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Estimation of PrEP Targets for Key and High - Risk Population in Thailand, 2020 - 2022

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Foreword

Thailand has experienced the steepest decline in HIV new infections of any country in the Asia - Pacific region. However, Thailand is still behind the global prevention target for reducing new HIV infections by 90% by 2030. To respond to this challenge, the country's 2017-2030 National AIDS strategy aims to cut annual new infections to less than 1,000 by accelerating HIV prevention with the focus on coverage and effective combination prevention service for key populations at elevated risk. Pre-exposure prophylaxis (PrEP) is one of the innovations for fast-tracking the HIV prevention effort.

After several years of PrEP experience, Thailand has moved from clinical trials and demonstration projects to a national roll-out of PrEP as a part of prevention services for key populations. Based on these efforts, Thailand has recently announced that PrEP will be included as benefit package for prevention among population at high risk of HIV under the Universal Health Coverage from October 2019, starting with a pilot phase for 2,000 clients.

Evidence-informed policy decision-making is the cornerstone of Thailand's success. With this regards, number of HIV-negative individuals at substantial risk of HIV who may be eligible for PrEP is needed. These information are important for planning for PrEP drug procurement, budget preparation and building clinical and community capacity to reach and provide PrEP with quality and coverage at the national and subnational levels.

As a result of the collaborative effort from key stakeholders, and technical support from UNAIDS, the Department of Disease Control has developed this report on "Estimation of PrEP Targets in Thailand." The information in this report will help plan the roll-out of PrEP at the national and provincial levels. The methods used for the estimation will help national partners to conduct projections for their own specific geographical areas and target populations. Moreover, this activity is the first pilot test in the Asia-Pacific region of the UNAIDS target-setting guide. This pilot-test experience will provide an important precedent and lessons learned for the region.

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Abbreviations and acronyms

AIDS	Acquired immunodeficiency syndrome
BMA	Bangkok Metropolitan Area
CI	Confidence interval
DDC	Department of Disease Control
FSW	Female sex worker
HIV	Human immunodeficiency virus
IBBS	Integrated bio-behavioral survey
KP	Key population at elevated risk of HIV
MOPH	Ministry of Public Health
MOOSE	Meta-Analysis of Observational Studies in Epidemiology
MSM	Men who have sex with men
NAP	National AIDS Program
NESDB	National Economic and Social Development Board
PLHIV	Person living with HIV
PR	Principal recipient of the national grant from the Global Fund to Fight AIDS, Tuberculosis and Malaria
PrEP	Pre-exposure prophylaxis
PSE	Population size estimate
PWID	Person who injects drugs
RDS	Respondent-driven sampling
STI	Sexually transmitted infection
TB	Tuberculosis
TLS	Time-location sampling
TW	Transwoman
UAI	Unprotected anal intercourse
UNAIDS	United Nations Joint Programme for HIV/AIDS
USAID	United States Agency for International Development
U.S. CDC	United States Centers for Disease Control and Prevention
WHO	World Health Organization

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Executive summary

Oral pre-exposure prophylaxis (PrEP) has been demonstrated to greatly reduce the probability of HIV acquisition and is recommended by WHO as a prevention strategy for population subgroups at substantial risk. Building on considerable experience over the past decade as a part of PrEP clinical trials, and piloting and scaling up PrEP in high-burden areas, Thailand is now moving toward adding PrEP provision to the Universal Health Coverage benefits package in order to accelerate uptake and move the country further toward meeting the global target of reducing new HIV infections by 75% by 2021.

The current exercise was carried out to project the number of individuals in Bangkok and nationally who are likely to be at substantial risk for HIV over the next three years (2020-2022), as an approximation of the number of individuals who could potentially benefit from PrEP, in order to assist government agencies in planning for adding PrEP to the UHC. The projections were developed by the national HIV Core Technical Working Group, following approaches outlined in an advanced draft of a recently developed UNAIDS PrEP target-setting guide.

Initially, populations known to be at elevated HV risk in Thailand were selected, based on estimated HIV prevalence, including men who have sex with men (MSM), transwomen (TW), and people who inject drugs (PWID). HIV-negative individuals in sero-discordant partnerships were also considered, as a natural beneficiary of PrEP, before partners attain viral suppression through treatment.

In each of the four groups, the projection began by compiling and reviewing the most recent available surveillance and program data. Over a series of five main steps, the TWG then deliberated on the strengths and weaknesses of available data to build consensus on a point estimate and range for the required estimates. First was determining the overall size of the population. Second, an estimate of HIV prevalence was needed to determine the number of HIV-negative individuals in the population. Third, the HIV-negative size estimate was projected forward to 2020, 2021, and 2022 based on census projections, in order to account for overall population growth rates in Bangkok and nationally. Forth, potential biases were considered and the size estimate adjusted to reflect any missing groups. Fifth, recognizing that not all members of the respective risk groups are actually at substantial risk (i.e., due to adopting effective prevention practices or engaging infrequently in risk behaviors), risk criteria for each group were developed by reviewing local and global evidence of risk factors; then the proportion of the population meeting the criteria was estimated from survey data. The final estimates reflect the number of HIV-negative members of the risk group each year between 2020 and 2022 that meet locally appropriate criteria for substantial risk.

For key populations (MSM, TW and PWID), data were drawn primarily from existing size estimates and integrated biological and behavioral surveys (IBBS). For HIV-negative individuals in sero-discordant partnerships, the estimates are based on the latest projections of the number of people living with HIV (from national projection models) who are not virally suppressed (based on national treatment and viral load testing data) and who engage in condomless intercourse with HIV-negative partners (based on behavioral surveys of PLHIV). Adjustments were made to avoid double-counting between key populations and sero-discordant couples.

Projections at the national level were constructed by dividing the country into regions, extrapolating the estimates required for each of the five main steps from Bangkok and other areas where data were available to remaining areas where data were not available, and then adding up the projections across regions to obtain the national figures. The projection for year 2020 was 48,154 (uncertainty range: 23,653-78,006) individuals at substantial risk in Bangkok and 148,487 (73,058-239,152) nationally.

The principle limitations to the calculations were a scarcity of data in rural areas and in urban areas outside of the largest cities, requiring several assumptions to develop the national figures. Data was largely unavailable regarding female PWID. In addition, size estimates for MSM and TW may not be representative as they are based largely on occupational subgroups of males and not able to follow on the recommended methods for hard-to-reach populations. Incomplete coverage of viral load testing among PLHIV in ART is likely to lead to a conservative (greater) target for HIV-negative individuals in discordant couples; and data on STI and sexual and injection behaviors among PLHIV were not up-to-date.

Introduction

Over the past decade, Thailand has experienced the steepest decline in HIV incidence of any country in the Asia and Pacific region. Projections suggest that new infections have declined by 58% between 2010 and 2017. Yet transmission must be reduced further to meet the global prevention target of reducing new infections by 75% by 2020. In 2017, 5,500 people became newly infected with HIV nationally. HIV incidence is greatest among men who have sex with men (MSM), transwomen (TW) and other higher-risk populations.

Building on Thailand's previous success toward expanding testing and treatment coverage will contribute substantially towards epidemic control in the coming years. The country's 2017-2030 National AIDS strategy aims to cut annual new infections to less than 1,000 per year by accelerating HIV prevention and supporting a combination prevention programme for key populations at elevated risk. Pre-exposure prophylaxis (PrEP) is one of the innovations for fast-tracking the HIV prevention effort. Thailand is preparing to move from trials and demonstration projects to a national roll-out of PrEP as a core part of the its combination prevention package.

Thailand has gained considerable experience with PrEP over recent years. The country participated in PrEP clinical trials since 2010. The National Guidelines on HIV/AIDS Treatment and Prevention recommend PrEP as an additional HIV prevention method for populations at substantial risk in 2014. Community-led and health facility-based PrEP implementation was piloted in four provinces in 2015 and has been scaled up in 25 high-burden provinces. As of early 2018, about 6,600 people had accessed PrEP from various service delivery modalities including private clinics.

Currently, Thailand is in the process of including PrEP provision as part of the benefits package under Universal Health Coverage (UHC). To support this process, an estimate of the number of HIV-negative individuals at substantial risk of HIV who may be eligible for PrEP is needed for policy makers and program managers. Such estimates are important to determine the potential health and financial impact of including PrEP in the benefits package and to support planning for drug procurement and building clinical and community capacity to distribute the PrEP medications at the national and sub-national levels. Targets are also needed to monitor progress.

