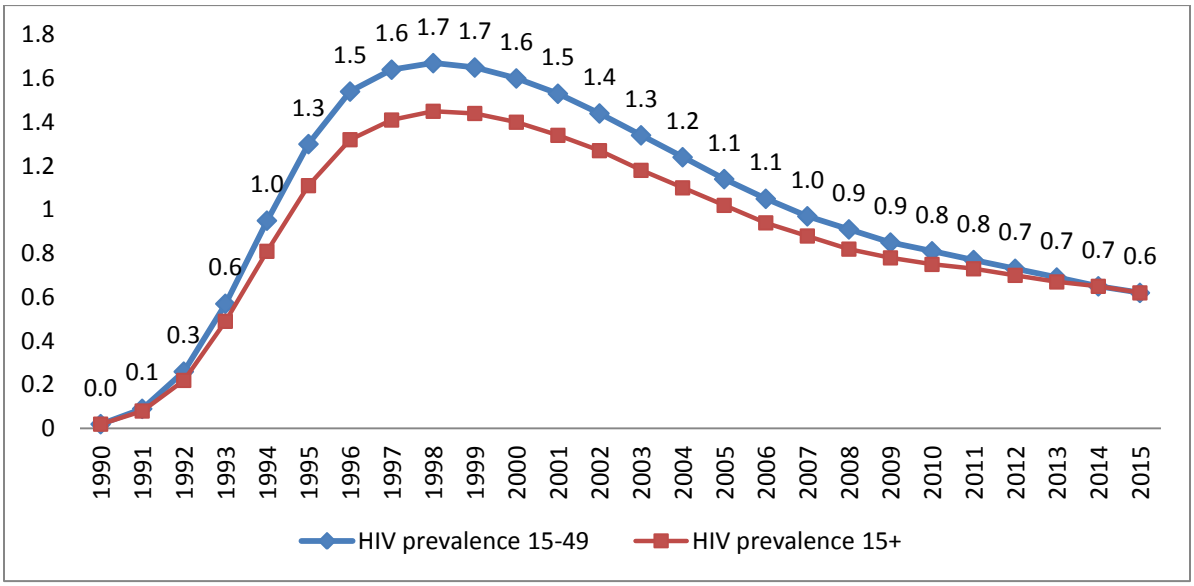
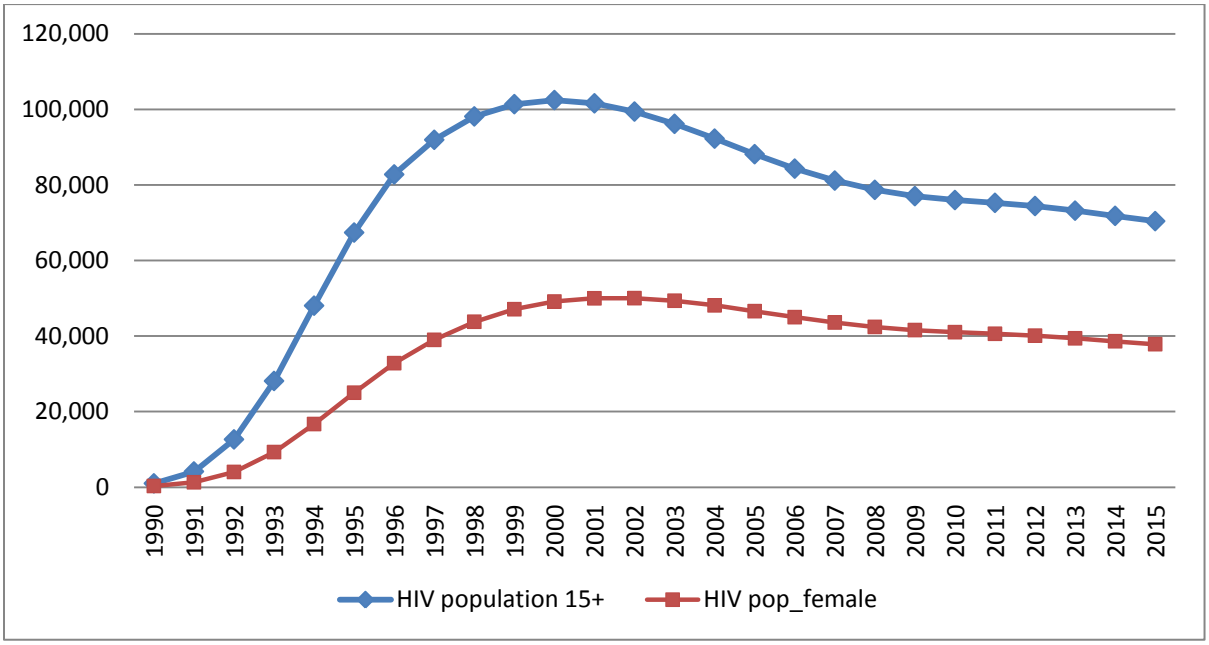


Figure 28: Number of HIV infected population aged 15+ (from Spectrum)



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

Figure 29: Number of HIV infected population aged 15+ over years (from Spectrum)

