NATIONAL & SUBNATIONAL ESTIMATIONS & PROJECTIONS OF HIV EPIDEMIC, MALAYSIA: 2019

HIV/STI/Hepatitis C Sector, Ministry of Health, Malaysia

National and Subnational Estimation and Projection of HIV Epidemic Malaysia: 2019

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Foreword

The first AIDS case was reported in Malaysia in 1986. As of December 2018, Malaysia has a total of 115,263 HIV cases reported to the national surveillance system. Of that, 72,399 people were living with HIV (PLHIV) from estimated of 87,122 based on Asian Epidemic Model (AEM) projection.
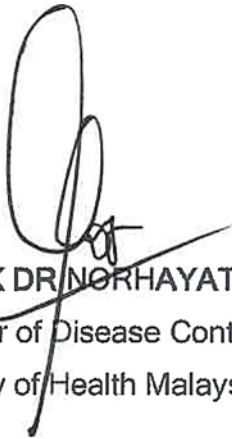
During the first 25 years into the HIV epidemic the main mode of transmission in Malaysia was through injecting drug use, specifically through the sharing of contaminated needles and syringes among people who inject drugs (PWID) bearing the brunt of 70%-80% of new cases annually. In 2014 the share of new infections attributed to sexual transmission had reached 80% of the annual total.

Maintaining business as usual, the AEM model projected that the HIV incidence in Malaysia will increase dramatically from 2018 onwards and by 2030, Malaysia is estimated to have 162,378 PLHIV. The model projected that Malaysia would have 14,534 new HIV infection in 2030 making it impossible to reach 'Ending AIDS' target in 2030. Kuala Lumpur, Sabah, Johor, Sarawak, and Selangor account for more than 60% (102,976) of new cases, contributed largely through sexual transmission.

We were successful in realizing our target in Millennium Development Goals by achieving 50% reduction of new HIV infection through our harm reduction programme ahead of time. However, the pace of declining has reached flat line. This report demonstrates that the country needs more focus strategies and interventions to end AIDS epidemic especially to the top five subnational and their key populations.

This is the second report for national HIV epidemic estimation and projection published by the Ministry of Health. It is a continuation of report which was produced earlier in 2016 for Ending AIDS in Malaysia. However, in this round, we include the estimation and projection for subnational which would help the policy maker and the implementors to understand the HIV epidemic trend from all aspects including its projection. This is important due to our varied socio-demographic structure and epidemic progress of each subnational which makes the interventions unique and different.

Lastly, I would like to acknowledge the admirable teamwork and hard work by the Malaysia AEM core team led by Ministry of Health's Disease Control Division especially the HIV/STI/Hepatitis C Sector and Malaysia AIDS Council as well as the technical consultant from East-West Centre Hawaii and UNAIDS in data gathering, processing, and analyzing, and publishing this report. I would also like to extend my sincere appreciation and gratitude to all the state AIDS Officers, public health physicians, and Family Medicine Specialists for their contribution to this report.

DATUK DR NORHAYATI BINTI RUSLI
Director of Disease Control
Ministry of Health Malaysia

EXECUTIVE SUMMARY

A series of national consultative workshops were conducted to develop the National AEM Baseline workbook as well as to update National Spectrum file and to develop subnational estimates. The outcomes of these workshops are to provide summary of national and subnational HIV estimates based on inputs, calculations, data triangulation and assumptions as well as the consensus agreement of national and subnational AEM and Spectrum update processes by the end of 2018.

One of the key findings highlighted in this report is the trend of new HIV cases that has reached a flat line from 2015 onwards. This phenomenon is also observed regionally and globally, where the declining in new HIV infections in the past 8 years has been stalled far from 2020 Ending AIDS fast-track target. In the beginning of the epidemic, the new HIV cases increased exponentially and peaked in year 2002. Subsequently, the infection rate declined steadily until 2015 where it began to stall. Given that IDU is the main mode of transmission for HIV infection in Malaysia during the earlier phase, the decline in new cases may be contributed by few reasons among others; (1) the success of the National Harm Reduction program introduced in 2005; and (2) changing addiction behavior among PWID from injecting to taking oral drugs.

After 2018, Spectrum projected that the HIV incidence will increase dramatically. A shift in the epidemic mode of transmission, from one previously driven by injecting drug use to one of sexual transmission may have contributed to this intense increase in HIV incidence.

Analysis by subnational reveals the same trend. At the beginning of the epidemic, majority of the new HIV cases were contributed by subnational with high number of PWID such as Johor, Terengganu, and Kelantan. While in the recent epidemic, majority of the new cases are mostly from Kuala Lumpur, Sabah, Sarawak, and Selangor, where majority of the reported cases are sexually transmitted. Other subnational such as Melaka, Labuan, Penang and Negeri Sembilan are also seeing increasing in new HIV infections in the last 10 years.

Based on the same analysis, the HIV epidemic in Malaysia by subnational can be summarized into 4 categories i.e., Category 1: Subnational with prevalence above national average and increasing. The subnational in this category are Kuala Lumpur; Category 2: Subnational with prevalence above national average and decreasing. Subnational in this category include Johor, Perlis, Pahang, Terengganu, Negeri Sembilan, and Kelantan; Category 3: Subnational with

prevalence below national average and stabilizing. Subnational in this category include Kedah, Penang, and Perak; and Category 4: Subnational with prevalence below national average and increasing. The subnational in this category is Melaka, Selangor, Sarawak, Sabah, and Labuan.

As predicted, Selangor, Kuala Lumpur, and Johor, contributed more than half of the new HIV cases in Malaysia in 2018. These subnational are the most developed or urbanized subnational. Urbanization often comes with social problem associated with dense and diverse populations especially among young and mobile populations.

Malaysia has a unique demographic structure peculiar to each subnational. Therefore, the interventions have to tailor to the need of each subnational and not 'one size fit all'. Focusing on effective strategies and interventions of the top five (5) subnational and their most affected key populations will have greater impact in ending AIDS by 2030.

INTRODUCTION

Background

Malaysia is a country with concentrated HIV epidemic with infection rates remain above 5% among key populations (KPs) especially people who inject drugs (PWID), female sex workers (FSW), transgender (TG) and men who have sex with men (MSM). PWID was the main driver bearing the brunt of about 70-80% of all new reported cases, yet the trend has started to decline constantly beginning 2004 and reached 3% in 2018. It is estimated that about 87,041 people living with HIV (PLHIV) in Malaysia in 2018, in which only 75,040 (86%) PLHIV who know their HIV status. PLHIV in Malaysia is generally predominant among males (82.9%). The national surveillance system indicated that the new HIV reported case has declined by 50%, while new HIV/AIDS reported death has stabilized from 2000 to 2018[1]. Malaysia had been significantly making progress in expanding antiretroviral (ARV) availability and accessibility as it became the integral component of care continuum, treatment, and prevention back in 1990. While approximately 41,486 (48%) PLHIV were on life-saving antiretroviral therapy (ART), the proportion of women (71%) getting ART was higher than that of men (43%) by the end of 2018. Therefore, there is much more work to do for Malaysia to achieve 90-90-90 treatment cascade targets in the global scale.

To predict the future trend of HIV and to assist in the appropriate national strategic planning, we embarked upon a process of constructing a national epidemic model for 2018 using AIDS Epidemic Model (AEM) and Spectrum tools. The analytical work and review process started in February 2019 to November 2019. A technical Working Group consist of expert in National HIV program, behavioral survey, M&E, representatives from civil societies and UNAIDS was responsible in collecting, collating, analyzing and triangulating data from various programmatic and survey data.

Treatment Cascade, Malaysia, 2018

Gap to reach the 1st 90: 12,001

Gap to reach the 2nd 90: 33,639

Gap to reach the 3rd 90: 1,316

86% — PLHIV who know their HIV status

55% — PLHIV on ARV

97% — PLHIV who are virally suppressed
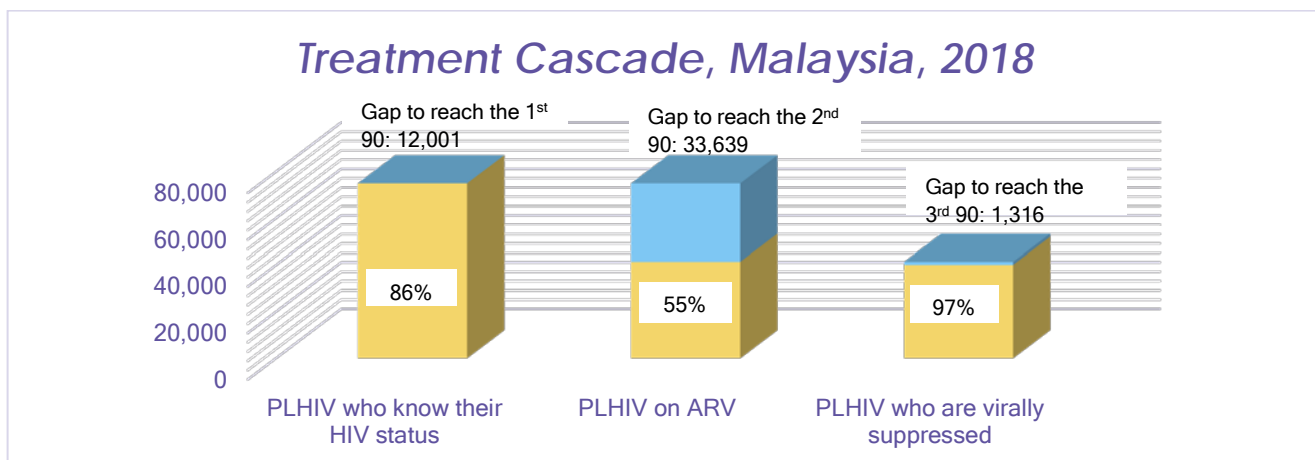
A series of technical workshop were conducted between March 2019 to November 2019 to develop, validate and analyze a baseline HIV model and estimates for national and subnational with expert assistance from East-West Center, Hawaii, Dr Wiwat Peerapatanapokin and UNAIDS data specialist, Dr Khin Cho Win Htin.

AIDS Epidemic Model (AEM)

The AIDS Epidemic Model (AEM) is an adult behavioral process model that generates the HIV estimates for the population 15 years and above. It is developed by the East-West Center with support from USAID, UNAIDS, Family Health International, World Health Organization, and World Bank[2]. It is mainly used for countries with concentrated epidemics, in which the models allow countries to build locally tuned models that represent their epidemiological situation. These models can then be used with a set of analytic tools–the AEM Workbooks (Baseline, Intervention, and Impact Analysis)–to prepare scenarios that analyze alternative responses to the epidemic, assess the impact of these responses, and estimate the cost of their implementation. These scenarios provide essential inputs to national strategic planning processes, help countries allocate their resources more efficiently, and to identify weaknesses that must be addressed to strengthen their responses.

The inputs for AEM fall into a number of general categories and are primarily behavioral in nature:

- The sizes of key populations (total male and female population, male clients, direct and indirect female sex workers, IDUs, MSM, etc.).
- Sexual risk behaviors (frequency of sexual contact between different partner types, levels of condom use with different partners).
- Injecting risk behaviors (frequency of injection, levels of sharing).
- Average duration in different key populations (average time in sex work, average time as a client, etc.).
- Levels of sexually transmitted diseases (STIs by type of partner, e.g., among sex workers, general population couples, etc.)
- Coverage of ART
- HIV progression and mortality rate (among PLHIV who are on ART and who are not on ART)

These inputs were used to calculate the number of new infections, PLHIV, and deaths among each sub-population and total population.

AEM tool suite includes 3 major workbooks – a) AEM baseline workbook; b) AEM intervention workbook; and c) AEM analysis workbook (Figure 1). However, in this report, we only develop National and subnational AEM baseline workbook.

