TECHNICAL REPORT ON HIV ESTIMATION IN SRI LANKA-2019

Sri Lanka College of Sexual Health and HIV Medicine

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Executive Summary

Since the beginning of the HIV epidemic in the late 1980s, Sri Lanka has been classified as a country with low level HIV epidemic. Even among key populations, HIV prevalence has not exceeded beyond 5%. In this background, Sri Lanka has been exploring the possibility of achieving the ending AIDS epidemic targets earlier than the global timeline. Although a number of expensive studies such as IBBS, population size estimations have been conducted during recent years, there is no clear picture emerged regarding the key populations and the direction of the epidemic pattern.

HIV estimation and projection in Sri Lanka are more important than ever when the country is trying to reach ending AIDS epidemic targets. It is expected that the correct HIV estimates will reflect the current state of epidemic to inform and guide the national response. AIDS Epidemic Model (AEM) and Spectrum were used as tools to generate the estimates by Technical Working Group (TWG) which was represented by the relevant government, non-government, UN and technical partners. Sub-national estimates were not attempted during the current AIDS Epidemic Modelling due to the lack of region-specific data as well as expected low numbers in a sub-national estimate in Sri Lanka.

Results of national estimates indicate that there are 3600 people living with HIV (PLHIV) in Sri Lanka in 2019. Of this estimate, 3,550 are adults who are 15 years and older, and the male to female ratio was 2.93. The trend of PLHIV is relatively stable in the past five years implying the state of balance between new infections and AIDS related deaths.

Total new HIV infections were estimated at 140 in 2019 with 137 new HIV infections among adults 15 years and older. New HIV infections were peaked in 2001 at around 500, but there was a steady decline of new HIV infections after reaching its peak as antiretroviral treatment (ART) coverage was increased rapidly. Although the epidemic is declining in terms of numbers, new HIV infections among Men who have Sex with Men (MSM) as share of total new HIV infections is growing. In 2019, more than half of (53%) new HIV infections were among MSM. New infections among Female Sex Workers (FSW) is declining remarkably as a result of the successes achieved in past interventions. AIDS-related deaths had peaked around 2013 at around 250 annual deaths. In 2019, there were 169 AIDS-related deaths among adults living with HIV. Although the new HIV infections among People who Inject Drugs (PWID) is very small, there is an increasing trend in absolute number.

Based on the estimated new HIV infections, recommendations are made to further scale up HIV testing programmes, scale up prevention programmes for MSM, maintain the success achieved in FSW prevention programmes and getting more efforts to prevent transmission among spouses and partners.

AIDS epidemic in Sri Lanka is seems to be under control but not yet over. The National Strategic Plan scenario showed that ending AIDS is achievable. However, this needs scale up of current HIV prevention efforts based on the informed policy and decision making.

Acknowledgements

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Abbreviations

- AEM AIDS Epidemic Model
- AIDS Acquired Immune Deficiency Syndrome
- ANC antenatal clinic
- ART antiretroviral treatment
- ARV antiretroviral drugs
- BB Beach boys
- CD4 Cluster of differentiation
- CSHW Castle Street Hospital for Women
- DMH De Soysa Maternity Hospital for Women
- DU Drug user
- EID early infant diagnosis
- EIMS Electronic Information Management System
- FPA Sri Lanka Family Planning Association
- FSW Female sex worker
- GFATM Global Fund to fight AIDS, TB and Malaria
- HIV human immunodeficiency virus
- HSS HIV sentinel surveillance
- IBBS integrated biological and behavioural surveillance
- IDU injecting drug user
- KP Key population
- MARP most at risk populations
- MEIMS Monitoring and Evaluation Information Management System
- MOH Ministry of Health
- MSM Men who have sex with men
- MTCT mother to child transmission
- M&E monitoring and evaluation
- NDDCB National Dangerous Drug Control Board
- NGO nongovernmental organization

- NSACP National STD/AIDS Control Programme
- PLHIV People living with human immunodeficiency virus
- PMTCT prevention of mother to child transmission
- PSE population size estimation
- PR principal recipient (of Global Fund)
- PWID people who inject drugs
- SIM Strategic Information Management
- STD sexually transmitted diseases
- STI sexually transmitted infections
- TA technical assistance
- TGW transgender woman
- UNAIDS Joint united nations programme on HIV/AIDS
- UNICEF United nations international children emergency fund
- VCT Voluntary Counselling and Testing
- WHO World Health Organization
- WG working group

1. Introduction

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). However, Sri Lanka has adopted the SDG target of "End AIDS by 2030" and has accepted the challenge of achieving this target five years before the rest of the world, i.e. by 2025. In this journey through the fast track, the National STD/AIDS Control Programme is the pioneer government institution in Sri Lanka which is taking the leadership and decisions to guide the national response to HIV and reach this goal timely (2).

1.1 Situation of HIV Epidemic in Sri Lanka as of end 2018

The estimated number of people living with HIV (PLHIV) in 2018 is 3,500 (3,100 – 4,000). This is very similar to the 2017 HIV estimation. The total number of PLHIV diagnosed and alive is 2,709 (cumulative reported number minus cumulative reported deaths). However, these are cumulative figures since 1987, and there are deaths that are not reported as AIDS deaths. Out of the total 1,656 PLHIV who are currently linked with HIV treatment and care services, 1,574 have been started on antiretrovirals (ART), and 1,338 were having viral suppression (2). A total of 350 HIV infected persons were newly reported during 2018. This is an increase of 23% from the number reported during 2017. Analysis of probable mode of HIV transmission in 2018 shows that the male-to-male (46%) and male-to-female sexual transmission (41%) are the most frequent modes of transmission. Of these, male-to-male HIV transmission has become the predominant mode of HIV transmission since 2017. Very low rates of HIV transmission due to injecting drug use and mother-to-child HIV transmission were reported. The latest case reporting data indicate that unprotected sexual intercourse among males is driving the HIV epidemic in Sri Lanka. Highest number of cases reported in Colombo during the past four years (2).

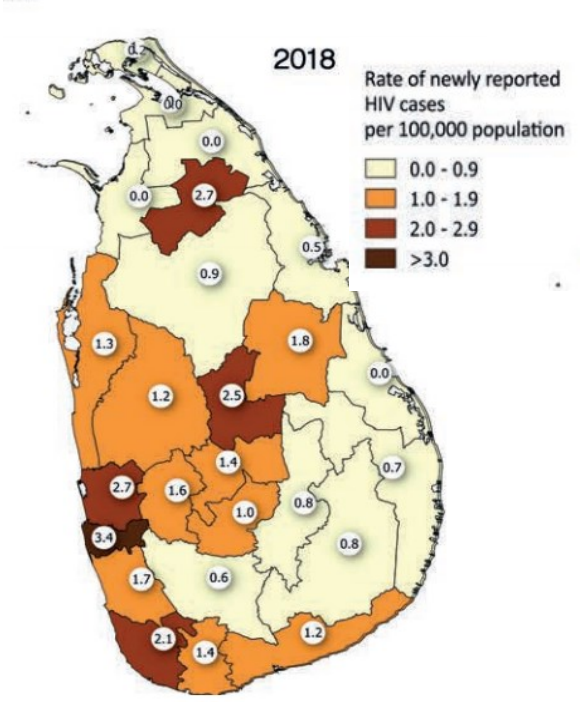

Figure 1: Rate of newly reported HIV cases per 100,000 population
Source: NSACP Annual Report - 2018

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) (3). HIV prevalence estimation carried out in the integrated biological and behavioural survey (IBBS) showed that HIV

prevalence among FSW, MSM and BB were 0.2% while the HIV prevalence among injecting drug users was 0% (5). It is noteworthy to highlight that for the first time in history, transgender women (TGW) were included in IBBS and HIV prevalence was found to be higher (1.2%) than other key populations. National size estimation study carried out in 2017/2018 showed an estimate of 30,000 female sex workers, 40,000 MSM, 4,500 BBs, 900 PWID and 2,200 TGW in the country (4).

1.2 AIDS Epidemic Model (AEM)

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.

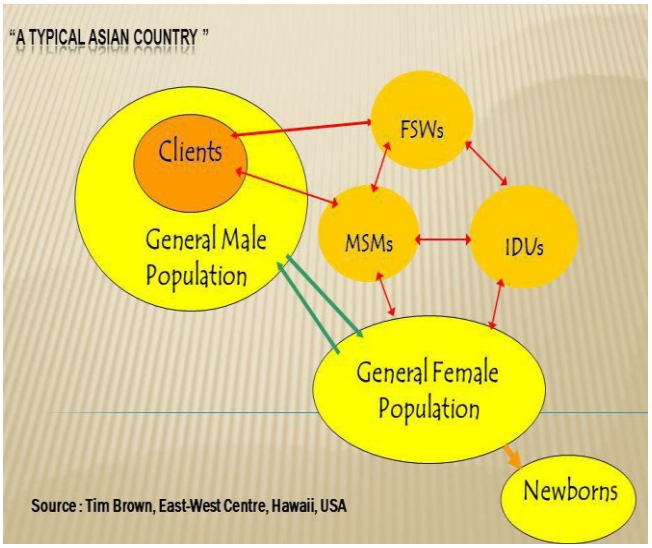

Figure 2: HIV transmission dynamics in AEM

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).

