सत्यमेव जयते

WHITE PAPER
on Mapping and
POPULATION
Size Estimation of High-Risk Groups for
HIV
IN INDIA

National AIDS Control Organisation
India's Voice against AIDS
Ministry of Health & Family Welfare, Government of India
www.naco.gov.in

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FOREWORD

World Health Organization (WHO) and The Joint United Nations Programme on HIV and AIDS (UNAIDS) has traditionally described HIV/AIDS into three groups: low level, concentrated and generalised. A concentrated epidemic means HIV has spread rapidly in a defined sub-population but is not well-established in the general population. The future course of the epidemic is determined by the size as well as frequency and nature of links between this highly infected sub-populations and the general population. In India, female sex workers, men having sex with men, hijra/transgender people and injecting drug users are groups which have much higher HIV prevalence than the rest of the population.

Recognising the concentrated nature of HIV/AIDS epidemic in India, the programme has periodically undertaken local area size estimation of population group with higher risk of HIV prevalence. The last such exercise was undertaken in 2012-13 among hijra/transgender people. In 2016, 'Mid Term Assessment' of national AIDS control programme recommended for updating the guidelines for population size estimation.

In view of the recommendations of 'Mid Term Assessment', national programme undertook the development of a White Paper on population size estimation with support from UNAIDS, WHO-India and CDC-DGHT India. The objective was to develop a systematic document which will describe various methodologies used globally, review the India experience and recommends the framework for HRG population mapping and producing size estimates in Indian context.

Mapping and size estimates of the high-risk group has been an extremely important but complex topic from both of epidemiological monitoring as well as programme implementation perspective. The different methods produce different results and none of them offers a gold standard or are universally followed.

While there is no 'Gold Standards', a mature, robust and community driven programme implementation design of National AIDS Control Programme in India produces a unique advantage. The grass root functionaries reaching to the high-risk groups are their peers through NGO/CBO's led targeted interventions; supportive technical supervision is ensured through the technical support units and epidemiological insights are provided through highly reputed public health institutes. This 'White Paper' acknowledges these unique strengths and structured institutional arrangements available under National AIDS Control Programme and recommend a technical framework which can be considered for mapping and size estimation of high-risk population in India.

Preventing the new HIV Infections has been core component of national AIDS response since its inceptions and high-risk group has been the top priority across the care continuum of prevention-detection-treatment. National AIDS response in the high-risk group is further being augmented with revamped strategies in line with the changing ecosystem in which the population operates. I am confident that all stakeholders engaged in epidemic monitoring as well as designing, implementation and monitoring of programme for high risk groups will use this 'White Paper' to further strengthen the national efforts to achieve 'End of AIDS' by 2030.

(Sanjeeva Kumar)

सत्यमेव जयते

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संयुक्त सचिव
Alok Saxena
Joint Secretary

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PREFACE

Mapping and population size estimation is a key component of evidence driven AIDS response in India. As early as in second phase of National AIDS Control Programme (NACP), there were efforts to map the locations and estimate the size of HRG associated with these locations to guide the planning and implementation of targeted interventions at these sites. Mapping and population size estimation for hijra/transgender population in 2012-13 was last such exercise undertaken under the National AIDS Control Programme.

In 2016, the Mid Term Appraisal of the NACP-IV concluded that methods, tools and related guidelines for Population Size Estimates (PSE) of high-risk groups (HRGs) need to be updated. This recommendation was reiterated in an Expert Consultation on HIV Surveillance and Estimations in India (2016) and in India's National Strategic Plan (2017-2024) which also emphasised the need for regular updates of HRG size estimates to facilitate strategic planning, costing, monitoring, reporting and evaluation. This white paper has been developed in line with these recommendations providing the technical roadmap for undertaking population size estimation in India.

This white paper covers history of mapping and population size estimation under NACP so far, various recommended methods for size estimation with their strengths and limitations as well as definition of HRG population with their epidemiological and programmatic implications. It also acknowledge the existence of population operating through web-based platforms and provides an insight into various pilots being implemented in India. Finally, the paper also provides critical considerations for a mapping and population size estimation exercise with specific recommendation and way forward.

