

Report on the AIDS Epidemic Model (AEM) baseline scenarios for Sri Lanka



**National STD/AIDS Control Programme, Sri Lanka
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01. Introduction and Background

1.1. Country Context

Sri Lanka has been categorized as a country with low-level of HIV epidemic and the HIV prevalence has not consistently exceeded 5% in any of the high risk sub-populations such as female sex workers (FSW), men who have sex with men (MSM), beach boys (BB) and people who inject drugs (PWID) (1). As of end 2016, a cumulative total of 2557 HIV positive persons have been reported to the National STD/AIDS Control Programme (NSACP), Ministry of Health, Sri Lanka. During 2016, total of 249 HIV cases reported to the NSACP and it was the highest number of HIV cases reported in a year (2). In general, an estimate of 10.5 new infections occurs per week while, only about 4.5 new cases reported to the NSACP per week (3).

The heterosexual and homosexual behaviour have been the main mode of HIV transmission in the country. During the last five years (2011-2015) proportion of heterosexual behaviour reduced from 74% to 54% while proportion of male-to-male sex increased from 20% to 41%. Mother to child transmission remained between 3-7% over the last 5 years. Injecting drug use as a mode of transmission reported in less than 1% of cases. However, transmission through, blood and blood products have not been identified as a method of transmission since 2000 (2). Therefore, the most relevant risk behaviours and key populations are those associated with the main routes of HIV transmission, such as unprotected vaginal sex, unprotected anal sex and use of non-sterile injections or materials (4).

Sri Lanka has identified different high risk subpopulations for HIV prevention interventions such as Female sex workers (FSW), men who have sex with men (MSM), beach boys (BB), clients of sex workers and drug users (DU) as most-at-risk populations (MARPs) (5). The mapping and size estimation study carried out in 2013 showed that estimate of 14,132 female sex workers, 7,551 MSM, 1314 BBs, and 17,459 DU in the country (6). HIV prevalence estimation carried out in the integrated biological and behavioural survey (IBBS) showed that HIV prevalence among FSW and MSM were 0.8% and 0.9% respectively while among DU and BB the HIV prevalence was 0% (7).

1.2. Current HIV Estimation Methodology in Sri Lanka

Estimation of people living with HIV (PLHIV) in Sri Lanka has been conducted using estimation and projection package (EPP) and Spectrum since 2009. During 2016 also PLHIV estimation was carried out using EPP and spectrum software (version 5.571 in 2016). Spectrum software was developed by Avenir Health (www.avenirhealth.org) and the Estimates and Projections Package, which is developed by the East-West Center (www.eastwestcenter.org). The UNAIDS Reference Group on Estimates, Modelling and Projections provides technical guidance on the development of the HIV component of the software (www.epidem.org). The assumptions in the models about patterns of HIV transmission and disease progression are used to obtain age- and sex-specific estimates of the number of people living with HIV, the number of people newly infected with HIV and the number of people dying from AIDS-related causes as well as other important indicators. These assumptions are based on systematic literature reviews and analyses of raw study data by scientific experts. Demographic population data, including fertility estimates, are derived from the latest revision of the United Nations Population Division's World Population Prospects (8). Table 1.1 summarized the Key HIV estimated figures for 2016 as per the spectrum outputs (2).

Table 1: Spectrum and EPP based PLHIV estimations for 2016

Indicator	Estimate	Confidence Interval	
		High	Low
HIV Prevalence (%)	<0.1	<0.1	<0.1
AIDS deaths	<200	<100	<200
People Living with HIV	4,000	2,700	6,000
Children Living with HIV	<100	<100	<100
HIV incidence per 1000 population	0.03	0.01	0.05
New HIV Infections	1000	500	1,100
Coverage (%) of PLHIV receiving ART	27	18	39
Mothers needing ART for PMTCT	<100	<100	<100
% of Pregnant women living with HIV who received ART for PMTCT	62%	51%	77%

1.3. Gaps in HIV estimation using spectrum in Sri Lankan context

There was a series of in country consultations and identified few gaps in PLHIV estimation using spectrum for Sri Lanka as a country with very low HIV prevalence.

- 01) HIV estimation among drug users as per the spectrum do not support with available research evidences. As per the spectrum relative high proportion of HIV new infections estimate among drug users (29% in 2016). However, as per the case reporting data and IBBS estimates HIV prevalence among IDUs is almost zero (2; 7). National Size estimation of IDUs is significantly low (6).
- 02) PMTCT coverage is not compatible with programmatic data.
- 03) Number of children living with HIV is lower than programmatic data.

Overall, spectrum is not designed to give accurate results for a country with very low HIV prevalence level.

1.4. HIV estimation using AIDS epidemic model

Considering the above gaps in current method of HIV estimation in Sri Lanka, National HIV/AIDS Control Programme explore the possibilities to use AIDS Epidemic Model (AEM) to estimate HIV figures from 2017. The NSACP recently (October, 2017) conducted a 6 day workshop to develop the Sri Lanka AIDS Epidemic Model in Hotel Narai, Bangkok, Thailand. The workshop was facilitated by East-West Center through the Policy Research and Development Institute Foundation and UNAIDS South Asian Regional Office. Financial Support was received from Global Fund using the NFM HIV Prevention (2016-2018) grant.

Following working group was involved in the development of AIDS Epidemic Model baseline scenarios for Sri Lanka.

- | | |
|--------------------------------|--|
| 01) Wiwat Peerapatanapokin | (East West Center) |
| 02) Khin cho Win Htin | (UNAIDS Regional Support Team, Asia Pacific) |
| 03) Ye Yu Shwe | (UNAIDS Regional Support Team, Asia Pacific) |
| 04) Ariyaratne Manathunge | (National STD/AIDS control programme, Sri Lanka) |
| 05) Sriyakanthi Beneragama | (National STD/AIDS control programme, Sri Lanka) |
| 06) Suchira Suranga | (Family Planning Association, Sri Lanka) |
| 07) Shunmuganathan Muraliharan | (National STD/AIDS control programme, Sri Lanka) |

Figure 1: Working group members who contributed to the development of Sri Lankan AEM baseline scenarios



1.5. AIDS epidemic model

In the early years of the global HIV pandemic, most HIV prevention efforts focused on changing behaviours by creating a supportive environment and providing people the knowledge and tools they needed to remove or reduce the risk associated with HIV transmitting behaviours. Recent years have seen the rise of new biologically based technologies for reducing HIV transmission including voluntary medical male circumcision and strategic use of antiretrovirals. Accordingly, tools to analyze the epidemiological impact of different prevention efforts must be built on a model that is able to relate changes in risk behaviours and the effects of biological interventions to their effects on new HIV infections and AIDS-related deaths. This cannot be done with simple curve fitting models based only on observed prevalence, such as the UNAIDS Estimation and Projection Package incorporated in Spectrum. Instead it requires models that are based on and capable of changing both Behavioural and biological inputs. In modeling terms, these are often called process models, because they model the Behavioural and biological processes that transmit HIV. The AIDS Epidemic Model (AEM) is one such process model. These tools must be applied in a comprehensive process that actively engages key partners in a way that leads to “enhanced partnership and coordination” (9). Key features of AEM includes;

- 01) Assess impacts by using process model which incorporate both Behavioural and biological aspects
- 02) AEM contains the major key populations affected by HIV in concentrated epidemics.
- 03) AEM calculates new infections for each key population based on user supplied inputs.
- 04) AEM relates behaviour and HIV prevalence through transmission probabilities and cofactors.
- 05) The AEM interface displays HIV prevalence for the key populations in concentrated epidemics.
- 06) Epidemics can be tuned to the local context by adjusting model parameters.
- 07) The new infection calculations in the latest version of AEM include the effects of ART on HIV transmission.
- 08) AEM permits entry of ART levels by male/female or by individual sub-populations if desired.