Using trends in risk behaviors among the important sub-populations in Asian epidemics as inputs, the model determines the HIV transmission probabilities necessary to fit observed epidemiological patterns, as seen in surveillance data. It then calculates the number of new infections through key routes of transmission including marital sex, extra-marital (casual) sex, sex work, male-male sex, needle sharing, and mother-to-child transmission. Specific outputs of the model include the number of new, current and cumulative HIV infections and AIDS related deaths for each year (7). In contrast to the curve fitting approaches used in the UNAIDS workbooks and the Estimation and Projection Package (EPP), the Asian Epidemic Model (AEM) is a full process model that mathematically replicates the key processes driving HIV transmission in Asia (8).

AEM tool suite includes 3 major workbooks – a) AEM baseline workbook, b) AEM intervention workbook and c) AEM analysis workbook (Figure 1.3). These workbooks can be used to analyze (1) HIV and AIDS disease burden and trends over time in the current scenario assuming the current situation will continue in the future as well (AEM baseline), (2) Economic and impact analysis such as resource needs estimation, cost-effectiveness analysis, and investment case analysis (AEM intervention and impact analysis) and (3) provide policy recommendations.

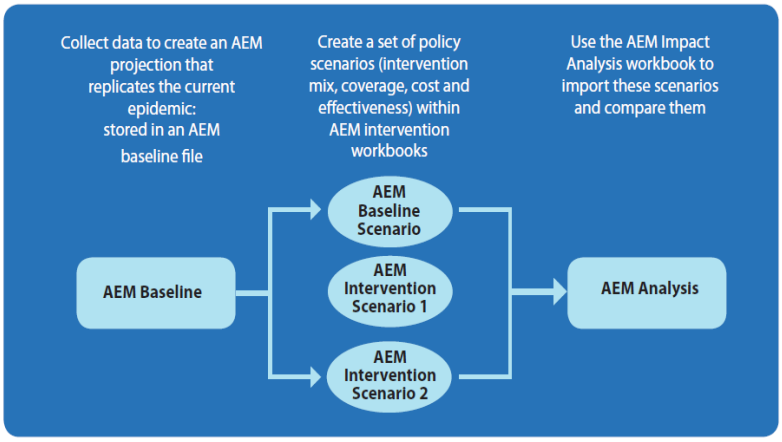

Figure 3 Overview of AEM workbook

Source: Technical note on AEM estimation, Cambodia (32)

1.3 Application of AIDS Epidemic Model (AEM) in Sri Lanka

New HIV infections and people living with HIV (PLHIV) in Sri Lanka had been estimated using Estimation and Projection Package (EPP) from 2009 to 2016. During 2017, the National estimation working group decided to use the AIDS epidemic model (AEM) in place of EPP as this would provide more details such as building intervention scenarios and impact analysis, etc. NSACP conducted a workshop to adopt AIDS Epidemic Model in Sri Lankan context in Bangkok, Thailand in October 2017. The working committee participated in the workshop developed the baseline scenario estimation for Sri Lanka. Following this, NSACP organized a workshop on AEM policy and impact analysis in April 2018 in Colombo, Sri Lanka with the aim of updating the AEM baseline model with newly available data and to develop estimations for different intervention scenarios and for possible policy options. The estimation of intervention scenarios with costing support the working team to identify best intervention to achieve said national objectives (2). However, during the dissemination meeting held in April 2018, it was decided to conduct another workshop using the finalized results of IBBS and Population size estimation conducted in 2017/2018. During the third workshop which was held in June 2018, the working group could finalize both AEM baseline as well as intervention scenarios. Since, estimations related to mother-to-child transmission and children cannot be generated by AEM, Spectrum software was used to come up with final national estimates. The results generated by AEM were used to develop the Global Fund concept note (2019-2022).

Figure 4: Sri Lankan working group on HIV estimation, February 2020.

After two years of initial implementation of AEM findings, NSACP organized the second round of AEM modeling in 2020. The first workshop was conduct from 24th to 27th February 2020 in Hilton hotel, Colombo and the dissemination meeting was conducted on 28th March 2020 at Citrus Hotel, Waskaduwa to a wider audience. This report describes the process and the results of PLHIV estimation done in 2020 using AEM and Spectrum in Sri Lanka.

2. Methodology

During 2020, a consultative process with more stakeholder engagement was adopted for development and finalization PLHIV estimations compared to the previous year. A wider range of stakeholder including NSACP consultants (venereologists, community physicians, epidemiologists and programme managers), consultants and medical officers from peripheral STD clinics, M&E officers from PR-2 of the Global Fund (The Family Planning Association of Sri Lanka) were participated in the estimation process using AEM and Spectrum. The team collected, generated, compared, examined, and built consensus on the data inputs for the AEM workbooks. The consultative meeting started with a comprehensive introduction to help the team understand the technical aspects of the AEM software, data needs, critical issues, assumptions, and validating results based on the context of the epidemic in Sri Lanka. Dr. Wiwat Peerapatanapokin, one of the experts who is working on AEM, facilitated the workshop and assist the team in finalizing data inputs and in generating, interpreting, and validating the results.

2.1 Scope and limitations

This paper focuses on the processes, key findings, program implications, and recommendations based on the results generated by the study. Technical descriptions and tutorials on how to use the AEM software will not be described in this report. However; such information can be found in the 2014 AEM 4.02b manual "Assessing HIV Program Impacts with AIDS Epidemic Model (AEM) - A Tutorial Introduction to the AEM Suite of Tools and Workbooks" developed by the EWC Research Program in Hawaii, USA. It was observed that the AEM tool does not have age disaggregation to describe the projections and interventions for different age groups. The AEM Included FSW, MSM, and PWID aged 15-49. Transgenders were not included in the Baseline file of AEM due to the lack of data on TG during the development of the baseline models.

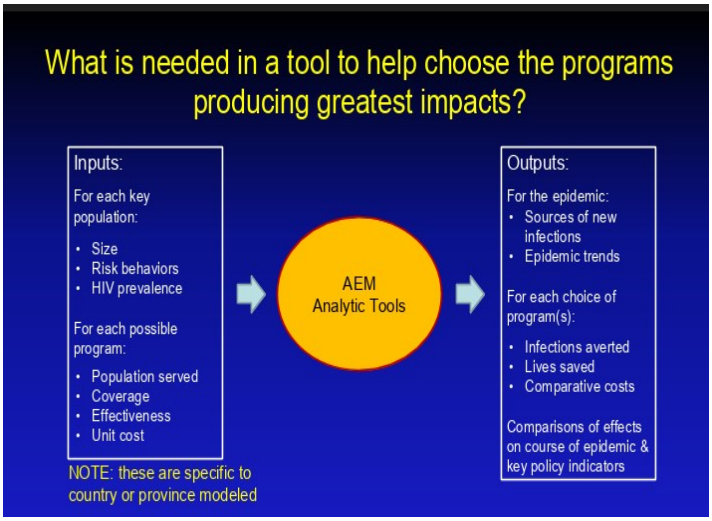

Figure 5 AEM inputs and outputs

2.2 AEM data requirement

Developing an AIDS epidemic model requires a careful and evidence-based understanding of the context of the epidemic using reliable data since these are crucial in presenting a realistic picture of the country situation when applied in modeling. These data, both published and unpublished, include epidemiological, behavioral, and response data. Upon validation, these data were encoded to AEM workbooks (Annexure 01: List of AEM inputs).

AEM is based on the epidemiological patterns commonly observed in concentrated epidemics, where the bulk of HIV transmission occurs among 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. As discussed, 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).

2.3 AEM data inputs in Sri Lankan context

2.3.1 Population data

This sheet of the AEM workbook contains the age 15+ population in the projection area covered by the baseline workbook. The Population data are entered by male-female in the categories 15+, 15-49, age 15 and 15-24. Demographic projections for Sri Lanka from 1975-2050 were done using the Spectrum DemProj module based on population parameters from the UN Population Division. These demographic projections were compared with the census and projection demographics of the Department of Census and Statistics of Sri Lanka. Annexure 02 presents the data sources and assumptions for each indicator in detail. It should be noted that there was a marginal increase in total population size compared to the previous AEM estimation which contributed to an increase in the estimated number of HIV infections and PLHIV.

2.3.2 Heterosexual Behaviors and STI

The heterosexual worksheet contains the size estimates and key risk behaviours for two groups of female sex workers and one shared group of clients of FSW, 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).

However, in the Sri Lankan context, the working group (WG) decided to include only one FSW group, as there are no enough size estimation and behavioural data to disaggregate datainto two FSW groups. FSW size estimation figures are available in 2010, 2013 and 2017 key population size estimation of NSACP (9; 10; 5). The WG agreed to use the consensus reached for FSW size estimation in 2017/2018 which is 30,100 (0.57% of the adult female population). Key risk behaviours of female sex workers and clients of female sex workers are available in Behavioural Surveillance Survey (BSS) and two Integrated Behavioural Surveillance Survey (Ex: - 2015 and 2017) (11; 12; 4). IBBS-2017 figure (78%) was used as it is more reliable and the latest (from 2006 onwards). 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). For other behavioral indicators 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 Census report (15). In addition, the programmatic data (client registration data) reported by respective Sub Recipients thorough FPA Sri Lanka Monitoring and Evaluation Information Management System - MEIMS (23) were used to gather Behavioural data. The 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 presents the data, data sources and assumptions of each indicator separately.