This white paper is another example of systematic standardized approach for strategic information management under National AIDS Control Programme. An application document based on this 'White Paper' is already under development to institutionalise the mapping and population size estimation under NACP. I am confident that all the stakeholders will find this document engaging, educational and use this as a reference document for key population size estimation under National AIDS Control Programme in India.

(Alok Saxena)

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MESSAGE

The old saying "What gets measured gets done" is very true for the HIV response as it means measuring something gives you the information you need in order to make sure you achieve what you set out to do. Over the years, a comprehensive understanding of the HIV epidemic was developed in India through the collection, analysis and dissemination of data, guiding programmes to reach the right people, in the right place and at the right time. Also, having high-quality data re the HIV response has enabled ambitious, measurable and time-bound targets to be set for monitoring progress and guaranteeing accountability.

With a concrete target set of end the AIDS epidemic by 2030 as part of the Sustainable Development Goals, it is vital to have the right data to track whether India is on course to meet its commitments to the 2016 United Nations Political Declaration on AIDS to achieve the 2020 targets and beyond.

This White paper on mapping and population size estimation of High-risk Groups for HIV in India offers valuable recommendations on how to proceed with the updating of key populations size estimates by capitalising on a very strong existing institutional arrangements, great experience in disease surveillance and use of data for decision making while addressing the challenges.

Reviewing the objectives of the size estimates, clearly defining High-risk groups for HIV, introducing new approaches and periodicity of population size estimates (e.g. stratified local area estimates, direct mapping in strategic locations, complemented with extrapolation and virtual mapping, biennially with revalidation between two rounds) will all improve the quality of the data at a lesser cost usable for local planning , implementation and monitoring of impact of programmes and will also help in the design of differentiated programmes targeting key populations based on their specific needs and location in both the physical and virtual space.

Finally, the data collected from size estimates will also support the development of projections and estimations of the HIV epidemic at national, states and districts levels. The proposed approach will further strengthen the institutionalization of the collaboration between different stakeholders involved in making available quality population size estimates of High-risk groups for HIV in India.

NACO must be commended for leading these strategic changes in the context of a concentrated HIV epidemic which will not only facilitate measuring the commitments made by India but will also support ''getting the job done'' in ending AIDS as a public threat in this country by 2030.

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The leadership towards development of the white paper on mapping and size estimation was provided by Dr Neeraj Dhingra (formerDeputy Director General, NACO) and Dr S. Venkatesh (the then Addl. DG, NACO and now DGHS, Officer In-Charge, MoHFW, Govt. of India). Dr Pradeep Kumar (NACO), Dr Savina Ammassari (Former Senior Strategic Information Advisor, UNAIDS) and Dr Rajatashuvra Adhikary (Formerly at UNAIDS India and now WHO India) conceptualized and developed this white paper under the guidance of Dr Neeraj Dhingra and Dr S. Venkatesh. We acknowledge the contribution of this core group towards development of this white paper.

The paper has gone through a series of review during its course of development. Dr Bhavani Singh Kushwaha (Deputy Director, NACO), Mr Rajeenald T Das, Ms Sophia Khumukcham, Mr Abraham Lincoln, Mr Lalit Singh Kharayat, Mr Samresh Kumar and Mr Dew Stanley (NACO) reviewed the white paper from programme perspective and provided critical insights. Ms Deepika Joshi (CDC-DGHT India) and Mr G S Shreenivas (FHI360 India) assisted in finalization of this White Paper. FHI360and USAID India provided insights into the mapping of HRG operating through virtual platform. Representatives from Technical Support Unit (TSU) and State AIDS Control Society (SACS)reviewed and provided insights at various stages of the development of this White Paper.The White Paper was also reviewed during the 'Expert Consultation onNewer Methods of HIV Surveillance & Estimation in India' which was attended by senior most experts in India including that of Dr DCS Reddy (Former HoD, Dept of PSM, IMS, BHU), Prof. Arvind Pandey (Former Director, NIMS-ICMR, New Delhi), Dr Asok Row Kavi (Humsafar Trust, Mumbai), Dr Taoufik Bakkali (UNAIDS, Bangkok), Dr Keith Savin (UNAIDS Geneva) and Dr Jesus M Garcia Calleja (WHO Geneva). The inputs from all experts towards development of this white paper is deeply acknowledged.