AEM Baseline	---->	Collect data to create an AEM projection that replicates the current epidemic: Stored in an AEM baseline file.
AEM Intervention Workbook	---->	Create a set of policy scenario (intervention mix, coverage, cost, and effectiveness) within AEM intervention workbooks.
AEM Analysis	---->	Use the AEM Impact Analysis workbook to import these scenarios and compare them.
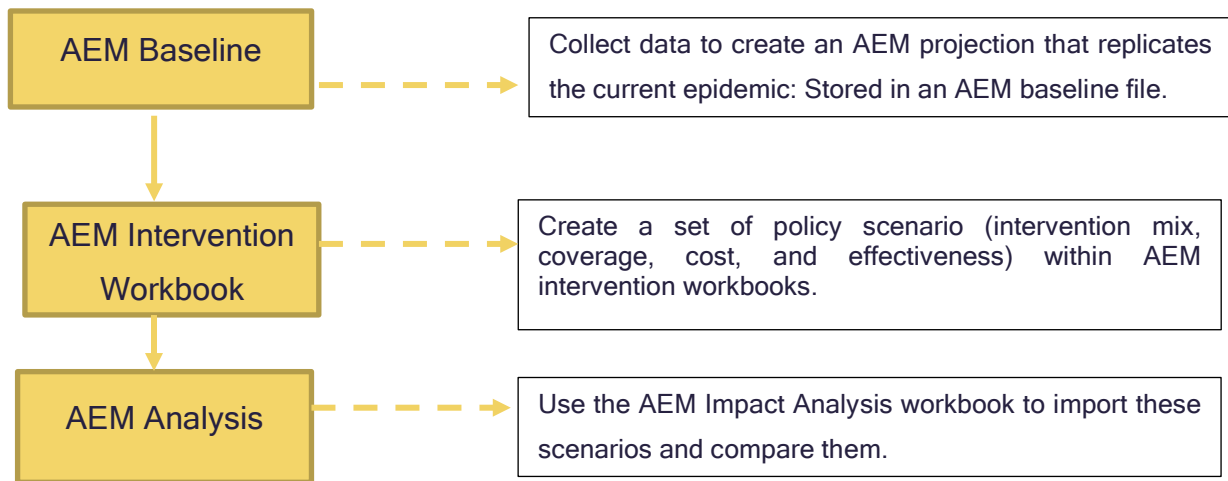
Figure 1: Overview of AEM workbook

Spectrum

The software package Spectrum *(https://www.avenirhealth.org/software-spectrum.php)* is used to produce estimates of adult incidence, prevalence, and mortality, as well as estimates for children infected via mother-to-child transmission. Spectrum uses the prevalence curves (recent versions of Spectrum allow users to import incidence curve from other modeling tools or directly input incidence curve) and applies a set of assumptions to produce age and sex-specific estimates of incidence, prevalence, and mortality for adults and children[3]. These assumptions are: i) female-to-male prevalence ratio; ii) effects of HIV on fertility; iii) mother-to-child transmission of HIV; iv) survival time from infection to death (for adults and children); v) age patterns of prevalence; and vi) effects and coverage levels for ART. The latest version of Spectrum (version 5.756) which was used in this consensus workshop can read incidence from AEM output file directly and use this information along with other inputs and assumptions to calculate the impact of the epidemic.

AEM-Spectrum

The limitation of AEM is that it can only generate the HIV estimates for the population 15 years and above, therefore we need to import the incidence trend from AEM model into spectrum software. This process is required to generate the national estimates that include adults (15+), children (0-14) and components of mother-to-child transmission of HIV (MTCT).

Objectives

The objectives of the report are:

i. To document the process, methodologies including assumptions, inputs, calculations, data triangulation and as well as the consensus agreement of national and subnational AEM and Spectrum update processes

ii. To provide summary of national and subnational HIV estimates

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.

METHODOLOGY

National Consultative Workshops

There were series of National Consultative Workshops conducted between March 2019 and November 2019. Participants of these workshops includes AEM consultant from East-West Centre Hawaii, data specialist from UNAIDS, National HIV Consultant from MOH Malaysia and representatives from Malaysia AIDS Council. The outcomes of the workshops were to develop National AEM Baseline workbook, to update National Spectrum file and to develop subnational estimates. The final findings were presented, discussed, and finalized with inputs and consensus agreement by stakeholders.

National Estimates

AEM software and Spectrum software were used for national estimation and projection. First, national AEM baseline model was developed to simulate the epidemic situation for adults (including key population and general population) in the country from the past to the present. This AEM baseline model also projects the epidemic situation to the future with assumptions that the risk behaviors and treatment coverage remain the same level as in 2018. Then overall adult incidence rate and female to male incidence ratio from AEM baseline model were used as inputs for Spectrum. With these inputs from AEM and other inputs including ART inputs and inputs related to mother to child transmission, Spectrum then generated both adult and child HIV estimates.

Data inputs and assumptions in the AEM

For the AEM data updates, all the relevant documents that were reviewed are listed below:

a) Country population: Population data including demographic information for adults aged 15+ (by age and gender) is based on UN population division data from 1970 to 2050 which were retrieved from Spectrum V5.756.

b) Population size estimates (PSE) for key populations (KP) derived from the recent PSE for KP[4].

c) Behavior data from five (5) studies:
   a. Behavioral Surveillance Survey (BSS), 2004.
   b. Integrated Bio-Behavioral Surveillance Survey (IBBS), 2009.
   c. Integrated Bio-Behavioral Surveillance Survey (IBBS), 2012.
   d. Integrated Bio-Behavioral Surveillance Survey (IBBS), 2014.
   e. Integrated Bio-Behavioral Surveillance Survey (IBBS), 2017.

All the data inputs on key population using the reviewed documents are summarized in Annex 1. Whenever necessary, data were interpolated for missing values and weighted to get national representativeness. Data were entered into AEM worksheets using AEM Tool as projection engine. Baseline estimates and projections resulting from the model were finally validated with national surveillance data and other available programmatic data.

Data inputs in the Spectrum

The AEM baseline workbook was imported into the Spectrum software V5.756. The defaults data and parameters for population and migration, mother-to-child transmission (MTCT) transmission probabilities, adult and paediatric HIV transition parameters were maintained. Whilst data such as Prevention of mother-to-child transmission (PMTCT) program, children (0 to 14 years) on ART, adults (15+ years) on ART and viral load suppression were input based on data from different sources from programmatic data (Annex 2).

Spectrum output on the impact of the epidemic explored as follow:

- People living with HIV and AIDS.
- New infections
- AIDS deaths
- Treatment needs (e.g., number of children and adults in need of ARV treatment)
- Treatment coverage
- PMTCT

National AEM and Spectrum comparison and adjustments

The results of the following indicators from AEM worksheet file and Spectrum were then compared to check the consistency of the outputs and results and adjusted accordingly if needed:

- Number and trend of adults (aged 15+) living with HIV.
- Number and trend of new infections among adults (aged 15+)
- Number and trend of AIDS related deaths among adults (aged 15+)

Subnational Estimates

Disaggregation analysis method

Disaggregation analysis using "proxy incidence" method was used to get the incidence rate by sex and subnational. The basic principle of this method is the use of proxy indicator for incidence and building on that, incidence proportion is calculated for sub-nationals (with assumption that proxy incidence proportion is the same as incidence proportion). The national TWG reviewed all the available data sources to get the best proxy incidence indicator such as ANC prevalence data, HIV surveillance data, pre-marital HIV screening data and voluntary counselling and testing (VCT) screening data. Finally, the ANC prevalence data as proxy incidence rate for female were selected to calculate proxy incidence proportion. As for male, we selected proportion from reported HIV cases as proxy incidence proportion. New infections by subnational were then calculated by multiplying proxy incidence proportion for each subnational to total national new HIV infections derived from national AEM/Spectrum. Demographic data by subnational is required by this method. It was calculated by multiplying proportion for each subnational to total national population age 15 to 49 by sex using the demographic data age 15 to 49 for each subnational[5]. Details on the steps of the calculation as in Annex 3.

Subnational Spectrum

To get the HIV estimates for each subnational, the latest National Estimations and Projections 2018 were imported into the Spectrum Software version 5.756 data file to create a template in Spectrum file. The incidence input for this template was then changed to use "Direct Incidence Input" option. Using the template, a spectrum file for each subnational was generated. The calculated subnational incidence rate from the disaggregation analysis method above, female to male incidence ratio, demographic data, and program statistic data (from National Surveillance Database) were then entered into the subnational spectrum template to generate other estimates measures such as PLHIV and AIDS-related deaths (Figure 2).
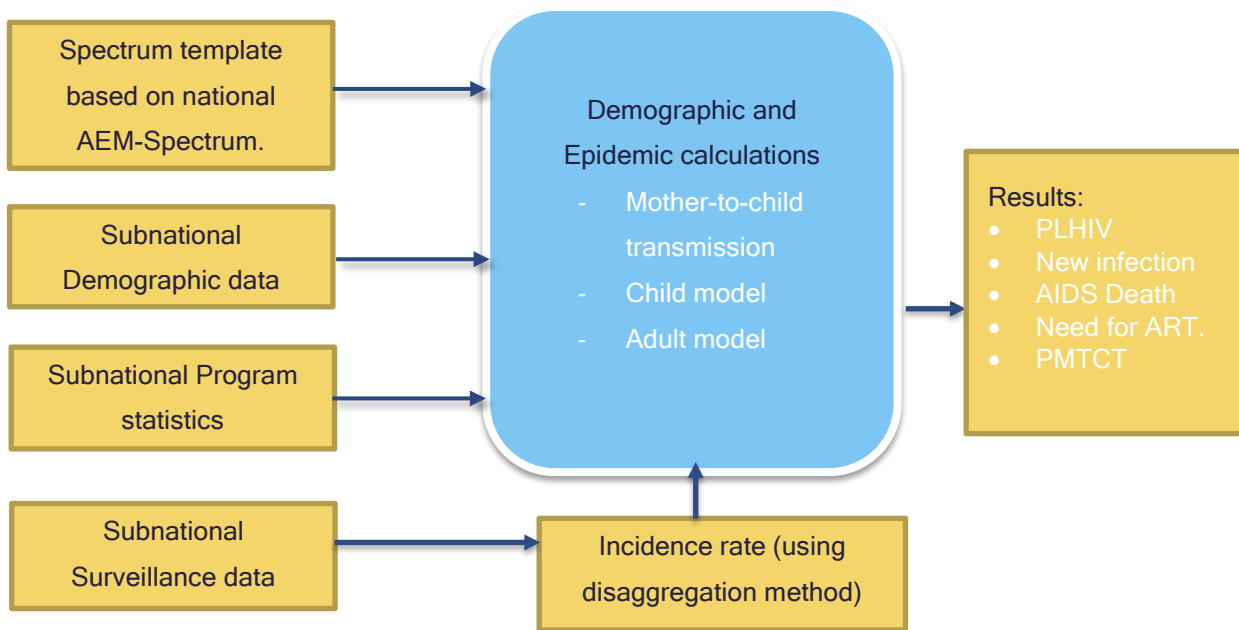
Figure 2: AEM-Spectrum Process for Subnational Estimates

RESULTS

National HIV Estimates

The national HIV estimates were based on the output generated from AEM and Spectrum package using the baseline scenario. The Baseline scenario is referred to the impact of HIV epidemic based on maintaining risk behaviors, prevention coverage, and treatment coverage as in 2018 (assuming no additional intervention after that or "business as usual").