Objectives

To estimate the number of HIV-negative individuals among key and other high-risk populations at great enough risk to consider PrEP as a prevention option during the period 2020 to 2022 in Bangkok and all of Thailand.

Specifically, estimates were developed for the following groups:

- Cisgender men who have sex with men (MSM)
- Transwomen (TGW)
- People who inject drugs (PWID)
- HIV-negative individuals in discordant couples

Process to develop the targets

The national HIV Core Technical Working Group (TWG) comprises of Bureau of AIDS, TB and STI, Bureau of Epidemiology, Thai Red Cross AIDS Research Centre, FHI360, The Global Fund Grant's Management Office, Key Population based organizations, Thai MOPH-U.S CDC Collaboration, USAID and UNAIDS developed the estimates. An international consultant familiar with the UNAIDS target-setting guide facilitated a series of virtual meetings of the TWG as well as a week-long workshop in January and February, 2019. A national HIV expert chaired the exercise. The main activities included:

- Compiling and reviewing available surveillance and program data relevant to each step of the calculation as proposed in the target-setting guide
- Adapting the estimation framework to the data available
- Deliberating the strengths, limitations, and potential sources of bias in the available data, and approaches to reduce their impact on the targets
- Developing strategies to build national targets by extrapolating estimates from areas where data were available to the remaining areas of the country.

The TWG developed consensus on key aspects of the target-setting calculation in each high-risk group, including the following:

- Which population size estimate (PSE) should form the starting point for the targets?
- Should the PSE be projected forward (2020-2022)?
- What adjustments, if any, are needed to account for population subgroups that may not have been adequately measured by the initial PSE?
- Which HIV prevalence estimates should be used to subset the PSEs to HIV-negative individuals?
- Given the epidemiology of HIV in Thailand, how should "substantial risk" be defined? What data should be used to estimate the proportion of the high-risk population that meets the risk criteria?

Draft estimates were reviewed, deliberated and refined several times over the course of the exercise.

PrEP Target-Setting Guide

A Guideline for PrEP Target-Setting for Key and Priority Populations ("Guide") was developed by UNAIDS in 2018-2019 and made available to Thailand in draft form. UNAIDS plans to pilot the Guide in a number of countries in 2019 and finalize it thereafter. The Guide was developed by exploring various estimation approaches on real-world surveillance data from countries primarily in the Americas and Africa to clarify the practical issues that arise when developing targets. The Guide was designed for use with MSM, TW, FSW, PWID, as well as adolescent girls and young women in contexts of increased general population risk. It includes resources to help countries develop criteria for substantial risk within each subgroup, such as reviews of risk factors for HIV and a math model to link levels of risk behavior to probabilities of acquiring HIV given the local epidemiology. The Guide was reviewed by a panel of experts from around the world who provided input.

Overview of the estimation approach

The target-setting approach in Thailand followed the six main steps in the Guide:

1. Define the geographic area and population for target-setting
2. Select an initial PSE for the population of interest
3. Project the PSE to the desired year of PrEP implementation, by applying population growth rates or the most recent census denominators
4. Narrow the PSE to the part of the population that is HIV-negative
5. If the PSE reflects only part of the intended population, expand it, if data permit
6. Narrow the PSE to reflect those at substantial HIV risk, drawing on representative survey data

Figure 1. Main steps of the UNAIDS Guideline for PrEP Target-setting

Data sources used to carry out these steps included:

- Population size estimates
- IBBS behavioral data and HIV prevalence (MSM, 2016; MSM, 2012; TG, 2016; PWID, 2014)
- Estimates of people living with HIV
- Program data from PrEP, VCT, ART, AIDS case reports in KPs

- Studies of risk factors for HIV among KPs from Thailand and globally
- Studies of STI and risk behaviors in PLHIV
- Census projections by sex, age, province, and year; in urban and rural areas

A key challenge was to define risk criteria in order to calculate the proportion at risk, for which the Guide offers two approaches:

1) **The "Exposures" approach**, which draws on a mathematical model to identify specific levels of risk behaviors (e.g., number of condomless sex acts and number of sex partners in a recent time period) that are equivalent to a chosen level of HIV incidence (i.e., such as the 3% level recommended by WHO). Prevalence of HIV, STI and treatment coverage are also taken into account.
2) **The "Risk Factors" approach**, based on a review of known risk factors (e.g., presence of STI and/or inconsistent condom use in the past year) in the respective population. Any member of the KP who meets these criteria is considered to be at substantial risk.

In Thailand, the available survey data support the Risk Factors approach. To carry out this approach, the TWG reviewed evidence from Thai and global studies on risk factors, reviewed survey questionnaires to determine how to measure the risk factors, and deliberated how to combine those factors that could be assessed accurately into a set of risk criteria. Because WHO recommends that PrEP be made available to groups characterized by at least 3% HIV incidence (i.e., "substantial risk"), the TWG sought to develop risk criteria that captured individuals in each group with STI and/or risk behaviors indicative of a high probability of acquiring HIV. For example, the final criteria for PWID required multiple shared injections during the past year, not just a "one-off" unsafe injection. The TWG also recognized that survey data have limitations, in particular non-response and under-reporting, so that the criteria were defined in a way that considered survey participants who might not report a critical risk factor such as condomless sex or unsafe injection, but did report another evidence-based risk factor, such as recent STI symptoms.

A second challenge was to develop national PrEP targets from surveys and other data available in a limited number of areas. The approach taken was to subdivided the country into regions, develop consensus on the assumptions needed to assign key inputs of the calculation (e.g., population size, prevalence of HIV and risk behaviors) to each region based on the data available, and then sum the targets across the regions. The geographic scheme was different in each population due to differences in data availability (Figure 2). Further details are described in the sections on each population.

Figure 2. Geographic divisions utilized to construct national estimates

MSM and TW	PWID	HIV-negative people in sero-discordant couples
▪ Bangkok metro area ▪ Priority Provinces • Chiang Mai • Phuket • Chonburi • Nakonratchasima • Ubonratchathani • Khon Khaen • Udonthani • Ratchaburi • Songkhla ▪ Remaining areas	▪ Bangkok metro area ▪ Remaining areas	▪ Bangkok ▪ Remaining areas

Men who have sex with men

Bangkok

Initial population size estimate

The PrEP Core Team identified two prior PSEs, each describing the percent of males who engage in sex with another male over a 12-month period. Both prior estimates reflected the combined cisgender MSM and TW population.

1) The "BOE-AEM" estimate of 3.3% of males aged 15 to 49 years has been used previously by the Bureau of Epidemiology (BoE) in the Asian Epidemic Model (AEM). It is a national estimate derived from surveys of male military conscripts aged 21 years and (primarily factory) workers aged 15-49 years in 24 provinces from 2010 to 2014.

2) The "meta-analysis" estimate is the result of a systematic review and meta-analysis of size estimation studies conducted between 1990 and 2015 in Thailand [1]. The review followed the Meta-Analysis of Observational Studies in Epidemiology (MOOSE) guidelines. The meta-analysis estimates were 6.6% of males aged 15 to 69 years in Bangkok and 5.2% nationally; estimates for other subnational areas were also reported.

Because these PSEs were reported relative to different age ranges, they were recalculated to be relative to males aged 15 to 59 years in 2015 (the reference year of the meta-analysis estimates) (Table 1), based on National Economic and Social Development Board (NESDB) projections of males under the low fertility assumption.[i]

[i] The adjusted PSE was calculated as follows: (population percentage) x (number of males in originally-reported age range in 2015) / (number of males in target age range in 2015).

A previous size estimate using the network scale-up method (NSU) in 2010 [2] was not considered credible due to ambiguity of the question item used to assess same-sex behavior.

Table 1. Previous size estimates of cisgender MSM and TW combined

Source / area	Population percentage	Age range of estimate as reported (years)	Population percentage converted to ages 15-59 in 2015
BOE-AEM			
National	3.3%	15 to 49	2.6%
Meta-analysis			
National	5.2%	15 to 69	5.9%
Bangkok	6.6%	15 to 69	7.2%

Limitations and potential biases of the BOE-AEM and meta-analysis size estimates are shown in Figure 3, based on deliberations of the PrEP Core Team. Taken together, they suggest the BOE-AEM estimate may under-estimate the number of MSM and the meta-analysis estimate could either under- or over-estimate MSM. Therefore, the BOE-AEM and meta-analysis estimates were taken as the lower and upper bounds of the size estimate, respectively; the best estimate was taken to be the midpoint (Table 2).