Dr Bilali Camara (Country Director, UNAIDS India) provided technical insights to firm up this paper in line with global standards. Dr Marjolein Jacobs, Ms Nalini Chandra (UNAIDS India) and Dr Arvind Kumar (NACO) coordinated publication of this critical document.UNAIDS India supported the printing of this white paper.

Shobini

(Dr Shobini Rajan)

CONTENTS

Tables

Boxes

ABBREVIATIONS

AIDS	Acquired Immuno Deficiency Syndrome
BSS	Behavioural Surveillance Survey
CBO	Community Based Organization
CM	Crosswise Method
DHS	Demographic and Health Survey
DSACS	Delhi State AIDS Control Society
FGD	Focus Group Discussion
FSW	Female Sex Worker
GPS	Global Positioning System
HIV	Human Immunodeficiency Virus
HRG	High-risk Group
H/TG	Hijra/Transgender People
IBBA	Integrated Biological and Behavioural Assessment
IBBS	Integrated Biological and Behavioural Surveillance
ICMR-NIE	Indian Council of Medical Research-National Institute of Epidemiology
IHAT	India Health Action Trust
HIF	Hotspot Information Format
IDU	Injecting Drug User
KII	Key Informant Interview
KP	Key Population
MPSE	Mapping and Population Size Estimation
MSM	Men who have Sex with Men
MSW	Male sex worker
MTR	Mid-term Review
NACO	National AIDS Control Organization
NACP	National AIDS Control Programme
NGO	Non-Governmental Organization
NFHS	National Family Health Survey
NSUM	Network Scale-up Method
NSP	National Strategic Plan
PLHIV	People Living with HIV
PSA	Participatory Site Assessment
PWID	People Who Inject Drugs
RDS	Respondent Driven Sampling
RDSAT	Respondent Driven Sampling Analysis Tool
RI	Regional Institute
SACS	State AIDS Control Society
TI	Targeted Intervention
TSU	Technical Support Unit
UNAIDS	Joint United Nations Programme on HIV/AIDS
UT	Union Territory
UN	United Nations
WHO	World Health Organization
WOTC	Wisdom of the Crowd

Executive summary

India's HIV epidemic is concentrated among high-risk groups-or key populations as they are referred globally-of female sex workers, men having sex with men, hijra/transgender people and injecting drug users. As the National AIDS Control Programme endeavors to further reinforce HIV prevention, early diagnosis, treatment and care services among these populations towards achieving 'End of AIDS by 2020', understanding the geographic location and size of these populations is critical to inform programme planning, location prioritization and resource allocation.

There are population size estimates for female sex workers, men having sex with men, and injecting drug users from 2004 and 2009-11 mapping and population size exercises conducted in the country. A separate exercise for hijra/transgender people was conducted in 2012-13 when the programme recognised them as separate group from men having sex with men. Asides from these initiatives, there has not been a major population size estimation exercise for the high-risk groups in recent times, although there has been 're-validation' exercise to update the information periodically by the National AIDS Control Organisation (NACO) with State AIDS Control Societies and Technical Support Units.

In 2016, the Mid Term Appraisal (MTA) of the National AIDS Control Programme (NACP) IV recommended that methods, tools and related guidelines for Mapping and Population Size Estimations (MPSE) of high-risk groups (HRGs) and their validation need to be upgraded. This recommendation was reiterated in an Expert Consultation on HIV Surveillance and Estimations in India (2016) and in India's National Strategic Plan (2017-2024) which also emphasised the need for regular updates of MPSE to facilitate strategic planning, costing, monitoring, reporting and evaluation. Consequently, NACO commissioned White Paper on mapping and population size estimation of HRG population in India to describe prevalent methods with their strengths and limitations, detail the evolution of size estimation under NACP and finally to recommend the contour for periodically undertaking the population size estimation in India.