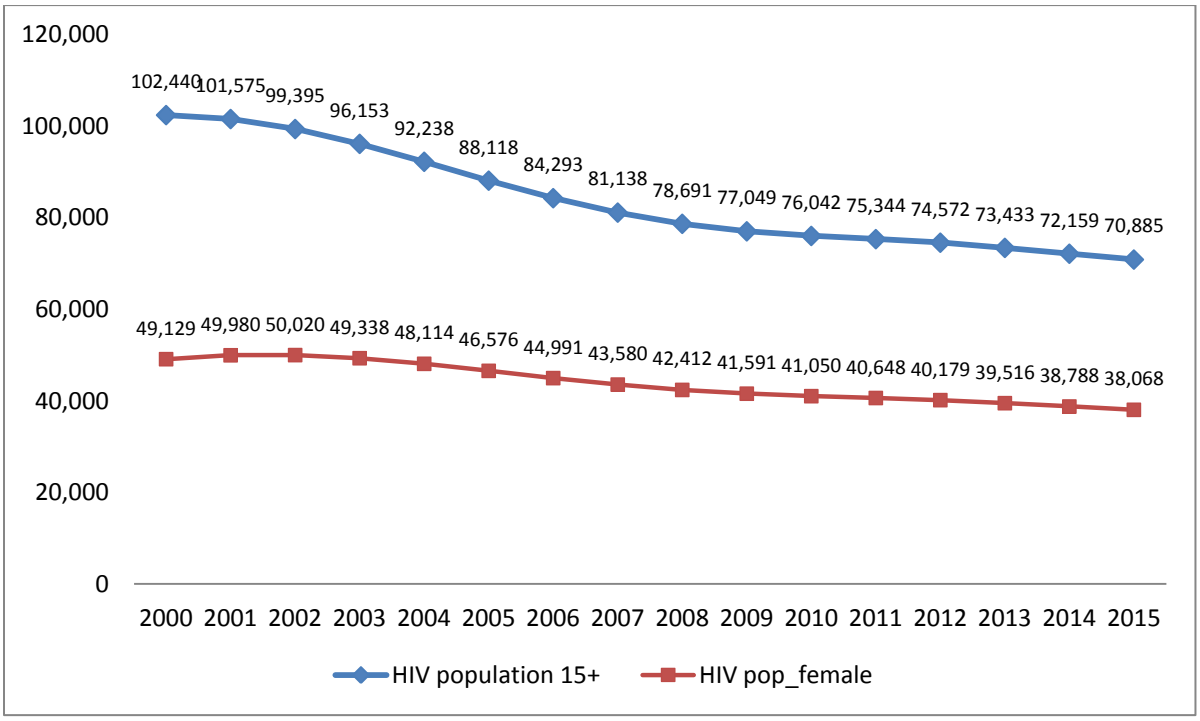
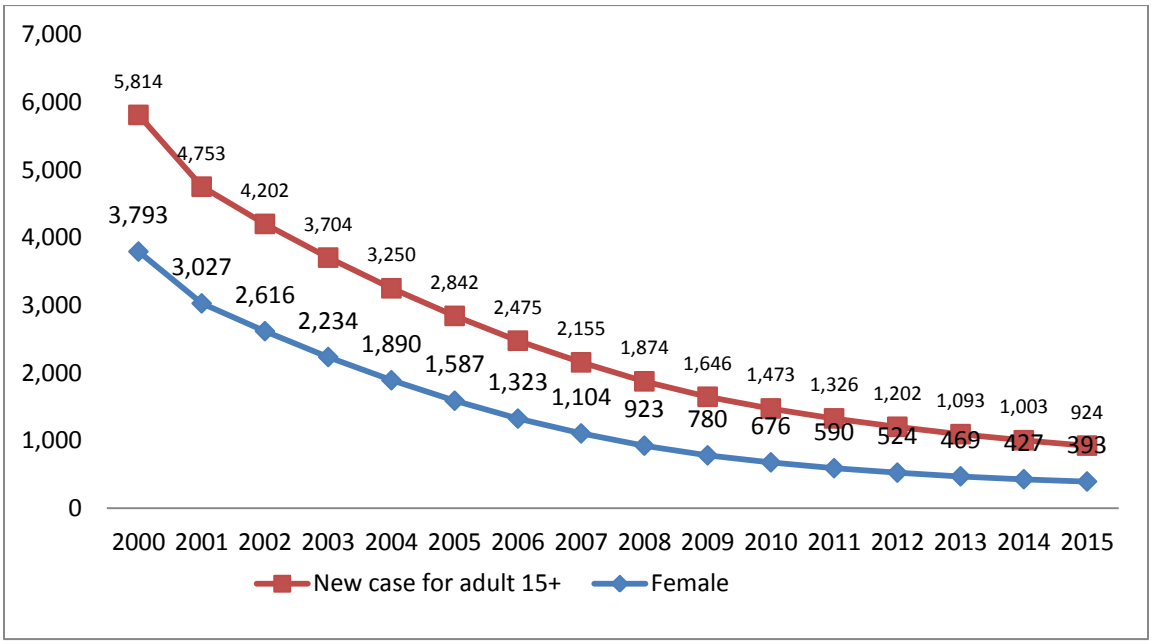
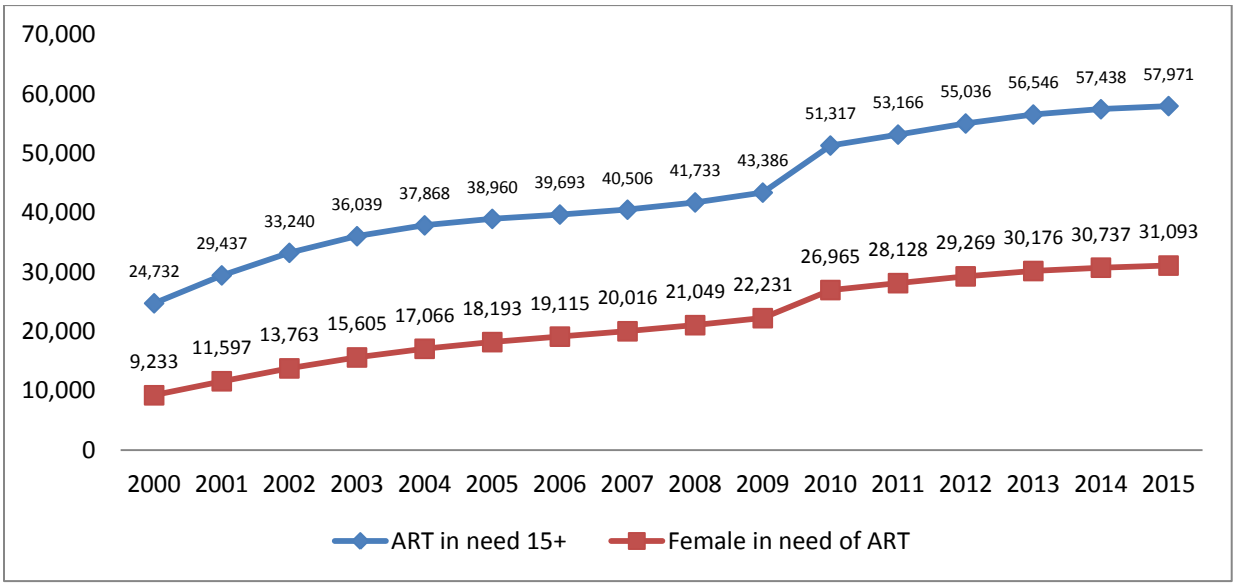