02. Data requirement and data sources for Baseline Estimates

The AIDS Epidemic Model (AEM) version 4.1 is an updated version of the Asian Epidemic Model designed for application in most low-level and concentrated epidemics, including those outside of Asia. AEM is based on the epidemiological patterns commonly observed in concentrated epidemics, where the bulk of HIV transmission occurs among a number of key populations and their sexual partners including:

1. Men who have sex with men (MSM) and male sex workers (MSW)
2. Female sex workers (FSW) and clients
3. People who inject drugs (PWID, male and female)
4. Transgender populations (TG)
5. Lower-risk members of the general population (both male and female)

Each of these populations and the primary behaviours which transmit HIV, including vaginal sex, anal sex, and sharing of injecting equipment are included in the model. AEM is a process model in which equations are used to calculate the number of annual new infections to and from each population by the specified transmission routes based on inputs provided by the user that include:

1. The size of these key populations, expressed as a percentage of adult males or females 15-49, and of the adult male and female population as a whole;
2. The average duration for which people remain in key populations, expressed in years, used to calculate turnover and movement between key populations such as sex workers and PWID and the general population;
3. The frequency of risk behaviours, e.g., number of vaginal or anal intercourse acts per week or number of injections with shared equipment in the last year;
4. The levels of protective measures taken with different partner types, e.g., condom use between sex workers and clients, reducing the fraction of injections shared or the prevalence of sharing;
5. HIV and STI prevalence in each key affected population (9).

AEM calculates the number of new infections in a year by multiplying the size of populations with a given risk behaviour by the average frequency of that behaviour and the probability of transmission for that behaviour. The number of new infections is corrected for various cofactors such as STI enhancement of transmission, reduction of transmission for those on antiretroviral therapy, and reduction of transmission to circumcised males. The effects of protective behaviours such as condom use are also incorporated directly into the calculations, allowing the model to incorporate the Behavioural outcomes of prevention programs (9).

2.1. List of indicators and indicator description for AEM baseline estimates

The Baseline Workbook serves as a self-contained summary of a national or sub-national epidemic. It contains:

1. All of the epidemiological, Behavioural and size inputs needed to run AEM;
2. The transmission probabilities and cofactors chosen to fit observed historical trends in the epidemic; and
3. The numerical results of applying AEM to these inputs, including HIV incidence, prevalence, AIDS deaths, ART numbers and needs, transmission modes and other valuable information for planning and policymaking. The user fills in a number of key input pages, invokes AEM from within the baseline workbook, and then stores the results produced by the software back into the original baseline workbook. This baseline then serves as the starting point for analyses done with the other workbooks.

The indicators for baseline AEM can be classified in to 09 major areas as follows,

1. Population as a whole
2. Heterosexual
3. PWID (labeled IDU)
4. MSM
5. Transgender
6. HIV Prevalence
7. Additional Infections (external to the model)
8. ART
9. Validation data (AIDS and HIV case reports and reported modes of transmission information).

Annexure 01 briefly describe the data requirement, list of indicators and indicator focus in relation to each target population / Sub population.

Values and assumptions of key AEM baseline indicators

The AEM process start with collection of the information needed to extract appropriately calibrated and representative trends on behaviours, population sizes and HIV/STI epidemiology for each of the populations and sub populations relevant to the epidemic. These trends should be representative at the level of the area being modeled; in Sri Lankan context, National. As the data is gathered through secondary sources, need to be critically reviewed to look for essential gaps in available information, make informed assumptions for model inputs where data is of poor quality or not available, and highlight these gaps to encourage others to gather this information in the future. Then, it is necessary to document the trends to be used, their derivation and their sources, along with any assumptions made, in a comprehensive inputs document allowing others to critically examine the evidence used in preparing the model. So, following sub topics of this report serves purpose of documenting availability and used of in-country data with key assumptions. Annexure 02 discuss the data, data sources and assumptions of each indicator in detail.

2.2.1. Population

Contains the total population in the projection area covered by the baseline workbook. Populations are entered by male-female in the categories 15+, 15-49, age 15 and 15-24. Migration is also entered on this page as the total number of male and female migrants entering or leaving the country in a year in the 15+ and 15-49 age groups.

Demographic projections for Sri Lanka was done by creating a Spectrum DemProj from 1975-2015 based on US demographic data for Sri Lanka. These demographic projections were compared with the census and projection demographics of the Department of Census and Statistics of Sri Lanka. Further, the population and housing projections 2012-2062 of De Silva IW was used to validate the results (10). Observed discrepancies of the population numbers were adjusted by changing TFRs from the DHS surveys (11; 12). Population and age groups calculated for male and female based on 2012 census ratio for the mid-year population published by Registrar General Department of Sri Lanka (13).

Migrant number of male and female received from Central Bank of Sri Lanka report 2016 (14). Fertility rates are considered from Demographic Health Survey 2016 as well from previous DHS and Population census reports (12; 15). Annexure 02 present the data sources and assumption for each indicator in detail.

2.2.2. Heterosexual

This worksheet contains the size estimates and key risk behaviours for two groups of female sex workers and one shared group of clients, heterosexual casual sex (sex outside of a relationship which does not involve exchange of money or goods), and sex with regular heterosexual partners (husband-wife in most cases).

The size estimates of key populations were derived from the figures available in 2010 and 2013 key population size estimation of NSACP (16; 17). Key risk behaviours of female sex workers and clients of female sex workers were derived from Behavioural Surveillance Survey (BSS) and Integrated Behavioural Surveillance Survey (7; 18). Data related to heterosexual casual sex (sex outside of a relationship which does not involve exchange of money or goods), and sex with regular heterosexual partners (husband-wife in most cases) were captured from Demographic and Health Survey Reports (11; 12). Other sub national publications were used where there are no national figures are available (19; 20; 21; 22). Data related to circumcision was derived from 2011 Censuses report (15). In addition, the programmatic data (client registration data) reported by respective Sub Recipients through FPA Sri Lanka Monitoring and Evaluation Information Management System - MEIMS (23) were used to gather Behavioural data. Data collection method of the MEIMS is described in the Global Fund PR2 M&E plan; an annexure to the national HIV prevention M&E plan (24). Annexure 02 present the data, data sources and assumptions of each indicator separately.

2.2.3. People Who Inject Drugs (PWID)

This Section contains size estimates, sexual and injecting risk behaviours and levels of needle sharing for men and women who inject drugs and sex workers who inject drugs. In Sri Lanka size estimates for PWID is not consistent and generally considered as low in numbers compared to other Asian countries. National Dangerous Drugs Control Board estimates that there are 45,000 inhalational drug users in the country and among them 2.5% are injecting. In the mapping method the point estimate is 705 with a range of 927- 1209 (25). In the National size estimation study commissioned in 2013 adopting hot spots based geographic mapping yielded 423 PWIDs in the country (16). As among drug users in the country, WP and NWP showed higher PWID separate proportions were calculated for WP and NWP and Outside WP=NWP, then average proportion was calculated and point estimate of PWID came as 2.4%, number of PWID for the country estimated as 1090. As in Sri Lanka female Injecting Drug use behaviour is very low, only male PWID was considered. Behavioural data on injecting Drug Use was extracted from IBBS survey 2014 (18). Injecting female sex workers were not considered in the model as the numbers is considered very small. Annexure 02 explain the data, data sources and assumptions of each indicator separately.

2.2.4. Men Who having Sex with Men (MSM)

MSM contains size estimates and anal sex risk behaviours for two groups of men who have sex with men (reachable by programmes and unreachable). Provisions are also made for sexual interaction with female sex workers and regular female partners.

The MSM population was divided in to two groups; reachable and un-reachable. Calculation of the size of the reachable MSM was using two key population size estimation figures carried out by NSACP. Mapping study in 2010 in 4 Districts in Sri Lanka, extrapolated to national level and projected MSM Population size using the regression model approach point estimate of 22,652 (range 12,549 to 30,475) (17). National size estimation study 2013 estimate is total of 7551 MSMs in the country with a minimum of 6547 to a maximum of 8554 (16). The size the Colombo district is almost consistent in above two estimates. Therefore 2013 size estimation figure was used for Colombo district and somewhat lower late derived using 2010 size estimate was adopted for outside Colombo as follows.