Figure 3. Limitations of previous size estimates of cisgender MSM and TW combined

PSE	Potential sources of under-estimation	Potential sources of over-estimation
BOE-AEM	• Same-sex behavior may be under-represented in factory worker populations due to patterns of self-selection into factory work. • The relatively young age of military conscripts (aged 21 years) may lead to under-estimates of same-sex behavior. Even though adjustments are applied based on the age distribution of same-sex behavior among factory workers, these may not fully correct the problem, since the factory worker data may also be biased, and may not be uniformly biased across age groups.	None

PSE	Potential sources of under-estimation	Potential sources of over-estimation
	• Self-report of MSM behavior may be under-reported due to social desirability bias.	
Meta-Analysis	• The estimates rely on assumed steep declines in past-year same-sex behavior with age (33% from 15-34 to 35-49 years and 33% again from 35-49 to 49-69 years; assumes no same-sex intercourse at ages 70 and older). • The estimates do not reflect MSM present in Thailand who are not Thai citizens. • Self-report of MSM behavior may be under-reported due to social desirability bias.	• The data include several studies from the 1990s that appear to report higher estimates than more recent studies. • Not explicitly limited to anal intercourse and therefore may reflect oral sex and other lower-risk sexual contact.

The range of the resulting national PSE was 2.6% (AEM-BOE) to 5.9% (meta-analysis) with a best estimate (midpoint) of 4.2%. As there was no BOE-AEM estimate specifically for Bangkok, the Bangkok lower bound was set to 44.4% of Bangkok's meta-analysis estimate, the same relationship as in the national estimate, leading to a range of 3.2% to 7.2% (midpoint 5.2%) (Table 2).

Table 2. Consensus size estimates of cisgender MSM and TW combined

	Percent of males aged 15 to 59 who engage in sex with other males		
Geographic strata	Best estimate (midpoint)	Lower bound (LB)	Upper bound (UB)
National	4.24	2.61	5.88
Bangkok	5.20	3.20	7.20

The combined number of cisgender MSM and TW in PrEP target year 2020 was calculated by multiplying these population percentages by the projected number of males ages 15 to 59 years residing in Bangkok in 2020 (Table 3).

Table 3. Projected number of cisgender MSM and TW in Bangkok in 2020

	Estimate	LB	UB
Cisgender MSM + TW	147,340	90,667	204,014
TW	8,907	4,258	13,555
Cisgender MSM	138,433	86,408	190,459

To limit this size estimate to cisgender MSM, the number of TW was subtracted. The number of TW was calculated from available estimates, following a process similar to the one described above:

- The national BOE-AEM PSE for TW (0.19% of males aged 15-49 years, recalculated as 0.15% of males age range 15-59 in 2015) was taken as representing a lower bound, given limitations similar to those described in Figure 3.
- For Bangkok, the same lower bound of 0.15% was assumed, as no subnational TW estimates were available.
- For the Bangkok upper bound, there was no meta-analysis estimate as there was for MSM+TW[ii]. Instead, services data were used. At Global Fund HIV testing sites during 2016-2018, TW represented 9.2% of all cisgender MSM and TW clients. Assuming 9.2% of the estimated 147,340 cisgender and MSM and TW in Bangkok were TW led to an upper bound for Bangkok of 13,555 TW.
- The best estimate for TW was set as the midpoint of this range [4,258 – 13,555] or 8,907 TW (Table 3)

Subtracting TW from the MSM+TW size estimate led to a projected 138,433 [86,408-190,459] cisgender MSM in Bangkok in 2020.

HIV-negative MSM

Data from the 2016 IBBS were used to derive estimates of HIV prevalence and levels of risk behaviors. A limitation of the IBBS is that it primarily reflects MSM who are recruited from "hotspots", places where MSM go to find sexual partners, and who therefore may be at greater risk than the larger MSM population. To overcome this limitation, the target-setting exercise drew on differences between two kinds of IBBS participants: those recruited from hotspots and those recruited from other, lower-risk venues.[iii] The difference in risk by type of venue are supported by the data: HIV prevalence was 23.6% at hotspots compared to 10.1% at non-hotspots in the 2016 IBBS (Table 4). One explanation is that hotspots reflect a higher-risk environment; sexual partners encountered there are more likely to be HIV-positive.

In order to capture these differences in risk, the MSM population was subdivided in two groups: those who frequent hotspots ("hotspot MSM") and those who do not ("non-hotspot MSM"). The proportion of MSM who frequent hotspots was assumed to be 45.3%, which was the proportion of

[ii] Also, a multiplier estimate based on the number of sex reassignment surgeries [1] was not seen as strong enough to adopt for purposes of target-setting.

[iii] Venues classified as hotspots in the IBBS were karaokes, gay bars, other bars, night clubs, discoteques, saunas, massage parlors, and public spaces. Venues classified as "non-hotspots" were schools, factories, malls, movie theatres, hotels, guest houses, restaurants, cafes, beauty salons, fitness centers, events, community and village locations.

MSM in the Princess PrEP cohort in Bangkok who reported meeting male sexual partners at hotspots in the past three months through 2017 (N=766, data provided by Thai Red Cross) (Table 5).

Hotspot MSM were assigned the HIV prevalence of IBBS participants recruited from hotspots. Non-hotspot MSM were assigned the HIV prevalence of IBBS participants recruited from non-hotspots (Table 5).

Table 4. HIV prevalence among MSM in Bangkok

IBBS recruitment venue	HIV prevalence	LB	UB
Hotspots	23.6%	18.0%	30.0%
Non-hotspots	10.1%	4.7%	18.3%

Source: 2016 IBBS, crude estimates

Table 5. Projected number of HIV-negative MSM in Bangkok in 2020

Subgroup	Estimated HIV-negative MSM	LB	UB
Total MSM	138,433	86,408	190,459
Hotspot	62,710	39,143	86,278
Non-hotspot	75,723	47,265	104,181
HIV-negative MSM	115,986	77,141	145,510
Hotspot	47,911	32,097	60,394
Non-hotspot	68,075	45,044	85,116

HIV-negative MSM at substantial risk of HIV

Risk criteria for MSM

To develop criteria for "substantial risk", the TWG examined evidence of risk factors for incident HIV from three cohort studies of cisgender MSM and TW in Thailand as well as global evidence presented in the target-setting guide. All of the Thai studies included participants in Bangkok and took place during 2013-2017 (Table 33, page 34). Findings largely coincided with the global findings.

Next, the IBBS questionnaires were reviewed to determine which risk factors could be assessed for MSM in Thailand. IBBS data were used to estimate the prevalence of potential risk factors by study site to determine whether the estimates seemed valid and complete (i.e., < 10% non-response). Selected data summaries appear in the annexes (page 35).

The consensus risk criteria are presented in Figure 4.

Figure 4. Consensus risk criteria for MSM and TW

Risk criteria:	
• STI symptoms or • UAI and multiple partners or • UAI and receptive anal sex	
Operational definitions:	
STI symptoms	Self-report of any STI symptom in the past month
UAI	Condomless anal sex in the past 3 months with any male partner, or at last sex in the past 12 months with any male partner
Multiple partners	Two or more male or TW anal sex partners in the past 3 months
Receptive anal sex	Either receptive, or receptive and insertive role, at last anal sex with a male in past 12 months

A forth criterion of "recent drug use and ≥ 2 male sex partners" was considered, but was not included as it had a negligible impact on the estimates (See Table 35, Page 36).

Proportion and number of MSM who meet the risk criteria

The proportion of MSM who met the risk criteria was estimated from the 2016 IBBS among HIV-negative survey participants separately by hotspot and non-hotspot venues (Table 6). The 95% confidence intervals served as the upper and lower uncertainty bounds, using an exact binomial approach. Survey estimates were not adjusted for sampling design as sampling weights were not available, so that the CIs are likely under-estimated.

Participants with incomplete data were generally excluded. However, any participant who met any of the three criteria was classified as being at risk, even if there was non-response on other criteria.