Figure 30: Number of New HIV cases among population aged 15+ years old (from Spectrum)



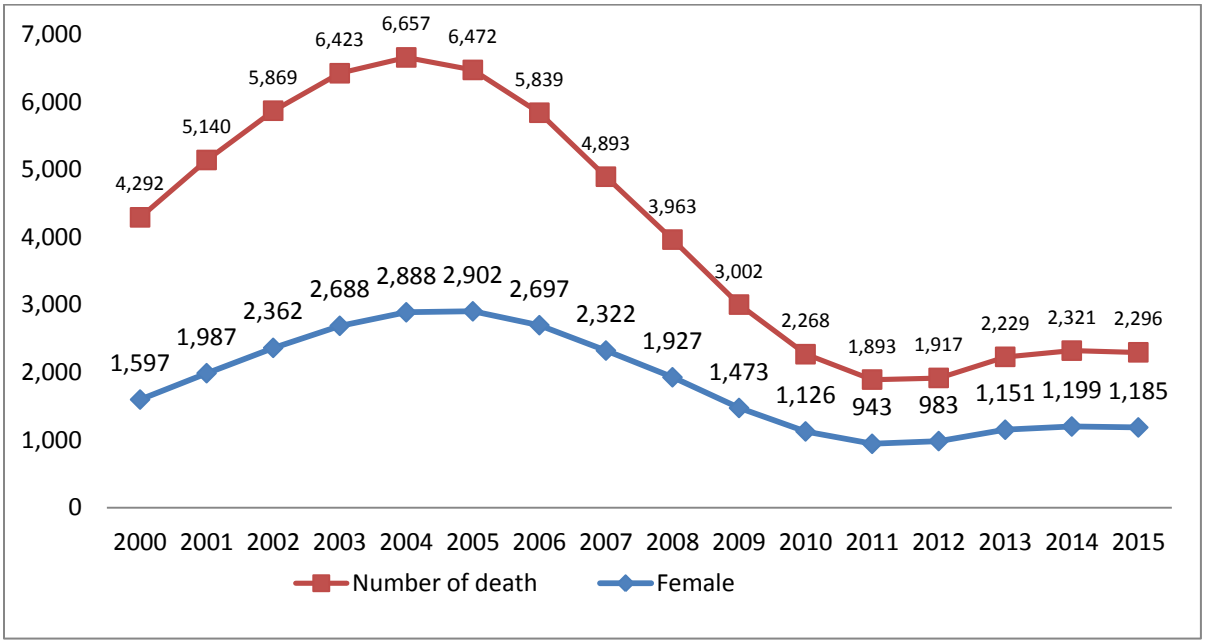
The projected number of new HIV cases among population aged 15+ was 1,473 in 2010, which was corresponding to about 4 newly infected per day. In 2015, there will be less than 3 people newly infected per day.

