



TECHNICAL NOTE ON NATIONAL AND SUB-NATIONAL HIV ESTIMATES AND PROJECTIONS

SEPTEMBER
2019

ACRONYMS AND ABBREVIATIONS

AEM	AIDS Epidemic Model
AIDS	Acquired Immune Deficiency Syndrome
AIM	AIDS Impact Model
ANC	Antenatal Care
ART	Anti-retroviral therapy
BIACM	Boosted Integrated Active Case Management
EPP	Estimation and Projection Package
FEW	Female entertainment worker
FHI	Family Health International
FSW	Female sex worker
HIV	Human Immunodeficiency Virus
IBBS	Integrated Biological and Behavioral Surveillance
IDU	Injecting Drug Users
ISW	Indirect sex worker
KPs	Key populations
MSM	Men who have sex with men
MSW	Male Sex Workers
NASA	National AIDS Spending Assessment
NCHADS	National Centre for HIV/AIDS, Dermatology and STIs
NMCHC	National Maternal and Child Health Center
PDI	Peer driven intervention
PEPFAR	The U.S. President's Emergency Plan for AIDS Relief
PLHIV	People living with HIV
PMTCT	Prevention of mother-to-child transmission
Pre-ART	Pre-Antiretroviral therapy
PrEP	Pre-Exposure Prophylaxis
PWID	People Who Inject Drugs
PWUD	People Who Use Drugs
RHAC	Reproductive Health Association of Cambodia
TG	Transgender people
TWG	Technical Working Group
UNAIDS	Joint United Nations Programme on HIV/AIDS
USAID	The United States Agency for International Development
US-CDC	The U.S. Centers for Disease Control and Prevention
WHO	World Health Organization

ACKNOWLEDGEMENT

National and sub-national HIV estimates were updated under the leadership of National Centre for HIV/AIDS, Dermatology and STIs with technical assistance from East-West Centre and UNAIDS.

The estimates update was made possible by the collective efforts and wisdoms of various agencies, organization and community of PLHIV and key populations.

Special appreciation goes to the members of HIV Estimates Technical Working Group that comprised of representatives from NCHADS, NAA, NMCHC, USAID, US-CDC, FHI 360-Linkages, Health Policy Plus, KHANA, RHAC, WHO, and UNAIDS

EXECUTIVE SUMMARY

Journey of AIDS response in Cambodia is nothing short of remarkable. In 1990s, Cambodia was one of the fastest growing HIV epidemics in Asia but Cambodia had successfully turned the epidemic around through phases of Cambodia 1.0, 2.0 and 3.0 responses coupled with strong commitments towards ending AIDS epidemic as a public health threat. These commendable responses and commitments led the country to become one of the first seven countries globally to achieve 90-90-90 treatment targets in 2017.

However, the success comes with the price to maintain the achievement while escalating the response momentum to reach the unmet targets. Accurate and timely generation of HIV estimates in Cambodia is more important than ever when the country is racing through the hurdles of the last and most difficult miles towards ending AIDS epidemic targets. At this critical juncture, it is vital that HIV estimates truly reflect the current state of epidemic to inform and guide the response, in a very tight timeline towards ending AIDS, with reduced funding envelope.

In light of these critical needs, national and sub-national HIV estimates are updated through extensive consultative processes with involvement of national partners, community, technical partners and stakeholders. AIDS Epidemic Model (AEM) and Spectrum were used as tools to generate the estimates and it was an iterative and six-month long process to ensure that data inputs are verifiable, sourceable, and also agreeable to the collective wisdom of Technical Working Group (TWG).

Results of national estimates indicated that estimated 73,000 people living with HIV (PLHIV) in Cambodia in 2018, of which 70,000 were adults 15 years and older, and females constituted 53% of adults living with HIV. 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 was estimated at 880 in 2018 with 777 new HIV infections among adults 15 years and older. New HIV infections were peaked in 1997 at 16,000 but there was a dramatic decline of new HIV infections after reaching its peak. By 2001, new infections were already reduced to halved from its peak. There was a continuous decline in new infections in the last 2 decades, but the pace of decline has noticeably slowed down since 2010. Although the epidemic is declining in terms of number, new HIV infections among Men who have Sex with Men (MSM) as share of total new HIV infections is growing. In 2018, 25% of new HIV infections are among MSM, more than three-fold increase from 7% in 2010.

AIDS-related deaths had peaked around 2003 with 7000 annual deaths. Annual deaths have been decreased to less than 1500 since 2013 and showing a gradual decline since then. In 2018, 1300 AIDS-related deaths among adults living with HIV and about 51% of AIDS-related deaths are among adult males.

HIV is concentrated in capital and major cities of Cambodia. Sub-national estimates showed that one in every three new HIV infections are in the capital city of Phnom Penh. Six provinces (Phnom Penh, Battambang, Siem Reap, Kampong Chan, Banteay Meanchey, and Takeo) account for 70% of total new HIV infections in Cambodia.

The results of HIV estimation exercise conclude that achievements have made and Cambodia is “on-track” towards ending AIDS targets, but the gains are fragile, and the risks are looming. The possibility of being “derailed or off-track” still cannot be eliminated when the pace of decline of new infections is slowing down in the past few years.

Almost into three decades, AIDS epidemic in Cambodia is now in the state of “control” but “not yet over”. However, at the same time, ending AIDS is just “in sight” and attainable, if paths are set straight through galvanized and concerted efforts that are steered by evidence informed policy and decision making with priority and efficiency-oriented programme implementation.

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1. INTRODUCTION

1.1. Background

Cambodia has a rich and interesting history of HIV epidemic. First case of HIV was detected in 1991, that was 7 years after the first case identified in the neighboring Thailand, but epidemic escalates very quickly in Cambodia and by mid-1990s Cambodia became one of the fastest growing HIV epidemics in Asia. But Cambodia had successfully turned the epidemic around within 5 years after the epidemic had reached its peak and maintained its success in the past decade, resulting in 62% decline in new HIV infections between 2010 and 2018.¹ Furthermore, the country is well publicized as one of the early achievers of 90-90-90 treatment targets in the global scale and these achievements have put the country under the spotlight in maintaining the success while accelerating the efforts to fill the response gaps.

HIV estimates are the center piece of strategic information in tracking the progress towards ending AIDS targets. It is crucial that HIV estimates truly reflect the current state of epidemic to inform and guide the responses towards HIV elimination.

Between November 2018 and May 2019, a series of technical workshops and webinars were conducted with participation of stakeholders and technical partners, to update national and sub-national HIV estimates in Cambodia using AIDS Epidemic Model (AEM) and spectrum tools

1.2. AIDS Epidemic Model (AEM)

AEM is a behavioral process model developed by East-West Center (EWC) and it is the adult model that generates HIV estimates for the population 15 years and older.² AEM simulates transmission dynamics in concentrated epidemic settings to generate HIV estimates. Transmission dynamics are determined by i) transmission routes (vaginal sex, anal sex, needle sharing); ii) population interaction (sex workers and clients, men who have sex with men, transgender people, people who inject drugs, currently low risk population (ex-key populations or partners of key populations) (Figure 1); and (iii) preventive effect of antiretroviral therapy. AEM tool suite include 3 major workbooks – a) AEM baseline workbook, b) AEM intervention workbook and c) AEM analysis workbook (Figure 2).