People Living with HIV (Adults 15+)

Figure 3 showed the trend of estimated PLHIV in Malaysia from 1985 to 2020. Since the beginning of the epidemic, proportion of male PLHIV remained higher than that of female. Total number of adults PLHIV had reached its peaked in 2003 and remained flat line until 2016 where it started to bounce back. This is contributed by the increased of male PLHIV since 2016 while the proportion of female PLHIV remained stable since 2011.
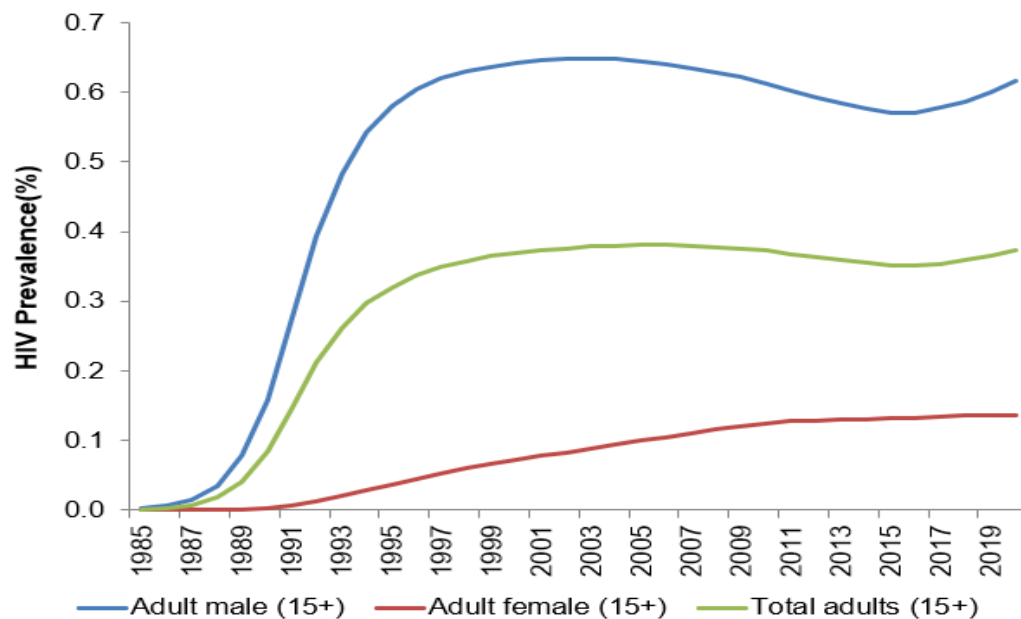
Figure 3: Trend of estimated PLHIV in Malaysia (aged 15+), 1985 - 2020

New HIV Infections (Adults 15+)

Figure 4 depicts the national trend of estimated new HIV infections with males dominate the epidemic since the early phase of the epidemic as projected. There were two peaks in the graph. The first peak is in 1992, where the new HIV infections among adults 15+ has reached the highest point and then reduced to almost half in 1996. This trend gradually increased and reached its second peak in year 2001, thereafter stabilizing. However, in 2018, the trend of new infections started to escalate dramatically especially among male. While new HIV infections among female remained unchanged since 1997. The estimated new HIV infections among adults 15+ in 2019 was 6,273.
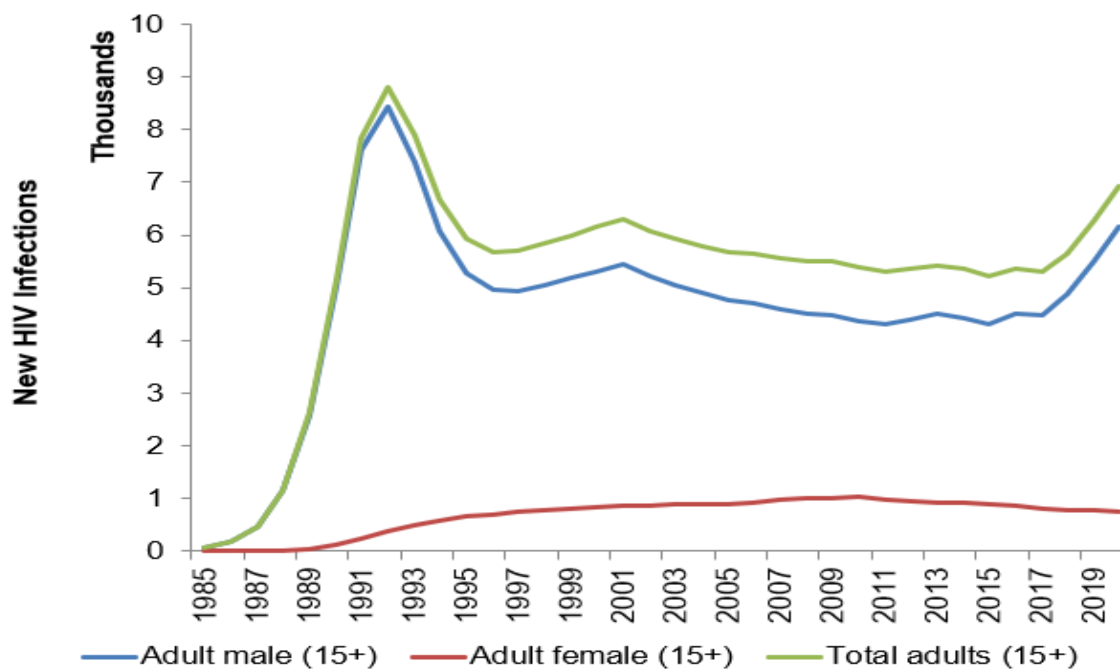
Figure 4: Trend of estimated new HIV infections by gender in Malaysia, 1985 - 2020

Adults (15+) New HIV Infections by Risk Population

As exhibited in Figure 5, the new HIV infections at the beginning of the epidemic was dominated by IDU until 2002. Since then, the share of total new HIV infections contributed by IDU has gradually reduced to only 3.7% in 2019 (Figure 6). By 2019, majority of new HIV infections are among MSM, a significant increase from only 18% to 66% between 2010 and 2019.

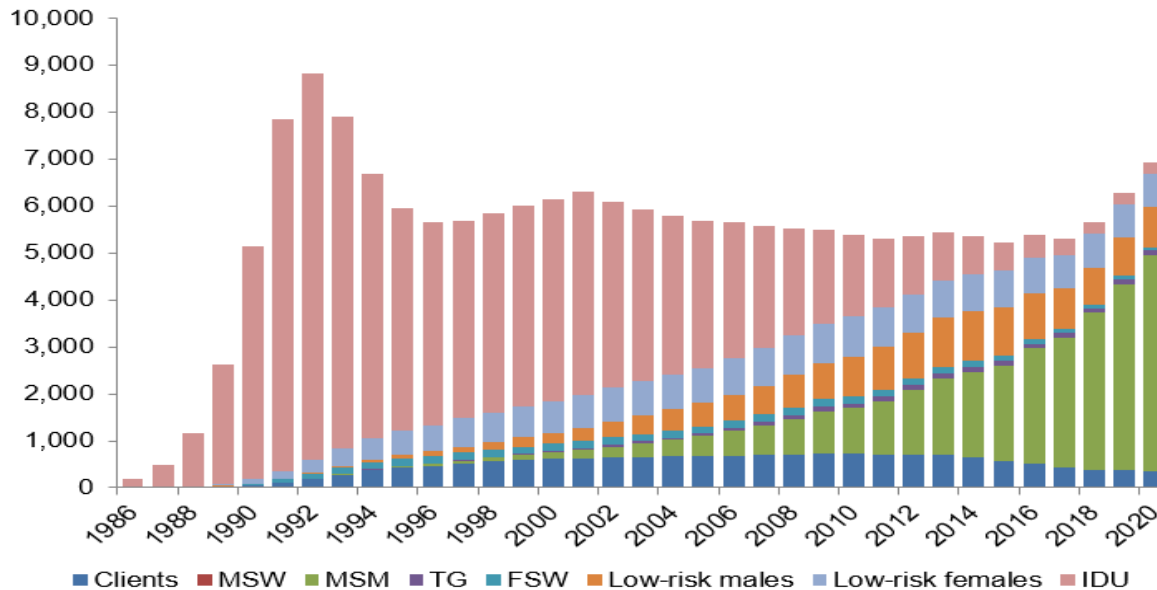Figure 5: Annual New HIV Infections by risk population in Malaysia, 1985 - 2020
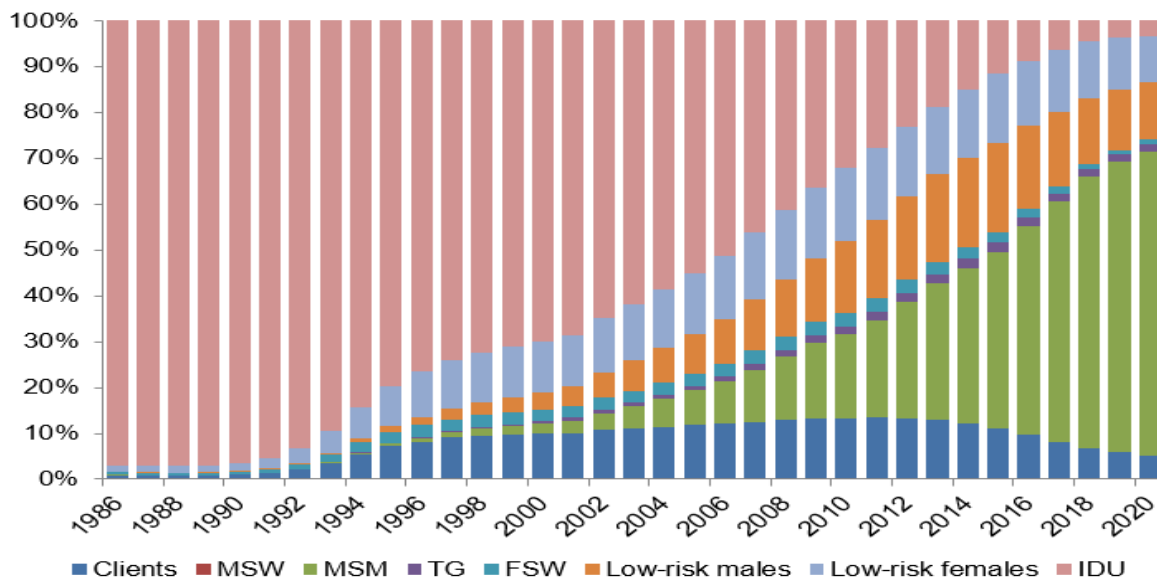

Figure 6: Annual New HIV Infections Proportion by risk population in Malaysia, 1985-2020

Subnational HIV Estimates

The subnational HIV estimates will be based on outputs generated from Spectrum Software.

HIV Prevalence by subnational

Using the data input by subnational, the HIV prevalence by subnational from 1990 to 2018 were plotted. Based on the graph, the HIV epidemic in Malaysia can be summarized into 4 categories as below:

A. **Category 1** (Figure 7): Subnational with prevalence above national average and increasing. The subnational in this category are **Kuala Lumpur (KL)**.
   Kuala Lumpur is the only subnational in this category. Its HIV prevalence has constantly following above the national average. However, this trend accelerated past the national trend in 2011.

B. **Category 2** (Figure 8): Subnational with prevalence above national average and decreasing. Subnational in this category include **Johor, Perlis, Pahang, Terengganu, Negeri Sembilan, and Kelantan**. All subnational in this category have always remained above the national average in the early phase but gradually declining.

C. **Category 3** (Figure 9): Subnational with prevalence below national average and stabilizing. **Kedah, Penang, and Perak** fall in this category with the HIV prevalence trend following below the national average and stabilizing.