Figure 31: Number of AIDS patients aged 15+ in need of ART (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.

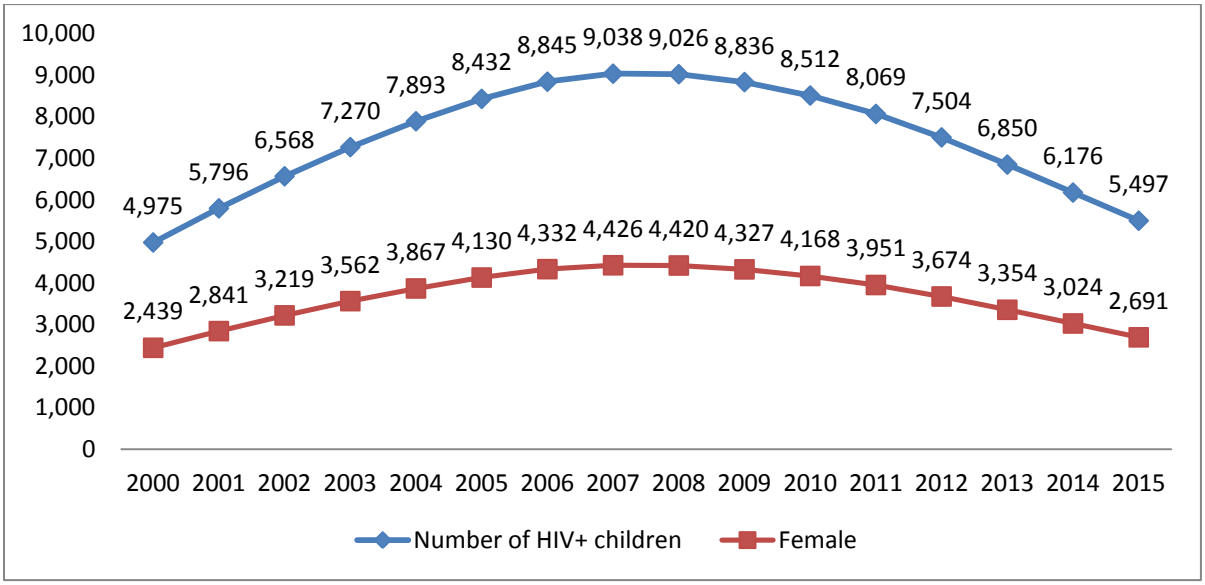
Figure 32: Number of AIDS deaths among adult population 15+ (from Spectrum)



With the assumption of maintaining the current expansion of the ART coverage (with annual scale up of 1400 patients per year) from 2010 to 2015, the annual number of HIV deaths among the population

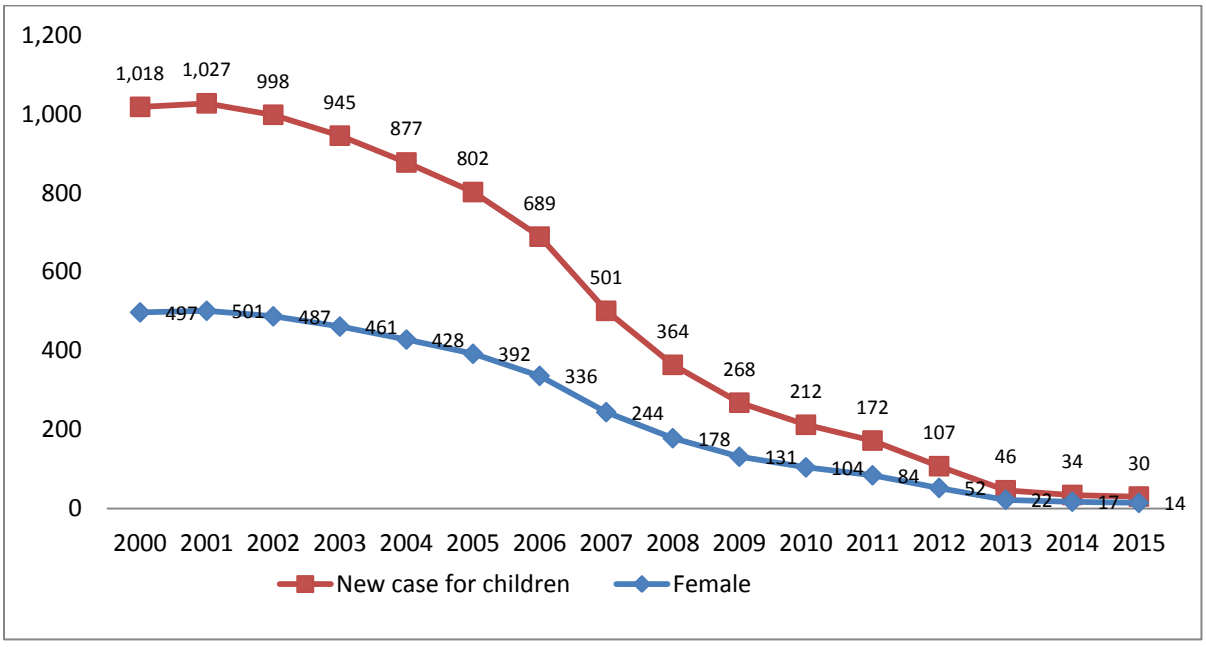
aged 15+ will decrease slightly from 2011 to 1,880 and would remain relatively stable at 2,195 in 2013 and about 2,213 in 2015.