Figure 1-Population groups included in AEM and population interactions

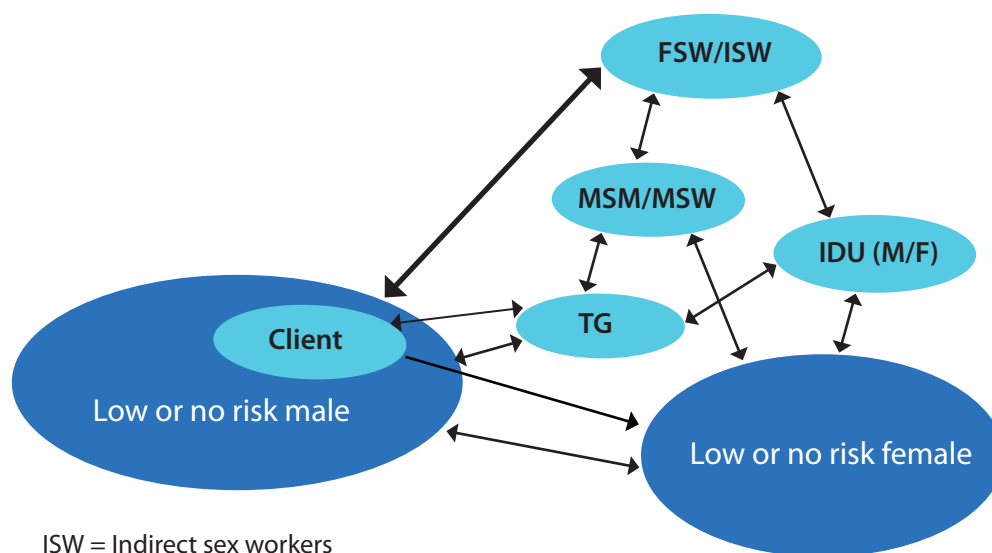
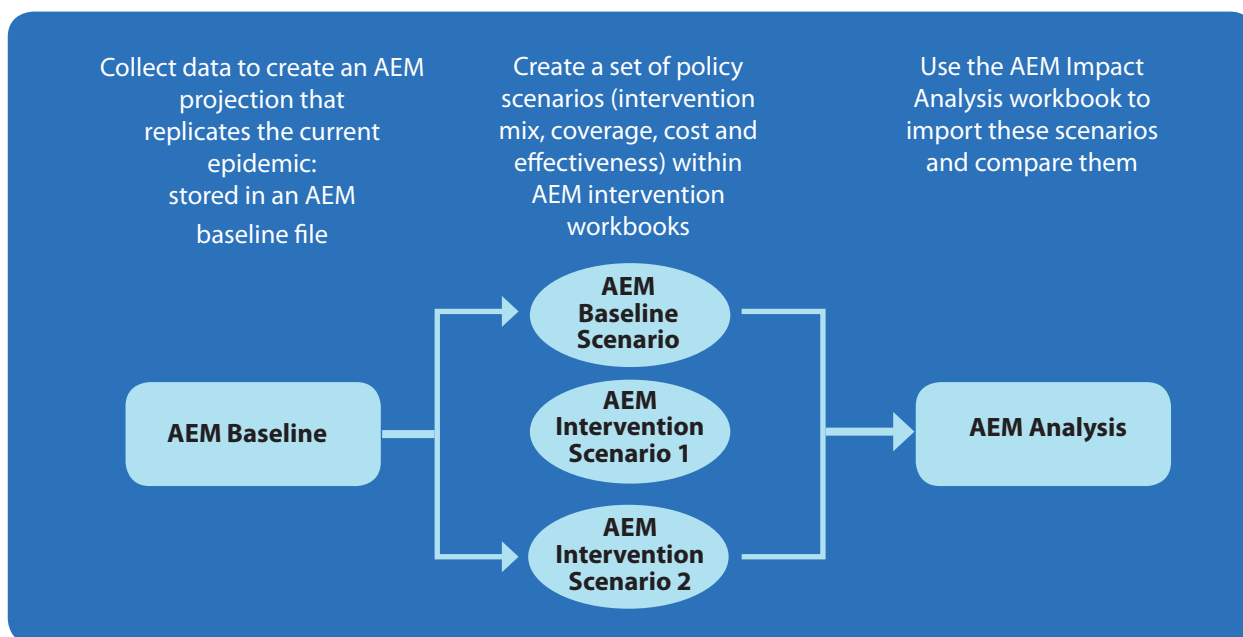


Figure 2 - Overview of AEM workbook²



Historically, Cambodia has been using AEM since 2002 to understand:

- (1) HIV and AIDS disease burden and trends over time (AEM baseline)
- (2) Economic and impact analysis such as resource needs estimation, cost-effectiveness analysis, and investment case analysis (AEM intervention and impact analysis)
- (3) Policy recommendations such as impact and scenarios on strategic use of ARVs (AEM intervention and impact analysis)

1.3. Spectrum

Spectrum software is developed by Avenir Health and there are a number of modules in the Spectrum software that include - AIM (AIDS Impact Model), MCH and other health priorities such as (TB, STI, Malaria, and non-communicable diseases).³ Spectrum software mentioned in this report will be focused on AIM module that estimate and project the HIV/AIDS among children, adults and pregnant women.

The required data inputs for national and sub-national spectrum include –

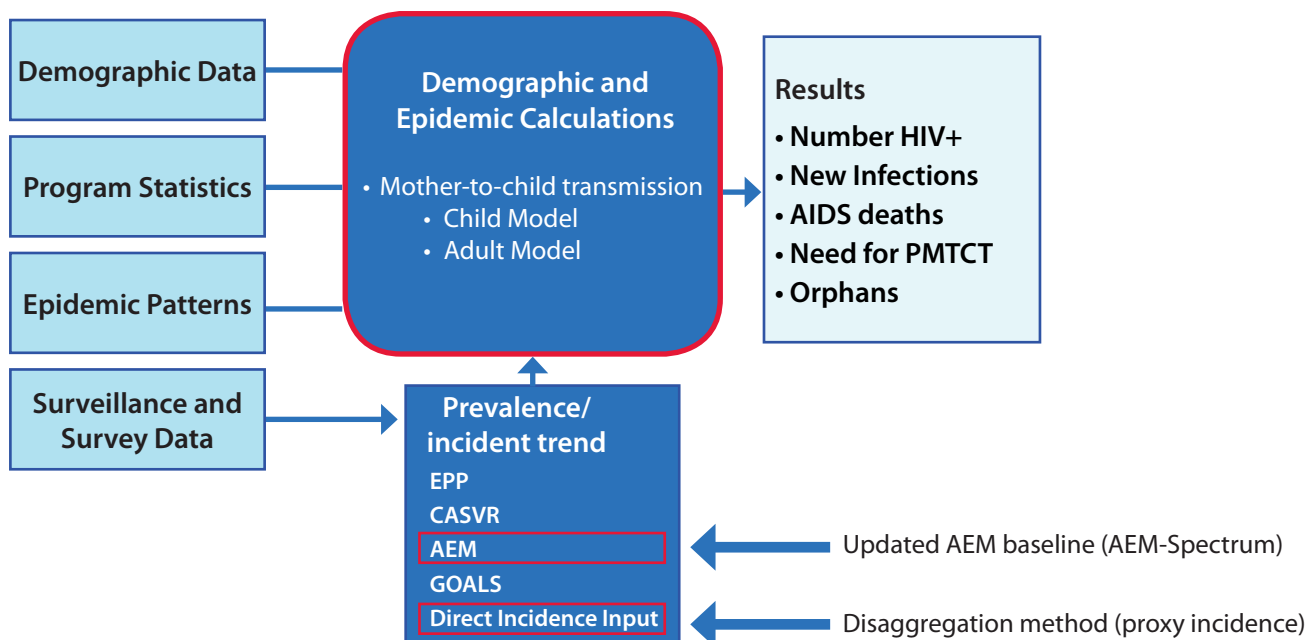
- Demographic population (default for national estimates and manual input for sub-national estimates)
- Programme statistics
 - Treatment: Knowledge of HIV status, adults and children on ART and viral suppression
 - PMTCT: HIV testing in ANC settings, pregnant women receiving PMTCT, breastfeeding

1.4. AEM-Spectrum

As mentioned previously, AEM is the 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 AEM baseline workbook that reads in the spectrum and generates estimates for both adults and children (Figure 3).

In Cambodia, technical working group with support from East-West Center update the AEM model regularly with newly available and updated data inputs such as key populations size estimates, key populations HIV prevalence, behavior indicators, number of adults on treatment, etc. Updated and validated AEM model is then linked with spectrum to generate estimates for adults, children and PMTCT.

Figure 3 - Spectrum structure



1.5. Disaggregation Method for Sub-national HIV Estimation

Disaggregation analysis using “Proxy Incidence” is a method to assign new infections, PLHIV, and death from national AEM results to the sub-national locations. The basic principle of this method is the use of proxy indicator for incidence and building on that, incidence proportion is calculated by sub-national location. Selection of proxy indicator for incidence varies depending on the availability of best proxy indicator for incidence in countries and usually the proxy incidence is available either for male or female. Hence, female to male ratio of each sub-national locations from most appropriate data sources in the country context such as reported cases or ART numbers are then applied to estimate number of new infections for the remaining gender. For instance, Thailand used HIV prevalence among young military conscript as proxy incidence rate for male and use male-female ratio from AIDS cases to calculate female incidence. Malaysia used ANC prevalence as proxy incidence rate for female and use male proportion from reported HIV cases to calculate proxy incidence among male. Cambodia used ANC prevalence as proxy incidence rate for female and used male-female ratio from ART and pre-ART to calculate male incidence. By using these proxy incidence proportion for each sub-national location, new infections for each sub-national can be calculated by multiplying each sub-national proportion to total national new HIV infections. Provincial or sub-national incidence can then be imported into spectrum using “Direct Incidence Input” in the spectrum tool to generate other estimates measures such as PLHIV and AIDS-related deaths (Figure 3). Please refer section 3.3.3 for the step-by-step calculation.

2. OBJECTIVES

The overarching aim of the exercise is to generate national and subnational HIV estimates using AEM and Spectrum tools.

The objectives of the technical report are:

1. To document the i) processes; ii) methodologies including assumptions, inputs, calculations, data triangulation, and iii) consensus agreement of national and sub-national AEM and spectrum update processes
2. To provide summary of national and sub-national HIV estimates

3. PROCESSES AND METHODS

3.1. Processes: National Consultative Workshops

Three consultative workshops were conducted between November 2018 and March 2019 with participation of a wide range of stakeholders (Annex 6.5). Summary of national consultative workshops is briefly described below.