A key consideration before undertaking any mapping and population size estimation exercise is defining the population as that will determine the population who 'are measured'. While there are broad definitions mentioned in UN documents, various countries have their own interpretations of these definitions to accommodate the local context and target-setting. While some define female sex workers, men

having sex with men, hijra/transgender people and injecting drug users quite specifically, others have it extremely broad. However, all in all, each of them can lead to varying estimates and essentially no population size estimate across countries can be compared unless they have the same definition.

There are direct and indirect methods to estimate the high-risk group population size. The direct methods-wherein data is collected from/on the high-risk groups-are: Wisdom of the Crowds, Census/ Comprehensive Mapping, Enumeration, Multiplier and Capture-Recapture. The indirect methods are: General Population Survey and Network Scale-up. Methods to undertake mapping of high-risk groups operating through web-based platforms for solicitation are in early stage of development with pilot initiatives underway in different parts of the country having high urban density.

While no method is perfect, building on India's history of conducting venue-based mapping and size estimates, local area estimates method using direct mapping and population size estimation approach is most suitable method from programme implementation purposes. However, in a large and heterogeneous country like India, with a total population of around 1.3 billion and 36 States/Union Territories, it is impossible to obtain local area estimates for all geographical areas across the country, no matter which methodology is used. Such an endeavour would be too time consuming and costly. Therefore, collecting local area estimates using direct mapping and population size estimates methods in strategically selected locations, and then using extrapolation procedures to make inferences about areas which do not have direct estimates, is recommended for India.

From implementation perspective, it is recommended to integrate MPSE in the HIV prevention Targeted Interventions of the National AIDS Control Programme with an aim to repeat the exercise biennially as that would periodically inform the programme plan for course-correction and re-calibration of interventions as and when required. As the Targeted Intervention programme has matured over the years and institutional arrangements are in place to undertake such a large-scale exercise, this approach will also enable community-driven mapping of high technical rigour in a resource efficient manner.

It will be strategic to complement the Mapping method with other direct methods also such as Multiplier and Capture-Recapture methods, as and when opportunities arise. Additionally, a size estimation component can be in-built into the periodic Behavioural Surveillance Surveys planned under the National AIDS Control Programme to further enrich understanding of the population size. Even specific assessments can be encouraged to include size estimation in local level data collection efforts subject to objective alignment and resource availability.

Recommendation is also to explore the possibility of integrating appropriate questions under relevant household surveys such as the National Family Health Survey. While household surveys tend to underestimate the prevalence of people engaged in High-risk behaviour, it will still provide information on the minimum estimated size of the relevant populations.

As a full-fledged MPSE exercise will take a minimum of 6-9 months from designing to outcome, it is recommended to develop an interim working estimate for the country on a priority basis using the same approach adopted during the planning stage of National AIDS Control Programme III. An immediate next step will be to develop an "application document" to implement periodic MPSE as recommended in this White Paper. Methods for mapping high-risk groups operating through web-platforms and use of social media/mobile phones also need further development, by building on the learnings from pilot initiatives being undertaken in some States.

1 Introduction

1.1 Background

In 2016, a mid term appraisal (MTA) of the National AIDS Control Programme (NACP) IV was conducted by the National AIDS Control Organization (NACO), in collaboration with a group of national and international experts. The MTA concluded that methods, tools and related guidelines for mapping and population size estimation (MPSE) of high-risk groups (HRGs), or key populations (KP) as they are referred to internationally, and their validation needed to be upgraded.[1] This recommendation was reiterated in an Expert Consultation on HIV Surveillance and Estimations held in India (2016)[2] and in India's national strategic Plan (2017-2024) which also emphasized the need to regularly update MPSE to facilitate strategic planning of the AIDS response costing, monitoring, reporting and evaluation.[3]

As an immediate follow-up, a Working Group on 'monitoring and evaluation and size estimation' was created by NACO with the task of reviewing current methods and practices of HRG mapping and size estimation used in India and making suggestions for their improvement. One of the recommendations by the group was to develop a White Paper to present experiences, best practices and lessons learned in India and across the world, in designing and implementing MPSE for different types of HRG. In addition, the paper also aimed to provide strategic recommendations on how to implement MPSE in India by building on past achievements and lessons, while at the same time addressing the need to conduct MPSE activities at scale, while using standardized approaches that were cost effective and efficient.