2.3.3 People Who Inject Drugs (PWID)

The 'PWID' worksheet contains the 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. Sri Lanka size estimates for PWID are low 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- 1,209 (25). In the National size estimation study commissioned in 2013 adopting hot spots based geographic mapping yielded 423 PWID in the country whereas the latest size estimation (2017/18) come-up with a slightly high figure (9; 5). The working team agreed to use the 2017 size estimation consensus figure of 900 (0.02% of the adult male population). As female injecting drug use behaviour is very low in Sri Lanka, only male PWID was considered in the AEM process. Behavioural data on injecting Drug Use was extracted from IBBS survey 2017 (4). Annexure 02 explains the data, data sources and assumptions of each indicator separately.

2.3.4 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. Provisions are also made for sexual interaction with female sex workers and regular female partners.

The MSM population in the Sri Lankan context was divided in to two groups; hotspot based and other. Data on the size of the hotspot based MSM is available in three 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) and the latest size estimation conducted in 2017 (10; 9; 5). The working group agreed to use the results of the 2017/18 national size estimation figure as it is the nationally agreed size of the key population by all the stakeholders (4). Therefore, 16,000 was used as the number of hotspots based MSM (MSM1 or reachable MSM) in the country.

The other MSM (MSM2 or unreachable MSM) who are having higher socioeconomic status, lower partner exchange rate and mostly heterosexuals considered to be low risk for HIV. The total number of MSM in the country (MSM 1 + MSM2) was considered as 2% of the total male population (15-59) which is around 99,200. Behavioral data of MSM are available in three studies; BSS-2006/07, IBBS 2013 and IBBS 2017/18 (11; 12; 4). The working group agreed to use behavioral data of the latest IBBS (2017/18) as behavioral data was not available in HSS-2019. Average figures of 3 districts (Colombo, Galle and Anuradhapura) were used as the national estimates. Annexure 2 critically evaluate data, data sources and assumption of each indicator in detail.

2.3.5 HIV Prevalence

On this worksheet of the AEM workbook, 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 the HIV Sentinel Surveillance Survey (HSS)-2016 report, 2 Integrated Biological and Behavioural Survey (IBBS) reports (2013 and 2027/18) and latest HSS (2019) unpublished data (26; 18). In the previous (2018) AEM estimation, 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. However, the existing ANC prevalence data were removed from AEM model as the HIV prevalence among antenatal mothers do not represent HIV prevalence of the general population women (During early phase of epidemic, ANC prevalence would be higher than that of general women because they are more likely to be sexually active. Therefore, they would have higher incidence and higher prevalence of HIV than older women. However, during the later phase of the epidemic if the incidence among women can be controlled, the prevalence among younger women including ANC women would decline, the prevalence among older women would become higher than younger women including ANC women because the cumulative of infections by age. Therefore, using ANC prevalence for AEM curve fitting will give an underestimate of PLHIV among the general population women. The prevalence among ANC is only 0.003% while the prevalence among general women is around 0.01%.) Prevalence of the male general population also was not included due to the non-availability of data at the time of modelling. Annexure 2 explains the data, data sources and assumptions of each indicator separately.

2.3.6 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.

2.3.7 ART (Antiretroviral treatment) data

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 the Spectrum.

However, the number on ART by Key population is not available for Sri Lanka as the risk behaviour data are not included in the ART database. This problem will be overcome once the proposed EIMS is in place. The data available in the ART cross-sectional 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 2019 (27). The number of PLHIV who are in ART up to 2016 was available in the existing AEM worksheet (finalized in 2018). The newly available figures for 2018 and 2019 were entered into the model. Annexure 2 present the data in detail.

2.3.8 Validation data

On this page, the 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 2019 was included (28). Heterosexual males were calculated subtracting MSM men from total men. Existing Sri Lanka AEM workbook contained data up to 2016. Newly available data from 2017 and 2018 were entered into the model. 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 at the model fit stage.

2.4 Data availability and input assumptions

As discussed above, the AEM process starts with the 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 subpopulations relevant to the epidemic. These trends should be representative of Sri Lankan context. As the data is gathered through secondary sources, these 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 as well as assumptions used in preparing the model. So, the following subtopics of this report serve the purpose of documenting the availability and use of in-country data with key assumptions. Annexure 2 discusses the data, data sources and assumptions of each indicator in detail.

2.5 What's new and/or changes in inputs from previous AEM estimation

The AEM workbook which was finalized in 2018 was upgraded to the latest version and the same prepopulated data were used with some adjustment with newly available data. The list of newly available data includes, HSS 2019 data, ART 2018 and 2019 data, IBBS and Size estimation (2017/18) data on transgender women (TGW), HIV testing data 2018 and 2019, HIV case reports 2018 and 2019, programme coverage data for 2018 and 2019, and sub-national KP data. The AEM working group, cleaned, sorted and critically analyzed all newly available data and populated in the existing AEM workbook. AEM working group agreed on the following key decision during the workshop.

01) The working group sought the possibilities include TGW data in the new AEM model which was not there in the AEM model finalized in 2018. Finally, the team decided to exclude TGW in this time as there were only a few data points (in terms of population size, prevalence and behavior) and low population size.

02) The working group discussed the importance of review the size of the MSM population and mode of transmission to ensure that the MSM epidemic is not under reported. The existing AEM model which was finalized in 2018 considered the number of MSM as 78,000 (taking 1.5% of the adult male population). However, it was realized that the cumulative infections exceeded cumulative case reporting alarming underestimation of population size or prevalence (MSM PLHIV estimate was 500-600 but the cumulative number was around 800. According to the HIV case reports, the cumulative number of MSM was around 900). As the HIV prevalence among MSM is well established with several scientific evidences, the working group agreed to change the MSM size estimation from 78,000 to 99,000 (taking 2% of the adult male population). Of the total 99,000 MSM 16,000 included in group one (hot spot based) and balance included in group 2.

03) HIV prevalence among MSM in HSS is 1.6% (It was discussed that this may have been an overestimate because this is an STD clinic prevalence). Case reports in 2018 and 2019 showed that there was an increasing number of MSM. It was discussed that this may be due to the number of tests done among MSM has increased because positivity rate is not increasing. However, HIV prevalence among MSM was used as 1.6% in the model. HIV prevalence among Female Sex Workers (FSW) was taken as 0.1% (HSS) and prevalence among clients was used as 0.1% (HSS). It was discussed that Male and Female heterosexual seroprevalence was thought to be stable or declining as the numbers of heterosexual reported cases were stable while the number of tests is increasing throughout the last few years.

04) It was highlighted that the programme doesn't have recent data on behaviour, especially on MSM since HSS didn't include behavioural data. So, the behaviours were thought to be the same as in the past. A condom use was found to be 67% among the MSM in 2017. Condom use among MSM was identified as the most important indicator for the country. However, it was suggested that programme coverage data suggest that the condom use level must be maintaining.

05) When it comes to STI, the trend of active syphilis among FSW has not increased. The level of active syphilis among the female sex workers was 1.4% according to the IBBS while the newer HSS shows it to be 1.2%. The prevalence of all STI was found to be 8% - 10% in HSS. It was thought that the low level of active syphilis among FSW could be due to FSW using more condoms.

06) Previous Sri Lanka AEM estimation which was finalized in 2018 used urban sector ANC data (from De Soysa and Castle Street Maternity hospitals) to represent the general female population. Now, the country has national data and it is very low compared to the previous (urban sector) ANC data. Working Group agreed to exclude ANC figures as ANC mothers do not represent the general sexually active women population (i.e. ANC women are younger than general women). As described earlier, during the early phase of the epidemic, ANC HIV prevalence would be higher compared to the general women's prevalence because they are more likely to be sexually active. Therefore, they would have incidence and prevalence more than the older general population women. However, during the later phase of the epidemic, the prevalence among older general population women become higher because of the cumulative of infections by age. Sri Lanka has a long-term HIV epidemic among females. The prevalence among ANC is only 0.003% while the prevalence among general women is around 0.01%. Therefore, we could not use ANC prevalence in the AEM fittings it would underestimate the number of PLHIV among general population women.

2.6 Spectrum Estimates

As mentioned previously, AEM is an adult model (adults 15+) and in order to generate national estimates including children (0-14) years old and components of mother-to-child transmission of HIV (MTCT) , incidence trend from AEM model is imported into Spectrum software to generate estimates for all people living with HIV including children and pregnant women. Spectrum software provides the option to choose and import the AEM baseline workbook that reads in the spectrum and generates estimates for both adults and children (Figure 2.2).

Once the AEM workbook is finalized, the AEM outputs were imported into the spectrum software. The incidence rate and female to male incidence ratio from AEM were transferred to Spectrum. Adult demographic and adult ART inputs are checked to be consistent between AEM and Spectrum. The modeling results from both models were inspected and calibrated with regards to comparability values related to key estimates of AEM and Spectrum. The following indicators were used to compare the results of AEM and Spectrum to check the consistency between AEM and spectrum outputs and results.

1. Number and trend of adults (15+) living with HIV
2. Number and trend of new HIV infections among adults (15+)
3. Number and trend of AIDS related deaths among adults (15+)

After certain adjustments, the number of adult PLHIV was consistent with that of AEM estimates.