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



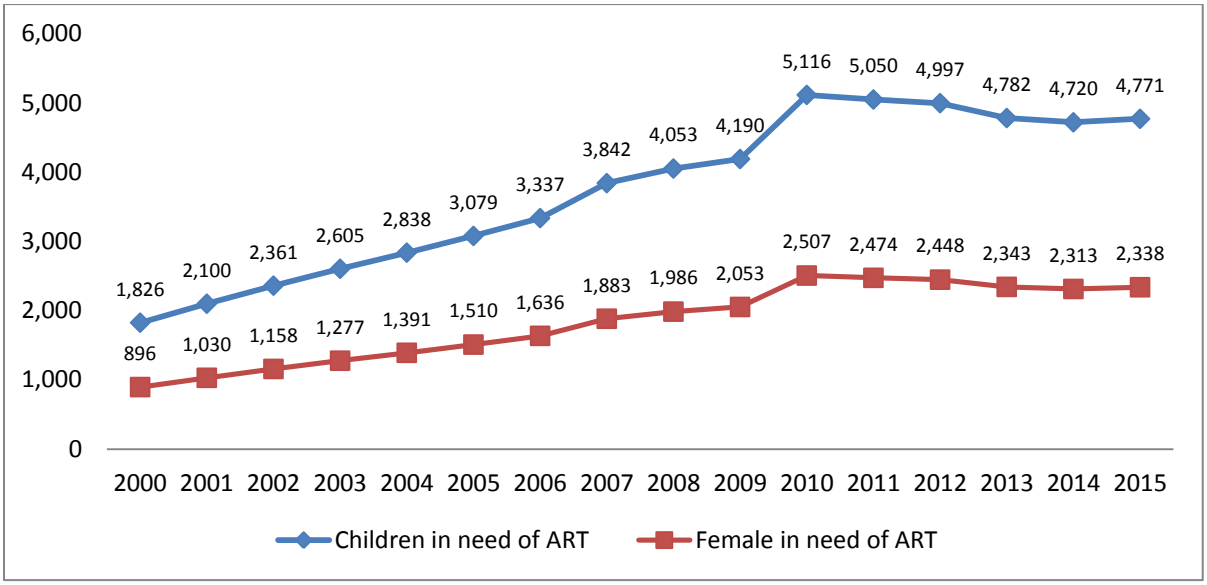
From Spectrum model, the number of HIV+ children age 0-14 was also estimated and projected. In 2010, there were 6,106 children living with HIV and in the year 2015, there would be only 4,234 HIV infected children.

Figure 34: Number of new HIV cases among Children aged 0-14 years old (from Spectrum)



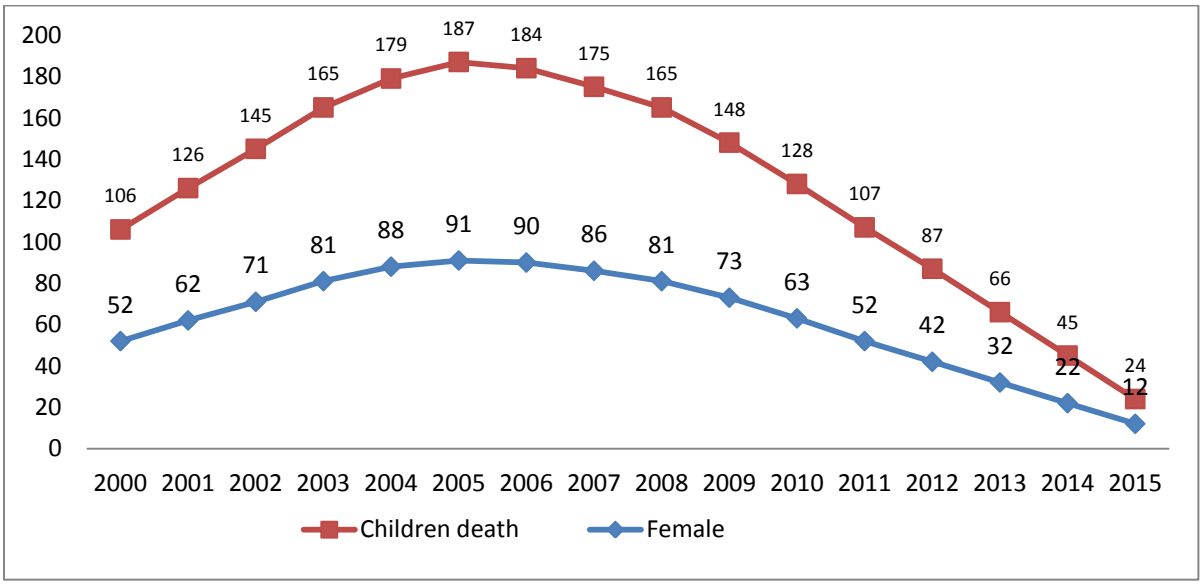
It had been projected that the number of new HIV cases among children would significantly drop from 2010 to 2015.