3.1.1. National AEM and Spectrum Consultative Workshop 1

- Date: 24-30 November 2018
- Participants: NCHADS, NAA, NMCHC, UNAIDS, USAID, FHI360, KHANA, RHAC, HP+
- Outcome: Key data sources and inputs were reviewed, triangulated and discussed for consensus

3.1.2. National AEM and Spectrum Consultative Workshop 2

- Date: 4-9 Jan 2019 (follow-up of the November workshop)
- Participants: NCHADS, NAA, NMCHC, UNAIDS, USAID, FHI360, KHANA, RHAC, HP+
- Outcome: Preliminary AEM baseline workbook and spectrum file updated. Preliminary spectrum file was to be used as working file for the Regional HIV Estimates Workshop in February 2019

3.1.3. Subnational Spectrum Consultative Workshop

- Date: 14-15 March 2019
- Participants: NCHADS, NAA, NMCHC, UNAIDS, USAID, FHI360, KHANA, RHAC, HP+
- Outcome: Preliminary sub-national estimates file updated, and national estimates finalized

After the 3rd consultative workshop in March, there were a series of webinars with stakeholders and a technical working group (TWG). The findings of national and sub-national estimates were presented, discussed, and finalized with inputs and consensus agreement by TWG and stakeholders. The updated national HIV estimates were officially submitted to the UNAIDS Global AIDS Monitoring Reporting and UNAIDS Estimates technical focal points in the end of May 2019.

3.2. Data Inputs for National Estimates

3.2.1. Data Inputs and Assumptions in the AEM

- For the AEM data inputs and updates, the TWG reviewed all the relevant documents, such as behavioral and serological data from surveys, number of key populations reached and HIV positivity rates from programme data, key population size estimation, and ART programme data, etc.
- For the demographic data, population variables for adult aged 15+ (1970-2050) were retrieved from Spectrum V5.755 as listed below.³
 - Males: adults 15+ years old, 15-49 years old, 15 years old, 15-24 years old, Migration 15+ and Migration 15-49.
 - Females: adults 15+ years old, 15-49 years old, 15 years old, 15-24 years old, Migration 15+ and Migration 15-49.

Table 1 - Operational definition of key population size estimates in AEM²

Population	Operational Definition
Female sex workers	Biological females, 15 to 49 years old, who sell sex in exchange of money or goods, in the last 12 months
FSW 1 in AEM	Female sex workers who have more than 7 clients per week
FSW 2 in AEM	Female sex workers who have less than 7 clients per week
Men who have sex with men	Biological males, 15 to 49 years old, who have anal sex with another male in last 12 months
MSM 1	Men who have sex with men who are reachable through physical and virtual locations
MSM 2	Men who have sex with men who are not reachable through physical and virtual outreach programmes
Transgender people	Biologically male at birth, 15 to 49 years old who self-identify as female or third gender. This entails dressing up, expressing characteristic, attitudes and behaviour of a woman
People who inject drugs (male)	Biological males, 15 to 49 years old, who injected drugs one or more times in the last month

• Key populations size estimations, assumptions and consensus:

- Female sex workers
 - After the review of existing data, TWG has decided to use programme data as a basis for the FSW population size estimates
 - Since programmes for FSW are operated in 17 out of 25 provinces in Cambodia, programme data can offer reasonably representative number of FSW that are reached through programmes and they also have mechanisms to deduplicate the multiple counts.
 - Based on 2018 programme data from KHANA and RHAC in 17 provinces in Cambodia, total of 32,541 FSW were reached through KHANA (21,221 FSW) and RHAC (11,320 FSW) for prevention interventions and HIV testing.⁴
 - After triangulation with IBBS and other sources, programme coverage is assumed to be 80% of total FSW population and thus around 20% has added to inflate the programme number
 - Based on the above-mentioned programme data inputs and assumptions, TWG endorsed and agreed to use 41,500 as FSW estimates in 2018.

- People who inject drugs:
 - IBBS: Capture-Recapture study was conducted as part of IBBS 2017 and it was estimated that total of 4,136 PWID nationally, of which 2,908 PWID were in Phnom Penh.⁵
 - Programme data showed that the number of PWID reached in Phnom Penh through needle and syringe programme in the last 6 months of 2017 were 562.⁴ whereas police report indicated that 1% of the 16,794 arrested drug users were heroin users in 2018 .^a
 - Base on the triangulation of above-mentioned information, team decided to calculate the consensus estimate based on the finding of capture and recapture study that showed 76.4% of injecting drug users injected drugs 1 or more times in the last month^b . Hence the consensus size estimation of PWID is 3,160 (4,136 x 76.4%) and it is also in line with data input needs for AEM that focused on risk of transmission related to frequency and/or exposure to risk behaviors.

^a Police verbal report in 2018.

^b IBSS 2017. Capture-Recapture.

- Transgender people:
 - In 2018, 726 TG were reached and tested for HIV through RHAC programme.⁶
 - Since there is no new study nor the supporting information to update the transgender population size estimates, the team decided to keep the same as the latest available estimate of 3,100.
- Men who have sex with Men:
 - IBBS: Capture and Recapture study in 2017 estimated the prevalence of same-sex behavior among biological males as 0.71% in the last 6 months.^{7,8}
 - Since the existing data and information is insufficient to make decision on national level population size estimates of MSM (reachable and unreachable), the TWG observed and compared the data on percentage of adult male population engaging in male-to-male sex in other countries and the observations are as follow - Vietnam (0.8%), Thailand (3.3%), Laos (3.0%) and Philippines (2.2%) of adult male (15-49) population.
 - Finally, the team decided to use 1.6% of adult males (15-49) or 72,000 as national level population size estimates for MSM

Table 2 - Population size estimates of key population, 2018

Indicators	2018	Source/Comment
Female Sex Workers (FSW)	41,500	
FSW group 1	4,700	Proportion distribution between FSW 1 and FSW 2 is based on the proportion of more than or less than 7 clients per week from the latest available IBBS
FSW group 2	36,900	
People who inject drugs	3,200	
Transgender	3,100	
Men who have sex with men (MSM)	72,000	
MSM group 1	36,000	Proportion distribution between MSM 1 and MSM 2 is based on consensus and wisdom of the crowd
MSM group 2	36,000	

• Behavioral data:

- Most of the behavioral data inputs remained unchanged from the last AEM update in 2017 since new IBBS studies are still underway in 2019. Behaviour data inputs by key population is summarized in tables below.

Table 3 - Behavioral data inputs for female sex workers^{9,10}

Indicators	FSW1		FSW2	
	2015	2018	2015	2018
Number of clients per day	2.8	2.8	0.2	0.2
Days worked per week	7.0	7.0	7.0	7.0
Percent condom use with clients	80%	80%	70%	65%
Average duration selling sex in group 1 (years)	5.0	5.0	5.0	5.0
STI prevalence	22.7%	22.7%	17.0%	17.0%

Source: IBBS data or calculations based on IBBS

Table 4 - Behavioral data inputs for people who inject drugs⁵

Indicators	2015	2018
Percent of males age 15-49 who inject drugs	0.07%	0.07%
Percent of male IDUs in high-risk networks	40.0%	40.0%
IDU mortality (crude mortality per year in %)	1.0%	1.0%
Percent of male IDUs who share needles *	21.3%	11.0%
Percent of all injections shared (among those who share)	50.0%	50.0%
Number of injections per day *	1.2	1.0
Average duration of injecting behavior (in years)	8.0	8.0
Sharing to non-sharing movement per year	20.0%	20.0%

Source: IBBS data or calculations based on IBBS

*2018 data is based on IBBS 2017, adjusted to national level

Table 5 - Behavioral data inputs for transgender sex workers¹¹

Indicators	2015	2018
Percent of transgender sex workers engaging in anal sex with clients	88.0%	88.0%
Number of anal sex contacts last week with clients (for those having anal sex)	2.0	2.0
Percent of anal sex contacts with clients which are receptive	90.0%	90.0%
Average duration selling sex (in years)	10.0	10.0
Percent condom use in anal sex with clients	61.0%	61.9%
Anal STIs (%) among transgenders who sell sex	12.0%	12.0%

Source: IBBS data or calculations based on IBBS

Table 6 - Behavioral data inputs for men who have sex with men

Indicators	MSM 1		MSM 2	
	2015	2018	2015	2018
Percent engaging in anal sex in the last year - MSMt	90.0%	90.0%	45.0%	45.0%
Number of anal sex contacts last week (among those having anal sex) - MSM	1.50	1.50	0.38	0.38
Average duration of same-sex behavior (years) - MSM	20.0	20.0	20.0	20.0
Percent of MSM with female partners	57.0%	57.0%	57.0%	57.0%
Percent condom use in anal sex with MSM	59%	59%	53.1%	53.1%
STI prevalence among MSM	5.0%	5.0%	0.6%	0.6%

Source: IBBS data or calculations based on IBBS

• Key populations HIV prevalence:

- HIV prevalence input by key populations was also remained unchanged from the last AEM update since the new IBBS studies are still underway

Table 7 - Key populations HIV prevalence

Population	HIV prevalence	Source
FSW 1	9.2%	Adjusted national prevalence based on IBBS 2016
FSW 2	4.6%	Adjusted national prevalence based on IBBS 2016
Male PWID	15.2%	IBBS 2017
MSM	2.3%	IBBS 2014
Transgender sex workers	10.3%	IBBS 2016

• Number of people on antiretroviral therapy

- Number of PLHIV on ART among adults 15+ also updated based on the data from care and treatment programme.