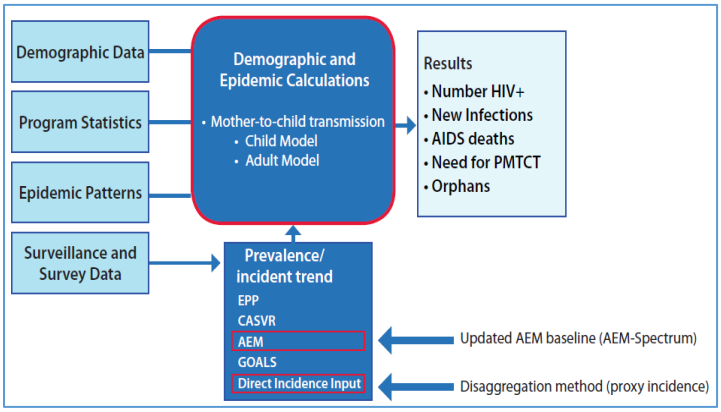

Figure 6 AEM – Spectrum Structure

For PMTCT calculation, local factor for Fertility reduction was calibrated to be 0.55 to get the number of PMTCT needs that reflex the current situation of PMTCT coverage that fits with the country statistic which is more than 95%. With this PMTCT coverage, the current Spectrum version generated a higher MTCT rate than what was expected given the standard ARV regimen. This higher than expectation of transmission rate was discussed of what may cause it and it was explained by the impact of incidence cases among pregnant women. There were some HIV incidences occur among pregnant women. These incidence cases would not be tested positive when they get tested at their first ANC visit. So, they would not be part of the PMTCT clients and never receive ARV. Their children would get a high transmission rate during delivery and the breastfeeding period. However, with this transmission rate, the final PLHIV children data produced by the Spectrum seems to match with the real data of HIV reported cases among young children.

3 . Results

3.1 AEM Baseline findings

AEM baseline scenario generates national level results on HIV epidemics with the assumption that the current situation and programme will continue for future years as well. Key outputs include but not limited to, estimated annual new infections, estimated number of PLHIV, annual death, annual ART requirement, etc. over time by risk groups and by mode of transmission.

3.1.1 Summary of Key findings

Table 1 provides a summary of outputs generated by AEM in the baseline scenario. As described in methodology, AEM outputs include only the HIV epidemic among adults and data related to children is not included. Estimated annual new infections in 2019 is 137 and reduce overtime up to 113 by 2025. Similarly, the estimated number of deaths due to HIV epidemic in 2019 is 169 and increases over time. In line with new infections and deaths, the estimated number of PLHIV are decreasing over time from 3,550 in 2009 to 3,231 in 2025. The epidemic is transforming to a more and more male type epidemic which is due to MSM transmission.

Table 1: Summary of AEM results 2019-2025

	2019	2020	2021	2022	2023	2024	2025
New HIV infections:	137	124	121	119	117	115	113
Current PLHIV:	3,550	3,520	3,475	3,419	3,358	3,294	3,231
Annual AIDS death:	169	155	166	175	178	178	176
Annual ART needs:	3,550	3,520	3,475	3,419	3,358	3,294	3,231
Number on ART:	1,668	1,776	1,775	1,772	1,767	1,760	1,752
Male-Female Inc Ratio:	4.15	4.61	4.70	4.77	4.87	4.99	5.12
Cumulative infections:	8,106	8,230	8,351	8,470	8,587	8,702	8,815
Cumulative deaths:	4,556	4,711	4,877	5,052	5,230	5,408	5,584
Cumulative M/F Ratio:	2.93	2.94	2.96	2.98	3.00	3.01	3.03

3.1.2. Annual new infections by Key Population

As per the AEM results, 137 new infections are estimated in 2019. More than half of new infections (53%) estimated among MSM followed by clients of FSW (21%) and low risk women (15%). The estimated number of new infections among male PWID (5%), FSW (4%) and low risk males (2%) are extremely low. As illustrated in figure 7, the percentages of new infections among MSM are increasing over time. Sri Lanka has been implemented interventions among FSW for more than two decades. Proportion of new infections among FSW and clients of FSW showing a reducing trend over time which can be attributed to a high level of condom use among FSW. However, the number of infections among low risk females is increasing during the next few years reflecting HIV transmission from bisexual MSM partners. These results clearly indicate that Sri Lankan HIV prevention programme needs to be more focused on designing interventions for MSM. Although there is no considerable

drive by the PWID, the numbers of infections among PWID are estimated to increase slightly over the next few years.

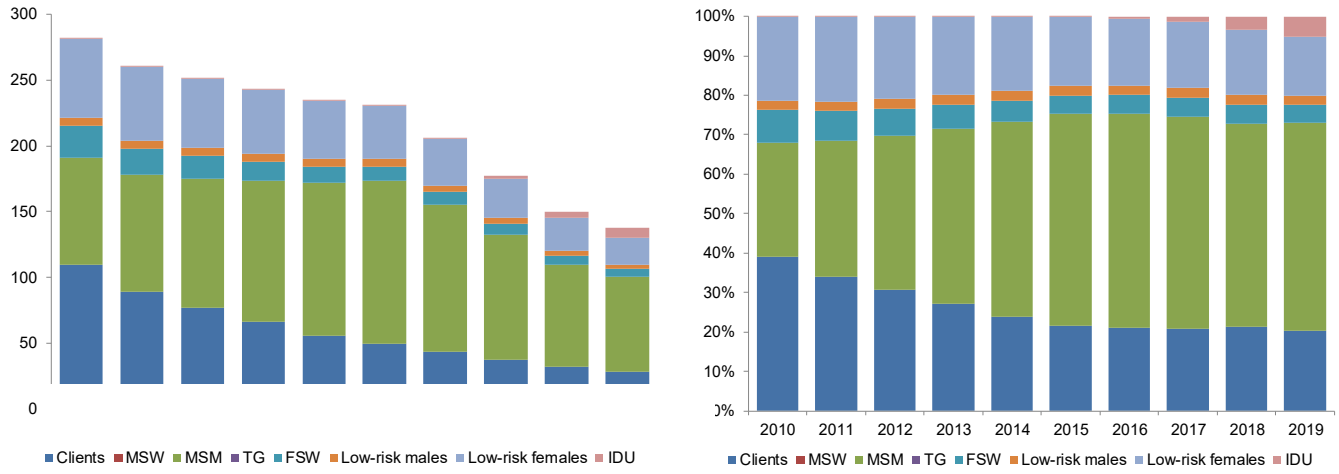

Figure 7: Estimated number (7a) and proportion (7b) of new infections by risk group

3.1.3. Estimated number of adults living with HIV (PLHIV 15+)

AEM estimated 3,550 adult PLHIV in the country and out of them 1,439 (41%) are high risk males. High risk males include clients of FSW (500), MSM (924) and male PWID (15). The number of high-risk females among PLHIV considered to be significantly low (4%) which includes 134 HIV positive FSW. Around one third of the PLHIV (31%) considered to be low risk males and balance 25% consists of low risk females. It is noteworthy that although the HIV prevalence is relatively low (Ex:- male = 0.02% and female = 0.01%), almost 56% of the total PLHIV coming from low risk population as the size of low risk population is very high. However, it is important to highlight that the proportion of high risk PLHIV is showing an increasing trend over the next decade with an increase of new infections among PWID and MSM.

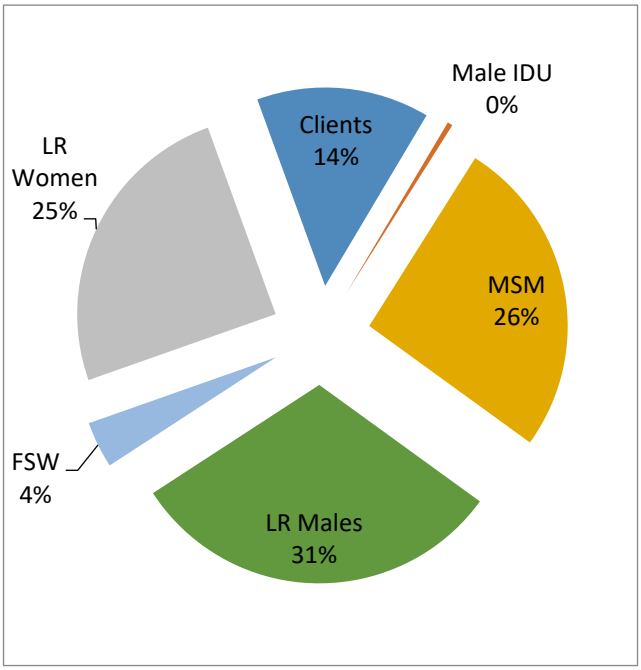

Figure 8: Estimated proportion of PLHIVs in 2019

3.1.4. Probable Mode-of-transmission

Out of the 137 estimated new infections in 2019, almost
half of infections (53%) are transmitted through male-to-male sex, followed by sex work (25%), husband-to-wife (14%), wife-to-husband (2%) and casual sex (1%). Only 5% transferred through injecting drug use. As illustrated in table 8, the proportion of male-to-male transition is estimated to be increasing up to 64% by the end of 2025. However, the proportion of HIV transition through sex work shows a decreasing trend over time with an increase in condom use among FSWs. As per the results of AEM, we are not expecting a significant change of proportion in HIV transmission through regular sexual acts among spouses, casual sex and injecting drug use.

However, the estimated proportion of sub-population among 3,550 People living with HIV (in 2019) shows a different picture. The majority (31%) of PLHIV are low risk males followed by MSM (26%), low risk female (25%), clients of FSW (14%) and FSW (4%). The percentage of male PWID estimated to be almost zero. Most of low risk male PLHIV were infected in the past when they were in high risk group at that time. Most of low risk female PLHIV were infected from their spouses who were in high risk or ex-high risk groups.