Table 2: Calculation of reachable MSM

	Colombo	A' pura	Batticaloa	N' Eliya	Out of Colombo (Total)	Sri Lanka (National)
MSM (2010)	8846	729	571	1008	19,635	28,481
Tot population¹	2,553,000	830,000	543,000	761,000	18,100,000	0,653,000
15-59 total	1,593,072	517,920	338,832	474,864	11,294,400	2,887,472
15-59 Male	771,047	250,673	163,995	229,834	5,466,490	6,237,536
% MSM²	1.15%	0.29%	0.35%	0.44%	0.36%	0.46%
Size estimation 2013	4563	324	36	11	3991	8554
% MSM³	0.59%	0.13%	0.02%	0.00%	0.07%	0.14%
% MSM used	0.59%	-	-	-	0.22%	0.26%
# of reachable MSM	4,563	-	-	-	11,813	16,376

¹Census projection(2010), ²of total male pop (15-59), ³of total male pop (15-59) - as per 2013 size estimation

As per above calculations, 16,376 was used as the number of reachable MSMs in the country. The unreachable MSM who are having higher socio-economic status, lower partner exchange rate and mostly heterosexuals considered to be low risk for HIV. Total number of MSMs were considered as 1.5% of the total male population (15-59) which is around 93,563. Remaining number of MSMs who haven't estimated above (77,186) were considered as unreachable MSM. Behavioural data and of MSM was derived from BSS-2006/07 and IBBS 2013 (7; 18). Average figures of 03 districts (Colombo, Galle and Anuradhapura) were used as the national estimates. Annexure 02 critically evaluate data, data sources and assumption of each indicator in detail.

2.2.5. HIV Prevalence:

On this page, the trends of HIV prevalence in each of the key populations for which survey or surveillance data on prevalence is available was entered. Only available trends were entered for each key population and general population, which should be representative of the overall prevalence at the specified points in time for that population. The HIV prevalence data for key populations were captured from HIV Sentinel Sero Surveillance Survey (HSS)-2016 reports and, Integrated Biological and Behavioural Survey (IBBS) - 2013 report (26; 18). The HIV prevalence of the female general population was captured using the proxy indicator; HIV case reports among ANC mothers captured from 14 data points in De Soysa and Castle street Maternity hospitals. Prevalence of the male general population was not included due to non-availability of data at the time of modelling. Annexure 02 explain the data, data sources and assumptions of each indicator separately.

2.2.6. Additional infections:

This page is used in AEM to add or remove additional infections that are not automatically calculated within the AEM model such as overseas migrant sex workers in some Asian countries who returned HIV-positive and large number of new infections related to plasma donation in China. This page of Sri Lankan model kept blank as no such obvious phenomenon is identified.

2.2.7. ART (Antiretroviral treatment):

This page contains either the number of males and females on ART (in historical times through the present) or the percent of those in need who receive antiretroviral therapy (for the future). In addition, the parameters describing the CD4 model, which controls HIV-related mortality are here and have been taken from Spectrum.

However, number on ART by Key population is not available for Sri Lanka as the epidemiology database and ART database is not linked to each other. It was decided to link these two databases using a common variable such as ART number. This problem will be overcome permanently once the proposed EIMS is in place. The data available in the ART database of the NSACP Strategic Information Management (SIM) unit was used to feed the number of ART patients and CD4 eligibility criteria for ART initiation from 2003 to 2016 (27). Annexure 02 present the data in detail.

2.2.8. Validation data:

On this page, reported AIDS cases and HIV infections along with information on the modes of transmission for reported AIDS cases and total HIV cases reported from 1987 to 2016 was included (28). Heterosexual males were calculated subtracting MSM men from total men. This is used to generate graphs in the interface that can then be compared against the model results to look for major discrepancies in trends and patterns.

03. Results of AEM baseline scenarios

3.1 PLHIV estimates for 2016

Table 3: Summary AEM model results for 2016

Estimates	Number
New HIV infections:	178
Current PLHIV:	3,353
Annual AIDS death:	218
Annual ART needs:	3,353
Number on ART:	898
Male-Female Inc Ratio:	3.53
Cumulative infections:	8,044
Cumulative deaths:	4,691
Cumulative M/F Ratio:	2.38

Table 3 shows the summary of HIV estimations arrived from the AEM baseline model. Current PLHIV number is 3,353 and this is within the confidence interval of the current Spectrum and EPP estimates (table 1). However, estimated new infections in 2016 by AEM is 178 and this is significantly lower than the Spectrum estimates of 500-1100.

Figure 2: Current PLHIV in 2016 by sub-population group (N=3353)

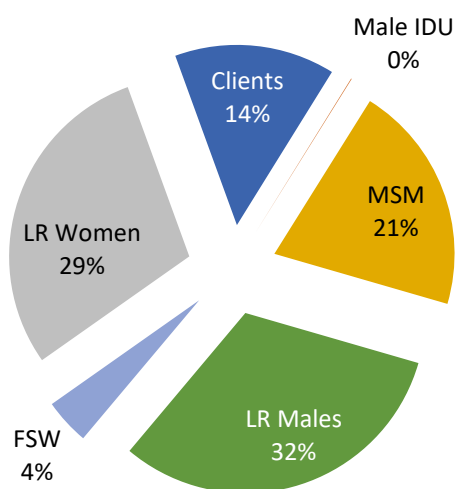


Figure 1 shows the estimated PLHIV by sub-populations. Significant difference is the proportion of infections due to drug users as Spectrum and EPP estimated that 29% of new infections are from drug users) . AEM is estimate is closer to programmatic data.

Figure 3: Annual new infection by sub population, 1990-2024

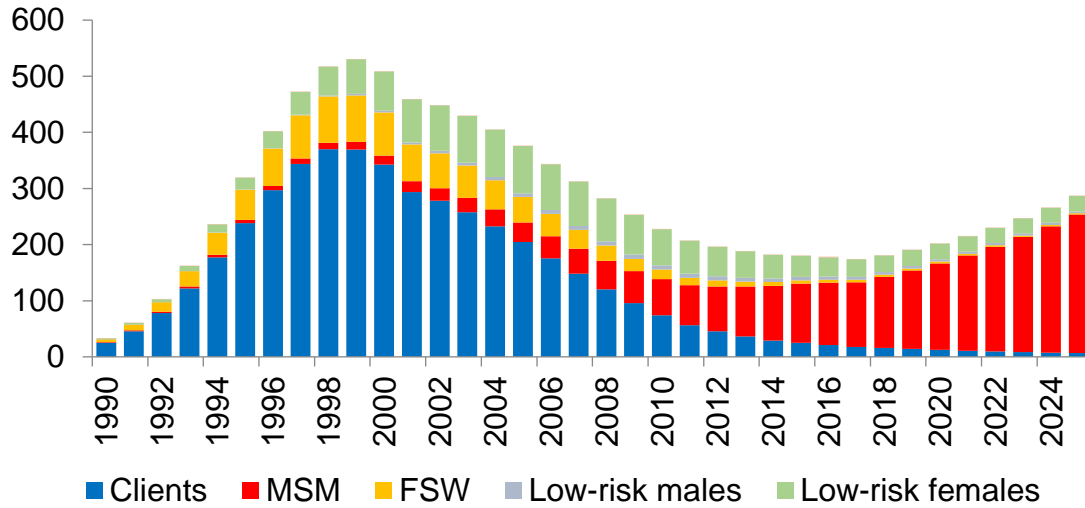


Figure 2 shows the composition of new infection by sub populations. AEM estimates that gradually higher proportion of new infections will arise from men who have sex with men. This is in agreement with the programmatic data and can be used as an advocacy material.