3.2.2. Processes and Data Inputs in the Spectrum

- Processes
 - Review the default demographic population^c in the spectrum and compared with the National Population Census 2013^d.
 - Use the default data and parameters for population, migration, MTCT transmission probabilities, adult and pediatric HIV transition parameters.
 - As mentioned in section 1.4, AEM model is imported into the spectrum by choosing “AEM” in the incidence options menu in the spectrum
- Data inputs
 - Programme statistics for 2018 such as PMTCT, children (0-14 years) on ART, Adult (15+ years) on ART, knowledge of HIV status and viral-load suppression data were also updated based on the programmed data from NCHADS and NMCHC
 - Data input for the “sex ratio” in spectrum is calculated based on the number of male and female who is registered in ART and pre-ART^e

Table 8 - Number of children (0-14) on ART, 2015-2018

Number of Children receiving ART	2015	2016	2017	2018
Children 0-14 Years old	4,003	3,626	3,408	2,983

Source: NCHADS Programme data, 2015-2018

^c It is based on the data from the UN Population Division

^d Ministry of Planning, 2014. Cambodia National Population Census 2013. Ministry of Planning: Cambodia.

^e NCHADS annual reports

Table 9 - Number of HIV positive pregnant women receiving ARVs for PMTCT by treatment regimen and time of initiation of treatment

Number of PMTCT	2015	2016	2017	2018
Single dose Nevirapine	29			
Option B+: ART started before current Pregnancy	720	588	608	505
Option B+: ART started during current Pregnancy > 4 weeks before delivery		84	81	104
Option B+: ART started during current Pregnancy < 4 weeks before delivery	48	48	71	10
Total	797	720	760	619

Source: NMCHC Programme data, 2015-2018

3.2.3. AEM and Spectrum Comparison and Adjustments

- Following indicators were used to compare the results of AEM and Spectrum to check the consistency between AEM and spectrum outputs and results
 - Number and trend of adults (15+) living with HIV
 - Number and trend of new HIV infections among adults (15+)
 - Number and trend of AIDS related deaths among adults (15+)
- The adjustment was done in Spectrum and/or AEM if the comparison results show a significant difference. For instance, adult transition parameter could be adjusted in the spectrum to fine tune the key results

3.3. Data Inputs for Sub-national Estimates

For estimation of people living with HIV, new HIV infections, AIDS related deaths, ART coverage and PMTCT coverage by province, spectrum software was used to generate sub-national estimates with inputs from the disaggregation method. Major data inputs required to generate sub-national or provincial HIV estimates include -

- Demographic population by province (male, female and by age group)
- Programme statistics such as number of people on ART by province (by gender, adult, children and PMTCT)
- Proxy HIV incidence rate by province
- Female to male (F:M) incidence ratio by province.

With these province-specific inputs, provincial spectrum files are created for each province.

3.3.1. Population and Migration by Province

- Following are the step-by-step summary of demographic data preparation and inputs for the sub-national spectrum files (disaggregation method)
 - National Census 2013 by provinces = (A); WPP^f in Spectrum V.5.73 (national population) (B)**
 - $B \div A$ (C) = (multiplication/adjustment factor to address the difference between census and the WPP)
 - Adjusted male population - $A \times C$ = Male population by province (D)
 - Adjusted female population - $A \times C$ = Female population by province (E)
 - Proportion of male in the province as % of total national male (F) = (D) / Total male population

^f WPP = World Population Prospects by UN Population Division

- a.5. Proportion of female in the province as % of total national female (G) = (E) / Total female population
- b. **Population by province in spectrum by age group**
- b.1. Population by age group x F
- b.2. Population by age group x G
- c. **Migration by province in Spectrum**
- c.1. Total male migration x F
- c.2. Total female migration x G

Table 10 – Demographic population calculation by province

No	Province of Cambodia		National Population Census 2013 by province			World Population Projected by SPECTRUM in Year 2013				
			Total (A)	Total Male in (A)	Total female in (A)	Total (B)	Total Males (D)	Total Females (E)	% Males (F)	% Females (G)
1	Banteay MeanChey	BMC	729,569	354,604	374,965	764,431	371,549	392,883	0.0498	0.0496
2	Battambang	BTB	1,121,019	557,164	563,855	1,174,587	583,788	590,799	0.0783	0.0746
3	Kampong Cham	KCM	1,007,277	479,631	527,646	1,055,410	502,550	552,860	0.0674	0.0698
4	Kampong Chhnang	KCG	523,202	250,548	272,654	548,203	262,520	285,683	0.0352	0.0361
5	Kampong Speu	KSP	755,465	363,337	392,128	791,565	380,699	410,866	0.0510	0.0519
6	Kampong Thom	KTH	690,414	333,979	356,435	723,405	349,938	373,467	0.0469	0.0472
7	Kampot	KTH	611,557	303,709	307,848	640,780	318,222	322,558	0.0427	0.0407
8	Kandal	KDL	1,115,965	538,040	577,925	1,169,291	563,750	605,541	0.0756	0.0765
9	Kep	KEP	38,701	19,016	19,685	40,550	19,925	20,626	0.0027	0.0026
10	Koh Kong	KKG	122,263	61,319	60,944	128,105	64,249	63,856	0.0086	0.0081
11	Kratie	KTE	344,195	167,425	176,770	360,642	175,425	185,217	0.0235	0.0234
12	Mondulkiri	MKR	72,680	37,098	35,582	76,153	38,871	37,282	0.0052	0.0047
13	Oddor Meanchey	OMC	231,390	116,090	115,300	242,447	121,637	120,810	0.0163	0.0153
14	Pailin	PLN	65,795	32,859	32,936	68,939	34,429	34,510	0.0046	0.0044
15	Phnom Penh	PNH	1,688,044	816,145	871,899	1,768,707	855,144	923,563	0.1146	0.1154
16	Preah Vihear	PVH	235,370	116,737	118,633	246,617	122,315	124,302	0.0164	0.0154
17	Prey Veng	PVG	1,156,739	557,793	598,946	1,212,014	584,447	627,567	0.0783	0.0793
18	Pursat	PST	435,596	208,292	227,304	456,411	218,245	238,166	0.0293	0.0301
19	Rattanakiri	RKR	183,699	91,265	92,434	192,477	95,626	96,851	0.0128	0.0122
20	Siem Reap	SRP	922,982	447,080	475,902	967,087	468,444	498,643	0.0628	0.0630
21	Sihanouk Ville	SHV	250,180	123,007	127,173	262,135	128,885	133,250	0.0173	0.0168
22	Stung Treng	STG	122,791	62,149	60,642	128,659	65,119	63,540	0.0087	0.0080
23	Svay Rieng	SRG	578,380	286,073	292,307	606,018	299,743	306,275	0.0402	0.0387
24	Takeo	TKV	923,373	440,805	482,568	967,496	461,869	505,627	0.0619	0.0639
25	Tbong Khum	TBK	749,946	355,238	394,708	785,782	372,212	413,569	0.0499	0.0522
*	Total Population		14,676,592	7,119,402	7,557,190	15,377,911	7,459,601	7,918,311	1.0000	1.0000

3.3.2. Programme Statistics by Province (Adult and Children ART)

- a. National program data for adult ART by province is available from 2003 to 2017.¹²
- b. However, child ART by province is available only for 2018.
- c. To calculate child ART number by province by year from 2003 to 2017, the following processes and assumptions were used.
- Proportion of child ART by province in 2018 = Child ART by province in Q4 of 2018 ÷ National child ART in Q4 of 2018.
 - Proportion distribution in 2018 is then applied for the earlier years
- d. Special matrix is used to re-assign the number of people on ART by residential area rather than service delivery site and number of people on ART by residential area is used as the numerator for ART coverage calculation

3.3.3. Calculation of Proxy Incidence by Province

A. Step 1: Proxy incidence calculation for females

In the absence of other measures, HIV prevalence among ANC attendees is used as a proxy measure for incidence among females in Cambodia, assuming that most pregnancies occurred at relatively younger age. Ideally, HIV prevalence among young pregnant women (15-24) should be used as the proxy but in the absence of HIV prevalence by age breakdown, HIV prevalence among all ANC attendees was used as follow:

- a. 1996 -2010 - HIV prevalence among ANC from HIV Sentinel Surveillance Surveys was used.¹³
- b. 2012-2017 – HIV prevalence from PMTCT programme data was used.¹⁴
- c. For provinces that do not have HIV prevalence among ANC women, HIV prevalence among ANC women from nearby province or province with similar epidemic burden is used, with the assumption that these provinces will have very similar level of HIV prevalence among pregnant women.