In the context of recommendations outlined above, this white paper describes various methodologies used globally to estimate sizes of different high-risk groups, highlights their strengths as well as weaknesses, reviews the India experience and recommends the framework for producing size estimates beneficial for HRG programming in the Indian context.

1.2 Rational and objective

In many countries, including in India, the HIV epidemic is concentrated among populations who are at higher risk of infection. These include female sex workers (FSW), men who have sex with men (MSM), hijras/ transgender (H/TG) people,

[1]Mid-term appraisal of national AIDS control programme phase IV, National AIDS Control Organisation, 2016.

[2]Expert Consultation on HIV surveillance and estimations in India, 2016. (2018). New Delhi: National AIDS Control Organization, Ministry of Health & Family Welfare, Govt of India.

[3]National Strategic Plan for HIV/AIDS and STIs 2017 –2024, National AIDS Control Organisation, 2017.

and people who inject drugs (PWID) or injecting drug users (IDUs), as they are more commonly referred to, in India.

The population is often described as 'hidden' because their behaviours continue to be stigmatized. In many countries, these behaviours are also illegal or criminalized. Therefore, comprehensively enumerating key populations is a challenging endeavour.

Yet, MPSE are important to understand the volume and patterns of the epidemic and its trends over time to put in place policies and programmes. As populations at higher risk are not uniformly distributed across the country, size estimations are important in the assessment of programmatic needs across different locations and planning of prevention, care and treatment interventions and services. They also facilitate target-setting and budgeting or costing of programme interventions.

These estimates are not only needed to ensure efficient allocation of resources. They are necessary also for advocacy and resource mobilization purposes. Understanding the populations at risk of HIV or living with HIV in specific settings helps inform policy decision-making to intervene with prevention and other measures to alleviate the burden of the disease.

MPSE are also a critical input in epidemiological models like Spectrum which is used to produce HIV estimations on core indicators at national and sub-national level to monitor and evaluate the response to the epidemic. Key indicators include HIV incidence and prevalence as well as numbers of people living with HIV (PLHIV), AIDS-related deaths and treatment needs.

As it is not possible to physically count all people belonging to various HRGs, their sizes are estimated using a variety of methods. Many different methods have been experimented, and some methods are used more often than others. However, the choice of a particular size estimation method, or a mix of methods, hinges on strategic information needs and the objectives for which MPSE are being developed at different levels.

Global experience accumulated over the years with implementation of population size estimations has shown that there is no single method uniformly suited to every context. There also is no perfect method; each has its own strengths and weaknesses.

This White Paper discusses various methods of MPSE, Indian experiences and lesson learnt, best practices in estimating the size of HRG in India and beyond, and also makes recommendations to update and further strengthen MPSE in India's national and sub-national context.

The specific aims of the white paper are to:

- Provide an overview of various methods of mapping and population size estimations.
- Discuss the strengths and weaknesses of different methods and tools in the light of strategic information needs in the AIDS response India.
- Recommend the contour for periodically undertaking the mapping and population size estimations in India.

1.3 Structure of the white paper

The succeeding sections of this White Paper are aligned with its objectives. Section 2 focusses on the issue of definitions of HRG as a fundamental aspect of size estimation. Section 3 provides an overview of the various methods of MPSE and also highlights best practices from various countries. Section 4 describes the history and current status of MPSE in India. Section 5 focuses on mapping and estimating populations operating via web-based platforms and provides insight into various pilots being implemented in India. Section 6 discusses the critical considerations while undertaking mapping and MPSE exercises. Recommendations for MPSE in India are included under Section 7. Section 8 provides the way forward.