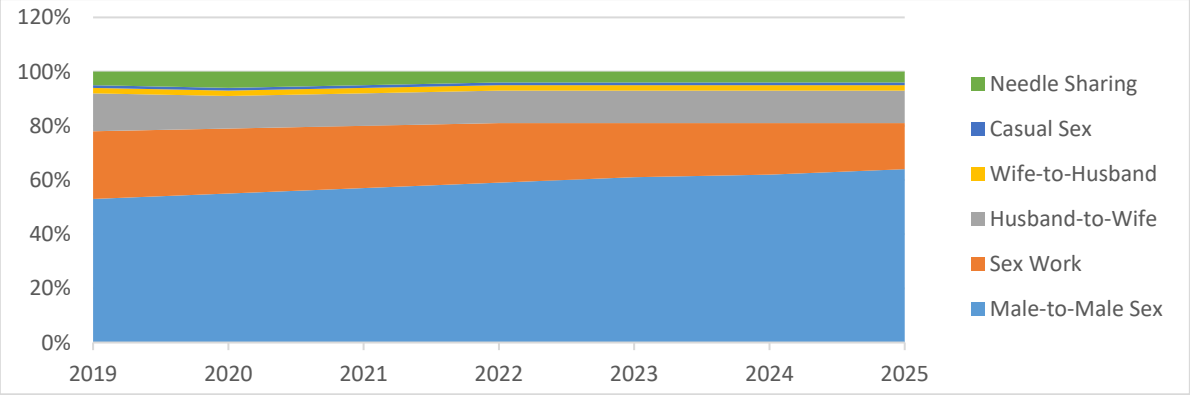

Figure 9: Percentage of new infections by mode-of-transition 2019-2025

Table 2 describes the estimated new infections in 2019 (total 0f 137) as a matrix of the "source of infections" vs "subpopulation". It is important to highlight that out of 20 new infections among low risk females, 14 transmitted from regular partners/spouses, 2 infected through casual sexual activities, and 4 infected through sex with MSM spouses who have bisexual behaviors.

Table 2: Number of new infections in 2019; Mode-of-Transfer among different sub-populations

		New Infections Occurring Among						
		SW Clients	Male PWID	MSM	LR Males	FSW	LR Females	Total (%)
Source of Infections	Sex with Female sex workers	28						**28**
	Spouses/regular partners				3		14	**18**
	Casual sex partners						2	**2**
	Injecting drug use		7					**7**
	Sex with MSM			72			4	**77**
	Sex with clients of FSW					6		**6**
	Total	28	7	72	3	6	20	**137**

3.1.5. Estimated HIV prevalence among sub-populations

AEM estimates HIV prevalence (%) among different sub populations, both high risk and low risk (Table 03). Results show that HIV prevalence among Sri Lankan total population is around 0.02% in 2019 and there will not be significant change during the next five years (the minor reduction over the years disappear when rounded to the second decimal point). Overall HIV prevalence among Sri Lankan males (0.03%) estimated to be 3 times higher than Sri Lankan females (0.01%). However, this disparity is lower among low risk males (0.02%) and low risk females (0.01%). HIV prevalence among low risk males and low risk females seems to be constant over the next five years (the minor reduction over the years disappear when rounded to the second decimal point).

However, HIV prevalence among MSM shows a slight increase from 2019 to 2025. Estimated HIV prevalence among hots spot based reachable MSM in 2019 is 1.5% which is increasing over the years up to 1.57% by mid-2025. HIV prevalence among unreachable MSM shows the same trend with 0.82% HIV prevalence in 2019. Overall HIV prevalence among MSM is 0.93% in 2019. In contrast, HIV prevalence among FSW shows a reducing trend from 0.45% in 2019. In line with high condom use among FSW, the HIV prevalence of male clients of FSW is also reducing from 0.13% (in 2019). However, the HIV prevalence of male PWID shows a rapid increase from 1.66% in 2019 to 3.89% in 2025. Although the prevalence is higher, it will not generate a high number of new infections as the size of the PWID population is very small.

Table 3: Estimated HIV prevalence (in %) by sub-population

	2019	2020	2021	2022	2023	2024	2025
Higher-risk populations							
Current male clients of sex workers (Clients)	0.13	0.12	0.11	0.10	0.09	0.09	0.08
Male Injecting drug users (Male PWID)	1.66	2.32	2.85	3.22	3.49	3.71	3.89
Men who have sex with men (Hotspot based MSM)	1.50	1.51	1.52	1.53	1.54	1.55	1.57
Men who have sex with men (Un-reachable MSM)	0.82	0.85	0.87	0.89	0.91	0.92	0.94
All Men who have sex with men (1+2)	0.93	0.96	0.98	1.00	1.01	1.03	1.04
All female sex workers	0.45	0.41	0.38	0.34	0.31	0.29	0.26
Lower-risk populations							
Low Risk Males	0.02	0.02	0.02	0.01	0.01	0.01	0.01
Low Risk Males	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total population-low-risk	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total Population							
Male overall prevalence	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Female overall prevalence	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total population prevalence	0.02	0.02	0.02	0.02	0.02	0.02	0.02

3.1.6. Estimated ART coverage

The requirement of ART depends on two factors; number of PLHIV in the country and medical criteria to initiate ART. Before 2009, ART initiated, if the CD4 count is lower than 200 which was increased up to 350 in 2009. The minimum required CD4 count to start ART again increased up to 500 in 2015. However, after 2016, NSACP decided to provide ART for all the PLHIV irrespective of their CD4 count. The number of PLHIV in the country is decreasing over time with an increase of the number of HIV related deaths and a reduction in new infections. The estimated number of PLHIV who need ART in 2019 is 3,550 (2,534 males and 1,016 females) which is similar to the estimated number of PLHIV in the country. As an average of around 120 new PLHIV (100 males and 20 females) who are in need of ART estimated to be added into the pool during the next five years.

The total estimated number of adult (15+) PLHIV who are receiving ART as of 2019 is 1,668 of which 1,178 (71%) are males. Estimated ART coverage as of mid, 2019 is less than half (47%) which is estimated to be increased up to 54% by the end of 2025 and 57% by end of 2030 under the baseline scenario (if the current programme is continued without any additional interventions). ART coverage of females is slightly higher than males. Therefore, the country is not going to reach 90:90:90 targets by the end of 2030, if the baseline scenario is continued (Figure 10).

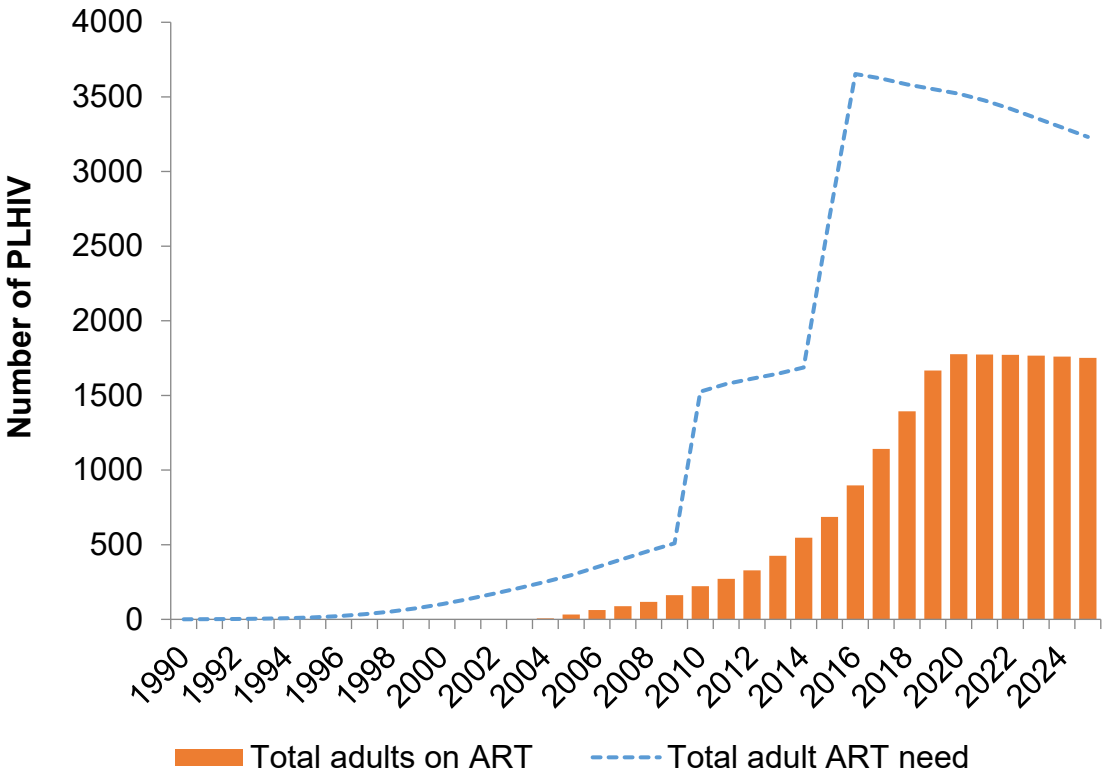

Figure 10: Number of adult PLHIV who need ART vs who are on ART

It is estimated that in 2019 around 21 adult PLHIV who are on ART (15 males and 6 females) die each year due to HIV related causes. Similarly, 22 adult PLHIV (17 males and 5 females) who are on ART die annually due to non-AIDs related causes. These deaths have been accounted for in estimating ART coverage.