D. **Category 4** (Figure 10): Subnational with prevalence below national average and increasing. In this category, four (4) subnational have HIV prevalence below the national average, but gradually increase with two (2) subnational (Melaka and Selangor) surpassed the national average in 2015. The subnational in this category is **Melaka, Selangor, Sarawak, Sabah, and Labuan**.
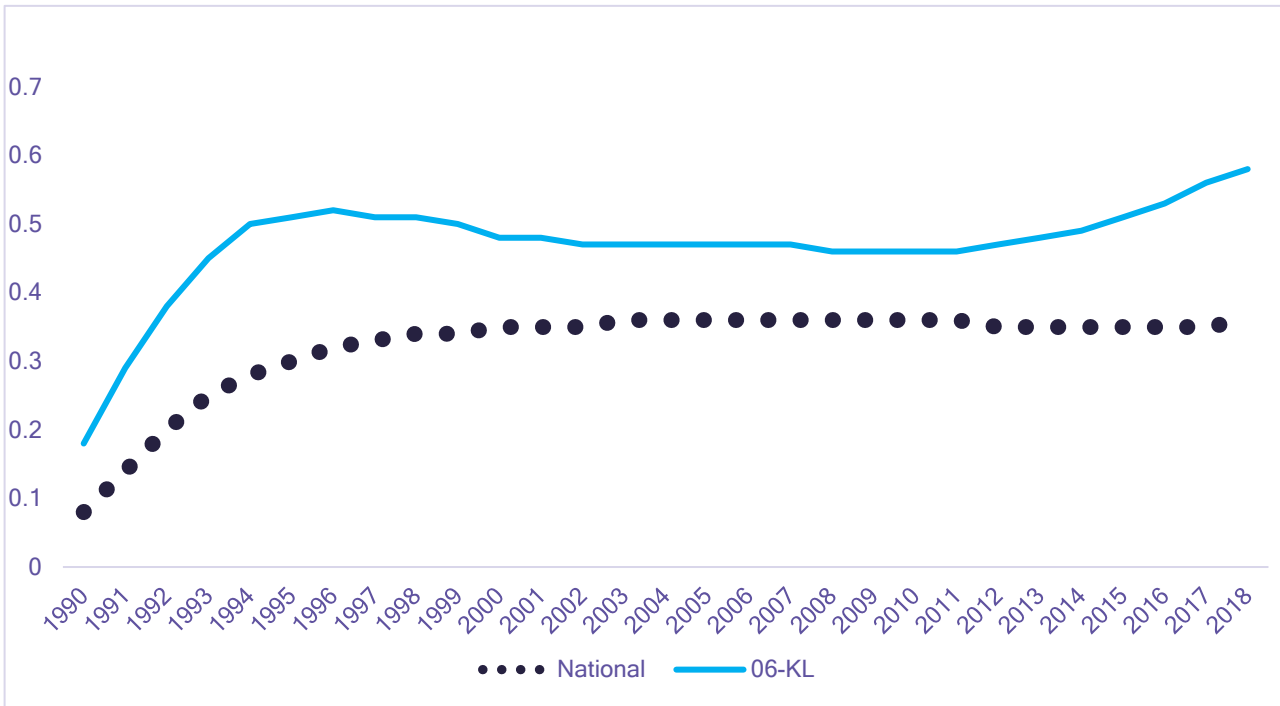
Figure 7: HIV Prevalence for Category 1, 1990-2018
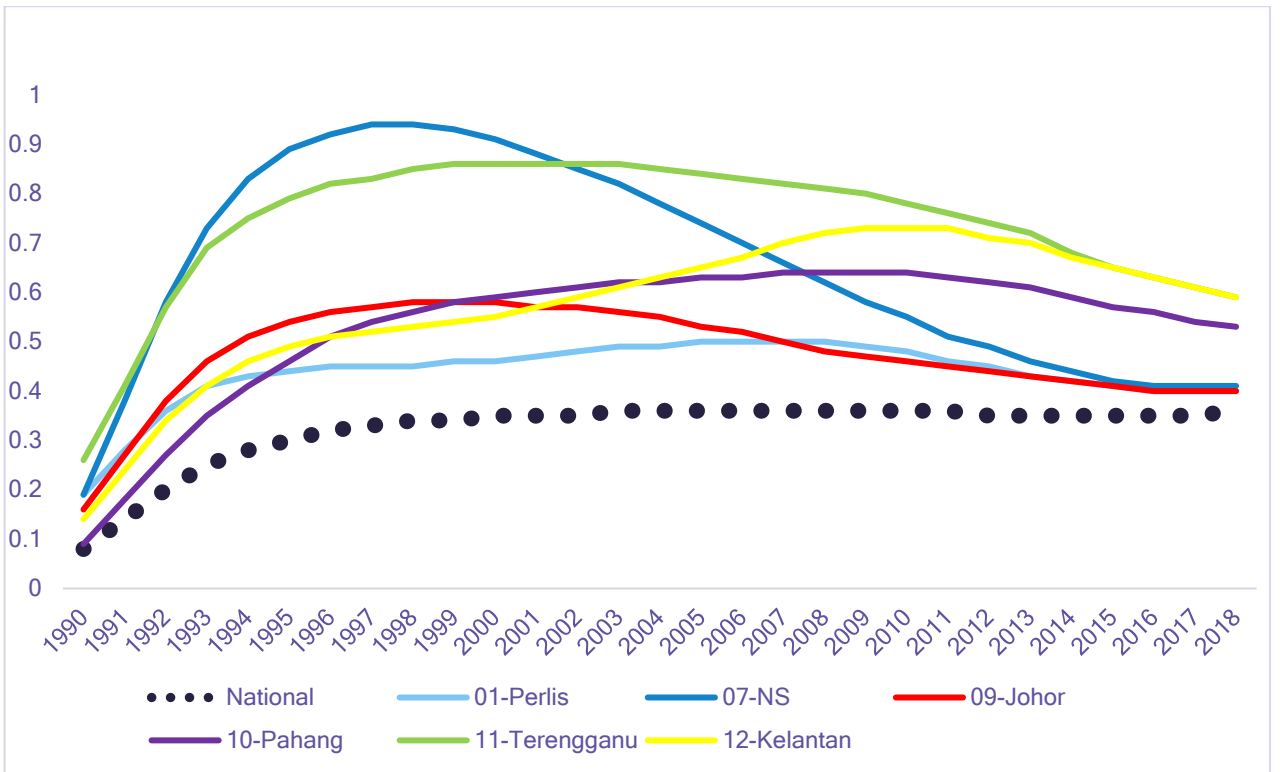
Figure 8: HIV Prevalence for Category 2, 1990-2018
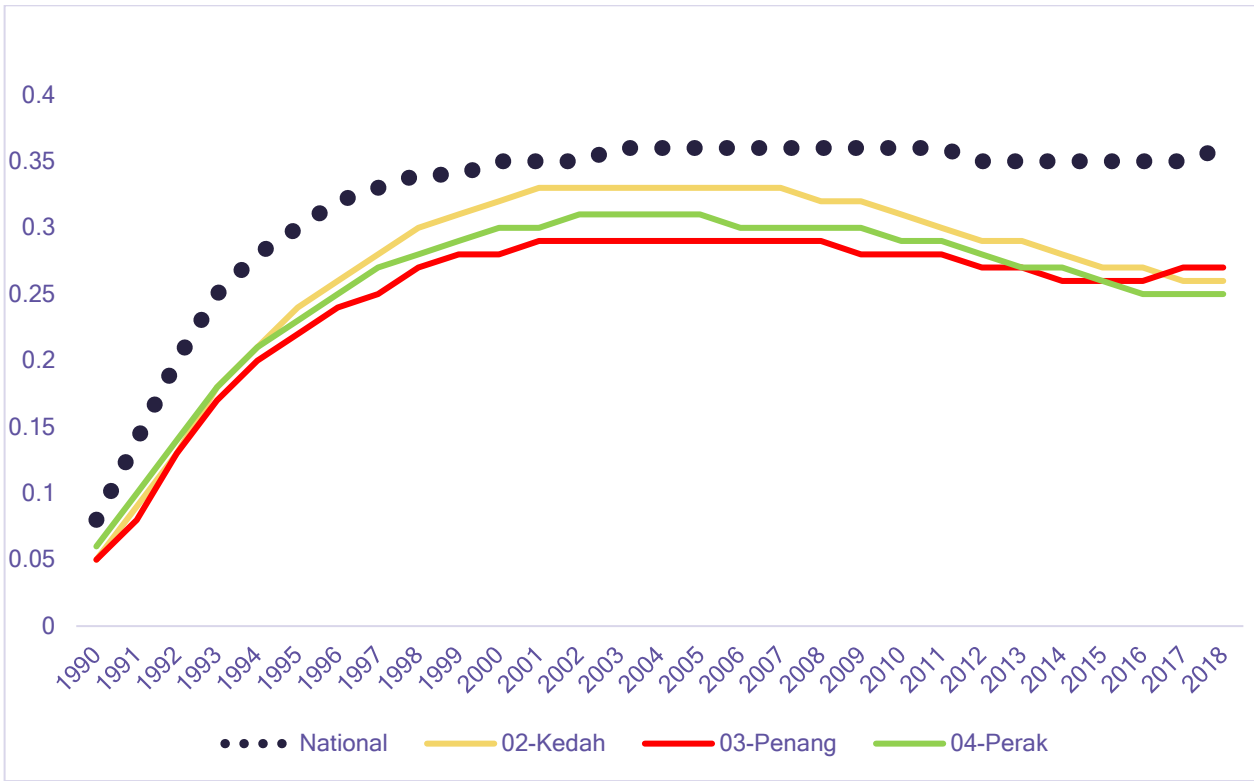
Figure 9: HIV Prevalence for Category 3, 1990-2018
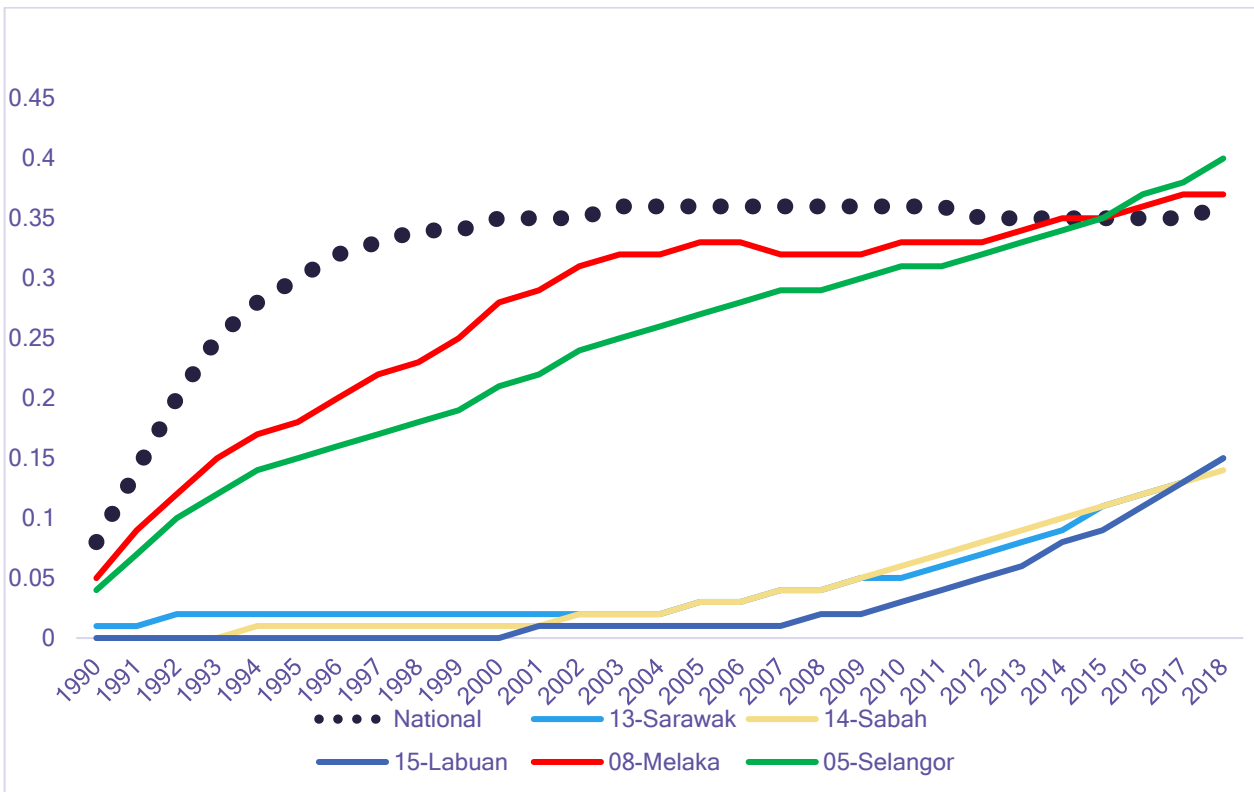
Figure 10: HIV Prevalence for category 4, 1990-2018