2 Definition of High-risk groups

The term 'High-risk group' is used to describe a group of people who are at increased risk of being exposed to HIV because they have frequent risky behaviour (unsafe sex or sharing of injecting equipment) on a regular basis. The definitions mentioned in various United Nations documents tend to adopt broader definitions of these groups as listed below: [4,5]

1 Sex workers

Consenting males, females or trans-gender adults (aged 18 years or older) who regularly or occasionally receive money or goods in exchange for sexual services

2 Men who have sex with men

Males who have sex with males regardless of whether or not they have sex with women or have a personal or social gay or bisexual identity

3 People who inject drugs

Men or women who have injected any time within the previous 12 months (not including for medical purposes)

While there are broader definitions mentioned in UN documents, they are not necessarily followed universally as standard definitions. Various countries have used various definitions in the past while carrying out population size estimation. For example, UNAIDS defines MSM as "males who have sex with other males, regardless of whether or not they have sex with women or have a personal or social identity associated with that behaviours, such as being 'gay' or 'bisexual'." However, definitions used by countries have varied by description of sexual behaviours (anal, oral) or nature of sexual encounter (any sex, paid sex only) and time frame (life time, past 12 months, past 6 months, past 3 months, etc.) (Table 1). While some definitions are quite specific, some are extremely broad. These local definitions may accommodate local programming. However, use of each of them can produce widely varying estimates and make comparability across countries and regional or global aggregation more challenging (Table 2).

[4]UNAIDS Terminology Guidelines (2015).
[5]Estimating sizes of key populations: guide for HIV programming in countries of the Middle East and North Africa / World Health Organization. Regional Office for the Eastern Mediterranean (2016).

Table 1: Men who have sex with men, definitions and size estimates [6]

Country	Estimated size	Definition	Males (15-49)	As% of males (15-49)
Afghanistan (2015)	10,700	Males 15+yrs; both active and passive	8,049,121	0.1
Australia (2011)	190,000	Self-identify as men who have sex with men	5,614,708	3.4
Bangladesh (2015)	MSM:101,695 MSW: 29,777	**MSM:** Males 10+ yrs; who had sex with males with consent in the last year regardless of whether they have sex with women or have a personal/social gay or bisexual identity but do not sell sex. **MSW:** Males who sell sex to other males in exchange of money or gifts in last 3 months	45,033,462	MSM: 0.2 MSW: 0.1
Cambodia (2012)	20,000	Males 15+yrs; who have sex with males in the last year regardless of whether they have sex with women or have a personal/social gay or bisexual identity	3,966,282	0.5
China (2013)	3,960,000	Males 15-65 yrs; who have sex with men in recent year	400,323,128	1.0
India (2012-13)	300,000	Programme data of Targeted Intervention Programme based on the criteria – Very high risk MSM (15 or more male partners per week). MSM: Males 15+ yrs; who had anal or oral sex with a male/hijra partner in the last one month and are visible on the hotspot	349,619,823	0.1
Indonesia (2012)	1,095,970	Males 15+ yrs; men who have sex with men excluding transgender	68,582,937	1.6
Japan (2013)	519,721	Not available	27,384,599	1.9
Lao PDR (2015)	58,320	Not available	1,793,814	3.3
Malaysia (2014)	170,000	Males 18+ yrs, who had engaged in anal sex with men at least once in the previous six months	8,472,244	2.0
Mongolia (2014)	3,118	Males 15-49 yrs; who had anal or oral sex with men in the past 12 months	836,336	0.4
Myanmar (2015)	252,000	Males 15+ yrs; who has had anal sex with another male in the past 6 months	14,349,533	1.8

[6]Source: GARPR online reporting 2016. China 2013 HIV estimation and United Nations, Department of Economics and Social Affairs, Population Division (2015), World Population Prospects. The 2015 Revision.

(Table 1: Contd...)