3.1.7. AIDS related deaths

The highest number of deaths among adult PLHIV per year in history is estimated in 2012 (n=281) and estimated to be decreased over time thereafter with an increase in ART coverage. Around 169 PLHIV deaths are estimated in 2019 and show a reducing trend over the next decade (Figure 11).

AEM results show that around 170 deaths per year (120 males and 50 females) among adult PLHVs will report during the next five years (2020-2025) within the country. Out of 170 deaths, around three fourth (76%) are expected to report among the PLHIV who are not on ART. It is noteworthy to highlight that of the total PLHIV deaths (170 per year), the majority (66%) are estimated to report among low-risk-males (n=70) and low-risk-females (n=45). The highest number of PLHIV deaths from high risk populations is expected among MSM (n=34), followed by clients of FSW (n=19) and FSW (n=5).

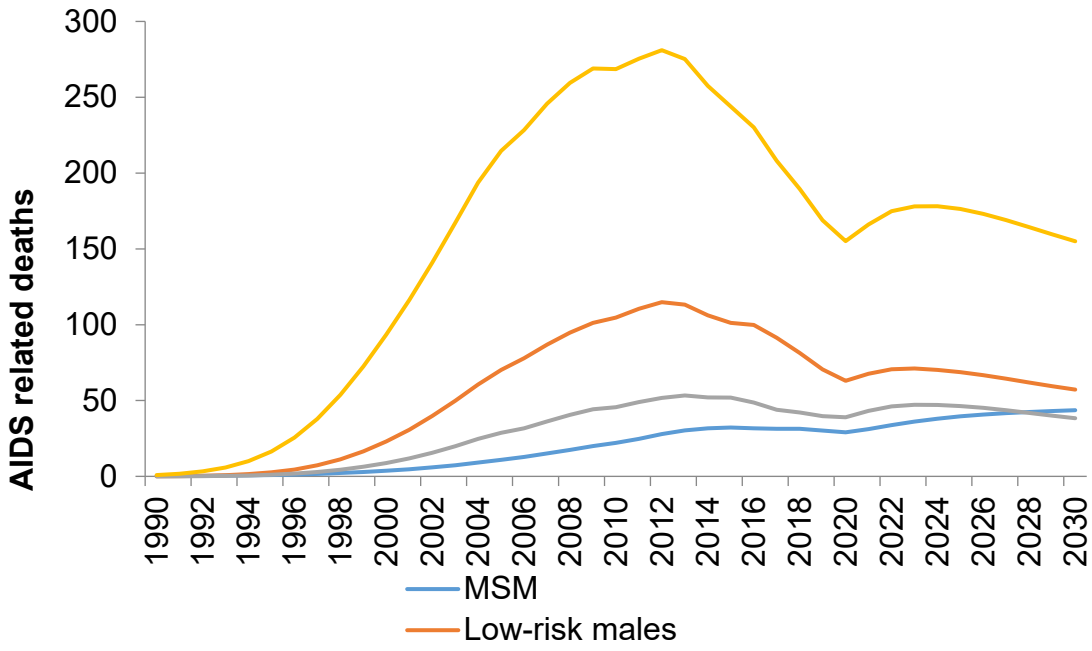

Figure 11: Number of PLHIV deaths by sub-population from 1990 -2030

3.2. AEM national strategic plan scenario

AEM results in the baseline scenario indicated that country cannot achieve 90:90:90 targets by 2025 or 2030 if there are no additional interventions during the next few years. Therefore, the country team worked on the national strategic plan scenario to compare the estimates, if we implanted the national strategic plan (2019-2022) and ensure the expected results in ART coverage and behavioral indicators.

Condom use among FSW and reachable MSM (MSM1) was gradually increased by up to 90% by the end of 2022 and STI prevalence among MSM and FSW was decreased to 4.8% and 4% respectively. Condom use

of unreachable MSM also increased up to 80% by end of 2022. Condom use among HIV serodiscordant couples was increased by up to 68% by the end of 2022. The percentage of male PWID who share needles is decreased to 27% by the end of the strategic plan period. Percent of all injections shared (among those who share) also gradually reduced from 90% in 2019 to 41% by 2022. Expected ART coverage was increased by up to 95% by the end of 2022. All other inputs were similar to the baseline scenario. AEM generated attractive results when applying the national strategic plan scenario (Table 4). We included only the behavioral aspects to generate the impact, but cost estimation was not performed due to time limitations.

Table 4: Summary of estimates under national strategic plan scenario (2019-2025)

	2019	2020	2021	2022	2023	2024	2025
New HIV infections (BS)	137	124	121	119	117	115	113
New infections (NSP)	**137**	**123**	**84**	**50**	**27**	**25**	**23**
Current PLHIV (BS)	3,550	3,520	3,475	3,419	3,358	3,294	3,231
Current PLHIV (NSP)	**3,550**	**3,522**	**3,479**	**3,430**	**3,376**	**3,324**	**3,271**
Annual deaths (BS)	169	155	166	175	178	178	176
Annual death (NSP)	**169**	**151**	**127**	**99**	**82**	**77**	**76**
Annual ART need (BS)	3,552	3,521	3,476	3,420	3,359	3,295	3,232
Annual ART need (NSP)	**3,552**	**3,524**	**3,481**	**3,432**	**3,377**	**3,325**	**3,272**
Number on ART (BS)	1,668	1,776	1,775	1,772	1,767	1,760	1,752
Number on ART (NSP)	**1,668**	**1,942**	**2,350**	**2,832**	**3,068**	**3,076**	**3,081**
Male-Female Infection Ratio (BS)	4.15	4.61	4.70	4.77	4.87	4.99	5.12
Male-Female infection Ratio (NSP)	**4.15**	**4.60**	**4.24**	**3.77**	**3.23**	**3.21**	**3.18**

Note :- **BS** = Baseline scenario, **NSP**=National Strategic Plan scenario

As given in table 4, the NSP scenario generated favorable estimates in terms of ending AIDS by 2025. Number of new infections by the end of 2025 reduced to 23 as opposed to 113 new infections generated in the baseline scenario. Estimated annual AIDS related death in 2025 also reduced from 176 in baseline scenario to 76 in NSP scenario with the increase of ART coverage. The estimated number of PLHIV on ART increased up to 3,081 by end of 2025. New infections among MSM drastically reduced and therefore, male: female infection ratio reduced from 5.12 (baseline scenario) to 3.18 (NSP scenario).

3.3. Spectrum estimation including children

The Spectrum software estimates all PLHIV including children below age 15 years. Version 5.87 of Spectrum used for HIV estimation for 2019. Spectrum software updates as given below.

Summary of Key findings of Spectrum estimations

Table 5 gives the selected key estimates for the total population living with HIV. The estimated total population living with HIV in 2019 is 3,600. This number is gradually reducing to around 3,400 in 2025. Adult HIV prevalence in 2019 is 0.03%. The number of new infections is estimated to be 140. HIV incidence is 0.01 per 1,000 uninfected population.

Annual AIDS deaths in 2019 are 135. The trend of annual AIDS death is seen to be reducing up to 2022 and then increasing again.

Table 5: Summary of Spectrum estimates

	2019	2020	2021	2022	2023	2024	2025
HIV population (total population)							
Total	3,605	3,595	3,578	3,543	3,496	3,441	3,383
Male	2,565	2,570	2,568	2,556	2,535	2,508	2,479
Female	1,040	1,026	1,010	987	961	933	904
Prevalence (15-49)	0.03	0.02	0.02	0.02	0.02	0.02	0.02
Number of new HIV infections							
Total	140	126	124	121	119	116	114
Male	112	103	101	99	98	96	94
Female	28	23	23	22	21	20	19
Incidence per 1000							
Total	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Male	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Female	0	0	0	0	0	0	0
Annual AIDS deaths							
Total	135	103	108	124	134	138	140
Male	96	71	75	85	92	95	97
Female	39	32	33	39	42	43	43
Cumulative AIDS deaths							
Total	3,922	4,025	4,133	4,257	4,391	4,530	4,669
Male	2,995	3,066	3,142	3,227	3,319	3,414	3,511
Female	927	959	991	1,030	1,073	1,116	1,159

3.3.2. Estimations on children with living with HIV

Table 6 shows Spectrum estimates on children living with HIV (0-14 years). It is estimated that 54 children are living with HIV in 2019 while new HIV infections and AIDS deaths are estimated to be 2.

Table 6: Summary of Spectrum estimates on children with HIV (0-14 years)

	2019	2020	2021	2022	2023	2024	2025
HIV population - Children 0-14							
Total	54	51	47	43	39	35	31
Male	27	26	24	22	20	18	16
Female	27	25	23	21	20	17	15
New HIV infections- Children 0-14							
Total	2	2	2	2	1	1	1
Male	1	1	1	1	1	1	1
Female	1	1	1	1	1	1	1
Annual AIDS deaths- Children 0-14							
Total	2	1	1	1	0	0	0
Male	1	1	1	0	0	0	0
Female	1	1	1	0	0	0	0

3.3.3. Estimations on Prevention of Mother to Child Transmission of HIV (PMTCT)

Table 7 indicates the Spectrum estimates relevant to the Prevention of Mother to Child Transmission of HIV (PMTCT). Spectrum estimates that the PMTCT coverage in 2019 is 99.7% with a Mother to Child Transmission rate (at 6 weeks) of 2.57 %. The number of new child infections due to mother-to-child transmission in 2019 is 2 and the antiretroviral treatment coverage for HIV+ pregnant women is estimated to be 99.7%. According to the Elimination of Mother to Child Transmission of HIV (EMTCT) criteria given by the World Health Organization, Mother to Child Transmission rate should be less than 2%. However, the current round of Spectrum estimated gives a MTCT rate at 6 weeks between 2-3% and the final transmission rate between 12-15% during 2019-2025 period. Although the transmission rate is higher than 2%, the absolute number of children infected from their mothers is very small only 1-2 new infections per year.