Figure 4: New HIV infections by sub-population in 2016 (number 177)

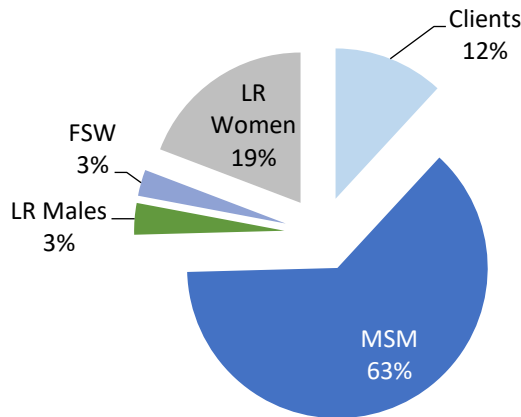


Figure 3 indicate the composition of the new HIV infections by sub populations. According to AEM, nearly 2/3 of new infections are arising from MSM. This is an overestimate according to case reporting data. However, reporting data represent both incident cases and prevalent HIV cases.

Figure 5 : Distribution of source of infection by sub-population, 2016

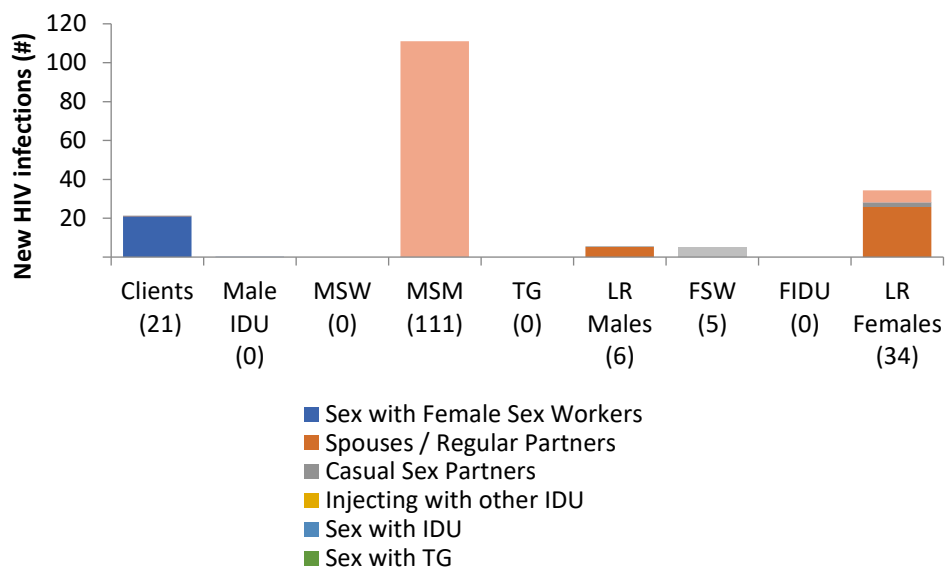


Figure 4 is the same information given in figure 3 as numbers.

3.2. Estimated People Living with HIV

Table 4: Number of current HIV infections in adult populations by year

Sub population	Year			
	2015	2016	2017	2018
Specific populations - male				
Current male clients of sex workers	541	483	433	388
Male Injecting drug users	1	2	2	2
Male sex workers	0	0	0	0
Men who have sex with men (1)	240	266	292	321
Men who have sex with men (2)	376	424	475	529
All Men who have sex with men (1+2)	616	690	767	850
Transgendered Sex Workers	0	0	0	0
Transgenders with Casual Partners	0	0	0	0
Transgenders with Regular Partners	0	0	0	0
All Transgender Populations	0	0	0	0
Specific populations - female				
Female sex workers who do not inject (1)	154	138	123	110
Female sex workers who do not inject (2)	0	0	0	0
All sex workers who do not inject (1 + 2)	154	138	123	110
Injecting female sex workers (1)	0	0	0	0
Injecting female sex workers (2)	0	0	0	0
All sex workers who inject (1 + 2)	0	0	0	0
All female sex workers (injecting and noninjecting)	154	138	123	110
Female Injecting drug users	0	0	0	0

Sub population	Year			
	2015	2016	2017	2018
Lower-risk populations				
Males who are not currently in at-risk populations	1,089	1,061	1,036	1,005
Females who are not now in at-risk populations	992	980	967	947
Total population currently at low-risk	2,081	2,041	2,003	1,952
Total Population				
Total males currently living with HIV	2,246	2,236	2,238	2,244
Total females currently living with HIV	1,147	1,117	1,091	1,057
Total adult population living with HIV	3,393	3,353	3,329	3,302

Table 4 shows a detailed breakdown of PLHIV according to sub populations for 2015 – 2018. Although estimations are generated up to 2050, only realistic number of years are given in this report.

3.3. Estimated New Infections

Table 5: Number of new HIV infections in adult sub populations by year

Adult sub population	2015	2016	2017	2018
Higher-risk populations - male				
Current male clients of sex workers	25	21	18	16
Male Injecting drug users	0	1	0	0
Male sex workers	0	0	0	0
Men who have sex with men (1)	51	54	56	61
Men who have sex with men (2)	55	57	60	65
All Men who have sex with men (1+2)	106	111	115	126
Transgendered Sex Workers	0	0	0	0
Transgenders with Casual Partners	0	0	0	0
Transgenders with Regular Partners	0	0	0	0
All Transgender Populations	0	0	0	0
Higher-risk populations - female				
Female sex workers who do not inject (1)	6	5	4	4
Female sex workers who do not inject (2)	0	0	0	0
All sex workers who do not inject (1 + 2)	6	5	4	4
Injecting female sex workers (1)	0	0	0	0
Injecting female sex workers (2)	0	0	0	0
All sex workers who inject (1 + 2)	0	0	0	0
All female sex workers (injecting and noninjecting)	6	5	4	4
Female Injecting drug users	0	0	0	0
Lower-risk populations				
Males who are not currently in at-risk populations	6	6	5	5
Females who are not now in at-risk populations	38	34	31	30
Total population currently at low-risk	43	40	36	35
Total Population				
Total new HIV infections among men	137	139	138	147
Total new HIV infections among women	43	39	35	34
New HIV infections in all adults	180	178	174	181

Table 5 shows a detailed breakdown of new PLHIV according to sub populations for 2015 – 2018. Although estimations are generated up to 2050, only realistic number of years are given in this report.

3.4. Estimated Mode of Transmission

Table 6: Number of new HIV infections by mode of transmission by year

Mode of transmission	2015	2016	2017	2018
Mode of Transmission				
Buying/selling sex (female sex workers)	31	26	22	20
Discordant couples: husband to wife	35	32	29	28
Discordant couples: wife to husband	6	6	5	5
Casual heterosexual sex	3	3	2	2
Sex between men (including TG and MSW)	105	111	116	126
Sharing of injections	0	0	0	0
Infections external to the epidemic (e.g., migrants)	0	1	0	0
Total	180	178	174	181

Table 6 indicates mode of transmission of new HIV infections for 2015-2018 and give in figures 3 and 4. HIV infections from migrants came as 0-1 per year. This needs to be explored further as case reports suggest number of migrant with HIV.

3.5. Estimated ARV Coverage

Table 7: Adults receiving ART, in need of treatment and covered by ART as of Dec. 31st of each year.

ART Summary	2015	2016	2017	2018
1. Adults currently receiving ART (15+)				
Adult males currently receiving ART	506	652	668	687
Adult females currently receiving ART	277	351	343	335
Total adults currently receiving ART	783	1002	1011	1022
2. Adult ART Coverage (15+)				
Percent of adult males in need currently receiving ART	23	29	30	31
Percent of adult females in need currently receiving ART	24	32	32	32
Percent of all adults in need currently receiving ART	23	30	30	31
3. Adults in need of ART (15+)				
Adult males currently in need of ART	1669	2235	2238	2244
Adult females currently in need of ART	872	1118	1091	1058
Total adults currently in need of ART	2542	3353	3330	3302

Table 7 is a summary from the ART result page of AEM. Estimations are available only for adults (15+ years). Only one third of ART need is currently met. However, programmatically, all PLHIV who are diagnosed and linked to services are provided with free ART services.