HIV Incidence (per 1000 population)

The trend for HIV incidence is almost similar to that of HIV prevalence. Therefore, for purpose of reporting, the subnational were categorized into 4 categories as in HIV prevalence. Overall, the new infections gradually declined for all subnational from year 2002 until 2015, after which the new infections for Malaysia began to surge for all subnational in all categories with Selangor and Kuala Lumpur contributed most of the HIV cases (Figure 11, Figure 12, Figure 13, and Figure 14). If the interventions continue at the present level, it is predicted that by year 2030, incidence rate per 1000 population for Selangor and Kuala Lumpur will continuously increase while remain almost similar to national average. The epidemic is concentrated in Selangor, Kuala Lumpur, and Johor as it contributes 50% of the new HIV cases in Malaysia (Figure 15).
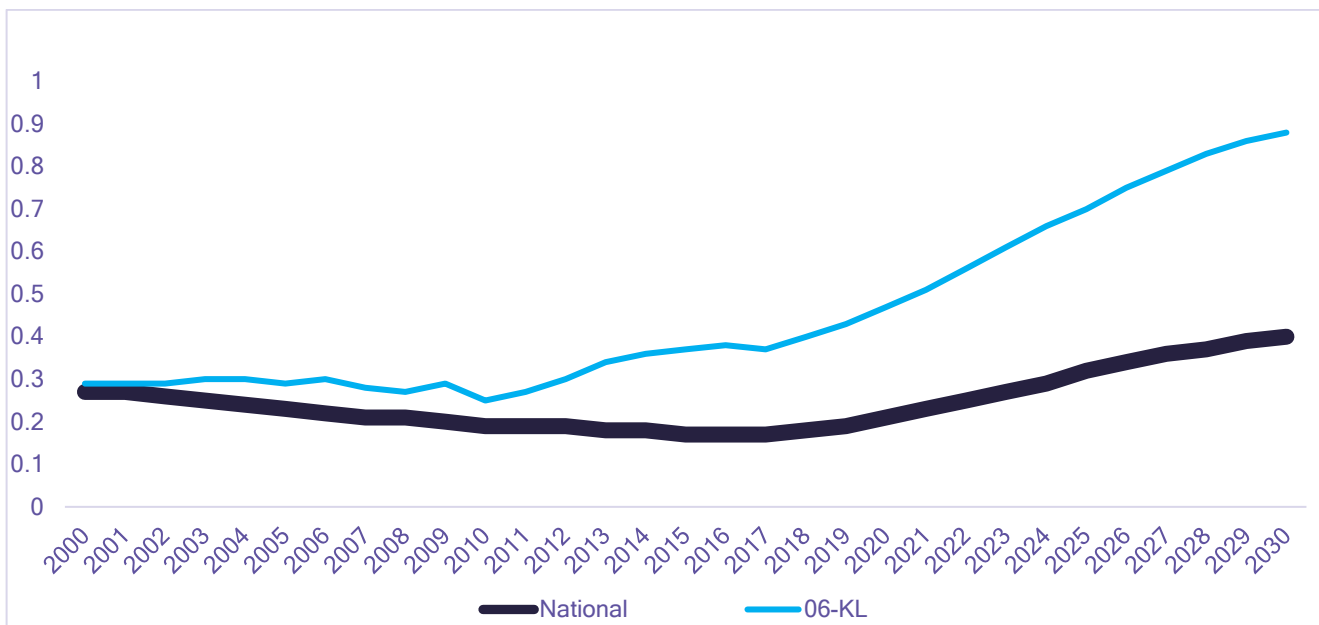
Figure 11: Incidence per 1000 population for category 1, 2000 – 2030
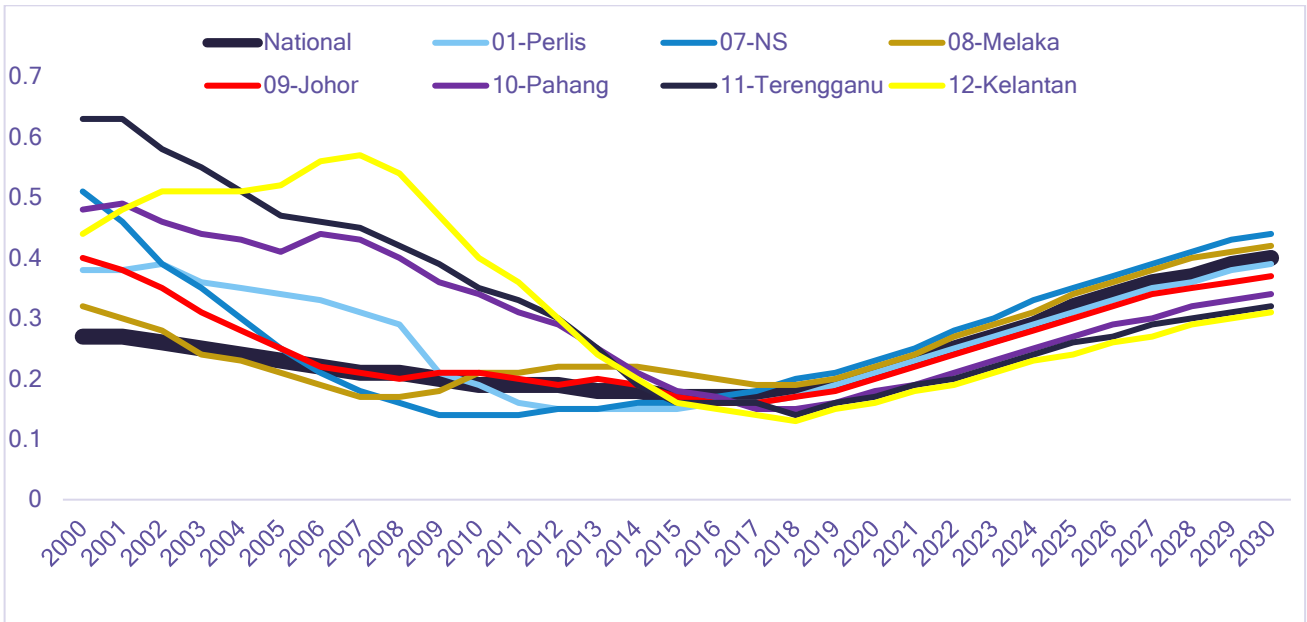
Figure 12: Incidence per 1000 population for category 2, 2000-2030
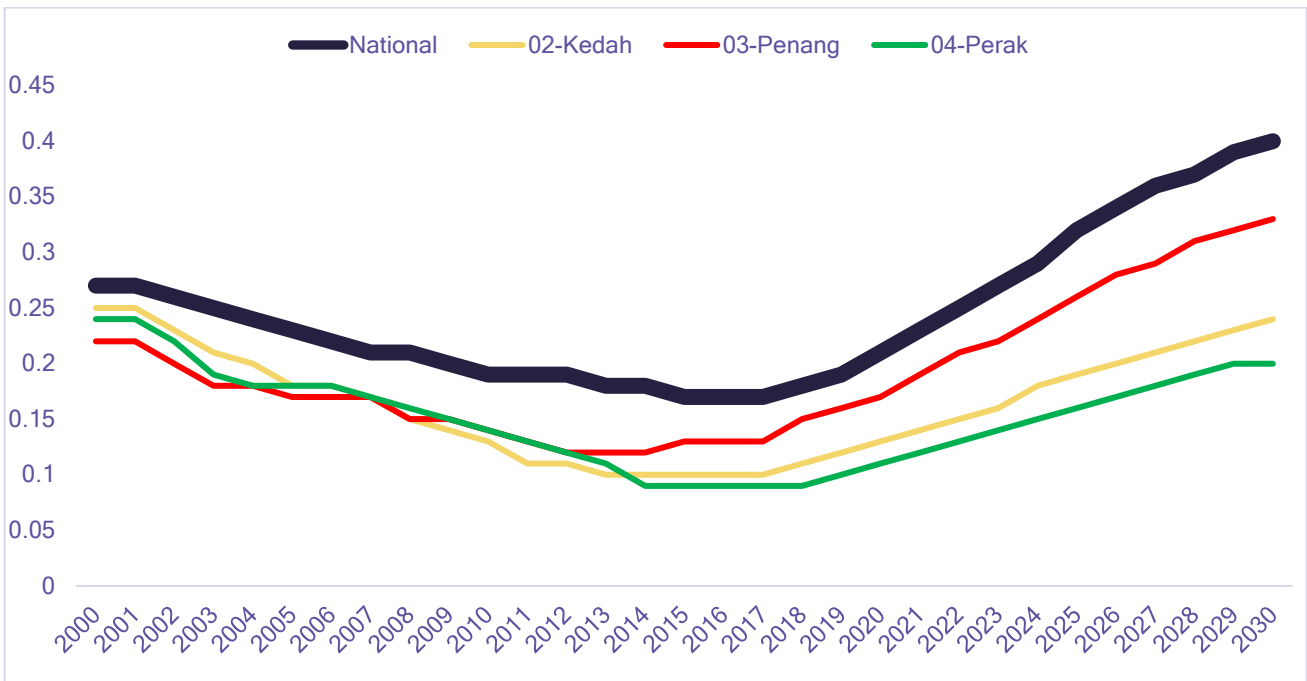
Figure 13: Incidence per 1000 population for category 3, 2000-2030
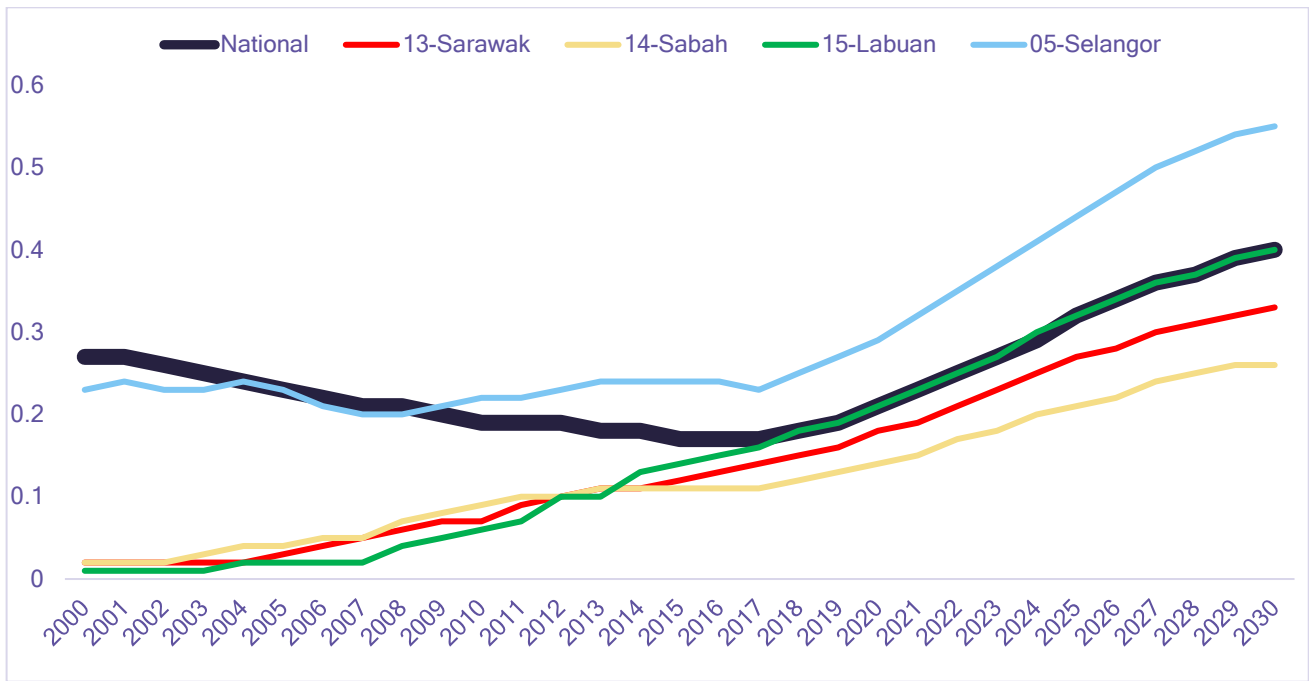
Figure 14: Incidence per 1000 population for category 4, 2000-2030
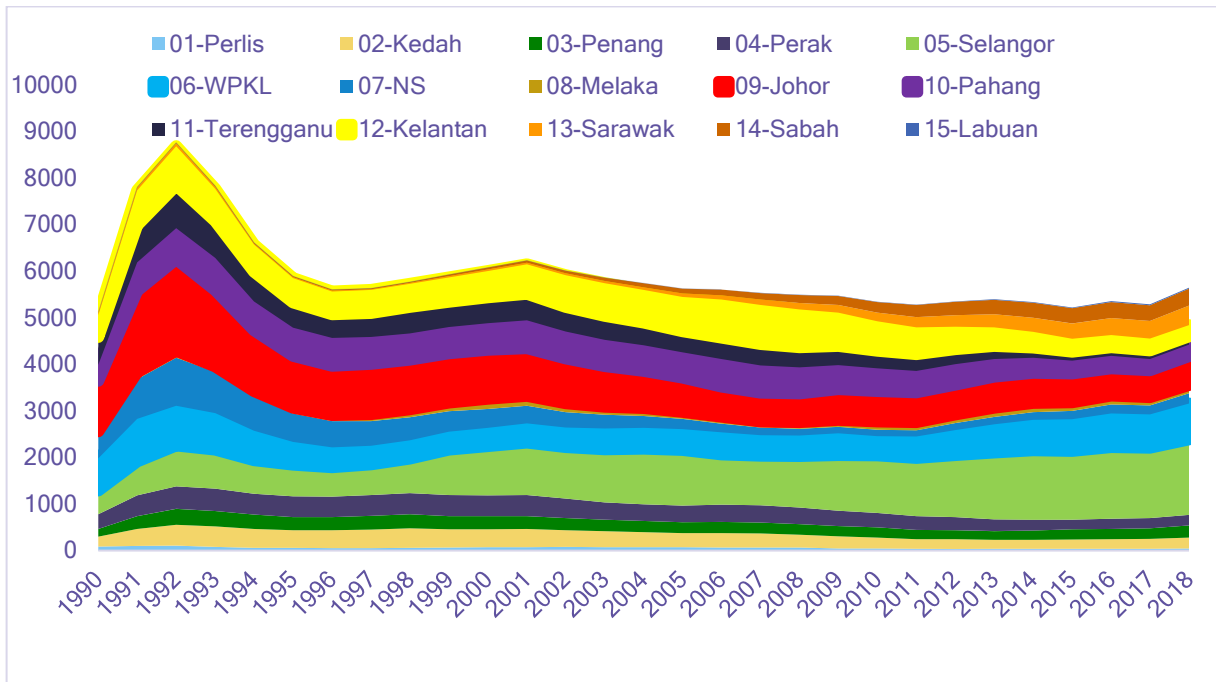
Figure 15: Subnational contributions for new infections, 1990 – 2030