B. Step 2: Intermediate proxy incidence number

- a. HIV prevalence by province (proxy incidence measure) from step 1 x Female demographic population (15-49) of the province (province specific intermediate proxy incidence number for females)
- b. Calculate national number by summing up all the provinces (national number for females)

C. Step 3: Calculation of proxy incidence proportion by province

- a. Intermediate proxy incidence number by province in step 2 (a) is divided by step 2 b to estimate the incidence proportion by province among females
- b. Once it is done for all provinces, it should sum up to 100% at the national level

D. Step 4: Estimation of new HIV infections among female in the province

- a. Total national estimated new HIV infections among female multiplied by the calculated proportion in the step 3 a

E. Step 5: Proxy incidence calculation for males

It is assumed that female to male ratio (F:M) of new HIV infections is the same as F:M of female and male registered in Pre -ART and ART programmes.¹²

- a. Calculate Female to Male Ratio from ART and Pre-ART by province
- b. Adult male new HIV infection by province = estimated female new HIV infections in step 4 x F:M ratio from ART and pre-ART in the province

F. Step 6: Calculation of total new infection for the province

- a. Sum of estimated new infections among females and males in step 4 and step 5

G. Step 7: Calculation of HIV incidence by province by year

Province specific HIV incidence rate (%) is calculated by dividing province specific number of total new HIV infections by total demographic population in the province. The trend of incidence rate is then feed into the spectrum as “direct incidence input” under incidence options in the spectrum AIM module

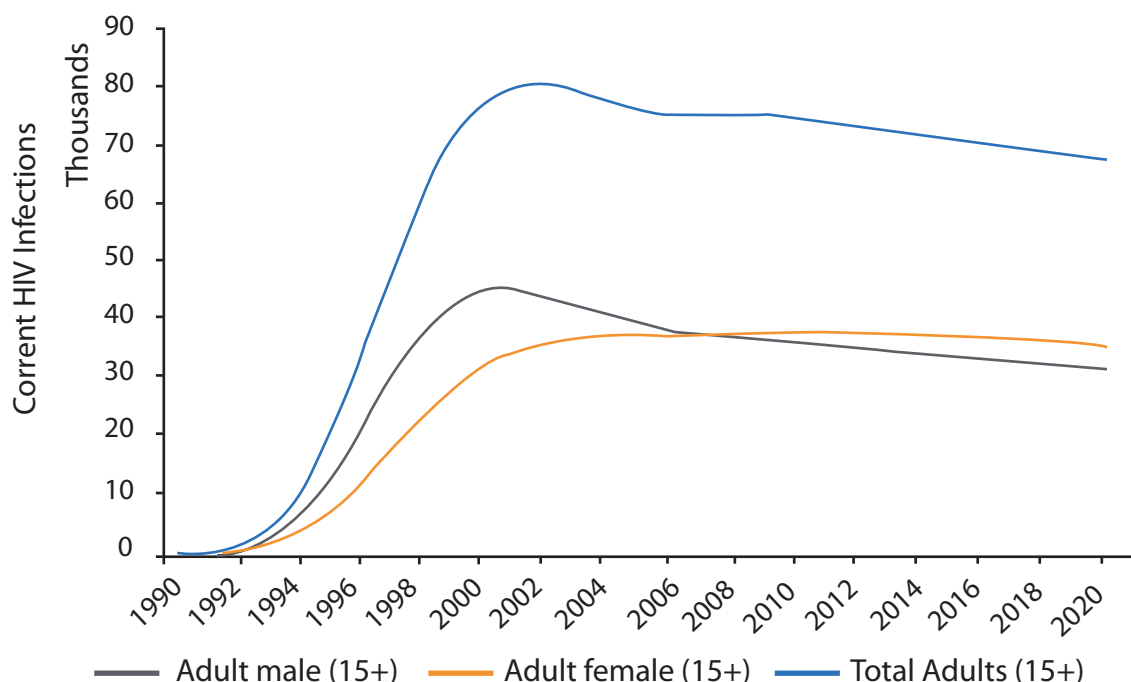
4. RESULTS AND DISCUSSION

4.1. National HIV Estimates

4.1.1. People Living with HIV (Adults 15+)

Total number of adults living with HIV had reached its peak in 2001 with estimated 81,000 adults living with HIV. Proportion of male PLHIV was higher than that of female in the early phase of epidemic but female proportion took over that of male since 2008 and the proportion is relatively unchanged since then. The trend of PLHIV is relatively stable in the past 5 years indicating the state of quasi balance between new infections and AIDS-related deaths. In 2018, 70,000 adults (15+) are living with HIV and of which 53% (37,000) are females.

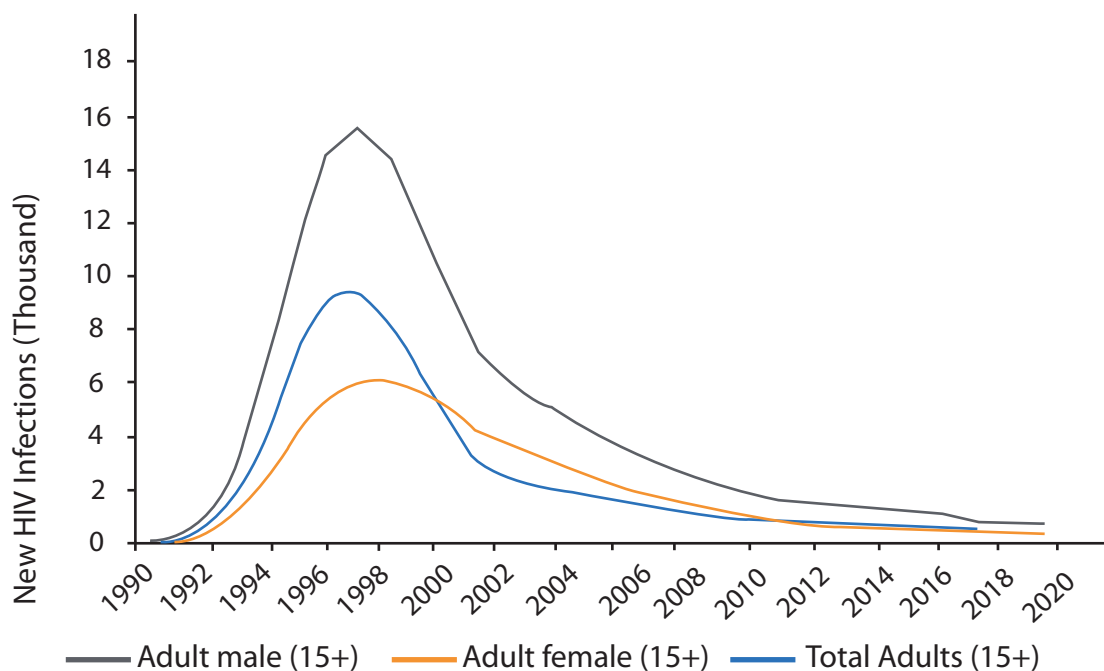
Figure 4 - Trend of estimated adults (15+) living with HIV in Cambodia, 1990-2020



4.1.2. New HIV Infections (Adults 15+)

In 2018, there was an estimated 777 new HIV infections among adult 15+. The graph below shows the number of HIV new infections trend by gender. New HIV infections were peaked in 1997 at 16,000 but there was a dramatic decline of new HIV infections after reaching its peak and by 2001 new infections were already reduced to halved from its peak. There is a continuous decline in new infections in the last 2 decades, but the pace of decline has slowed down since 2010.

Figure 5 – Trend of new HIV infections among males and females (15+), 1990-2020



4.1.3. Adults (15+) New HIV Infections by Risk Population

Figure 6 elaborates the new HIV infections by population from 2000 to 2020. Although the epidemic is declining in terms of number, MSM new HIV infections as share of total new HIV infections is growing and by 2018 about one in four new HIV infections are among MSM, a significant increase from only 7% of total new HIV infections in 2010 (Figure 7).

Figure 6 - Annual number of adult (15+) new HIV infections by risk population, 2000-2020