Table 7: Summary of Spectrum estimates on PMTCT

	2019	2020	2021	2022	2023	2024	2025
Mothers needing PMTCT	16	15	13	12	11	9	9
Mothers receiving PMTCT	16	15	13	12	11	9	8
Single dose nevirapine	0	0	0	0	0	0	0
Dual ARV	0	0	0	0	0	0	0
Option A – maternal	0	0	0	0	0	0	0
Option B - triple prophylaxis from 14 weeks	0	0	0	0	0	0	0
Option B+: ART started before current pregnancy	6	6	5	5	4	4	3
Option B+: ART started during current pregnancy > 4 weeks before delivery	10	9	8	7	6	6	5
Option B+: ART started during current pregnancy < 4 weeks before delivery	0	0	0	0	0	0	0
PMTCT coverage	99.72	99	99	99	99	99	99
PMTCT coverage of more efficacious regimens	99.72	99	99	99	99	99	99
MTCT rate at 6 weeks	2.57	2.52	2.6	2.69	2.8	2.91	3.02
Final transmission rate including breastfeeding period	12.76	12.1	12.53	13.05	13.6	14.15	14.68
Number of HIV+ breastfeeding women at 3 months	0	0	0	0	0	0	0
Number of HIV+ breastfeeding women at 12 months	0	0	0	0	0	0	0
Number of new child infections due to mother-to-child transmission							
Total	2	2	2	2	1	1	1
Male	1	1	1	1	1	1	1
Female	1	1	1	1	1	1	1
Treatment coverage for HIV+ pregnant women	99.72	99	99	99	99	99	99

3.4. 90:90:90 targets

Based on the findings of the AEM and spectrum estimations, the country team worked on 90:90:90: targets. Results show that major drop is estimated in the first 90, followed by 2nd 90 and third 90 (Table 8).

Table 8: Achievement of 90:90:90: targets

	# of cases (Cumulative)[1]	# of deaths (Cumulative)[2]	PLHIV know their status[3]	PLHIV Estimation[4]	1st 90[5]	Total on ART[6]	2nd 90[7]	3rd 90
2010	1,317	1,022	295	3,975	7%	265		
2011	1,463	1,054	409	3,964	10%	311	76%	
2012	1,649	1,084	565	3,934	14%	387	68%	
2013	1,845	1,111	734	3,891	19%	516	70%	
2014	2,073	1,137	936	3,848	24%	639	68%	
2015	2,308	1,168	1,140	3,809	30%	803	70%	
2016	2,557	1,215	1,342	3,758	36%	1,068	80%	
2017	2,842	1,248	1,594	3,698	43%	1,297	81%	84%
2018	3,192	1,284	1,908	3,634	53%	1,574	82%	85%
2019	3,631	1,329	2,302	3,605	64%	1,846	80%	86%

As per the analysis, the highest gap to achieve 90:90:90 targets in 2015 is related to knowing the HIV status; which is related to HIV testing. Achievement of the first 90 is only 64% by the end of 2019. Annual incremental change in the 1st 90 is only around 10%. Therefore, the country must strengthen its HIV testing strategies both among key populations and the general population.

[1] From NSACP Programme data from 1987
[2] From NSACP programme data. However, the number is underestimated. 1003 PLHIV who reported before 2008 and not on ART were assumed as deaths for this calculation.
[3] PLHIV know their status = Cumulative cases – Cumulative deaths
[4] From spectrum
[5] 1st 90 = PLHIV know their status / Estimated number of PLHIV
[6] Total on ART = Adult (from AEM) + Children (from spectrum)
[7] 2nd 90 = Total on ART / PLHIV know their status

4. Policy/Programme implications and recommendations

- Sri Lanka is still a low-level HIV epidemic country with an adult HIV prevalence of less than 0.1%. The major mode of transmission in the past was from commercial sex work. The current major mode of HIV transmission is MSM. The future major mode of transmission also will be MSM. Sri Lanka has not seen a major PWID epidemic. The contribution of MSM is getting higher and higher.

- Since MSM is the major mode of transmission currently as well as in the future, increasing prevention and treatment among MSM is the key to the future.

- Maintaining the success in the FSW program is necessary.

- Baseline scenarios show continuing to reduce the HIV epidemic, but not enough to end AIDS by 2025. National Strategic scenarios can produce ending AIDS impact by 2025 (New infections in 2010 is 280 while new infections from NSP scenarios will be 23 in 2025 which is more than 90% reduction from the year 2010)

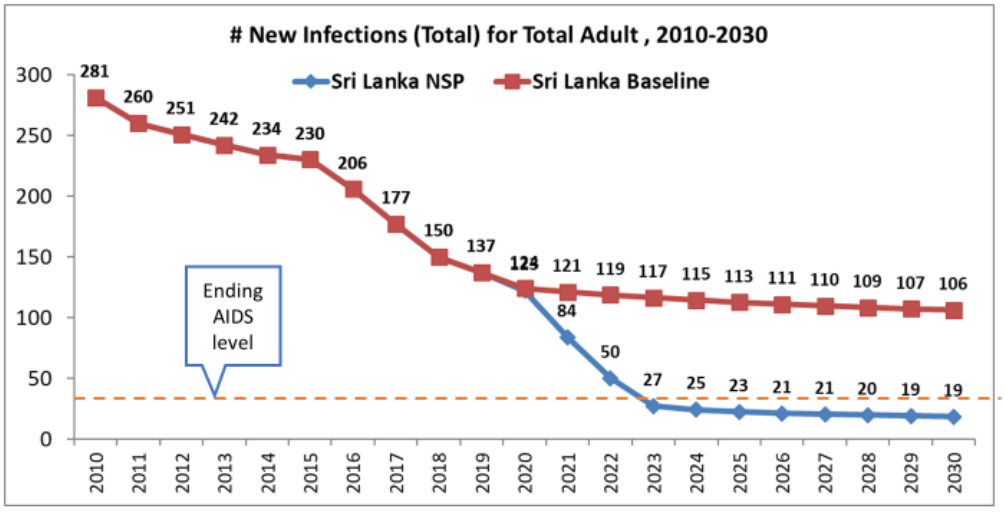

Figure 12: New infections among adults, 2010-2030, baseline vs NSP scenarios

- ART Coverage is around 50%. The main reason for this low ART coverage is the low number of PLHVI who know their status (only 64% in 2019). To increase this level (first 90 target), Sri Lanka needs to increase targeted HIV testing.

- Higher ART coverage will help to reduce all kinds of transmission especially reducing transmission between husband and wife. Higher ART coverage will reduce AIDS related deaths significantly.

- HIV prevention among serodiscordant couples should be improved (Partner testing, Condom use and PrEP) as this will reduce transmission among serodiscordant couples.

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Annexure 1:- List of AEM baseline input indicators

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
	Safe Sax Practices	1.9 Percent condom use with clients
2. Clients of Female Sex Workers	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
		2.3. Average duration buying sex (years)
	Safe Sax Practices	2.4. Percent of adult males who are circumcised
3. Males engaging in casual sex	Population Size	3.1. Estimated size of the males engage in casual sex /Population (in thousand)
	Behavioural HIV Risk Factors	3.2. Percent of males engaging in casual sex in the last year
		3.3. Average number of sex contacts in the last year (male)
	Safe Sax Practices	3.4. Percent condom use in casual sex
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
		1.3 Percent of male PWID in high-risk networks
		1.4. PWID mortality (crude mortality per year in %)
	Behavioural HIV Risk Factors	1.5. Percent of male PWID 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 PWID visiting female sex workers
		1.11 Number of contacts with regular partners (per week)
	Safe Sex Practices	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 PWID in high-risk networks
	Behavioural HIV Risk Factors	2.4 Percent of male PWID 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
	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
3. Injecting Female Sex Workers	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
		3.3 Percent of injecting FSW in group 1 in high-risk networks
	Behavioural HIV Risk Factors	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
	Safe Sex Practices	2.7 Percent condom use in anal sex with male sex workers

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
		1.7 Men who have Sex with Men
	High risk Female Population	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
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
		2.7 Men who have sex with men
	High risk Female Population	2.8 Female Sex Workers
		2.9 Injecting Female Sex Workers
		2.10 Female Injecting drug users
	Currently lower risk populations	2.11 Males who are not now in at-risk populations
		2.12 Females who are not now in at-risk populations

g) ART

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

h) ART by risk populations

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 PWID	ART Coverage	3.1 Number of Male PWID receiving ART
		3.2 Percent of Male PWID 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
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 2:- Data, Data sources and Assumptions

a) Population as a whole

Indicator	Data Source	Values	Assumption / Remarks
1.1. Residential Male Population Disaggregated by age	UN population data captured from Spectrum software	1975 – 4,404,922 2012 – 7,311,998 2050 – 8,277,664	In 2012, Males 15+ is considered as 73.6% of total male population.
1.2. Migrated Male Population Disaggregated by age	N/A	N/A	N/A
1.3. Ratio of 15-49 to 15+ Male population	UN population data captured from Spectrum software	1975- 78.83% 2012 – 69.42% 2050 – 55.12%	N/A
2.1. Residential Female Population Disaggregated by age	UN population data captured from Spectrum software	1975 - 4,149,980 2012 –7,993,666 2050 – 9,503,202	N/A
2.2 Migrated Female Population Disaggregated by age	N/A	N/A	N/A
2.3 Ratio of 15-49 to 15+ Female population	UN population data captured from Spectrum software	1975- 80.37% 2012 - 66.83% 2050 – 50.00%	N/A

b) Heterosexual

Indicator	Data Source	Values	Assumption / Remarks
1.1. Estimated size of the female sex worker / population (in thousand)	N/A	2017 – 30.1	Auto Calculated by the software
1.2. Percent of females aged 15-49 who sell sex	Population Size estimation 2017/18, NSACP, Mid-Year Population 2017, UN population data derived from spectrum software	0.57%	Denominator - female population 15 to 59 from mid-year 2017 UN population data captured from spectrum. Numerator - 2017 Size estimation national figure which was arrived through consensus The same percentage was used for all the years (1975-2050)
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.