PLHIV by Subnational, 2018 – 2022

Estimated number of PLHIV by subnational from 2018 to 2022 are as presented in Table 1. The top 5 subnational with the highest number of PLHIV in 2019 are Selangor (24% of total PLHIV), Johor (13%), Kuala Lumpur (10%), Kelantan (9%) and Pahang (8%). As for new HIV infections, in 2019, Selangor has the highest proportion of new HIV infections in Malaysia (29%) seconded by Kuala Lumpur (14%) and Johor (11%).

Table 1: PLHIV and new HIV infection by subnational, 2018 - 2021

| Subnational	PLHIV					New Infection				
	2018	2019	2020	2021	2022	2018	2019	2020	2021	2022
Perlis	808	825	846	873	906	46	51	57	63	69
Kedah	4442	4529	4637	4772	4937	233	258	286	317	350
Penang	3728	3880	4055	4256	4488	259	287	318	352	389
Perak	4904	4948	5011	5098	5216	232	257	284	315	348
Selangor	19933	21120	22413	23839	25422	1621	1792	1982	2194	2421
KL	8655	9239	9878	10585	11368	768	849	939	1039	1146
NS	3542	3618	3719	3849	4009	221	245	271	300	331
Melaka	2725	2832	2949	3082	3232	180	199	220	244	269
Johor	11294	11487	11729	12033	12414	616	681	754	834	921
Pahang	6802	6762	6738	6738	6771	248	275	304	337	372
Terengganu	5598	5513	5441	5390	5336	177	196	217	240	265
Kelantan	8157	8046	7946	7870	7826	241	267	296	328	363
Sarawak	3205	3613	4055	4533	5051	420	464	514	569	628
Sabah	3422	3765	4135	4533	4965	365	403	446	495	546
Labuan	118	137	158	180	204	19	21	23	25	26
Total (National)	86,616	89,626	93,072	97,063	101,684	5,638	6,236	6,903	7,641	8,436

DISCUSSIONS

Malaysia has seen reduction of new cases by more than half from 2000 peak but in 2015 onwards, the trend has reached a flat line. This phenomenon is also seen globally and regionally, where the declining in new HIV infections in the past 8 years has been stalled and far from Ending AIDS fast-track target year 2020 (Figure 16).
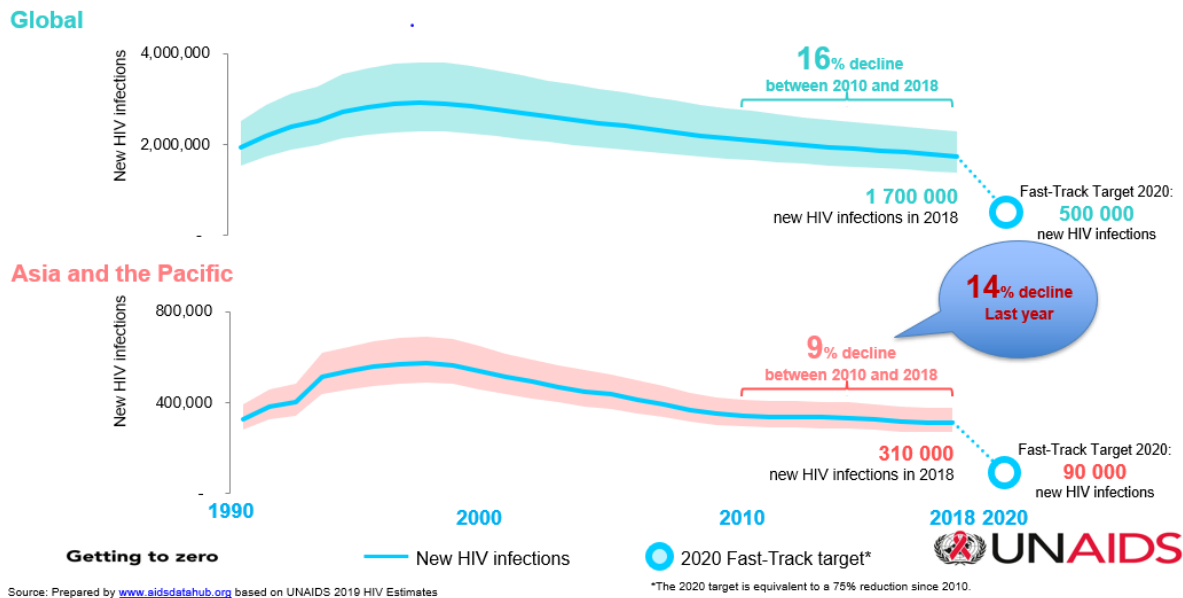
Figure 16: Global and Regional Progress on HIV Infection, 1990-2018

As exhibited in the National HIV data in Figure 17, new HIV cases increased from the beginning of the epidemic and peaked in year 2002. Subsequently, this trend has declined and stabilized until 2016. Given that IDU is the main mode of transmission for HIV infection in Malaysia during the earlier phase, the decline in new cases may be contributed by few reasons among others; (1) the success of the National Harm Reduction program introduced in 2005; and (2) changing addiction behavior among PWID from injecting to taking oral drugs.

For the past one decade, the country has observed significant changes in the HIV epidemic landscape from predominantly sharing injecting equipment to more sexual transmission (Figure 18). These changes may contribute to dramatic increase in HIV incidence after 2018 as projected by Spectrum (Figure 4).
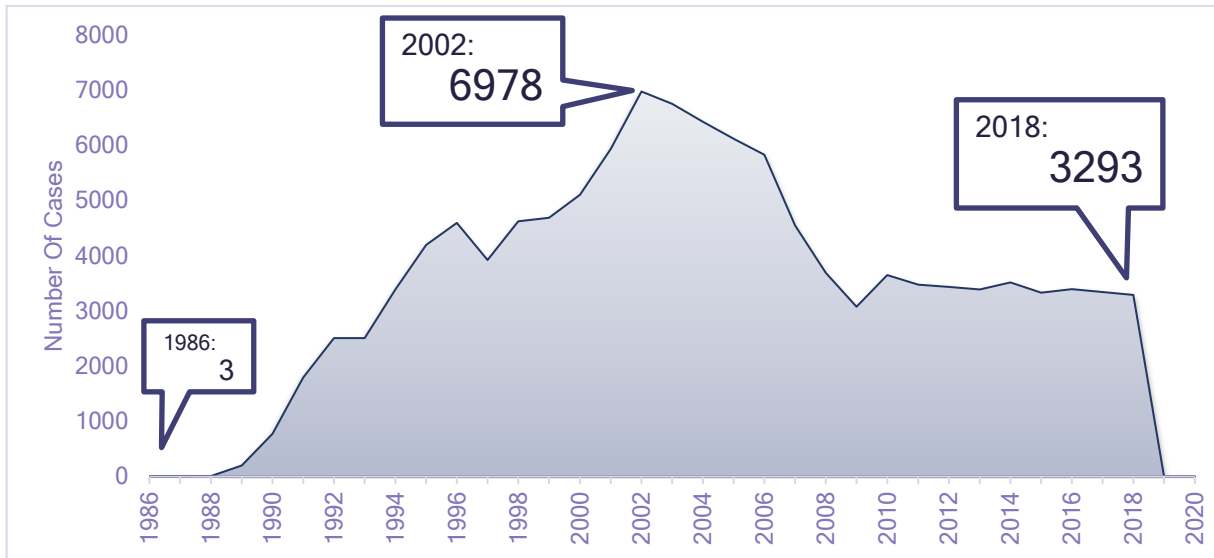
Figure 17: National HIV data, new cases, 1986 - 2018
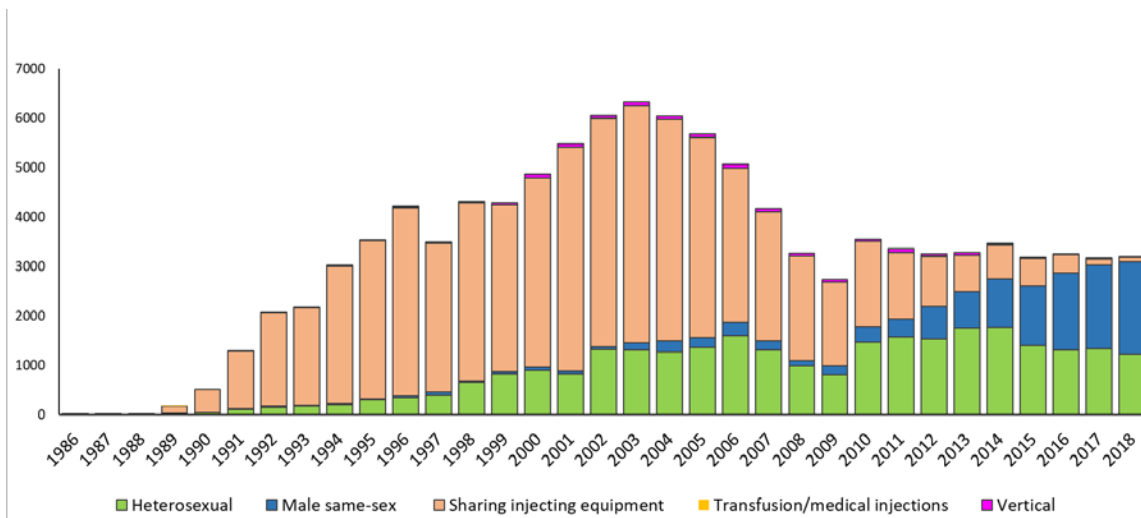
Figure 18: Distribution of HIV Infection by Mode of Transmission in Malaysia, 1986-2018