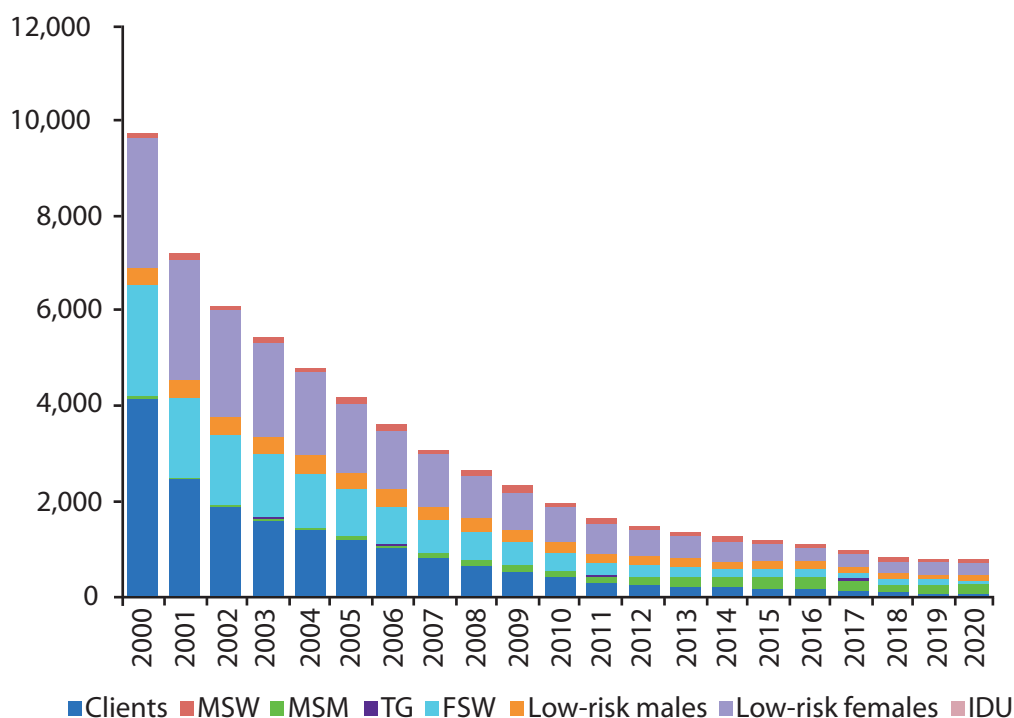
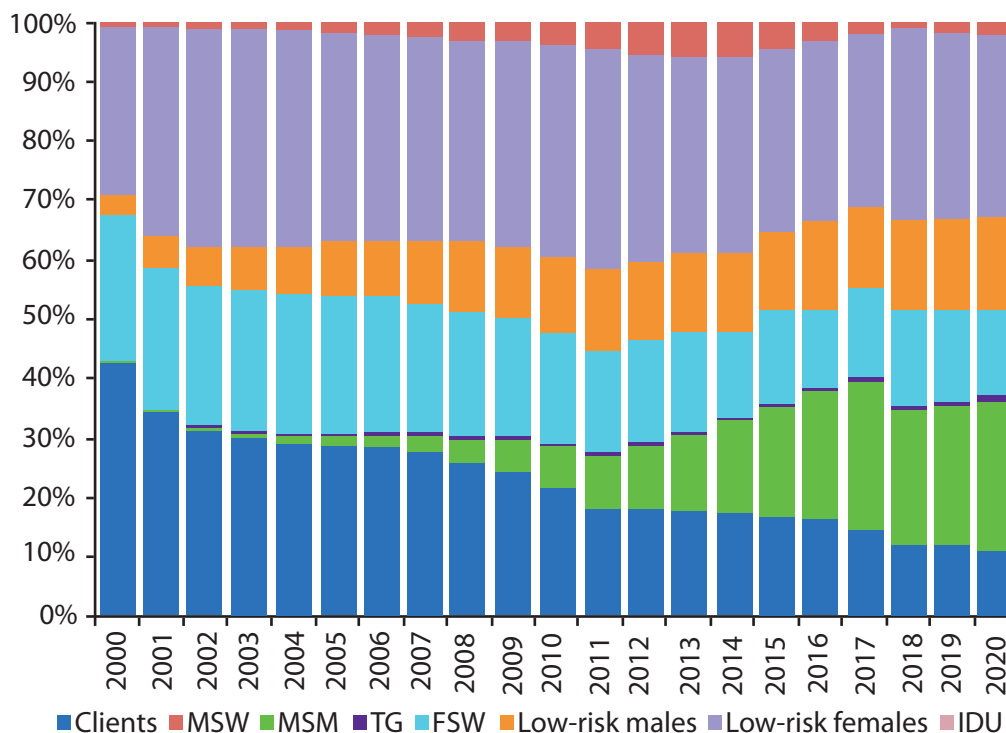


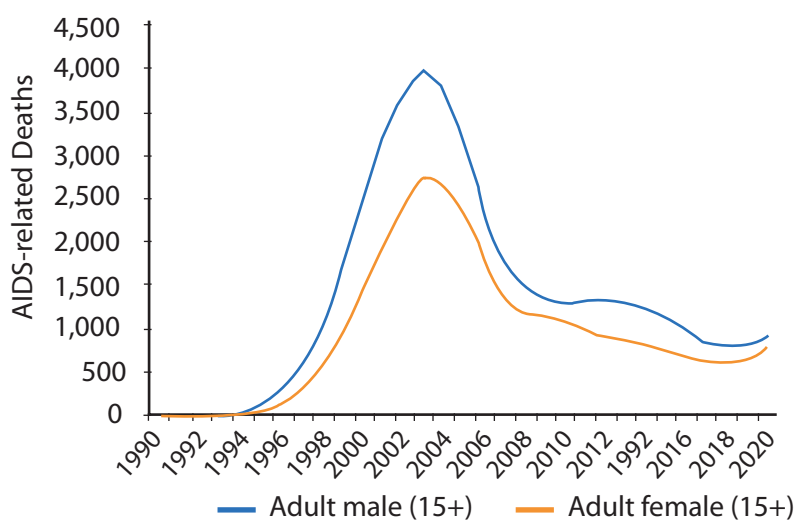
Figure 7 - Proportion of adult (15+) new HIV infections by risk population, 2000-2020



4.1.4. Adults (15+) AIDS-related Deaths

AIDS-related deaths had peaked around 2003 with 7000 annual deaths. Annual deaths have been decreased to less than 1500 since 2013 and showing a gradual decline since then. In 2018, 1300 AIDS-related deaths among adults living with HIV and about 51% of AIDS-related deaths are among adult males.

Figure 8 - Annual AIDS deaths among adults (15+), 1990- 2018



4.2. Sub-national HIV Estimates

In 2018, one in three new HIV infections in Cambodia was in Phnom Penh. Other province have relatively higher share of new HIV infections as percentage of total new HIV infections are – Battambang (11%), Siem Reap (7%), Kampong Cham (7%), Banteay Meanchey (6%), and Takeo (6%) respectively.

However, both distribution and concentration of PLHIV were different from new HIV infections. Though Phnom Penh was still the location with highest number of PLHIV (22% of total PLHIV), the second highest was Kandal (9% of total PLHIV), followed by Siem Reap and Battambang with both at 8% of total PLHIV.

16% of total AIDS-related deaths were estimated to be in Phnom Penh but the same proportion, 16% of AIDS-related deaths were also in Siem Reap though only 7% total estimated PLHIV were from Siem Reap. 6% of AIDS-deaths was estimated to be in Kandal and 5% in Battambang.

Table 11 Total PLHIV, new HIV infections and annual deaths by province, 2018

Summary HIV 2018		PLHIV 2018				New Infection 2018				Deaths 2018			
Code	Provinces	Male	Female	Children	Total	Male	Female	Children	Total	Male	Female	Children	Total
BMC	Banteay Meanchey	2,093	2,439	185	4,717	25	25	6	55	42	35	4	81
BTB	Battambang	2,596	3,000	263	5,859	44	41	8	93	27	34	1	63
KCM	Kampong Cham	2,493	2,760	223	5,476	26	25	7	58	50	37	4	91
KCG	Kampong Chhnang	613	827	89	1,529	5	6	2	13	15	20	1	36
KSP	Kampong Speu	968	1,441	181	2,590	3	3	4	10	19	34	1	53
KTH	Kampong Thom	678	914	86	1,677	4	4	2	10	26	33	1	61
KPT	Kampot	1,095	1,259	112	2,467	13	12	3	28	9	12	1	22
KDL	Kandal	2,965	3,052	216	6,233	7	7	5	19	32	36	4	72
KEP	Kep	90	113	9	212	2	3	1	6	2	3	-	6
KKG	Koh Kong	650	618	46	1,315	9	9	2	20	11	7	1	19
KTE	Kratie	363	379	30	772	4	4	1	9	5	5	1	11
MKR	Mondulkiri	43	55	4	102	1	1	1	3	1	1	-	2
OMC	Oddor Meanchey	300	347	36	683	3	3	2	8	6	6	1	13
PLN	Pailin	204	245	23	472	4	4	2	10	2	3	-	6
PNH	Phnom Penh	7,867	7,754	626	16,247	149	128	23	300	117	83	6	205
PVH	Preah Vihear	247	279	28	554	6	5	1	12	4	4	-	8
PVG	Prey Veng	1,599	2,221	222	4,042	8	9	6	23	52	61	3	116
PST	Pursat	817	938	83	1,838	13	13	3	29	20	16	1	37
RKR	Rattanakiri	214	201	20	434	1	1	2	4	5	4	-	9
SRP	Siem Reap	2,661	3,063	333	6,057	28	26	8	62	106	94	2	202
SHV	Sihanouk Ville	1,120	1,151	95	2,367	13	12	3	28	16	13	1	31
STG	Stung Treng	205	207	21	433	3	3	1	7	4	3	-	7
SRG	Svay Rieng	761	1,058	105	1,924	2	2	2	6	25	32	1	58
TKV	Takeo	1,411	1,722	139	3,272	21	24	4	49	19	20	1	39
TBK	Tbong Khum	838	987	80	1,905	7	7	3	17	24	18	1	43
Total		32,891	37,029	3,256	73,176	402	375	103	880	638	615	37	1,290

Table 12 shows ART coverage of adult male, female and children by province in 2018. The numerator, the number of adult or children receiving ART was calculated based on the residential area to correspond with the construct of denominator values.