Indicator	Data Source	Values	Assumption / Remarks
			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 of selling sex	Client Registration Data (2016) available in the FPASL database	10.00	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).
1.8. STI prevalence among female sex worker	Samarawickrama NA, et. al. (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 -8.1% 1988 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 8.1%. Values for 1988-2010 was calculated by interpolation.
1.9. Percent condom use with clients	HSS-2006 IBBS- 2014 IBBS-2017	1987 and before- 10% 2006 and thereafter - 75.8% 1988 to 2006 – Interpolation	It was assumed that the condom use among FSWs in early years was low (10%) and increased gradually thereafter. 75.8 – Average figure of HSS-2006, IBBS 2014 and IBBS-2017. IBBS-2017 estimate is lower than IBBS-2014.
2.1. Estimated size of the clients of female sex worker / population (thousand)	N/A	401 in 2013	Auto Calculated by the software

Indicator	Data Source	Values	Assumption / Remarks
2.1. 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 and thereafter-10%. 1975 - 7.0% 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.
3.1. Estimated size of the males engage in casual sex /Population (in thousand)	N/A	2012 - 160	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 for all years	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 available in AEM was used

Indicator	Data Source	Values	Assumption / Remarks
3.4. Percent condom use in casual sex	Avg of study among females 1994 study on extramarital 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	320 in 2012	Auto Calculated by the software
4.2. Percent of females engaging in casual sex in the last year	Avg of study among females 1994 study on extramarital sex	1991 - 3% (Same figure for all years)	Avg of study among females 1994 study on extramarital sex
4.3. Percent condom use in casual sex	BSS-2007 Factory workers last time condom use with NRP	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. BSS-2007 Factory workers last time condom use with NRP
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.

Indicator	Data Source	Values	Assumption / Remarks
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% 2019 and thereafter – 47.4%	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 PWID)

Indicator	Data Source	Values	Assumption / Remarks
1.1 Estimated size of the Injecting drug users male/Population (in thousand)	N/A	1975- 0.6 2012 – 0.9 2050 – 0.8	System auto calculated figures
1.2 Percent of males age 15-49 who inject drugs	Population Size estimation 2017, Consensus	0.02% (for all years)	Number of PWID was considered as 900 as per the consensus figure in 2017/18 size estimation
1.3 Percent of male PWID in high-risk networks	N/A	5% (for all years)	No country specific data. An estimated fitting parameter considering low PWID prevalence in SL
1.4. PWID mortality (crude mortality per year in %)	N/A	1% (for all years)	No country specific data. AEM default figure as regional approximation average
1.5. Percent of male PWID who share needles	PWID rapid assessment 2017	2017 – 62% (for all years)	Rapid assessment of PWID conducted by NSACP on 2017.
1.6. Percent of all injections shared (among those who share)	IBBS-2013	89.9% for all the years	IBBS 2017 last injection shared among who shared injections on last day.
1.7. Number of injections per day	IBBS-2017	0.1 for all the years	IBBS 2017/18 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. Multiply by 1.5 to account continue to share injections after the survey.
1.9 Sharing to non-sharing movement per year	IBBS-2013	10%	No country specific data. AEM default figure as regional approximation average

Indicator	Data Source	Values	Assumption / Remarks
1.10 Percent of male PWID visiting female sex workers	IBBS-2013	35.6%	IBBS-2013
1.11 Number of contacts with regular partners (per week)	Heterosexuals data sheet	0.1	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	2.0% (All years)	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 PWID size estimation
2.2 Percent of females age 15-49 who inject drugs	N/A	0%	No data and less PWID size estimation
3.1 Estimated size of the Injecting Sex Workers/Population (in thousand)	N/A	0	No data and less PWID size estimation
3.2 Percent of female sex workers in group 1 who inject drugs	N/A	0%	No data and less PWID 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	2017 - 99.2	Total number of MSM were considered as 2.0% of the total male population (15-59) which is around 99,200. This estimation includes both reachable and unreachable MSM.
1.2 Percent of males aged 15-49 engaging in same sex behaviour	N/A	2.0%	Previous AEM model which was finalized in 2018 considered number of MAM as 78,000 (taking 1.5% of the adult male population). However, after model fit it was realized that the cumulative infections exceeded cumulative case reporting alarming under estimation of population size or prevalence (MSM PLHIV estimate was 500-600 but the cumulative number was around 800. According to the HIV case reports, cumulative number of MSM were around 900). As the HIV prevalence among MSM is well established with several scientific evidences, the working group agreed to increase the MSM size estimation from 78,000 to 99,000 (taking 2% of the adult male population).
1.3 Percent of MSM in risk group 1 (Reachable)	Key population size estimation 2017	16.4%	Of the total 99,000 MSM 16,000 included in group one (hotspot based) and balance included in group 2. This figure is based on Population size estimation 2017.
1.4 Shift from MSM group 1 to group 2	N/A	10% (for all years)	AEM default
1.5 Percent of MSM1 with female partners	IBBS-2013	34.592%	Weighted average of all districts
1.5 STI prevalence among MSM1		8%	

Indicator	Data Source	Values	Assumption / Remarks
1.7 Percent engaging in anal sex in the last year - MSM1	IBBS-2013 BSS-2006	93.7%	Average value of IBBS-2013 and BSS-2006.
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
1.10 Percent condom use in anal sex with MSM1	IBBS-2017 IBBS-2013 BSS-2006	1987 and before 10% 2007-42.1% 2014 -47% 2017 and thereafter – 67.2%	IBBS 2017/18, 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 before 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	2017-82.9	Remaining number of MSM who haven't included in the group 1 (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 (For all years)	No data. Since the unreachable MSM 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	4.0%	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

Indicator	Data Source	Values	Assumption / Remarks
			HIV. Therefore, STI prevalence is assumed to be half of the 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	1.25	No data. Frequency of anal sex is assumed to be 2 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	67.2% in 2017	No data. Similar to reachable MSM

e) HIV Prevalence :

Indicator	Data Source	Value	Assumption / Remarks
1.2. HIV Prevalence among Female Sex Workers	IBBS-2013/14 IBBS-2017/18 HSS-2019	2013- 0.81% 2017- 0.24% 2019-0.08%	Only two data points were available in the previous (2018) AEM estimation. HSS-2019 data is included.
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	IBBS-2017/18 HSS-2019	2017-0.00% 2019-0.79%	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	HSS-2009 HSS-2011 IBBS-2013 HSS-2016 IBBS-2017/18 HSS-2019	7/1/2009 0.50% 1/1/2011 0.90% 7/1/2014 0.88% 1/1/2016 1.50% 11/1/2017 0.22% 1/1/2019 1.57%	HSS – 2019 figures added during the current AEM workshop
4.1. HIV Prevalence among female general population	ANC HIV testing data - NSACP		Few data points from the urban ANC prevalence (from De Soysa and Castle street Maternity hospitals) was used in previous AEM estimation. However, it is removed in the current estimation. As ANC mothers are young and do not represent general women.

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
2017	845	411	1256	1000
2018	1063	468	1531	1000
2019	1293	511	1804	1000

The 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 were included. 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.

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

**Validation data table was not updated during the current AEM estimation workshop

Annexure 3: Basic epidemic related data used in AEM estimation (for best fit)

Epidemic start years - BEST FIT	
Type	Year
Heterosexual	1989
Injecting	1988
Male-Male Sex	1992

Transmission Parameters and cofactors - BEST FIT	
Transmission probability - male to female (M->F)	0.00170
Transmission probability - female to male (F->M)	0.00050
Transmission probability - per needlestick	0.00500
Transmission probability - anal to receptive partner (I->R)	0.00900
Transmission probability -anal to insertive partner (R->I)	0.00500
Heterosexual STI cofactor F-->M (increase for males)	27.00
Heterosexual STI cofactor M-->F (increase for females)	9.00
Circumcision Cofactor	3.00
Anal STI cofactor I->R (increase for receptive partner)	2.00
Anal STI cofactor R->I (increase for insertive partner)	2.00
Primary HIV Cofactor	1.00