Figure 35: Number of Children aged 0-14 in need of ART (from Spectrum)



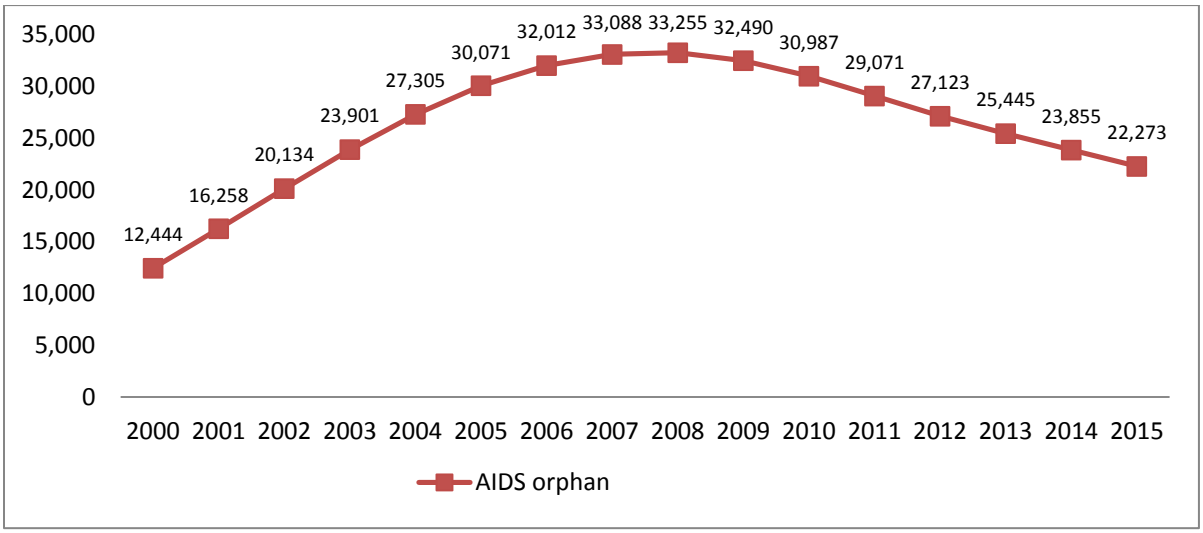
The number of children in need of ART would be stable from 2010 to 2015, while the number of deaths would decline. It might be possible that the number of children in need of ART would be about 4,770 by 2015.

Figure 36: Number of AIDS deaths among Children aged 0-14 years old



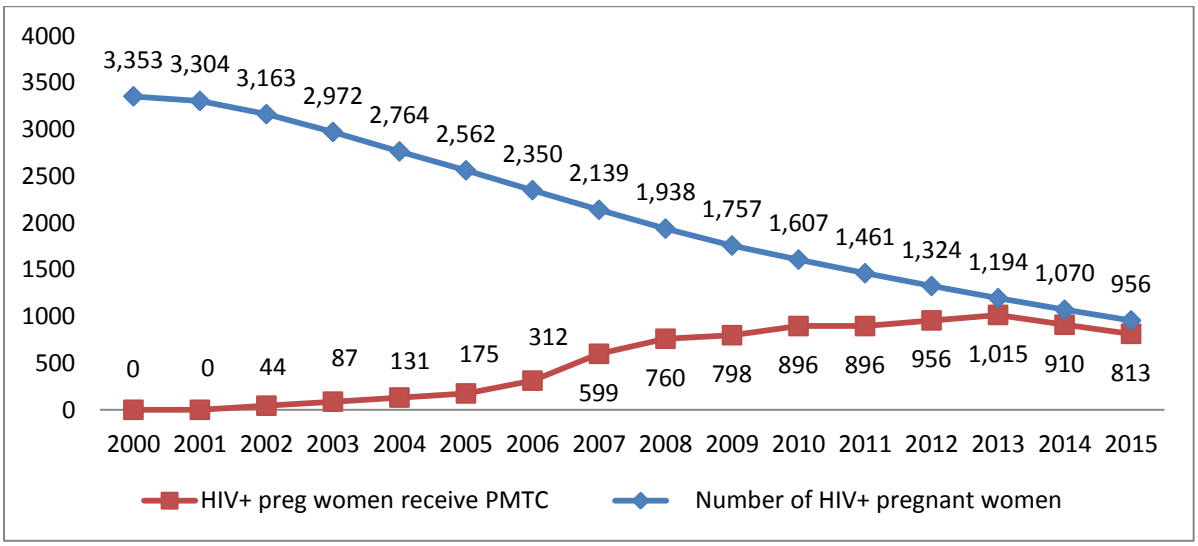
Number of AIDS orphan is newly estimated in this round of HIV/AIDS estimation and projection. It has been found that the number of total AIDS orphans would go down from about 32,000 in 2010 to 22,800 in 2015.