Care was taken to account for questionnaire skip patterns. For example, participants who reported never having engaged in anal sex, and who therefore were not asked specifically about receptive anal sex, multiple anal sex partners, and UAI, were included in the calculation and coded as not meeting these risk criteria.

Table 6. Percent of HIV-negative MSM who meet risk criteria in Bangkok

Recruitment venue	Prevalence of risk criteria	LB	UB
Hotspot	37.5	30.0	45.9
Non-hotspot	33.3	22.7	45.2

Finally, the number of HIV-negative MSM in 2020 in Table 5 was multiplied by the percent at risk to obtain the targets (Table 7).

For PrEP target year 2020, the projected number of MSM at substantial risk in Bangkok was 40,636 (uncertainty interval: 19,854-66,193).

Table 7. Projected number of HIV-negative MSM who meet risk criteria in Bangkok in 2020

Subgroup	Estimated MSM	LB	UB
Hotspot	17,967	9,629	27,721
Non-hotspot	22,669	10,225	38,472
Total	40,636	19,854	66,193

National estimates

To develop the national targets, the country was subdivided into three regions:

- Bangkok
- Nine other “priority provinces” where recent IBBS data were available
- Remaining areas

Targets were calculated for each region and summed for the national estimate. The purpose of the geographic stratification was to account for geographic differences regarding key inputs to the targets, i.e., population size, HIV prevalence, and the risk criteria.

Priority provinces were defined as those with an HIV prevalence among MSM of at least 5% based on the 2012 IBBS (Table 8). These provinces largely corresponded to those prioritized for HIV interventions and considered to have the greatest HIV burden. The 2012 IBBS was used to classify provinces because it included sites in 11 provinces compared to the 3 provinces included the 2016 IBBS (Chiang Mai, Phuket and Chonburi).

Priority Provinces and Remaining Areas were further subdivided into urban and rural areas.

Table 8. Geographic subdivisions used to calculate national targets for MSM

Geographic strata	Census Projections for 2020, NESDP		HIV Prevalence in 2012 (IBBS)	
	Males ages 15-59	Percent of population in urban areas[1]	N	HIV prevalence (%)
Bangkok	2,832,285	100.0	226	21.7
Priority provinces				
Chiang Mai	524,400	77.2	200	23.0
Phuket	151,800	82.7	100	14.0
Chonburi	579,500	82.5	117	7.7
Nakonratchasima	748,300	35.6	154	14.3
Ubonratchathani	499,200	32.4	223	6.3
Khonkhaen	523,500	55.0	217	10.0
Udonthani	376,100	50.8	198	6.6
Ratchaburi	240,700	53.6	103	5.8
Songkhla	488,400	66.7	198	11.1
Subtotal	4,131,900	57.4		
Remaining areas				
Phatthalung	151,000		193	1.6
Patumtani	523,500		296	3.4
All other provinces in Thailand	13,058,846		n/a	n/a
Subtotal	13,733,346	41.5		

[1] Provinces were assigned the NESDB-reported proportion urban of the respective region (Peripheral, Sub-Central, East, West, North, Northeast and South).

Several assumptions were needed to extrapolate the data available, which largely reflected Bangkok and urban areas in the Priority Provinces, to other areas of the country.

Assumptions regarding the population percentage of MSM and TW combined

- The national-level BOE-AEM and meta-analysis size estimates were taken to represent urban areas and served as a starting point for deriving the PSEs in each region.
- For the national PSE, the uncertainty range was defined by the BOE-AEM and meta-analysis estimates; the point estimate was defined as the midpoint between them.
- For Bangkok's PSE, the upper bound (UB) was set to the meta-analysis estimate for Bangkok. There was no BOE-AEM estimate specifically for Bangkok; therefore, the lower bound (LB) was set at 44% of the UB, as in the national estimate.

- The size estimate for the Priority Provinces was set to the midpoint of national and Bangkok point estimates. The uncertainty range was calculated so that (1) the point estimate was equal to the midpoint of LB and UB; (2) the LB was equal to 44% of the UB, as in the national estimate.
- The size estimate for Remaining Areas was calculated so that the number of urban MSM in all subregions summed correctly to the national PSE.
- The population percentage in rural areas was assumed to be 50% of that in urban areas within the same region (i.e., Priority Provinces or Remaining Areas).

Table 9. Consensus size estimates of cisgender MSM and TW combined, in urban areas, by subregion, 2020

	Percent of males aged 15 to 59 who engage in sex with other males		
Geographic strata	Best estimate	LB	UB
National	4.24	2.61	5.88
Bangkok	5.20	3.20	7.20
Priority Provinces	4.72	2.64	5.95
Remaining Areas	3.67	2.33	5.25

The number of males ages 15-59 in urban areas in each region was calculated as the total number of males ages 15-59 multiplied by the percent urban. The percent urban in a region was calculated as the weighted average across provinces of the number of males aged 15-59 years and the percent urban in the province (see Table 31 in the Annexes).

As in the Bangkok calculation, the number of TW was calculated and subtracted to obtain the number of cisgender MSM. The lower bound of TW as 0.15% of males aged 15-59 years and the upper bound of TW as 9.2% of all cisgender MSM and TW combined were assumed to be the same throughout the country, as no subregional estimates were available.

These assumptions led to the number of MSM shown in Table 10 and Table 11.

Table 10. Projected number of cisgender MSM in 2020

Geographic strata	Estimated MSM	LB	UB
National	605,932	376,819	841,776
Bangkok	138,433	86,408	190,459
Priority Provinces	144,072	81,110	179,383
Remaining Areas	323,427	209,300	471,935

Table 11. Projected number of cisgender MSM by subgroup in 2020

Geographic strata	Estimated MSM	LB	UB
Bangkok			
Hotspot	62,710	39,143	86,278
Non-hotspot	75,723	47,265	104,181
Priority Provinces			
Urban	105,079	59,158	130,833
Rural	38,993	21,952	48,550
Remaining Areas			
Urban	189,713	122,770	276,824
Rural	133,714	86,531	195,111

Assumptions regarding prevalence of HIV and risk

- In Priority Provinces, levels of HIV prevalence and risk behaviors among urban MSM were approximated by estimates from the 2016 IBBS participants at hotspots. 2016 IBBS estimates from non-hotspots approximated the rural population. Estimates were pooled across Chiang Mai and Phuket.
- In Remaining Areas, 2012 IBBS estimates from all Phattalung participants approximated the urban population. The rural population was assumed to have 50% of these levels.
- 95% confidence intervals from the survey estimates formed the upper and lower bounds of the uncertainty intervals. The CIs were based on the crude estimates as survey weights were unavailable.

The estimated prevalence of HIV and of meeting risk criteria, among HIV-negative MSM, are shown in Table 12.

Table 12. HIV prevalence and percent of HIV-negative MSM who meet risk criteria by subregion

Geographic strata	HIV prevalence	LB	UB	Prevalence of risk criteria among HIV-negative MSM	LB	UB
Bangkok						
Hotspot	23.6	18.0	30.0	37.5	30.0	45.9
Non-hotspot	10.1	4.7	18.3	33.3	22.7	45.2
Priority Provinces						
Urban	7.7	5.0	11.2	44.1	38.2	50.0
Rural	2.2	0.8	4.8	35.5	29.7	41.6
Remaining Areas						
Urban	1.6	0.3	4.5	10.3	6.1	16.0
Rural	0.8	0.2	2.3	5.2	3.1	8.0

The number of MSM at substantial HIV risk in each region was obtained by multiplying the population size estimate by the estimated percent HIV-negative and the percent who met risk criteria; these estimates were summed across regions to obtain the national target (Table 13).

There were a projected 40,636 (uncertainty range: 19,854-66,193) MSM in Bangkok and 123,004 (57,892-201,067) MSM nationally at substantial risk of HIV for year 2020.

Table 13. Projected number of HIV-negative MSM who meet risk criteria in 2020 by subregion

Geographic strata	Estimated MSM at substantial risk	LB	UB
Bangkok	40,636	19,854	66,193
Priority Provinces	56,310	27,936	77,317
Remaining Areas	26,059	10,102	57,556
National	123,004	57,892	201,067

Transwomen

Initial population size estimate

The process for developing the size estimates for TW is described in the previous section on MSM. The key points are summarized below:

Urban areas:

- The lower bound for the population percentage of TW was set as the BOE-AEM of 0.19% of males ages 15-49 years, recalculated as 0.15% of males ages 15-59 years.
- The upper bound was calculated as 9.2% of the best estimate of the number of urban MSM and TW combined; this was based on the share of TW relative to all cisgender MSM and TW clients who received HIV testing at service sites under the Global Fund and National Program supporting areas during the period 2016-2018.
- The best estimate was set at the midpoint of the LB and UB.