These changes can also be seen in the top 5 subnational reporting HIV new cases (Table 1). At the beginning of the epidemic, majority of the new HIV cases were contributed by subnational with high number of PWID such as Johor, Terengganu, and Kelantan. While in the recent epidemic, majority of the new cases are mostly from Kuala Lumpur, Sabah, Sarawak, and Selangor, where majority of the reported cases are sexually transmitted. Other subnational such as Melaka, Labuan, Penang and Negeri Sembilan are also seeing increasing in new HIV infections in the last 10 years (Figure 19). While percentage change in new HIV infection in Kelantan, Pahang, Terengganu, and Perak is decreasing since 2010.
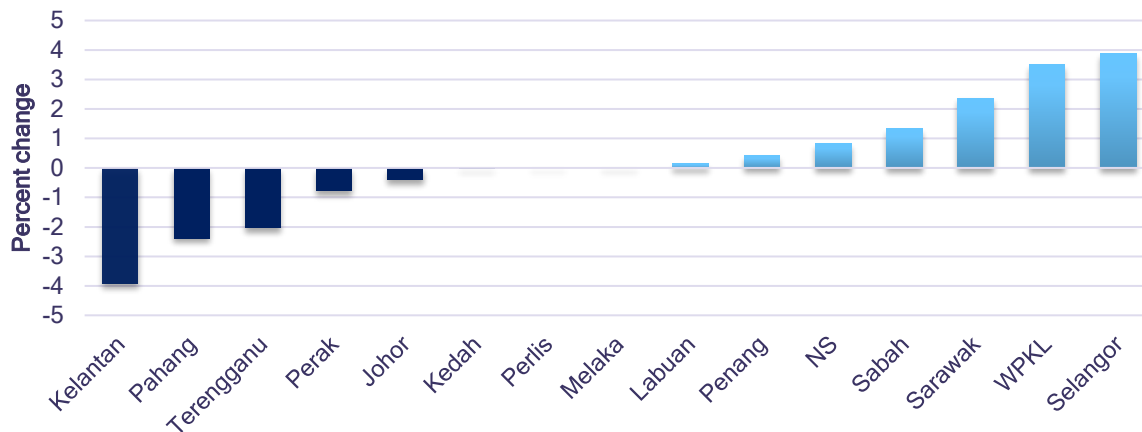
Figure 19: Percentage change in new infection by subnational, 2010-2018

In 2018, the top 5 subnational (Selangor, Kuala Lumpur, Johor, Sarawak, and Sabah) contributed almost three quarter (70%) of the new HIV cases in Malaysia. Three of five subnational (Selangor, Kuala Lumpur, and Johor) are the most developed hence urbanized subnational while Sabah and Sarawak are separated and located in Borneo island. Urbanization may have negative impact to the HIV epidemics in Malaysia with dense population due to migration, young, mobile, diverse populations, they are easy target for social problem.

One interesting finding is observed in Penang, an island-state off the northwestern coast of Peninsular Malaysia with capital city Malaysia's second largest and takes up the third position in economy after Selangor and Johor. Contrary to its urban counterparts, Penang's HIV prevalence had remained lower than the national average. One critical observation that make Penang different from the rest of the subnational – it has a well-established NGO that provide sexual and reproductive health services, supported by many volunteers among health professionals from both the private and government health facilities. In addition, strong support from state health department in implementing the prevention and control programs is also a plus factor.

Top 5 subnational with highest HIV new infection in 2018:
Selangor, Kuala Lumpur, Johor, Sabah & Sarawak

ENDING AIDS 2030: FUTURE ENDEVEOURS

In preparing for our National Strategic Plan for Ending AIDS 2016-2030, we used AEM model to help the country to generates options that will guide the country in future planning[6]. However, due to unique demographic structure of each subnational, the interventions planned based on the national AEM model may not fit for all subnational. From the projection data, we concluded that the epidemic in Malaysia is driven by five (5) subnational - Kuala Lumpur, Selangor, Johor, Sabah, and Sarawak. The main risk of infection has shifted from sharing of injecting paraphernalia among PWID to sexual risk especially among the MSM. Focusing effective strategies and interventions at these five subnational and their most affected key populations will have greater impact in ending AIDS by 2030. However, if the interventions continue at the present level, the model predicted that the new HIV cases will continue to rise from 2018 onwards. A situational analysis is indeed required to these subnational to ascertain the main driver of the epidemic for a comprehensive and effective interventions.

ANNEX 1

Data Input for Malaysia AEM Worksheet

Data Input for Malaysia AEM baseline worksheet is based on the following sources. Adjustments and assumptions are made when necessary and they are also described in the document below. The percentage of the in between data points are interpolated and the trend after the last available data point is kept constant using the last data point percentage. In this AEM Model, only FSW1 (direct FSW), MSM1 (reachable), MSM2 (not reachable), TG and Male PWID data are used. Other groups of KPs are not included.

1. Heterosexual sheet

a) <u>FSW1 size estimate</u>

Based on the Consensus 2014 which is 21,000 FSW in 2013 (0.23%). We maintained using this size estimation throughout from 1975 to 2014. The FSW size estimation was then changed to 22,000 in 2018 based on the new size estimation of KP study (Malaysia, 2018). Only 1 group of FSW is modeled (FSW1).

b) <u>Number of clients per day / Days worked per week.</u>

Based on IBBS 2017, the average number of clients is taken as 1.2 per day. Number of days work per week is 5 days.

c) <u>Percent condom use</u>

Percentage of condom use is assumed at 15% from 1975 to 1990, increasing to 45% in 1995 (Singh & Croft 1992). Then, the trend is increase to 55% in 2000 (Choon et. al. 1997). Using the IBBS study data in 2012, 2014 and 2017 (after adjusting for over-reporting), the percentage of condom use frequency with clients (always use) is 63.7%, 61% and 63.9%% accordingly. The percentages in between are interpolated. The trend after 2017 is kept constant at 63.9% onwards.

d) <u>Duration of selling sex (year)</u>

The average duration of sex work is taken as 5 years from 1975 to 1990. It is then increased to 12 years in 2012, 14 years in 2014 and 18 years in 2017 which is based on the IBBS studies.

The duration in between is interpolated. The duration of 18 years is constant from 2017 onwards.

e) STI prevalence among FSW1

Based on a study by Ramachandran & Ngeow, 1990, total STI incidence is 40.75%. Since this study was performed in only one site, a reduction of ¾ was used to represent the national incidence. With assumptions of (1) a person may get infected with STI with average of 4 times a year and (2) duration of STI of 0.17 year (2 months), the STI prevalence of 7.1% was then calculated based on formula of prevalence equal to incidence multiply with duration (Prevalence = Incidence x Duration). The STI prevalence of 7.1% was used to represent national STI prevalence starting from 1975 onwards until 1990. The STI prevalence was assumed to reduce at 6.1% in 2014 using data collected from IBBS 2014, which is supported by an increase in condom use from the same survey. The prevalence was then interpolated in between while the trend after 2014 is kept constant at 6.1% onwards.

f) Percent of males aged 15-49 visiting sex workers in last year.

The percentage of males visiting sex workers is set to 6.8% (IBBS 2014). The percentage from 1975 and 2014 was interpolated to get the percentage in between and the percentage of 6.8% was kept constant from 2012 onwards.

g) Duration of buying sex.

Duration of buying sex is derived from IBBS 2014. Based on this survey duration of buying sex is calculated by subtracting median age of male who came for premarital screening (28 years) with median age at sex debut (19 years). Therefore, we assume that duration of buying sex among male is 9 years.

h) Percent of adult males who are circumcised.

Based on country demographic pattern, Muslim contribute to 65% of total population. We assume that all Muslim males are circumcised.

i) Percent of males engaging in casual sex in the last year.

Based on 2009 HIV Expert Consensus, percent of males engaging in casual sex is 5%.

j) Percent of females engaging in casual sex in the last year.

We take percent for female as half of that in male population (2%).

k) Percent condom use with casual partner.

The percentage of condom use before 2004 is set at 10.5% - calculated based on weighted average of condom use found in BSS 2004. The percentage of condom use in 2009 is 11.8% (scale down by half to adjust for general population from IBBS 2009). The percentage is interpolated in between those values. The percentage was constant from 2009 onwards.

l) Average number of sex contacts in the last year (male).

Since there is no available data, we leave this number at default value (15).

m) Number of sexual contacts with spouse or regular partners (per week).

Number of sexual contacts is set at 1 per week.

n) Percent condom use with spouses or regular partners.

The percentage of condom use with spouses or regular partner was set at 2.0% before 1990. Assuming that most PLHIV are PWID in Malaysia, the percentage of condom use with spouse or regular partner is taken as percentage of condom use with spouse among PWID which is 32.3% (IBBS 2012). The percentage are interpolated in between those values and was set as constant from 2012 onwards.

o) STI prevalence in adult population.

The STI prevalence (0.7%) is based on sero-prevalence rate in Western Pacific region.

2. PWID Sheet
a) Percent of adult males 15-49 years of age who inject drugs.

We estimate that the current PWID population at 170,000 based on 2009 consensus. We maintained using this size estimation throughout from 1975 to 2005. The size estimation of IDU

was then changed to 75,000 in 2018 based on the new size estimation of KP study (Malaysia, 2018) which is approximately 56% reduction from the 2009 estimates.

b) PWID mortality

PWID mortality in this exercise is estimated at 1.1% based on MOH Malaysia report 2009.

c) Percent of PWID in high-risk networks

This parameter is considered as a model fitting parameter and the value of 30% was used as it provided the best fit for HIV prevalence among PWID.

d) Percentage of male PWID who share needles.

For earlier data point (1975 to 2004), we take the mid-point (60%) of data derived from 2 studies – BSS 2004 and BSS 2007. Data points for 2014 and 2017 are then based on the IBBS study which is 27.4% and 20.3% respectively. The percentage in between is then interpolated. The trend is constant from 2017 onwards.

e) Percentage of injection shared among PWID who shared needles.

The percentage is calculated based on median of frequency of needles shared among PWID who shared needle in BSS 2004 and CAHR 2011 study, which fall in 'half of the time sharing'. Thus, 50% were used to get the frequency of injections were shared among PWID who shared needles from 1975 to 2000. While data point for 2004 were based on the BSS 2004 which is 30% while 19% were used for 2014 data point which is based on the IBBS 2014 study. The in between data point from 2000 to 2014 are then interpolated while the trend is kept constant from 2014 onwards.

f) Number of injections each day.

Data points for 1975 to 2004 are based on finding from BSS 2004 i.e., 3 times/day. Data points from 2012 onwards are based on IBBS 2012, IBBS 2014 and IBBS 2017 i.e., 2.6, 2.4 and 2.0 times/day, respectively. Data from 2004 are interpolated to 2017 and then kept constant from 2017 onwards.

g) Average duration of injecting (years).

The average duration of injections is derived from BSS 2004 i.e., 15 years and is used to fit in data points from 1975 to 2004. Subsequent data points in 2004, 2012 and 2014 are using finding from BSS 2004, IBBS 2012 and IBBS 2014. The in between data points are then interpolated and is kept constant from 2014 onwards.

h) Percent visiting female sex workers.