Table 12 ART coverage by province, 2018

Summary HIV 2018		#On ART 2018				%On ART 2018				
Code	Provinces	Male	Female	Children	Total	Male	Female	Children	TT Adult	TT A+C
BMC	Banteay Meanchey	1,682	2,014	97	3,793	80.3%	82.6%	52.6%	81.5%	80.4%
BTB	Battambang	2,366	2,718	315	5,399	91.1%	90.6%	119.9%	90.8%	92.2%
KCM	Kampong Cham	1,912	2,304	134	4,350	76.7%	83.5%	60.2%	80.3%	79.4%
KCG	Kampong Chhnang	475	595	66	1,136	77.5%	71.9%	73.9%	74.3%	74.3%
KSP	Kampong Speu	758	916	234	1,908	78.3%	63.5%	129.6%	69.5%	73.7%
KTH	Kampong Thom	494	603	35	1,131	72.9%	66.0%	40.6%	68.9%	67.5%
KPT	Kampot	969	1,183	99	2,251	88.5%	94.0%	88.1%	91.4%	91.3%
KDL	Kandal	2,338	2,584	126	5,047	78.9%	84.6%	58.4%	81.8%	81.0%
KEP	Kep	60	81	4	145	66.5%	71.5%	44.3%	96.3%	68.2%
KKG	Koh Kong	504	582	30	1,116	77.4%	94.2%	65.0%	85.65	84.9%
KTE	Kratie	296	349	19	664	81.6%	92.2%	63.1%	87.0%	86.1%
MKR	Monduliri	37	51	2	90	85.7%	93.0%	49.9%	89.8%	88.2%
OMC	Oddor Meanchey	258	330	25	613	85.9%	95.1%	69.2%	90.8%	89.7%
PLN	Pailin	175	230	23	428	85.9%	94.0%	99.7%	90.3%	90.8%
PNH	Phnom Penh	6,534	6,726	870	14,130	83.1%	86.7%	139.0%	84.9%	87.0%
PVH	Preah Vihear	171	185	22	378	69.3%	66.5%	78.3%	67.8%	68.3%
PVG	Prey Veng	1,171	1,597	148	2,916	73.2%	71.9%	66.8%	72.5%	72.1%
PST	Pursat	609	735	62	1,407	74.6%	78.4%	74.5%	76.6%	76.5%
RKR	Rattanakiri	130	150	11	291	60.8%	74.9%	54.8%	67.6%	67.0%
SRP	Siem Reap	1,909	2,103	303	4,315	71.8%	68.7%	91.0%	70.1%	71.2%
SHV	Sihanouk Ville	942	1,070	75	2,087	84.1%	92.9%	78.7%	88.6%	88.2%
STG	Stung Treng	132	149	26	307	64.5%	72.2%	123.5%	68.3%	71.0%
SRG	Svay Rieng	573	579	76	1,408	75.3%	71.7%	72.2%	73.2%	73.2%
TKV	Takeo	1,113	1,523	135	2,770	78.9%	88.4%	96.8%	84.1%	84.7%
TBK	Tbong Khum	635	765	46	1,445	75.7%	77.5%	57.3%	76.7%	75.9%
Total Population		26,242	30,301	2,983	59,526	79.8%	81.8%	91.6%	80.9%	81.3%

5. LIMITATIONS

5.1.National Level

- Data inputs in the AEM are based on the latest available surveys and programme data and there is a possibility that emerging risks associated with - digitalization, diffusion of behavior patterns from neighboring countries and/or tourists/investors, behavior and risks dynamics associated with socio-economic growth - may not fully capture as part of the data inputs due to lack of mechanisms or resources to validate at the time of estimation exercise
- Electronic ART database at the central level does not capture all the ART sites. For instance, ART data from health facilities, such as Kunthabopha, Angkor children Hospital etc are not yet incorporated into the central ART database ⁹.
- Limited availability of unique identifier across prevention and care continuum has impact on accuracy of data triangulation for size estimates and other programme data inputs that are used in the estimate processes
- AIDS-related deaths are not well captured by the vital registration system and model generated deaths cannot be validated and triangulated with reported deaths among PLHIV. Lost to follow-up can neither be distinguished from deaths nor the re-registration as new cases in another ART site.
- PMTCT database is not yet harmonized and synchronized with NCHADS data system and it hampers the validation of accuracy of programme data inputs for PMTCT

5.2.Sub-national Level

- Internal and international migration make it difficult to differentiate and track the number of people on ART by current residential location and by status of registration (e.g old cases are re-registered in another location as new cases)
- Limited or lack of granularity for the sub-national programme data such as child ART and PMTCT

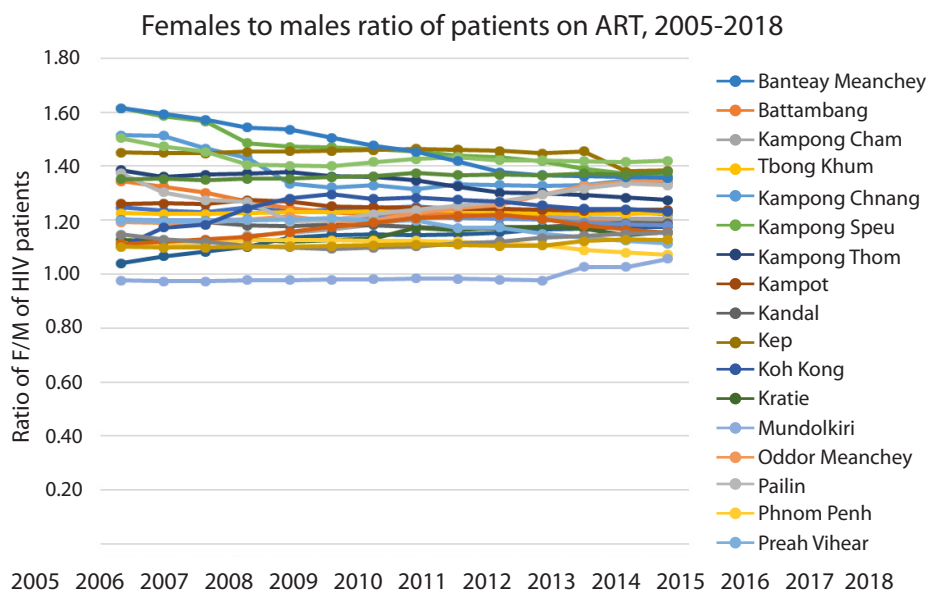
⁹Preliminary findings of Joint Programme Review 2019

6. ANNEXES

6.1. Total Key Population Size Estimation by Province

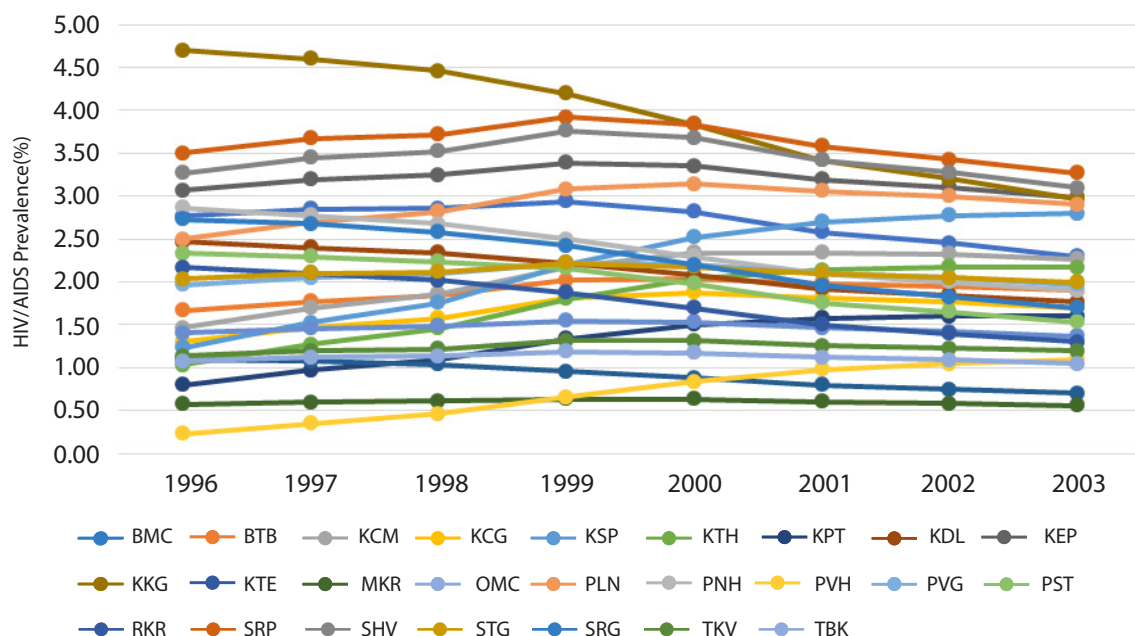
Provinces		Population aged 15-49 years old				Size estimation of Key Population 2018			
		M15-49, 2018	F15-49, 2018	Male proportion	Female proportion	MSM	FSW	TG	IDU
Banteay MeanChey	BMC	219,042	221,409	0.0498	0.0496	3,550	2,059	154	159
Battambang	BTB	344,164	332,944	0.0783	0.0746	5,578	3,096	243	250
Kampong Cham	KCM	296,272	311,564	0.0674	0.0698	4,802	2,898	209	216
Kampong Chhnang	KCG	154,765	160,996	0.0352	0.0361	2,508	1,497	109	113
Kampong Speu	KSP	224,436	231,543	0.0510	0.0519	3,637	2,153	158	163
Kampong Thom	KTH	206,301	210,467	0.0469	0.0472	3,343	1,957	145	150
Kampot	KPT	187,603	181,777	0.0427	0.0407	3,040	1,691	132	137
Kandal	KDL	332,351	341,252	0.0756	0.0765	5,386	3,174	234	242
Kep	KEP	11,747	11,624	0.0027	0.0026	190	108	8	9
Koh Kong	KKG	37,877	35,986	0.0086	0.0081	614	335	27	28
Kratie	KTE	103,419	104,379	0.0235	0.0234	1,676	971	73	75
Mondulkiri	MKR	22,916	21,010	0.0052	0.0047	371	195	16	17
Oddor Meanchey	OMC	71,709	68,082	0.0163	0.0153	1,162	633	51	52
Pailin	PLN	20,297	19,448	0.0046	0.0044	329	181	14	15
Phnom Penh	PNH	504,139	514,838	0.1146	0.1154	8,170	4,788	355	367
Preah Vihear	PVH	72,109	70,050	0.0164	0.0157	1,169	651	51	52
Prey Veng	PVG	344,553	353,665	0.0783	0.0793	5,584	3,289	243	251
Pursat	PST	128,663	134,218	0.0293	0.0301	2,085	1,248	91	94
Rattanakiri	RKR	56,375	54,580	0.0128	0.0122	914	508	40	41
Siem Reap	SRP	276,165	281,010	0.0628	0.0630	4,476	2,613	195	201
Sihanouk Ville	SHV	75,982	75,093	0.0173	0.0168	1,231	698	54	55
Stung Treng	STG	38,390	35,808	0.0087	0.0080	622	333	27	28
Svay Rieng	SRG	176,709	172,601	0.0402	0.0387	2,864	1,605	125	129
Takeo	TKV	272,289	284,946	0.0619	0.0639	4,413	2,650	192	198
Tbong Khum	TBK	219,433	233,066	0.0499	0.0522	3,556	2,168	155	160
Total		4,397,706	4,462,356			71,270	41,499	3,101	3,202