Rural areas:

- The population percentage of TW in rural areas was assumed to be 50% of that in urban areas within the same region.

The absolute number of TW was determined based on the above rules (Table 14). For reference, the population percentages were calculated by dividing the number of TW by the number of males aged 15 to 59 years in the respective area (Table 15).

Table 14. Projected number of TW in 2020

Geographic strata	Estimated TW	LB	UB
National	41,668	23,756	59,579
Bangkok	8,907	4,258	13,555
Priority Provinces	9,509	4,889	14,129
Remaining Areas	23,252	14,609	31,894

Table 15. Consensus size estimates of TW, in urban areas, by subregion, 2020

	Percent of males aged 15 to 59 who are TW		
Geographic strata	Best estimate	LB	UB
Bangkok	0.314	0.150	0.479
Priority Provinces	0.292	0.150	0.435
Remaining Areas	0.314	0.150	0.479

HIV-negative TW at substantial risk of HIV

Risk criteria for TW

The same risk criteria were adopted for cisgender MSM and TW (Figure 4). As in MSM, the 2016 IBBS data for TW were examined to confirm, that estimates seemed valid and complete.

Potential differences between hotspot/non-hotspot TW were explored using the 2016 IBBS data. Because no significant differences were identified, the TW population was not subdivided into hotspot/non-hotspot subgroups. Urban/Rural differences were considered. The following assumptions were made.

Assumptions regarding prevalence of HIV and risk

- In Bangkok, levels of HIV and risk criteria were estimated based on all TW participants in the 2016 Bangkok IBBS.
- In Priority Provinces, levels for urban areas were based on estimates pooled across Chiang Mai and Phuket from the 2016 IBBS.
- In Remaining Areas, there were no direct IBBS estimates available for TW. Therefore, levels for the urban TW population were extrapolated from the levels in urban Priority Provinces, based on the ratio of urban Remaining Areas to urban Priority Provinces among MSM. The derivation of these ratios is shown in Table 17.
- Rural areas of Priority Provinces and Remaining Areas were assumed to have 50% of the levels of HIV and risk criteria in urban areas in the respective region.

The projected number of urban and rural TW in Priority Provinces and Remaining Areas (Table 16) was calculated by multiplying the population percentages in Table 15 by the projected numbers of urban and rural males, respectively, aged 15 to 59 years.

Table 16. Projected number of TW by subgroup in 2020

Geographic strata	Estimated TW	LB	UB
Bangkok	8,907	4,258	13,555
Priority Provinces			
Urban	6,936	3,566	10,305
Rural	2,574	1,323	3,824
Remaining Areas			
Urban	13,639	8,569	18,708
Rural	9,613	6,040	13,186

Table 17. Relative estimates among urban MSM in Remaining Areas vs. urban MSM in Priority Provinces

	HIV Prevalence			Prevalence of risk criteria among HIV-negative MSM		
Geographic strata	Estimate	LB	UB	Estimate	LB	UB
Remaining Areas	1.6	0.3	4.5	10.3	6.1	16.0
Priority Provinces	7.7	5.0	11.2	44.1	38.2	50.0
Remaining / Priority	20.8%	6.0%	40.2%	23.4%	16.0%	32.0%

These assumptions led to the estimated HIV prevalence and percent meeting risk criteria among TW shown in Table 18.

Table 18. HIV prevalence and percent of HIV-negative TW meeting risk criteria by region

	HIV prevalence			Prevalence of risk criteria among HIV-negative TW		
Geographic strata	Estimate	LB	UB	Estimate	LB	UB
Bangkok	12.0	7.3	18.3	48.2	38.7	57.9
Priority Provinces						
Urban	3.0	1.4	5.7	48.8	42.9	54.7
Rural	1.5	0.7	2.9	24.4	21.5	27.4
Remaining Areas						
Urban	0.6	0.1	2.3	11.4	6.9	17.5
Rural	0.3	0.0	1.1	5.7	3.4	8.8

The number of TW at substantial HIV risk in each region was obtained by multiplying the population size estimate by the estimated percent HIV-negative and the percent who met risk criteria; these estimates were summed across regions to obtain the national target (Table 19).

There were a projected 3,778 (uncertainty range: 1,528-6,412) TW in Bangkok and 9,2909 (3,825-16,285) TW nationally at substantial risk of HIV for year 2020.

Table 19. Projected number of HIV-negative TW who meet risk criteria in 2020 by subregion

Geographic strata	Estimated TW at substantial risk	LB	UB
Bangkok	3,778	1,528	6,412
Priority Provinces	3,902	1,790	6,332
Remaining Areas	2,091	793	4,341
National	9,770	4,111	17,085

People who inject drugs

Initial population size estimate

Three previous estimates of the size of the PWID population were identified:

1. National estimates based on the network scale-up (NSU) method conducted in 2009 and 2014. The 2014 estimate was reported as a range of 71,083-75,441 PWID. The 2009 and 2014 NSU estimates reflected people who had injected in the past 12 months.
2. A multiplier-method estimate based on a respondent-driven sampling (RDS) survey in 2003-2004, which estimated 3,595 PWID (95% CI 3296-3810) in Bangkok [3]. However, the RDS-estimated percentage used in this calculation was a crude estimate, not adjusted for the RDS sampling design, so that it may not be representative of the larger population.
3. Estimates based on services data and outreach workers' perceptions of the percent of the local PWID population they reached in their service areas. These size estimates were calculated as the number of PWID actually reached by services divided by the perceived percentage reached, leading to a national estimate of 26,057 PWID in 2018.

Of these, the 2014 NSU estimate was seen as acceptable as it utilized a size estimation method appropriate for hard-to-reach populations [4], was nationally representative, and had been conducted in the past 5 years.

A previous consensus[iv] size estimate developed for the most recent GAM, which was based on the 2014 NSU estimate, was adopted for purposes of PrEP target-setting. In that consensus, the

[iv] PWID size estimation national consensus meeting was held in 2014 led by National AIDS Management Center, Department of Disease Control.

size estimate was calculated as the lower bound of the 2014 NSU range, 71,083 PWID, multiplied by 60%, which was the share of PWID who injected in the past month as estimated by the 2014 IBBS. This led to a size estimate of 42,650 PWID nationally in 2014.

To develop PrEP targets for Bangkok and nationally, it was necessary to apportion the 2014 NSU size estimate between Bangkok and other areas in the country. This was done by assuming the geographic distribution of PWID presented in the 2009 NSU (Table 20), because the 2014 NSU report did not present subnational estimates. The 2009 NSU estimated 14.4 thousand PWID in the Bangkok Metropolitan Area (BMA) (35.7%) and 25.9 thousand PWID in other areas combined (64.3%).

Table 20. Geographic distribution of PWID derived from the 2009 network scaleup exercise

Geographic strata	Estimated PWID in 2009 (1000s)	Percent
National	40.3	100.0
Bangkok metropolitan area	14.4	35.7
All other areas	25.9	64.3

Apportioning the 2014 consensus size estimate of 42,650 by these percentages led to 15,240 PWID in BMA and 27,410 PWID in all other areas as of 2014 (Table 21).

These figures were assumed to reflect PWID in urban areas. The target-setting calculation was limited to urban areas because no information was available regarding rural PWID and it was unclear whether there was any significant amount of injection behavior in rural areas.

The number of PWID was projected to year 2020 by expressing the 2014 size estimates as a percentage of the number of persons (males and females) aged 15 to 59 years in the respective area in 2014 and multiplying by the projected number of persons aged 15 to 59 years in 2020. The census figures are presented in Table 32 in the Annexes.

Table 21. Estimated PWID in 2014 and 2020, limited to past-year injection behavior

Geographic strata	Estimated PWID in 2014	As percent of urban population aged 15-59 years in 2014	Projected PWID in 2020
National	42,650	0.21	46,233
BMA	15,240	0.26	14,967
All other areas	27,410	0.19	31,265

A more granular geographic subdivision was not possible due to the limited IBBS data available for PWID.