Figure 37: Number of total AIDS orphans



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

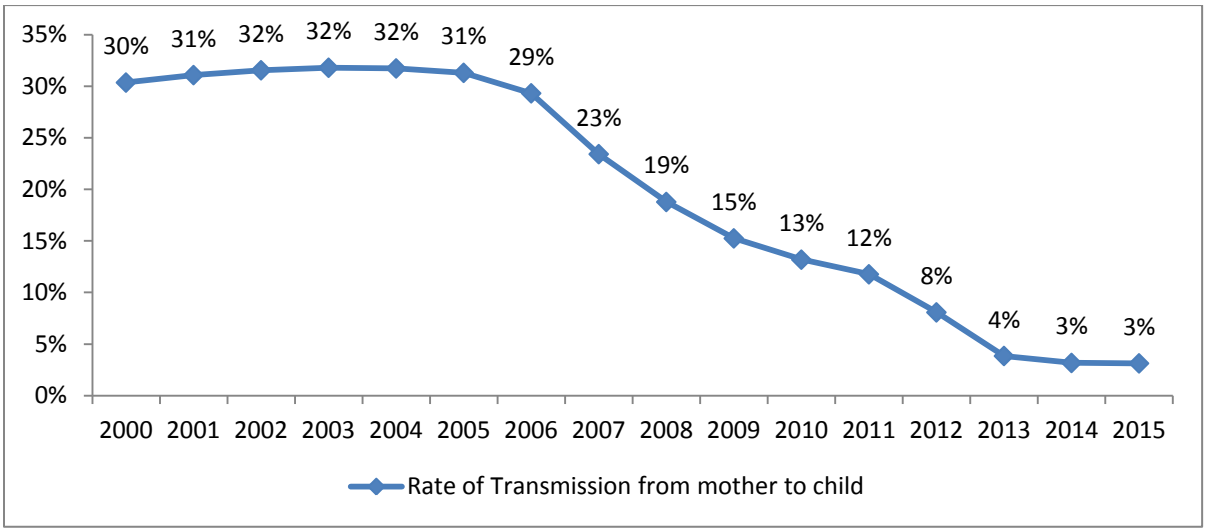
Figure 38: Estimated Number of HIV+ infected women & those receiving PMTCT



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 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.

[1111] 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 (from spectrum)



The mode of transmission, which was an output from AEM model, was presented below. This mode of transmission was estimated based on the estimated 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 did take into account different group of population.