6.2. Female to Male Ratio of PLHIV on ART

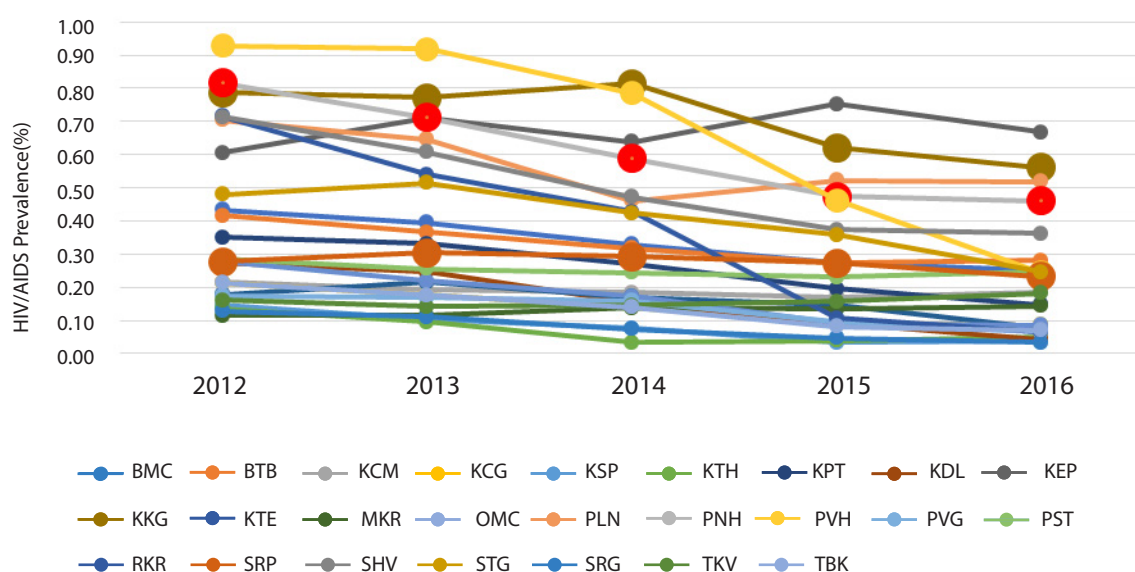


6.3. HIV Prevalence among Pregnant Women, 1996 to 2016

HIV prevalence among ANC attendees, HIV Sentinel Surveillance, 1996 to 2003



HIV prevalence among ANC attendees, PMTCT Programme data, 2012 to 2016



6.4. HIV Testing and Treatment Cascade (90-90-90 Treatment Target and 90-81-73)

90-90-90 targets & HIV Testing and treatment cascade 2018				
All PL HIV	73177	3257	32891	37029
	All	Children <15 years	Males 15+ years	Females 15+ years
People living with HIV who know their HIV status	59,837	3,111	26,331	30,395
People on antiretroviral treatment	59,526	2,983	26,242	30,301
People newly initiating antiretroviral treatment	3,527	138	2,034	1,355
People on antiretroviral treatment who have suppressed viral load	56,844	2,530	25,079	29,217
People who are virally suppressed among those tested	47,112	2,017	20,329	24,766
People receiving a routine viral load test among those on antiretroviral treatment	49,335	2,378	21,272	25,685
	All	Children <15 years	Males 15+ years	Females 15+ years
People living with HIV who know their HIV status (First 90)	82%	96%	80%	82%
People living with HIV who are on treatment (Target: 81%)	81%	92%	80%	82%
People living with HIV who have a suppressed viral load (Target:73%)*	78%	78%	76%	79%
People who are on treatment among those who know their HIV status (Second 90)	99%	96%	99.7%	99.7%
People on antiretroviral treatment who have a suppressed viral load (Third 90)	95%	85%	96%	96%
People on antiretroviral treatment who have had a viral load test	83%	80%	81%	85%

Definition and indicator description of 90-90-90 and 90-81-73

90-90-90

	First 90 90% of estimated PLHIV know their status	Second 90 90% of PLHIV who know the status are on treatment	Third 90 90% of PLHIV on treatment are virally suppressed
Numerator	number of PLHIV who know their HIV status (that is not cumulative and excludes deaths)	number of PLHIV currently on treatment	number of PLHIV currently on treatment who have achieved viral suppression (<1000 copies/ml)
Source (Numerator)	case reports, programme data and case registries	treatment database, data from care and treatment programme	treatment database, data from care and treatment programme, lab database
Denominator	estimated number of PLHIV	number of PLHIV who know their HIV status	number of PLHIV currently on treatment
Source (Denominator)	EPP-spectrum, AEM-spectrum	case reports, programme data and case registries	treatment database, data from care and treatment programme

90-81-73

	90 90% of estimated PLHIV know their status	81 81% of estimated PLHIV on treat- ment	73 73% of estimated PLHIV are virally suppressed
Numerator	number of PLHIV who know their HIV status (that is not cumulative and also excludes deaths)	number of PLHIV currently on treatment	number of PLHIV currently on treatment who have achieved viral suppression (<1000 copies/ml)
Source (Numerator)	case reports, programme data and case registries	treatment database, data from care and treatment programme	treatment database, data from care and treatment programme, lab database
Denominator	estimated number of PLHIV	estimated number of PLHIV	estimated number of PLHIV
Source (Denominator)	EPP-spectrum, AEM-spectrum	EPP-spectrum, AEM-spectrum	EPP-spectrum, AEM-spectrum

Interpretation and use of 90-90-90 and 90-81-73 treatment targets

90-90-90 calculation use different denominators for indicator 2 (2nd 90) and 3 (3rd 90) and it monitors the sequential achievement of programme rather than population or community level treatment coverage or viral suppression. Whereas 90-81-73 (HIV treatment cascade) monitor the progress of treatment target at population level when the denominator, "estimated number of PLHIV", is consistently used throughout the cascade.

90-90-90 measurement is useful but there is possibility of generating deceiving message, depending on the way how the data is presented. If the country is not doing well in "know the status" (first 90) and for instance only 10% of estimated PLHIV know their status, but it is possible to put 90% of those who know the status on treatment and in that case 2nd 90 will be 90% and if more than 90% of those on treatment are virally suppressed, 3rd 90 will also be 90. Hence 90-90-90 needs to be interpreted as a whole spectrum and just looking at indicator 2 and 3 alone will be misleading and deceiving.

Whereas for HIV treatment cascade, representation is at population level (of PLHIV) and it is easier to see how well the country is progressing in all 3 areas of know the status, on treatment and virally suppressed.

6.5. HIV Estimates Technical Working Group in Cambodia

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6.6. National HIV Estimates, 2000-2018

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
PLHIV	Total	81214	83509	83789	83017	82120	81552	81255	80993	80643	80060	78764	78240	77634	76885	76066	75196	74225	73176
	Adults(15+)	78280	80238	80226	79204	78107	77380	76935	76550	76063	75387	74147	73725	73274	72725	72115	71462	70733	69919
	Children(0-14)	2934	3271	3562	3813	4014	4172	4320	4443	4580	4673	4663	4618	4515	4360	4160	3952	3735	3492
New HIV infections	Total	10734	8163	7035	6317	5589	4919	4266	3648	3166	2746	1942	1756	1600	1444	1322	1240	1049	880
	Adults(15+)	9679	7165	6094	5433	4767	4158	3573	2641	2290	1947	1615	1471	1360	1247	1167	1102	947	777
	Children(0-14)	1055	998	941	884	822	761	693	592	525	456	326	285	240	197	155	138	102	103
AIDS related deaths	Total	4459	5383	6113	6403	5856	4935	4052	3038	2820	2501	1916	1655	1569	1559	1509	1469	1381	1290
	Adults(15+)	3845	4761	5498	5799	5260	4357	3537	2718	2573	2291	1766	1528	1458	1458	1446	1418	1341	1253
	Children(0-14)	614	622	615	604	597	579	516	428	320	248	210	150	128	111	63	51	40	37

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