HIV-negative PWID at substantial risk of HIV

Risk criteria for PWID

Risk criteria for PWID were developed by reviewing global evidence of risk factors for HIV. Risk factors with the strongest evidence were frequent sharing of syringes and other injection equipment, recent STI symptoms, number of sex partners, and injection partners or sex partners of positive or unknown HIV status. A history of jail or prison was also seen as an important marker for risk in Thailand and has been associated with prevalent HIV elsewhere [5,6]. The risk criteria shown in Figure 5 were adopted, based on data available in the 2014 IBBS. All criteria reflected the past 12 months.

Figure 5. Consensus risk criteria for PWID

Risk criteria:	
• STI symptoms or • Needle sharing or • Jail or prison	
Operational definitions:	
STI symptoms	Self-report of any STI symptom in the past 12 months
Needle sharing	Shared needles in the past 12 months
Jail or prison	Was in jail or prison in the past 12 months

Sharing of injection equipment could not be assessed as there were no related variables present in the IBBS dataset. The item on needle sharing did not specify receptive or distributive sharing.

Sexual behaviors were also considered, by exploring the criterion, “condomless sex with a casual partner or sex worker, and ≥ 2 recent sex partners in the past year”. However, IBBS data on condom use were characterized by a high degree of non-response (>90%) and only past 1-month condom use could be evaluated. Yet, adding the sexual behaviors measure had a negligible impact on the estimated proportion at risk (See Table 37, page 37) and was not included in the final risk criteria. Selected data summaries used to examine the prevalence of potential risk factors appear in the annexes (page 37).

Proportion of PWID at substantial risk

Prevalence of HIV and of the risk criteria were estimated using the 2014 IBBS, which included study sites in BMA, Chiang Mai and Songkhla (Table 22). The IBBS recruited PWID using RDS. Estimates were based on the subsample of survey participants who reported having injected drugs in the past 30 days, for consistency with the past-month injection size estimate. Estimates were adjusted for the RDS sampling design in the software RDS Analyst, using the RDS-II estimator. The 95% CIs served as the lower and upper bounds of the uncertainty intervals. BMA estimates were based on survey participants from Bangkok and Samutprakarn, while estimates for all other areas were averages across Chiang Mai and Songkhla participants.

Table 22. HIV prevalence and percent of HIV-negative PWID meeting risk criteria by subregion

	HIV prevalence			Prevalence of risk criteria among HIV-negative PWID		
Geographic strata	Estimate	LB	UB	Estimate	LB	UB
BMA	27.9	20.0	35.8	30.0	18.4	40.9
Other Areas (average of Chiang Mai and Soingkhla)	20.9	13.3	28.6	44.6	35.1	54.0

The number of PWID at substantial HIV risk in BMA and other areas was obtained by multiplying the population size estimate by the estimated percent HIV-negative and the percent who met risk criteria; these estimates were summed to obtain the national target (Table 19).

There were a projected 3,237 (uncertainty range: 1,768-4,897) PWID in Bangkok and 14,255 (9,598-15,544) PWID nationally at substantial risk of HIV for year 2020.

Table 23. Projected number of HIV-negative PWID who meet risk criteria in 2020 by subregion

Geographic strata	Estimated PWID at substantial risk	LB	UB
BMA	3,237	1,768	4,897
Other Areas	11,018	7,830	14,646
National	14,255	9,598	15,544

HIV-negative people in sero-discordant couples

The approach for HIV-negative individuals in sero-discordant couples was to estimate the number of people living with HIV (PLHIV) who were not virally suppressed, and who had engaged in condomless sex with a recent HIV-negative, stable sexual partner. Data were not available to account for multiple HIV-negative stable partners or to account for injection partners. The calculation focuses on stable sexual partners as they can be reached more easily via HIV services than infrequent or one-off partners. Additionally, a reduction factor is applied to exclude MSM, TW and PWID in order to avoid double-counting with the previous targets.

It should be noted that although the approach below follows the target-setting guide, the Guide does not specifically discuss sero-discordant couples.

PLHIV not virally suppressed

The first step was to estimate the number of people living with HIV (PLHIV) who were not virally suppressed. This was calculated as the projected number of total PLHIV (including diagnosed and undiagnosed individuals) for year 2020, multiplied by 100% minus the percentage of PLHIV known to be virally suppressed (viral load <1000 copies / ml):

(PLHIV not virally suppressed) = (PLHIV aged ≥ 15 alive) x (1 - Percent of PLHIV on ART who are virally suppressed)

The total number of adult PLHIV alive in 2017, 2018 and 2020 was based on projections from official NAP projections using tools recommended by WHO and UNAIDS (Spectrum). The number of adult PLHIV registered on ART and virally suppressed was determined from services data from the NAP for years 2017 and 2018 (Table 26). For year 2020, this figure was projected by increasing the 2018 figure by twice the average annual increase during the period 2013-2018. Then, the number of adult PLHIV *not* virally suppressed was calculated by subtracting the number virally suppressed from the total number of adult PLHIV. It should be noted that the number virally suppressed does not reflect PLHIV who attained suppression but did not have a viral load test.

Table 24. Derivation of number of adult PLHIV not virally suppressed in 2020

Area / Year	PLHIV aged ≥ 15 years alive (Spectrum projection)[1]	PLHIV aged ≥ 15 years registered in ART	
		Virally suppressed (NAP database)[2]	Not virally suppressed (= PLHIV alive - suppressed)
National			
2017	439,610	258,499	181,111 (41.2%)
2018	429,863	280,440	149,423 (34.8%)
2020	410,137	Projection: 322,730	87,407 (21.3%)
Bangkok			
2017	78,369	30,870	47,499 (60.6%)
2018	77,365	33,902	43,463 (56.2%)
2020	74,627	Projection: 40,688	33,939 (45.5%)

Notes:

[1] Estimated number of adult PLHIV are from Spectrum projections for Thailand and Bangkok produced by the national HIV Estimation and Projection Working Group and updated in May, 2018.

[2] The number of people on ART and virally suppressed in 2017 and 2018 is from the NAP database, National Health Security Office, May, 2019. The projection for 2020 was set as the 2018 figure plus twice the average annual increase during the period 2013-2018.

With a steady, HIV-negative sexual partner

The projected number of PLHIV not virally suppressed (87,407 nationally and 33,939 in Bangkok) was then multiplied by the estimated percent of PLHIV who had an HIV-negative sex partner in the past 3 months. This percentage, 17.5%, was derived from data from a 2008-2009 study of PLHIV receiving care at four hospitals (three tertiary hospitals in Bangkok and one community hospital in Chiang Rai) by Baipluthong (2017)[7]. This was the most recent survey estimate available.

Table 25. Derivation of percent of PLHIV with recent HIV-negative, steady sex partners

Estimates from Baipluthong (2017)	n/N	Percent
PLHIV who had a steady partner in the past 3 months	475/756	62.8
Steady partner had been tested for HIV	353/475	74.3
Negative HIV test result	132/353	37.4
Among all PLHIV, the percent who had a steady, HIV-negative partner in the past 3 months (calculated based on the above)	132/756	17.5

Engaging in condomless sex

Next, the figure was multiplied by the percent of PLHIV estimated to have had condomless anal or vaginal sex with any partner in the past 3 months (Table 26). This percentage, 11.8%, again derived from Baipluthong (2017), reflects sexual behavior with all partners and was not specific to HIV-negative partners. Data specific to HIV-negative partners were not available.

Table 26. Derivation of percent of PLHIV engaging in recent condomless intercourse

Estimates from Baipluthong (2017)	n/N	Percent
Had vaginal or anal sexual intercourse in the past 3 months	427/756	56.5
Had vaginal or anal sex without a condom in the past 3 months	89/427	20.8
Among all PLHIV, the percent who had vaginal or anal sex without a condom in the past 3 months (calculated based on the above)	89/756	11.8

And not part of a key population group

Finally, to avoid double-counting between the discordant couples target and the KP targets, the figure was reduced further to exclude PLHIV who identified as MSM, TW, or PWID, based on program data among individuals registered in ART during 2017-2018 (Table 27). The proportion of PLHIV in ART who were MSM, TW or PWID (19.3% nationally and 28.3% in Bangkok) reflects PLHIV rather than HIV-negative partners of PLHIV, as there were no data available specifically from HIV-negative partners. Thus, the calculation assumes stable sexual partners of MSM, TW, and PWID also belong to these groups.