Based on average of 5 studies (BSS 2004: 11.1%, IBBS 2009: 15.1%, CAHR 2011: 22%, IBBS 2012: 8.4% and CAHR 2014: 7.1%), percent visiting female sex workers are set at 12.74% for all years.

i) Percent condom use with FSW1.

Assuming the data is similar with the percentage of condom use with clients for FSW group 1 in the heterosexual sheet.

j) Percent condom use with spouse or regular partner.

As there is no available data or study in early years, we assume the percentage of condom use is 2% from 1975 to 1990. The percentages of condom use are 11.7% (BSS 2004), 19.1% (IBBS 2009), 32.3% (IBBS 2012), 30.0% (IBBS 2014) and 28.4% (IBBS 2017). Percentages in between are interpolated.

k) Number of sexual contacts with regular partner.

We use number of sexual contacts 1 per month or 0.20 per week and set same value throughout the years (Drug and Alcohol Dependence 2011).

3. MSM Sheet

MSW population is not considered in this AEM Model because of unavailability of data.

General MSM

a) Percentage of males aged 15-49 engaging same sex behavior is set at 2% from 1975 to 2006 based on National Health Morbidity Survey 2006. The size estimation of MSM was

then changed to 220,000 in 2018 based on the new size estimation of KP study (Malaysia, 2018) which is approximately 2.5% of male adult population.

b) Percent of MSM in risk group 1 is considered proportion reachable and is set at 30% from 1975 to 2010 based on consensus in 2010. Based on the new size estimation of KP study (Malaysia, 2018), approximately 156,000 MSM are reachable through social media in 2018 which is about 70.9% of total MSM.

c) Shift from MSM group 1 to group 2 (non-reachable) is assumed at 5% based on consensus.

MSM1 population

a) Percent engaging in anal sex in the last year is set at 95% consistent to the findings from IBBS 2009 and IBBS 2012 at 95% and 94.3% respectively.

b) Number of anal sex contacts in the last week is taken at 2.0 based on IBBS 2012, IBBS 2014 and IBBS 2017.

c) Average duration of same sex behavior is set at 13 years based on IBBS 2012 and IBBS 2014.

d) Percentages of MSM1 with female partners are based on multiple studies, i.e., Kana & Koh 2008 (17.8%), VDTS 2009 (16.7%), IBBS 2014 (18.3%) and IBBS 2017 (20.8%). The percentage of 17.8% is used from year 1975 to 2008. The percentages in between the data points are interpolated to produce trend between year 2009 and 2017. 20.8% is used after 2017.

e) Percentages of condom use in anal sex with MSM1 are based on several data points from Kana & Koh 2008 (23.5% condom used last anal sex), VDTS 2009 (31.4% condom used last anal sex), IBBS 2014 (56.7% always used condom) and IBBS 2017 (65% always condom used). Earlier data points (1975 to 1985) were taken at 10% assuming there was no awareness program for MSM. Data in between are interpolated to get the trend. The percentage of 65% is used after 2017 onwards.

f) STI prevalence among MSM1 is based on VDTS 2009 (6.8%), IBBS 2014 (8.1%) and IBBS 2017 (14.7%) of MSM reported to be tested and have STI. Data in between are interpolated to get the trend. The percentage of 14.7% is used from 2017 throughout.

MSM2 population (non-reachable)

Data points for this sub-population are based on assumption as below.

a) Percent engaging anal sex is assuming as half of that of MSM1 (47.5%).

b) Number of anal sex contact in the last week is 0.25 (less by 5 times) compared to MSM1.

c) Average duration of same-sex behavior is set at same proportion as MSM1 (25 years)

d) Percentages of MSM2 with female partner equals to those of MSM1.

e) Percentages of condom used in anal sex with MSM2 equals to those of MSM1.

f) STI prevalence among MSM2 is 1.4% which is 5 times lower than that of MSM1.

4. Transgender Sheet

<u>5.1 Transgender population - General</u>

a) Percent of males aged 15-49 who are TG is set at 0.17% throughout the years from 1975 to 2050 based on the new size estimation of KP study (Malaysia, 2018).

b) Percent of TG who sell sex is 85% in 2009 and 87% in 2014 based on IBBS 2009 and IBBS 2014. The in between data points are then interpolated and data points from 2014 onwards are kept constant at 87%.

c) Percent of TG who engage in casual sex but not sex work is 11.4% (IBBS 2012)

<u>5.2 Transgender Sex workers - Sexual Behavior.</u>

a) Percent of TG sex workers engaging anal sex with clients is 84% throughout. This is based on weighted average between IBBS 2009 and IBBS 2012.

b) Number of anal sex contacts in the last week with clients is set at 10 throughout the year based on BSS 2004 and IBBS 2012.

c) Percent of anal sex contacts with clients which are receptive is 91.6% based on IBBS 2009.

d) It is assuming that average duration selling sex (in years) is at 7 years in 1975. While in 2014, the data points are set at 14 years (based on IBBS 2014 in which the median is 7 years and multiplied with 2). Data points in between are interpolated and data points after 2014 are set at 14.

e) Percent condom use in anal sex with clients is set at 10% from 1975 to 1990 (the initiation of awareness program). Thereafter, data points used are using the condom used last anal sex data in BSS 2004 (74.9%) and IBBS 2009 (82.5%) but scale down by 0.6 for each data points. Whereas data points for 2012 and 2017 are using frequency of condom use (always and often use) (52.2% and 67.3% respectively). Data points in between are interpolated and data points after 2017 are set at 67.3%.

f) It is assumed that prevalence of anal STI among TG is much lower than MSM1 as condom use behavior is better among TG (based on BSS and IBBS). Thus, percent of anal STIs among TG who sell sex is taken at 3.4% which is half of that of MSM1.

<u>5.3 Transgender sex worker – client make up (sums to 100%)</u>

Based on consensus, it is assumed that:

a) 85% of TG clients are low-risk males.

b) 7.5% of TG clients are also clients of female sex workers.

c) 7.4% of TG clients are MSM.

5.4 TG engaging in casual sex – sexual behavior.

a) About 92.5% of TG with casual sex partners engaged in anal sex (IBBS 2012)

b) Number of anal sex contacts in the last week is 0.96 (IBBS 2012)

c) About 91.6% of anal sex contacts are receptive (assume similar to that of TGSW)

d) Percent condom use in anal sex is assumed at 0% from 1975 to 2011. The trend is set to increase from 2012 and 2017 using recalculated data from IBBS 2012 and IBBS 2017 which is 39.3% and 52.3% respectively. The in between data points are interpolated, and data is set at 52.3% from 2017 onwards.

e) Percent anal STIs among TG who have casual partners is assumed half of that of TGSW which is 1.7%.

5.5 TG Sex Workers – Partner Make up for those with CPs (sums to 100%) Partner make-up is the same as that of TGSW client make-up.

5.6 TG with regular partners – sexual behaviors

a) About 90% of TGs with regular partners engages in anal sex (IBBS 2012)

b) Number of anal sex contacts with regular partner in the last week is 0.4 (IBBS 2012)

c) Percent of anal sex contacts with regular partner which are receptive is taken as 91.6% (assume similar as TGSW)

f) Percent condom use in anal sex with regular partner is assumed at 0% from 1975 to 2011. The trend is set to increase from 2012 and 2017 using recalculated data from IBBS 2012 and IBBS 2017 which is 61.9% and 61.3% respectively. The in between data points are interpolated, and data is set at 61.3% from 2017 onwards.

d) Percent anal STIs among transgender who have regular partners only is 0.85% (assuming that STI prevalence is about half of that of TG casual sex).

5.7 TG sex workers – regular partner make-up

Regular partner make-up for TGSW is assumed to be similar as TGSW client make-up. Based on consensus, it is assumed that:

a) 85% of TG clients are low-risk males.

b) 7.5% of TG clients are also clients of female sex workers.

c) 7.0% of TG clients are MSM.

5. HIV Prevalence for key populations

	FSW	MSM	TG	PWID
1985-1987				0%
1988				0.11%
1989				4.06%
1990				6.75%
1991	0.80%			11.29%
1992				13.64%
1993				14.47%
1994				16.07%
1995				15.7%
1996	5.60%			19.13%
1997				17.64%
1998				19.11%
1999				21.06%
2000				24.9%
2004				24.9%
2009				22.10%
2012	5.80%	6.80%	4.80%	18.9%
2014	8.00%	8.80%	5.60%	16.3%
2017	6.30%	16.70%	8.70%	13.5%

ANNEX 2

Sources of data:

    i.   Ministry of Health HIV and AIDS Surveillance

    ii.   Data from subnational-level reporting systems; compiled and summarized at the national registry.

    iii.   Data on reported cases (HIV /AIDS as a notifiable disease)

    iv.   Relevant information available includes distribution by sex and risk factors (transmission route).

    v.   National and subnational Prevention of Mother to Child HIV Transmission Program data.

    vi.   Country Progress Report 2018 Malaysia.

    vii.   Behavioural Surveillance Survey Reports (2004, 2009, 2012, 2014 and 2017)

    viii.   Size estimation of KP 2018 for IDUs, FSW, MSM and TG.

    ix.   HIV/AIDS Surveillance Data Base. U.S. Census Bureau - USAIDS HIV/AIDS Reference's list: Published research reports and journal articles.

    x.   Subnational-level surveillance program data.

    xi.   Community-based VCT data.

Data input:

- HIV/AIDS reported cases from National Surveillance System
- ART coverage by sub-populations from National Surveillance System
- National M & E data for HIV screening among antenatal mothers, premarital couples, closed settings (rehabilitation centers and prisons), STI and TB cases.
- HIV screening at VCT centers in the government health clinics and community-based clinics.
- Outreach program coverage from civil societies.

ANNEX 3

Calculation of Proxy Incidence by Subnational

Proxy incidence calculation for females

Step 1: Proxy incidence calculation for females in the absence of other measures, HIV prevalence from PMTCT programme data was used as a proxy measure for incidence among females in Malaysia by subnational.

Step 2: Intermediate proxy incidence number:
a. HIV prevalence by subnational (proxy incidence measure) from step 1 x Female demographic population (15-49) of the subnational (subnational specific intermediate proxy incidence number for females)
b. Calculate national number by summing up all the subnational (national number for females)

Step 3: Calculation of proxy incidence proportion by subnational:
a. Intermediate proxy incidence number by subnational in step 2 (a) is divided by step 2 (b) to estimate the incidence proportion by subnational among females.
b. Once it is done for all subnational, it should sum up to 100% at the national level.

Step 4: Estimation of new HIV infections among female in the subnational:
a. Total national estimated new HIV infections among female multiplied by the calculated proportion in the step 3 (a)

Proxy incidence calculation for males

Step 1: In the absence of other measures, number of reported HIV cases from programme data was used to calculate proxy incidence proportion among male by subnational.
a. Prepare HIV case report by subnational and by year (for males)
b. Calculate national number by summing up all the subnational (national number for males)

Step 2: Calculation of proxy incidence proportion by subnational:

    a. Male case reported number by subnational in step 1 (a) is divided by step 1 (b) to estimate the incidence proportion by subnational among males.

    b. Once it is done for all subnational, it should sum up to 100% at the national level.

Step 3: Estimation of new HIV infections among male in the subnational:

    a. Total national estimated new HIV infections among male (from national AEM-Spectrum) multiplied by the calculated proportion in the step 2 (a)

The estimated new infections for male and for female from steps above with subnational demographic data were used to calculate trend of adult incidence rate and female to male incidence ratio. This trend of incidence rate and female to male incidence ratio were then feed into the spectrum as "direct incidence input" under incidence options in the spectrum AIM module.

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Contact Information

HIV/STI/Hepatitis C Sector, Disease Control Division

Ministry of Health Malaysia, Level 4, Block E10
Federal Government Administration Centre,
62590, Putrajaya, Malaysia

Tel +603-88834387
Fax +603- 88834285
www.moh.gov.my