Figure 40: Mode of Transmission based on new HIV cases

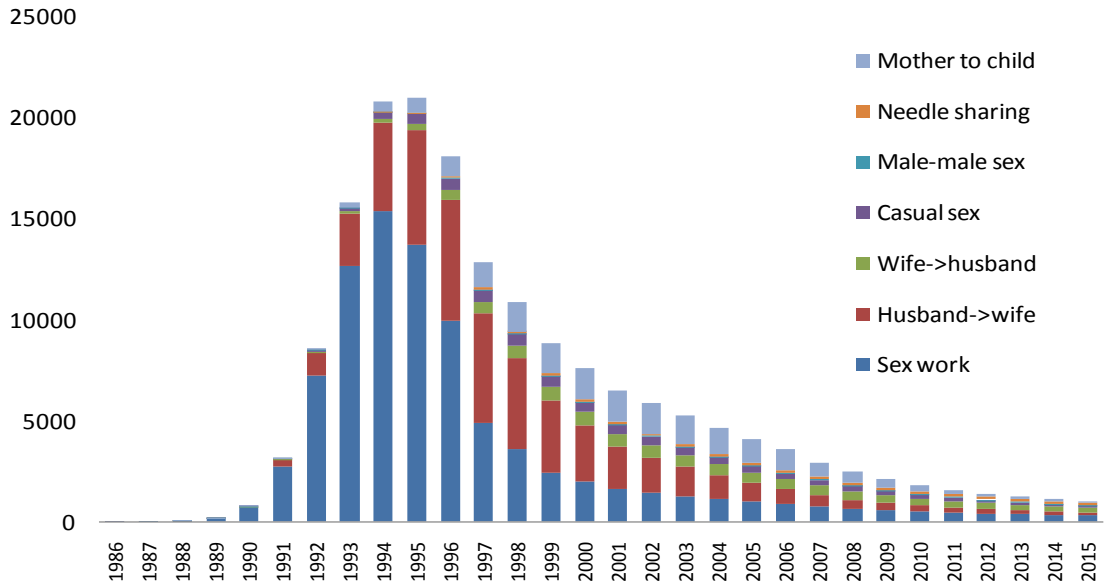
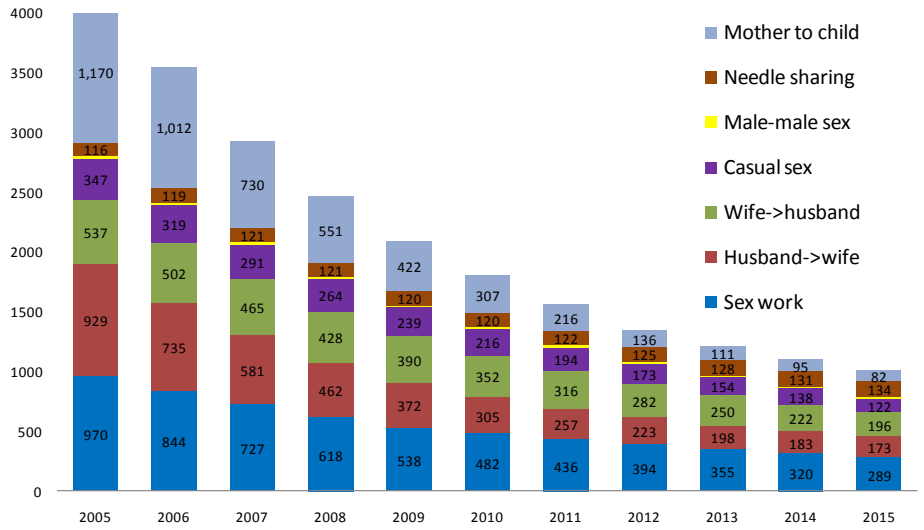
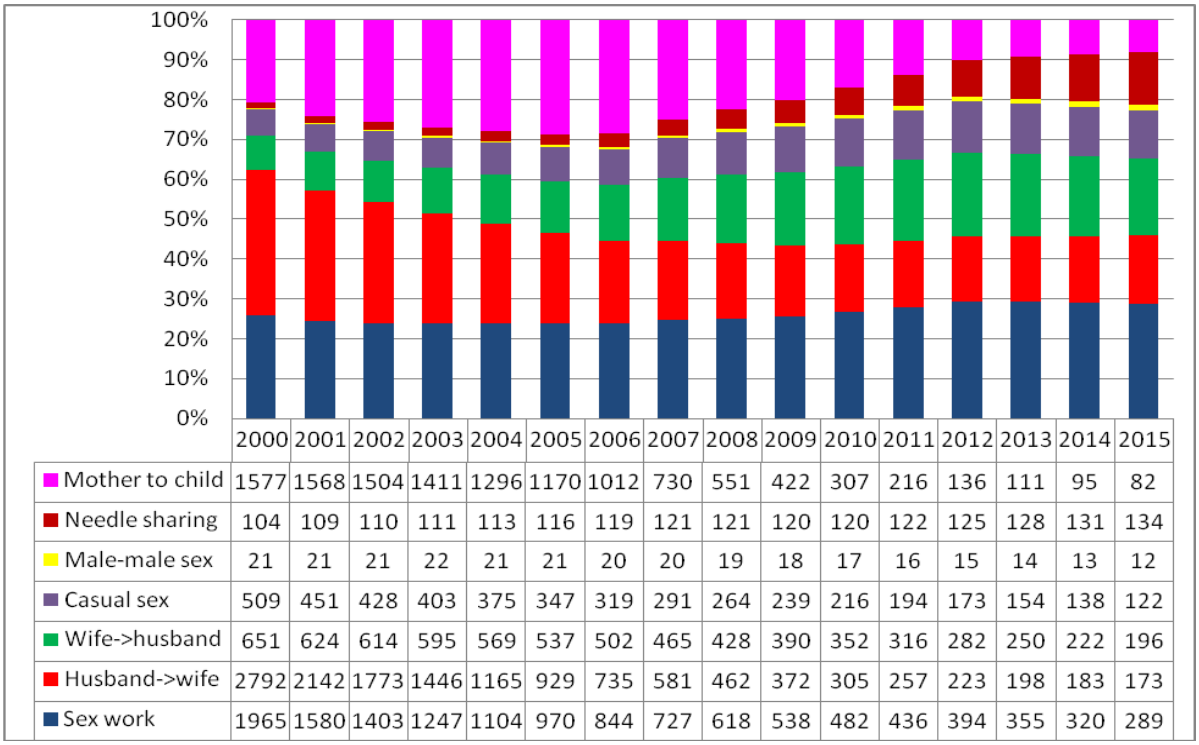


Figure 41: Number of new cases by different Modes of Transmission



Based from the mode of transmission, sex work and transmission from husband to wife and from wife to husband were 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 route 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 between 2000 and 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 were not similar.

It has been argued that there are two other important determinants of the slope of each curve. Those determinants were 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 estimated in one estimation exercise to another estimation exercise were; the improvement of the models because the model developers have increased the capacity of their model account for more variables affecting actual HIV prevalence. In addition, the changes of 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. Until recently (3-4 years ago), the number of deaths due to HIV/AIDS was reduced considerably, thanks to the wide expansion of ART program and its good service quality. Consequently, HIV infected individuals are staying alive longer which, in turn, make the number of people living with AIDS remain constant. Further, ART also reduces the infectivity 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 higher proportion of the number of new HIV cases still derived from sex work. However, HIV infection among 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 continues to decline by 2015. The decline that occur between 2006 and 2015, is due to 1) an 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 projection from 2010 to 2015 also shows a decline of HIV prevalence and HIV incidence. However, the rate of the decline is decreasing. This is due to lower mortality rate of HIV infected individuals, who are currently on care for opportunistic infections or on ARV treatment at 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 user (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 STI

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 is 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 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 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
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 dead among Children without ARV (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