Table 27. PLHIV registered for ART who identified as MSM, TW or PWID

	2017 N	Percent	2018 N	Percent	Mean % 2017-2018
National					
Total PLHIV registered	31,093	-	28,614	-	
MSM	4,958	15.9	5,605	19.6	
Male sex workers	77	0.2	69	0.2	
TW	135	0.4	305	1.1	
TW sex workers	0	0.0	13	0.0	
PWID	145	0.5	136	0.5	
Total KPs (sum)	5,315	17.1	6,128	21.4	19.3

	2017 N	Percent	2018 N	Percent	Mean % 2017-2018
Bangkok					
Total PLHIV registered	6,239	-	5,518	-	
MSM	1,559	25.0	1,520	27.5	
Male sex workers	12	0.2	17	0.3	
TW	42	0.7	104	1.9	
TW sex workers	0	0.0	2	0.0	
PWID	35	0.6	23	0.4	
Total KPs (sum)	1,648	26.4	1,666	30.2	28.3

Source: National AIDS Program database

Complete calculation

The complete calculation for target year 2020 was as follows:
National:
(87,407 PLHIV alive and not virally suppressed)
x 17.5% PLHIV with a steady, HIV-negative partner in the past 3 months
x 11.8% PLHIV who had condomless vaginal or anal sex in the past 3 months
x 80.7% PLHIV who were not MSM, TW or PWID
= 1457 PLHIV with HIV-negative, stable sex partners at substantial risk

Bangkok:
(33,939 PLHIV alive and not virally suppressed)
x 17.5% PLHIV with a steady, HIV-negative partner in the past 3 months
x 11.8% PLHIV who had condomless vaginal or anal sex in the past 3 months
x 71.7% PLHIV who were not MSM, TW or PWID
= 503 PLHIV with HIV-negative, stable sex partners at substantial risk

Summary estimates by subgroup

Targets for years 2021 and 2022 were developed using the same approaches described above with the exception of HIV-negative people in sero-discordant couples (Table 28).

Table 28. Projected number of people at substantial HIV risk by subgroup, 2020-2022

Subgroup	2020		2021		2022	
	Estimate	Uncertainty Interval	Estimate	Uncertainty Interval	Estimate	Uncertainty Interval
National						
MSM	123,004	57,892 – 201,067	123,112	57,950 – 201,201	123,209	58,006 – 201,299
TW	9,770	4,111 – 17,085	9,793	4,122 – 17,122	9,816	4,134 – 17,160
PWID	14,255	9,598 – 19,544	14,379	9,690 – 19,703	14,509	9,787 – 19,871
HIV-negative people in discordant couples	1,457	1,457	1,457	1,457	1,457	1,457
Total	148,487	73,058 – 239,152	148,740	73,219 – 239,483	148,990	73,383- 239,788
Bangkok						
MSM	40,636	19,854 – 66,193	40,317	19,699 – 65,675	40,027	19,557 – 65,202
TW	3,778	1,528 – 6,412	3,748	1,516 – 6,362	3,721	1,505 – 6,316
PWID	3,237	1,768 – 4,897	3,213	1,755 – 4,860	3,185	1,740 – 4,818
HIV-negative people in discordant couples	503	503	503	503	503	503
Total	48,154	23,653 – 78,006	47,781	23,472 – 77,399	47,437	23,304 – 76,840

Limitations

MSM and TGW

The following data were not available for MSM and TW, so that assumptions were needed:

- Recent size estimates of MSM and TW using appropriate methodology for hard-to-populations. Available size estimates based on population subgroups (military conscripts, factory workers, students, etc) are likely to suffer from bias, however the level of bias has not been evaluated.
- Size estimates at the subnational level
- Confidence intervals for the AEM-BOE estimates, since they are based on survey data. Statistical error of the AEM-BOE estimates is not reflected in the uncertainty range of the targets.
- IBBS sampling weights. Statistical uncertainty of HIV prevalence and risk behaviors is not accurately reflected in the targets.
- Data for rural areas, including size estimates and IBBS data, and for urban areas outside of Bangkok, Chiang Mai and Phuket, so that assumptions were needed to develop national estimates
- IBBS question items on important risk factors, including:
  - Having a sex or injection partner of positive or unknown HIV status
  - Number of recent condomless sex partners

In addition, MSM and TW who do not frequent hotspots were characterized using data on IBBS participants who were recruited from "non-hotspot" venues. These data are a unique strength of the Thai IBBS, however because the data cannot be regarded as representative, their value is unclear.

PWID

Similarly, the following data were not available for PWID:

- Size estimates at the subnational level
- Data on female PWID, as most samples reflect primarily male PWID
- IBBS data outside of BMA, Chiang Mai and Songkhla
- IBBS question items on important risk factors, including:
  - Needle/syringe sharing questions specific to receptive sharing
  - Sharing of injection equipment (on questionnaire but not in the data set)
  - Having a sex or injection partner of positive or unknown HIV status

In addition, the targets do not account for statistical error in the NSU size estimate because only the lower bound of the NSU was used, in accordance with a previous consensus reached for purposes of the GAM report.

HIV-negative people in sero-discordant couples

The primary limitation was limited recent data on sexual and injection risk behaviors among PLHIV at the national and subnational levels.

In addition, the targets are subject to potential sources of bias:

- They may be under-estimated if PLHIV engage in condomless sex with multiple steady partners as the calculation assumes one partner for each PLHIV who reports having a steady partnership.
- They may be over-estimated since the calculation does not take into account PLHIV who have achieved viral suppression yet who are not tested for viral load.
- They may be over-estimated if discordant couples are more likely to use condoms than non-discordant couples because the estimated prevalence of condomless sex was based on survey data among all PLHIV.
- They may be either over-estimated or under-estimated as a result of using program data to estimate the percent of PLHIV who are MSM, TW or PWID. Greater barriers to care compared to non-KPs or failing to identify as KPs at services because of stigma would lead to under-estimation; over-estimation could be caused by overlap among groups (i.e., PLHIV who are both MSM and PWID).

Recommendations to strengthen data for PrEP target-setting

Recommendations related to size estimation for key populations

1. Conduct new size estimates for MSM and TGW using other methods recommended for hard-to-reach populations [8]. Potential methods include:

    a. Capture-recapture with ≥ 3 or more data sources using a unique, person-level identifier to link individuals across captures. This method is more robust than 2-source "multiplier method" estimates. Captures could include: IBBS survey; mapping during preparation for IBBS; program data from services (e.g., HIV testing, outreach); unique object distribution. There is no requirement that these sources be random samples. For an example,see [9,10].
    b. Virtual mapping to determine the number who use online social networking apps; this could be made more robust by incorporating question items on social network utilization into IBBS and/or other surveys, to determine platforms used, number of accounts and frequency of usage.
    c. Network scale-up

2. Existing surveys of military recruits and workers used for MSM and TW size estimation in Thailand have large sample size and are nationally representative. However, they may be subject to selection bias. Studies should be developed to determine levels of bias, such as comparison with multiple-source capture-recapture. In addition, confidence intervals should be developed based on the statistical error of the underlying sources.

3. PWID size estimates can be improved by incorporating multipliers in the IBBS or, preferably, multiple-source capture-recapture as described above.

Recommendations related to IBBS

4. MSM and TW venue-based IBBS should be strengthened by:
    a. Strengthening the venue selection criteria, sampling plan, and related SOPs to ensure a robust sampling frame and random selection of sites
    b. Random selection of times as well as venues in order to account for variation in attendance over time (e.g., time-location sampling rather than venue-based sampling)
    c. Sampling weights are recommended for all venue-based surveys such as the MSM and TW IBBS [11,12]. Data required for sampling weights should be collected during the survey. The weights should be used in survey analysis.
    d. The mapping phase of the IBBS provides an opportunity for mapping-based size estimates, as well as an additional "capture" for capture-recapture size estimates.
    e. Adding question items on:
        i. Having a sex or injection partner of positive or unknown HIV status
        ii. Number of recent condomless sex partners

5. Adjust data coding so that "no" responses can be differentiated from non-response, especially on "check all that apply" items.