3.6. Estimated AIDS related deaths

Table 8: AIDS Deaths in each population group by year (#)

Deaths in each population group	2015	2016	2017	2018
Higher-risk populations - male				
Current male clients of sex workers	39	33	27	27
Male Injecting drug users	0	0	0	0
Male sex workers	0	0	0	0
Men who have sex with men (1)	9	8	8	9
Men who have sex with men (2)	15	15	15	18
All Men who have sex with men (1+2)	24	23	24	27
Transgendered Sex Workers	0	0	0	0
Transgenders with Casual Partners	0	0	0	0
Transgenders with Regular Partners	0	0	0	0
All Transgender Populations	0	0	0	0
Higher-risk populations - female				
Female sex workers who do not inject (1)	11	9	7	7
Female sex workers who do not inject (2)	0	0	0	0
All sex workers who do not inject (1 + 2)	11	9	7	7
Injecting female sex workers (1)	0	0	0	0
Injecting female sex workers (2)	0	0	0	0
All sex workers who inject (1 + 2)	0	0	0	0
All female sex workers (inject.+ noninjecting)	11	9	7	7
Female Injecting drug users	0	0	0	0
Lower-risk populations				
Males who are not currently in at-risk populations	98	93	85	87
Females who are not now in at-risk populations	66	60	54	60
Total population currently at low-risk	163	153	140	147
Total Population deaths				
Total males	161	149	136	141
Total females	77	69	62	67
Total adult population	237	218	198	208

Table 8 gives a detailed breakdown of estimated AIDS deaths by sub populations. Although a detailed breakdown is not available, Spectrum and EPP also give a fairly similar estimated number of AIDS deaths for 2016 (table 1).

04. Advantages and disadvantages of the AEM process

Advantages

1. AEM includes specific and considerable number of indicators per sub-population allowing the country to have a more realistic projection and model.
2. Since AEM is a process model, it allows the country to consider behavioural and biologic data that are changing over a period of time secondary to prevention and treatment interventions.
3. Compared to other projection and modeling software, AEM is more suitable for Asian type of HIV epidemics..

Disadvantages

1. Some indicators in AEM are not collected in Sri Lanka and this creates data gaps. The application of assumptions in this case, depending on the level of expertise, may or may not reflect a “real” epidemic.
2. PMTCT data and detailed age breakdown estimates are not available in AEM.
3. AEM software does not work effectively and efficiently when the data in the baseline do not follow a smooth trend. This could lead to manipulation of data to some extent which could alter the actual data gathered.
4. AEM tool does not have age disaggregation to describe the projections and interventions for different age groups. The AEM collectively addresses issues on FSW, MSM, and IDU aged 15-49.

05. Way forward

Next step in AEM modeling is to complete the process of policy analysis. The objectives of the AEM Policy Analysis is to refine, validate and finalize AEM baseline; to analyze and estimate unit cost, coverage, and effectiveness of prevention and treatment program; to develop intervention scenarios for possible policy options; and to gain clarity on interpretations of impact analysis outputs.

National STD/AIDS control programme of Sri Lanka has currently initiated conducting a new round of populations size estimation and Integrated Biological and behavioural survey (IBBS). Results of these two activities will be important to do a proper AEM policy analysis exercise. Moreover, local programme managers’ inputs need to be taken during this process. Considering all these factors, it was decided to conduct AEM policy activity in April 2018 in Colombo.

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Annexure 01:- List of AEM baseline indicators and indicator focus

a) Population as a whole

Population	Focus	Indicator
1. Male	Residential Population	1.1. Residential Male Population Disaggregated by age
	Migrated Population	1.2. Migrated Male Population Disaggregated by age
	Population Ratio	1.3. Ratio of 15-49 to 15+ Male population
2. Female	Residential Population	2.1 Residential Female Population Disaggregated by age
	Migrated Population	2.2 Migrated Female Population Disaggregated by age
	Population Ratio	2.3 Ratio of 15-49 to 15+ Female population

b) Heterosexual Population

Population	Focus	Indicator
1. Female Sex Workers	Population Size	1.1 Estimated size of the female sex worker / population (in thousand)
		1.2 Percent of females aged 15-49 who sell sex
		1.3 Percent of female sex workers in group 1
		1.4 Movement from group 1 to group 2 each year
	Behavioural HIV Risk Factors	1.5 Number of clients per day
		1.6 Days worked per week
		1.7 Average duration selling sex
		1.8 STI prevalence among female sex worker
2. Clients of Female Sex Workers	Safe Sax Practices	1.9 Percent condom use with clients
	Population Size	2.1. Estimated size of the clients of female sex worker / population (in thousand)
	Behavioural HIV Risk Factors	2.2. Percent of males aged 15-49 who visited FSW in the last year
3. Males engaging in casual sex	Safe Sax Practices	2.3. Average duration buying sex (years)
		2.4. Percent of adult males who are circumcised
	Population Size	3.1. Estimated size of the males engage in casual sex /Population (in thousand)
		Behavioural HIV Risk Factors
Safe Sax Practices	3.3. Average number of sex contacts in the last year (male)	
	3.4. Percent condom use in casual sex	

Population	Focus	Indicator
4. Females engaging in casual sex	Population Size	4.1. Estimated size of the females engages in casual sex / Population (in thousand)
	Behavioural HIV Risk Factors	4.2. Percent of females engaging in casual sex in the last year
	Safe Sax Practices	4.3. Percent condom use in casual sex
5. Low Risk males/females	Behavioural HIV Risk Factors	5.1. Number of sexual contacts with spouse or RP (per week)
		5.2. STI prevalence in adult population
	Safe Sex Practices	5.3. Percent condom use with spouses or regular partners

c) PWID (Labelled IUD)

Population	Focus	Indicator
1. Injecting Drug Users Male	Population Size	1.1 Estimated size of the Injecting drug users male/Population (in thousand)
		1.2 Percent of males age 15-49 who inject drugs
	Behavioural HIV Risk Factors	1.3 Percent of male IDUs in high-risk networks
		1.4. IDU mortality (crude mortality per year in %)
		1.5. Percent of male IDUs who share needles
		1.6. Percent of all injections shared (among those who share)
		1.7. Number of injections per day
		1.8. Average duration of injecting behaviour (in years)
		1.9 Sharing to non-sharing movement per year
		1.10 Percent of male IDUs visiting female sex workers
	Safe Sex Practices	1.11 Number of contacts with regular partners (per week)
		1.12 Percent condom use with female sex worker group 1
		1.13 Percent condom use with female sex worker group 2
		1.14 Percent condom use with spouse or regular partner
2. Injecting Drug Users Female	Population Size	2.1 Estimated size of the Injecting drug users Female/Population (in thousand)
		2.2 Percent of females age 15-49 who inject drugs
		2.3 Percent of female IDUs in high-risk networks
	Behavioural HIV Risk Factors	2.4 Percent of male IDUs who share needles
		2.5 Percent of all injections shared (among those who share)
		2.6 Number of injections per day
		2.7 Average duration of injecting behaviour (in years)
		2.8 Sharing to non-sharing movement per year