6. PWID IBBS using RDS could be strengthened:
    a. In order to make the survey more representative:
        i. Ensure adequate number and geographic coverage of survey offices (multiple survey offices may be needed)
        ii. Ensure adequate number and distribution of female seeds, as female PWID appear to be under-represented
        iii. Review all aspects of survey promotion in the community and SOPs, and conduct qualitative, formative research, in order to identify strategies to improve participation by PWID subgroups
    b. Adding question items on:
        i. Needle/syringe sharing questions specific to receptive sharing
        ii. Sharing of injection equipment (on questionnaire but not in the data set)
        iii. Having a sex or injection partner of positive or unknown HIV status

Recommendations for developing national estimates

7. Developing national estimates from subnational data—both size estimates and IBBS—was the key challenge during this exercise. Robust national estimates can be developed by careful selection of study sites for IBBS and size estimation, in order to generate information that reflects all types of regions within the country. For example, consider dividing the country into specific strata (e.g., low- and high-burden areas; rural, small city, large city, large city-high burden areas) and ensuring at least one data collection site in all strata. Even without random selection of sites, having some data from all strata will allow a more credible estimate and reduce the assumptions needed, particularly for lower burden areas.

Recommendations for targets for HIV-negative people in sero-discordant couples

8. Conduct new surveys to update estimates of STI and sexual and injection risk behaviors among PLHIV.

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Appendices

I. General population estimates and projections derived from census data

Table 29. Projected number of males ages 15-59 in target years

Geo strata	2020	2021	2022
National	20,697,531	20,591,035	20,468,819
Bangkok	2,832,285	2,810,089	2,789,870
Priority Provinces	4,131,900	4,103,400	4,071,900
Remaining Areas	13,733,346	13,677,546	13,607,049

Source: Projections from NESDB in February 2013 under normally decreasing fertility rate assumption

Table 30. Projected percent of males ages 15-59 living in urban and rural areas

Geo strata	2020	2021	2022
Priority Provinces			
Urban	57.4	59.0	60.7
Rural	42.6	41.0	39.3
Remaining Areas			
Urban	41.5	42.2	42.9
Rural	58.5	57.8	57.1

Source: Calculated from annual NESDB census projections of percent urban (by region) and number of males aged 15-59 years (by province)

Table 31. Projected number of males ages 15-59 years in urban and rural areas

Geo strata	2020	2021	2022
National	20,697,531	20,591,035	20,468,819
Urban	10,903,334	11,003,019	11,098,937
Rural	9,794,197	9,588,016	9,369,882
Bangkok	2,832,285	2,810,089	2,789,870
Urban	2,832,285	2,810,089	2,789,870
Rural	-	-	-
Priority Provinces	4,131,900	4,103,400	4,071,900
Urban	2,371,711	2,421,006	2,471,643
Rural	1,760,189	1,682,394	1,600,257
Remaining Areas	13,733,346	13,677,546	13,607,049
Urban	5,699,339	5,771,924	5,837,424
Rural	8,034,008	7,905,622	7,769,625

Source: Derived from Table 29 and Table 30.

Table 32. Estimated number of males and females ages 15-59 years in urban areas in year of PWID size estimate and PrEP target years

Geo strata	2014	2020	2021	2022
Bangkok metropolitan area	5,968,649	5,862,055	5,817,042	5,767,653
Remaining areas in Thailand	14,228,370	15,961,972	16,203,997	16,430,848

Source: Calculated from annual NESDB census projections of percent urban (by region) and number persons aged 15-59 years (by province)

II. Risk factors for incident HIV from cohort studies of cisgender MSM and TW in Thailand

Table 33. Risk factors for incident HIV from cohort studies of cisgender MSM and TW in Thailand

Risk Factor	Hazard ratio (95% CI)	Recruitment	Reference
Inconsistent condom use	2.5 (1.2-5.1)	Individuals seeking HIV testing at government facilities and who reported inconsistent condom use in past 6 months; 2015-2016	Thai MOPH-U.S. CDC Collaboration, unpublished manuscript
Identifies as gay vs. TW	4.9 (1.7-14.2)		
Receptive anal intercourse past 6 months	3.6 (1.4-9.5)		
Consumed alcohol in past 6 months	3.3 (1.3-8.3)		
Consumed poppers in past 6 months	4.4 (1.7-11.2)		
Age 18-21 vs. >30	2.49 (1.64-3.78)	Individuals seeking HIV testing, encountered at known MSM venues, or recruited through advertisements; 2006-2012	[13]
Age 22-29 vs. >30	1.69 (1.19-2.40)		
Living alone or with roommate	1.52 (1.13-2.05)		
Drug use for sexual pleasure	2.25 (1.51-3.36)		
Inconsistent condom use	4.84 (1.78-13.19)		
Did not have anal sex	0.35 (0.13-0.94)		
Had receptive anal sex	1.67 (1.24-2.25)		
Had group sex ever	1.51 (1.09-2.08)		
STI (HSV-1, HSV-2, syphilis)	148 (1.12-1.94) 1.52 (1.09-2.11)1.82 (1.05-3.17)		

III. Prevalence of risk factors and risk criteria among MSM, 2016 IBBS

Table 34. Prevalence of potential risk factors among MSM, 2016 IBBS

	Recruitment venue (percent of participants)	
Risk factor / site	Non-hotspots	Hotspots
1. STI symptoms		
Bangkok	6.3	6.3
Chiang Mai	14.2	11.3
Phuket	9.6	18.2
2. UAI and ≥ 2 partners		
Bangkok	12.5	25.7
Chiang Mai	34.5	30.1
Phuket	11.0	22.3
3. UAI and receptive anal sex		
Bangkok	18.1	25.7
Chiang Mai	41.4	22.7
Phuket	11.7	15.8
4. Drug use and ≥ 2 partners		
Bangkok	13.2	4.2
Chiang Mai	2.6	6.6
Phuket	2.1	5.0

Table 35. Prevalence of meeting alternative definitions of risk criteria among MSM, 2016 IB

	Recruitment venue (percent of participants)	
Site / Risk definition	Non-hotspots	Hotspots
Bangkok		
Any of the 4 criteria	34.3	38.9
Excluding 'Drug use and ≥ 2 partners'	33.3	37.5
Excluding 'UAI and receptive anal sex'	20.6	31.9
Chiang Mai		
Any of the 4 criteria	50.9	50.6
Excluding 'Drug use and ≥ 2 partners'	50.9	47.6
Excluding 'UAI and receptive anal sex'	40.5	42.2
Phuket		
Any of the 4 criteria	24.0	40.0
Excluding 'Drug use and ≥ 2 partners'	23.3	39.2
Excluding 'UAI and receptive anal sex'	19.2	37.2

IV. Prevalence of risk factors and risk criteria among PWID, 2014 IBBS

Table 36. Prevalence of potential risk factors among PWID, 2014 IBBS

Risk factor / site	N	Percent of participants
1. STI symptoms in past 12 months		
Bangkok	220	3.2
Samutprakarn	83	1.0
Chiang Mai	187	5.3
Songkhla	188	4.9
3. Needle sharing past 12 months		
Bangkok	219	10.0
Samutprakarn	82	9.8
Chiang Mai	187	44.4
Songkhla	187	11.2
2. Jail or prison in past 12 months		
Bangkok	218	21.1
Samutprakarn	83	41.0
Chiang Mai	186	38.2
Songkhla	188	9.0
3. ≥ 2 sex partners and condomless sex with a casual partner or sex worker in past 1 month		
Bangkok	209	1.9
Samutprakarn	78	0.0
Chiang Mai	169	13.6
Songkhla	187	0.5

Table 37. Prevalence of meeting alternative definitions of risk criteria among PWID, 2014 IBBS

Site / Risk definition	N	Percent of participants
Bangkok		
Any of the 4 criteria	213	32.9
Excluding sexual behaviors criterion	218	30.7
Samutprakarn		
Any of the 4 criteria	81	44.4
Excluding sexual behaviors criterion	83	43.4
Chiang Mai		
Any of the 4 criteria	181	71.3
Excluding sexual behaviors criterion	186	69.4
Songkhla		
Any of the 4 criteria	187	22.5

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The estimates presented in this report were developed by Thailand's Extended PrEP Core Team during a series of meetings at the Bureau of AIDS, TB and STIs, Department of Disease Control, MOPH in Bangkok between February and March of 2019. Participants are listed below.

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