Population	Focus	Indicator
3. Injecting Female Sex Workers	Safe Sex Practices	2.9 Percent whose regular partners also inject drugs
		2.10 Number of contacts with regular partners (per week)
		2.11 Percent condom use with spouse or regular partner
	Population Size	3.1 Estimated size of the Injecting Sex Workers/Population (in thousand)
		3.2 Percent of female sex workers in group 1 who inject drugs
	Behavioural HIV Risk Factors	3.3 Percent of injecting FSW in group 1 in high-risk networks
		3.4 Percent of injecting FSW in group 1 who share injections
		3.5 Percent of all injections shared (among those who share)
		3.6 Number of injections per day for injecting FSW in group 1
		3.7 Average duration of injecting for FSW in group 1
Safe Sex Practices	3.8 Percent condom use with clients - Injecting FSW in group 1	

d) MSM worksheet

Population	Focus	Indicator
Men Who have Sex with Men (MSM)	Population Size	1.1 Estimated size of Men who have sex with men/Population (in thousand)
		1.2 Percent of males aged 15-49 engaging in same-sex behaviour
		1.3 Percent of MSM in risk group 1
		1.4 Shift from MSM group 1 to group 2
		1.5 Percent of MSM1 with female partners
		1.6 STI prevalence among MSM1
	Behavioural HIV Risk Factors	1.7 Percent engaging in anal sex in the last year - MSM1
		1.8 Number of anal sex contacts last week (among those having anal sex) - MSM1
		1.9 Average duration of same-sex behaviour (years) - MSM1
	Safe Sex Practices	1.10 Percent condom use in anal sex with MSM1
Male Sex Workers	Population Size	2.1 Estimated size of Male Sex Workers/Population (in thousand)
		2.2 Percent of males aged 15-49 who sell sex
		2.3 Shift from MSM to MSW
	Behavioural HIV Risk Factors	2.4 Average duration selling sex (in years)
		2.5 Percent of MSW reporting anal sex with clients in the last year
		2.6 Percent MSW with female regular partners in the last year
		2.7 Percent condom use in anal sex with male sex workers
Safe Sex Practices		

e) HIV Prevalence

Population	Focus	Indicator
Female Sex Workers	HIV Prevalence	1.1. HIV Prevalence among Female Sex Workers
Injecting Drug Users	HIV Prevalence	2.1. HIV Prevalence among Injecting Sex Workers. 2.2. HIV Prevalence among male Injecting drug users 2.3. HIV Prevalence among female Injecting drug users
Men who have sex with men and TG	HIV Prevalence	3.1. HIV Prevalence among MSM 3.2. HIV Prevalence among male Sex Workers 3.3. HIV Prevalence among TG sex workers 3.4. HIV Prevalence among TG with casual sex partners 3.5. HIV Prevalence among TG with regular partners
General Population	HIV Prevalence	4.1. HIV Prevalence among male general population 4.1. HIV Prevalence among female general population

f) Additional Infections

Population	Focus	Indicator
Persons living with HIV added	High risk Male Population	1.1 Current male clients of sex workers
		1.2 Male injecting drug users
		1.3 Male Sex Workers
		1.4 Transgender sex workers
		1.5 Transgender with casual partners
		1.6 Transgenders with regular partner
	High risk Female Population	1.7 Men who have Sex with Men
		1.8 Female Sex Workers
		1.9 Injecting Female Sex Workers
		1.10 Female Injecting Drug users
	Currently lower risk populations	1.11 Males who are not now in at-risk populations
		1.12 Females who are not now in at-risk populations

Population	Focus	Indicator
Number of persons living with HIV removed	High risk Male Population	2.1 Current male clients of sex workers
		2.2 Male injecting drug users
		2.3 Male Sex Workers
		2.4 Transgender sex workers
		2.5 Transgender with casual partners
		2.6 Transgenders with regular partner
	High risk Female Population	2.7 Men who have sex with men
		2.8 Female Sex Workers
		2.9 Injecting Female Sex Workers
	Currently lower risk populations	2.10 Female Injecting drug users
		2.11 Males who are not now in at-risk populations
		2.12 Females who are not now in at-risk populations

g) ART

Adult ART

Population	Focus	Indicator
Male	Adult ART provided Annually	1.1 Number of male adults receiving ART
	ART Need	1.2 Percent of male adults need receiving ART 1.3 Calculated number of male adults needing ART
	Adult ART provided Annually	2.1 Number of male adults receiving ART
Female	ART Need	2.2 Percent of male adults need receiving ART 2.3 Calculated number of male adults needing ART

Use ART

Population	Focus	Indicator
Clients of FSWs	ART Coverage	1.1 Number of Clients of FSWs receiving ART 1.2 Percent of Clients of FSWs in need receiving ART
Lower risk males	ART Coverage	2.1 Number of Lower risk males receiving ART
		2.2 Percent of Lower risk males receiving ART
Male IDU	ART Coverage	3.1 Number of Male IDU receiving ART
		3.2 Percent of Male IDU receiving ART
Male Sex Workers	ART Coverage	4.1 Number of Male sex workers receiving ART
		4.2 Percent of Male sex workers receiving ART
Men who have sex with men	ART Coverage	5.1 Number of Men who have sex with men receiving ART
		5.2 Percent of Men who have sex with men receiving ART
TG Sex Workers	ART Coverage	6.1 Number of TG sex workers receiving ART
		6.2 Percent of TG sex workers receiving ART
TG with Casual Partners	ART Coverage	7.1 Number of Casual Partners receiving ART
		7.2 Percent of TG with casual Partners receiving ART
TG with Regular Partners	ART Coverage	8.1 Number of TG with Regular partners receiving ART
		8.2 Percent of TG with Regular partners receiving ART

Population	Focus	Indicator
Female Sex Workers	ART Coverage	9.1 Number of Female sex workers receiving ART
		9.2 Percent of Female Sex workers receiving ART
Injecting Sex Workers	ART Coverage	10.1 Number of Injecting sex workers receiving ART
		10.2 Percent of Injecting sex workers receiving ART
FSW who do not inject	ART Coverage	11.1 Number of FSW who do not inject receiving ART
		11.2 Percent of FSW who do not inject receiving ART
Lower risk females	ART Coverage	12.1 Number of lower risk females receiving ART
		12.2 Percent of lower risk females receiving ART
Female Injecting Drug Users	ART Coverage	13.1 Number of Female Injecting Drug Users receiving ART
		13.2 Percent of Female Injecting Drug Users receiving ART

Annexure 02:- Data, Data sources and Assumptions

a) Population as a whole

Indicator	Data Source	Values	Assumption / Remarks
1.1. Residential Male Population Disaggregated by age	Census of Population and Housing – 2011 And Spectrum	1975- 4,429,987 2012 - 7,235,513 2050 – 8,528,551	In 2012, Males 15+ is considered as 73.6% of total male population.
1.2. Migrated Male Population Disaggregated by age	N/A	Missing??	No data
1.3. Ratio of 15-49 to 15+ Male population	Census of Population and Housing – 2011 And Spectrum	1975- 78.7% 2012 - 73.6% 2050 – 57.2%	Further to, Census of Population and Housing data other data sources highlighted in 2.1.1 were used to validate the data.
2.1. Residential Female Population Disaggregated by age	Census of Population and Housing – 2011 And Spectrum	1975- 4,171,797 2012 – 7,930,005 2050 – 9,711,255	N/A
2.2 Migrated Female Population Disaggregated by age	N/A	Missing??	No data
2.3 Ratio of 15-49 to 15+ Female population	Census of Population and Housing – 2011 And Spectrum	1975- 52.2% 2012 - 66.5% 2050 – 80.3%	Further to, Census of Population and Housing data other data sources highlighted in 2.1.1 were used to validate the data.

b) Hterosexual

Indicator	Data Source	Values	Assumption / Remarks
1.1. Estimated size of the female sex worker / population (in thousand)	N/A	25.4	Auto Calculated by the software
1.2. Percent of females aged 15-49 who sell sex	Population Size estimation 2013, NSACP, Mid-Year Population 2010, DCS.	0.48%	Size estimation for the districts outside the Colombo was arrived by taking the average percentages of 2010 and 2013 size estimation figures (Denominator - female population 15 to 59 from mid-year 2010 population in DCS). 2013 Size estimation figure was taken for Colombo. This method was arrived considering the programme data (number of FSW reached and tested) by end September, 2017).
1.3. Percent of female sex workers in group 1	N/A	100%	Considering the unavailability of Behavioural data, low prevalence, low size estimation all the FSWs were considered as one group in the AEM.
1.4. Movement from group 1 to group 2 each year	N/A	N/A	Considering the unavailability of Behavioural data, low prevalence, low size estimation all the FSWs were considered as one group in the AEM.
1.5. Number of clients per day	BSS 2006 IBBS-2014	Before 2006 – 2.8 From 2006 – 2014 – 2.8 to 2.0 (interpolated) After 2014 – 2.0	Average number of clients (2.8) per day reported in the IBBS-2014 (average of Colombo, Galle, Kandy and Anuradhapura) was consider for 2013 and thereafter. Number of clients (2.0) reported in BSS 2006 was considered from 1985 to 2006. Two figures were interpolated between two years to obtain values for 2007-2012.
1.6. Days worked per week	IBBS-2014	3.3	Average number of days worked per week was not directly available in the available literature. So, this figure was calculated indirectly using available information in IBBS-2013. Average number of clients in the last week of 3 cities (Colombo, Galle and Anuradhapura) were divided by the average number of clients per day to calculate the number of days worked per week. $[(6.7+6.9+6)/3]/2.0]$
1.7. Average duration selling sex	Client Registration Data (2016) available in the FPASL data base	10.90	The average number of years worked by a FSW client (5.45) was multiply by 2 to calculate the average duration of selling sex by a Female Sex Worker (Sample size=4760).

Indicator	Data Source	Values	Assumption / Remarks
1.8. STI prevalence among female sex worker	Samarawickrama NA, <i>et. al.</i> (2015) Prevalence of Trichomonas vaginalis, Chlamydia trachomatis, Neisseria gonorrhoeae and human papillomavirus in a sexual health clinic setting in urban Sri Lanka	1987 and before- 30% 2010 and thereafter - 8.3% 2088 to 2009 – by interpolation	Since the condom use is low in early stages in the country with low health seeking behaviour and STI care, the prevalence of STI among FSW was assumed to be high (30%) before 1987. As per a Survey conducted in 2015 and published in International Journal of STD & AIDS 2015, Vol. 26(10) 733–739 STI prevalence was recorded as 8.3%. Values for 1988-2010 was calculated by interpolation.
1.9. Percent condom use with clients	BSS 2016 and IBBS 2014	1987 and before-10% 2006 – 81.6% 2013-85.6%	It was assumed that the condom use among FSWs in early years was low (10%) and increased gradually thereafter. The average figures available in IBBS-2013 and BSS-2006 were used as two different data points and interpolated for all other years.
2.1. Estimated size of the clients of female sex worker / population (thousand)	N/A	394 in 2013	Auto Calculated by the software
2.2. Percent of males aged 15-49 who visited FSW in the last year	IBBS-2013	7.9%	N/A
2.3. Average duration buying sex (years)	Census and Statistics - 2012 IBBS-2013	7.8	Age of marriage for males (15 to 49) as per the Department of Census and Statistics (2012) is 27.8. Age of first sexual intercourse for males (15-49) was taken as 20 considering the age of first sex of MSM available in IBBS-2013 (18 years). Average duration of buying sex was assumed to be the duration in-between the first sex and marriage which is 7.8 (27.8-20).
2.4. Percent of adult males who are circumcised	Population and Housing Survey (1971 and 2012)	2012- 10% and thereafter 7.0% in 1975 All other years- Interpolation	All the males belong to the ethnic group Muslim undergo circumcision in Sri Lanka. As per the population and housing cense data Moor population (male 15 to 49) percentage in 1971 and 2012 are 7.0% and 9.3%. Other circumcisions considered to be 0.1 percent or less.

Indicator	Data Source	Values	Assumption / Remarks
3.1. Estimated size of the males engage in casual sex /Population (in thousand)	N/A		Auto Calculated by the software
3.2. Percent of males engaging in casual sex in the last year	BSS-2006 A survey on effect of extra marital sex on HIV conducted in 1994	6.3%	There was not a direct record to capture data for this indicator. Hence, the average figure of two approximate estimates (study on extramarital sex in 1994 available in JSTOR and the estimate for Factory workers available in BSS 2006) were used.
3.3. Average number of sex contacts in the last year (male)	AEM – Asia	10	There was not a direct record to capture data for this indicator. Asian Average was used
3.4. Percent condom use in casual sex		1987 and before – 5% 2007-33.3% 2013 and thereafter - 35.6% All other years - Interpolation	Use of condoms was assumed to be very low in early stage of the epidemic due to lack of awareness on HIV and STIs. There for condom use was considered as only 5% percent for 1987 and before which reflect use of condoms for birth control.
4.1. Estimated size of the females engage in casual sex / Population (in thousand)	N/A	394 in 2013	Auto Calculated by the software
4.2. Percent of females engaging in casual sex in the last year		3%	
4.3. Percent condom use in casual sex		1987 and before – 5% 2007-33.3% 2013 and thereafter - 35.6% All other years – Interpolation	Use of condoms was assumed to be very low in early stage of the epidemic due to lack of awareness on HIV and STIs. There for condom use was considered as only 5% percent for 1987 and before which reflect use of condoms for birth control.

Indicator	Data Source	Values	Assumption / Remarks
5.1. Number of sexual contacts with spouse or RP (per week)	Plantation sector study By NSACP 2014	0.5	There was not a direct record to capture data for this indicator. Assuming the plantation sector workers represent the general population of Sri Lanka the average of once a week and once a month was used as a proxy.
5.2. STI prevalence in adult population		0.5%	Assumption based on case records?????
5.3. Percent condom use with spouses or regular partners	DHS – 1995, 2006 and 2016 BSS-2007	From 1975 to 1987-2% 1995-10% 2007-7.8% 2014 and thereafter – 18%	Use of condoms was assumed to be very low in early stage of the epidemic due to lack of awareness on HIV and STIs. There for condom use was considered as only 2% percent for 1975 to 1987 and assumed to be increased thereafter gradually with introduction of the Family Planning Programme.

c) PWID (labeled IDU)

Indicator	Data Source	Values	Assumption / Remarks
1.1 Estimated size of the Injecting drug users male/Population (in thousand)	N/A	1975- 0.8 2013 - 1.1 2050 – 1.1	System auto calculated figures
1.2 Percent of males age 15-49 who inject drugs	Population Size estimation 2013, NSACP, Estimated DU by NDDCB	0.02% (for all years)	As among drug users in the country, WP (3.5%) and NWP (2.7%) showed higher percentage of PWID (per DU). Therefore different proportions were calculated for WP and NWP and Outside WP=NWP, then average proportion was calculated and point estimate of PWID came as 2.4%, number of PWID for the country estimated as 1090 (in 2013).
1.3 Percent of male IDUs in high-risk networks	N/A	60%	No country specific data. AEM default figure as regional approximation average
1.4. IDU mortality (crude mortality per year in %)	N/A	1%	No country specific data. AEM default figure as regional approximation average
1.5. Percent of male IDUs who share needles	IBBS-2013 BSS-2007	2013 and thereafter- 51% 2006 and before - 46.7% 2006-2013-Interpolation	
1.6. Percent of all injections shared (among those who share)	IBBS-2013	56.9% for all the years	IBBS 2014 last injection shared among who shared injections on last day (29%/51%)
1.7. Number of injections per day	IBBS-2013	0.1428 for all the years	IBBS 2013/14 median is around one per week. Calculated for a day
1.8. Average duration of injecting behaviour (in years)	IBBS-2013	16.5 years	IBBS 2013/14 Median duration of injecting x 1.5
1.9 Sharing to non-sharing movement per year	IBBS-2013	10%	No country specific data. AEM default figure as regional approximation average
1.10 Percent of male IDUs visiting female sex workers	IBBS-2013	35.6%	IBBS-2013

Indicator	Data Source	Values	Assumption / Remarks
1.11 Number of contacts with regular partners (per week)	Heterosexuals data sheet	0.5	No data. Used the values of the approximate indicator – “Heterosexuals - Number of sexual contacts with spouse or RP (per week)”
1.12 Percent condom use with female sex worker group 1	Heterosexuals data sheet	85% - 2012	No data. Used the values of the approximate indicator – “Heterosexuals - Percent condom use with clients – FSW”
1.13 Percent condom use with female sex worker group 2	N/A	N/A	Due to low prevalence and size estimation only one group was defined.
1.14 Percent condom use with spouse or regular partner	IBBS 2013/14	2013 and thereafter - 25.9% 1987 and before - 5% 1987-2013-interpolation	IBBS 2013/14 (condom use last sexual partner was used as a proxy). Use of condoms was assumed to be very low in early stage of the epidemic due to lack of awareness on HIV and STIs. There for condom use was considered as only 5% percent for 1987 and assumed to be increased thereafter gradually with introduction of the Family Planning Programme.
2.1 Estimated size of the Injecting drug users Female/Population (in thousand)	N/A	0	No data and less IDU size estimation
2.2 Percent of females age 15-49 who inject drugs	N/A	0%	No data and less IDU size estimation
3.1 Estimated size of the Injecting Sex Workers/Population (in thousand)	N/A	0	No data and less IDU size estimation
3.2 Percent of female sex workers in group 1 who inject drugs	N/A	0%	No data and less IDU size estimation

d) MSM

Indicator	Data Source	Values	Assumption / Remarks
1.1 Estimated size of Men who have sex with men/Population (in thousand)	N/A	2013 - 74.5	Total number of MSMs were considered as 1.5% of the total male population (15-59) which is around 93,563. This was assumed without country specific evidence, to align with the regional average. This estimation includes both reachable and unreachable MSM.
1.2 Percent of males aged 15-49 engaging in same-sex behaviour	N/A	1.5%	Total number of MSMs were considered as 1.5% which is align with the regional average. This was assumed without country specific evidence, to align with the regional average. This estimation includes both reachable and unreachable MSM.
1.3 Percent of MSM in risk group 1 (Reachable)	PSE-2013 PSE-2010	22%	Reachable MSMs were used as group 1. As per the calculations in the section, 2.1.4, 16,376 was used as the number of reachable MSMs in the country.
1.4 Shift from MSM group 1 to group 2	N/A	10%	AEM default
1.5 Percent of MSM1 with female partners	IBBS-2013	34.592%	Average
1.5 STI prevalence among MSM1		8%	
1.7 Percent engaging in anal sex in the last year - MSM1	IBBS-2013 BSS-2006	93.7%	Average value of IBBS and BSS
1.8 Number of anal sex contacts last week (among those having anal sex) - MSM1	PR2- Programme data	2.5	PR2 programme (client registration) data
1.9 Average duration of same-sex behaviour (years) - MSM1	N/A	30 years	AEM default value

Indicator	Data Source	Values	Assumption / Remarks
1.10 Percent condom use in anal sex with MSM1	IBBS-2013 BSS-2006	1987 and before 10% 2007-42.1% 2013 and thereafter -47%	IBBS 2013/14 and BSS 2006 figures were used as point estimates. Use of condoms was assumed to be very low in early stage of the epidemic due to lack of awareness on HIV and STIs. There for condom use was considered as only 10% percent for 1987 and assumed to be increased thereafter gradually with introduction of the Family Planning Programme. Figures for in-between years were calculated by interpolation.
1.11. Men who have Sex with Men group 2 (MSM2) / population (unreachable)	System auto calculation	2013-58.1	Remaining number of MSMs who haven't included in the above (77,186) estimation were considered as unreachable MSM. The unreachable MSM who are having higher socio-economic status, lower partner exchange rate and mostly heterosexuals considered to be low risk for HIV.
1.12. Percent of MSM2 with female partners	N/A	41.5	No data. Since the unreachable MSMs includes most of the heterosexual males, number of female partners is assumed to be 1.2 times greater than for reachable MSM.
1.13. STI prevalence among MSM2	N/A	3.3%	No data. The unreachable MSM who are having higher socio-economic status, lower partner exchange rate and mostly heterosexuals considered to be low risk for HIV. Therefore, STI prevalence is assumed to be 3 times lower than for reachable MSM.
1.14. Percent engaging in anal sex in the last year – MSM2	N/A	75%	No data. Anal sexual practices is assumed to be 0.8 times of the reachable MSM.
1.15. Number of anal sex contacts last week (among those having anal sex) – MSM2	N/A	0.83	No data. Frequency of anal sex is assumed to be 3 times lower than for reachable MSM.
1.16. Average duration of same-sex behaviour (years) – MSM2	N/A	30 years	No data. Similar to reachable MSM
1.17. Percent condom use in anal sex with MSM2	N/A	34%	No data. Similar to reachable MSM

e) HIV Prevalence :

Indicator	Data Source	Value		Assumption / Remarks
1.2. HIV Prevalence among Female Sex Workers	IBBS-2013	2013- 0.81%		Only one data point
2.4. HIV Prevalence among Injecting Sex Workers.	N/A	N/A		No data. Not included in the model
2.5. HIV Prevalence among male Injecting drug users	HSS-2016	0%		Only one data point
2.6. HIV Prevalence among female Injecting drug users	N/A	N/A		No data. Not included in the model
3.1. HIV Prevalence among MSM	IBBS-2013 HSS-2016	0.9%	1.5%	Only two data points
4.1. HIV Prevalence among female general population	ANC HIV testing data - NSACP	2003	0.01%	4 data points from the urban ANC perveances De Soysa and Castle street Maternity hospitals
		2004	0.01%	
		2005	0.02%	
		2006	0.02%	
		2007	0.02%	
		2008	0.02%	
		2009	0.02%	
		2010	0.02%	
		2011	0.02%	
		2012	0.02%	
		2013	0.01%	
		2014	0.02%	
		2015	0.03%	
		2016	0.01%	

f) ART:

Following number of adult males and females on ART (in historical times through the present) entered in this page. In addition, following CD4 eligibility criteria entered in the same page.

	Adult Male	Adult Female	Adult Total	CD4 eligibility criteria for ART initiation
2003	0	0	0	200
2004	8	6	14	200
2005	30	21	51	200
2006	43	30	73	200
2007	61	42	103	200
2008	78	54	132	200
2009	114	79	193	200
2010	146	105	251	350
2011	163	130	293	350
2012	210	153	363	350
2013	296	193	489	350
2014	385	220	605	350
2015	491	277	768	500
2016	668	359	1027	1000

Number on ART by Key population is not available for Sri Lanka as the epidemiology database and ART database is not linked to each other. It was decided to link these two databases using a common variable such as ART number. This problem will be overcome permanently once the proposed EIMS is in place.

g) Validation data:

On this page, reported AIDS cases and HIV infections along with information on the modes of transmission for reported AIDS cases and total HIV cases reported to NSACP from 1987 to 2016 was included. Heterosexual males were calculated subtracting MSM men from total men. by This is used to generate graphs in the interface that can then be compared against the model results to look for major discrepancies in trends and patterns.

Year	AIDS total		Mode of transmission of male AIDS			Mode of transmission of female AIDS		HIV total	
	male	female	injecting males	heterosexual male	male-male sex	injecting female	heterosexual female	male	female
1987	2	0	0	2	0	0	0	2	0
1988	2	0	0	3	0	0	0	3	0
1989	1	2	0	8	0	0	3	8	3
1990	2	0	0	6	0	0	1	6	1
1991	2	1	0	10	0	0	3	10	3
1992	8	2	0	19	0	0	8	19	8
1993	8	3	0	26	0	0	11	26	11
1994	13	1	0	15	0	0	8	15	8
1995	9	2	0	12	0	0	10	12	10
1996	9	2	0	20	0	0	10	20	10
1997	3	6	0	16	0	0	16	16	16
1998	11	4	0	29	0	0	26	29	26
1999	7	5	0	24	0	0	18	24	18
2000	9	5	0	34	0	0	20	34	20
2001	11	2	0	28	0	0	19	28	19
2002	6	1	0	26	0	0	24	26	24
2003	11	11	0	30	1	0	37	31	37
2004	16	2	1	47	7	0	37	55	37
2005	16	12	0	61	8	0	60	69	60
2006	13	6	0	47	8	0	40	55	40
2007	22	18	1	56	9	0	54	66	54
2008	9	4	0	60	3	0	39	63	39
2009	10	10	0	75	17	0	45	92	45
2010	22	9	3	69	8	0	44	80	44
2011	23	11	1	58	24	0	64	83	64
2012	36	22	0	82	38	0	66	120	66
2013	41	18	4	77	52	0	67	133	67
2014	44	13	2	104	63	0	61	169	61
2015	37	17	2	87	87	0	61	176	61
2016	42	12	0	97	91	0	61	188	61