Country	Estimated size	Definition	Males (15-49)	As% of males (15-49)
Nepal (2012)	MSM: 196,270 MSW: 11,376	**MSM:** Males who have oral and/or anal sex with other biological males, at least once, in the past 12 months. **MSW:** Males 16+yrs; who had oral and/or anal sex with other males in the past 12 months in exchange for money or other benefits.	6,373,961	MSM: 3.1 MSW: 0.2
Pakistan (2012)	MSM: 150,000 MSW: 63,732	**MSM:** Not available. **MSW:** Males 13+yrs; who undertakes sexual activity with a man in return for money or benefits	46,674,112	MSM: 0.3 MSW: 0.1
Philippines (2015)	MSM: 531,500 MSW: 86,600	**MSM:** Males 15+ yrs; who had oral or anal sex with a male in the past 12 months. **MSW:** Males 15+yrs; who had oral or anal sex with a male in the past 12 months and accepted cash or kind in exchange for sex regardless of establishment-based or not	24,435,734	MSM: 2.2 MSW: 0.4
Sri Lanka (2013)	7,551	All men who have sex with other men as a matter of prevalence or practice, regardless of their sexual identity or sexual orientation.	5,049,250	0.1
Thailand (2015)	571,000	Prevalence of same sex behaviors in the last 12 months among males	17,681,890	3.2
Viet Nam (2013)	382,506	Men who have sex with men	26,182,125	1.5

Table 2: Population proportions of High-Risk Groups in UNAIDS regions

Proportion of adult population (15-49) that is a member of each group, by appropriate gender		UNAIDS regions							Total
		Asia and Pacific	Caribbean	East and Southern Africa	East Europe and Central Asia	Latin America	North Africa and Middle East	West and Central Africa	
Female sex workers	Number of Countries	12	2	7	9	5	3	11	**47**
	Median	0.35	–	0.58	0.68	0.49	1.18	1.19	**0.67**
	range	0.18–2.33	2.40–2.50	0.25–3.00	0.42–1.25	0.12–1.91	0.94–2.78	0.57-3.00	**0.12–3.00**
	25–75 Percentiles	0.26–0.67	–	0.41–1.66	0.46-0.97	0.16-1.52	–	0.84-1.88	**0.39–1.23**
Men who have sex with men	Number of Countries	14	4	9	11	9	3	12	**62**
	Median	1.69	2.71	1.28	1.39	1.49	0.9	0.72	**1.22**
	Range	0.09–4.06	0.40-5.00	0.16–3.20	0.18–4.00	0.59–5.47	0.61-2.08	0.05-2.00	**0.05–5.47**
	25–75 Percentiles	0.26–3.0	–	0.25–1.85	0.62–2.04	0.99–3.30	–	0.34-1.38	**0.50–2.00**
People who inject drugs	Number of Countries	10	–	7	8	–	1	3	**30**
	Median	0.06	–	0.6	2.18	–	0.06	0.1	**0.11**
	range	0.001–1.04	–	0.004–2.72	0.47–3.30	–	–	0.05-1.60	**0.001–3.30**
	25-75 Percentiles	0.03–0.16	–	0.03–1.58	1.11–2.97	–	–	–	**0.05–1.41**
Transgender people	Number of Countries	3	1	1	–	5	–	–	**10**
	Median	0.02	0.38	0.31	–	0.12	–	–	**0.11**
	range	0.02–0.06			–	0.03–0.42	–	–	**0.02–0.42**
	25-75 Percentiles	–	–	–	–	0.06-0.18	–	–	**0.04-0.25**

Source: Quick Start Guide for SPECTRUM Avenir Health, January 2017

3 Review of MPSE methods

This section describes the main mapping and population size estimations (MPSE) methods and discusses how they work as well as their respective strengths and weaknesses.

The review of scientific literature and reports in the preparation of this paper has focused mainly on experience with implementation of these methods in the past 10 years. However, additional readings are suggested in the bibliography section of the paper.

Select examples from India and the Asia Pacific region as well as other parts of the world are presented to understand advantages, limitations, challenges and lessons learned in estimating the sizes of HRG by using different MPSE methods and tools. Except for MPSE methods using representative population-based surveys, most of these approaches are intended to produce estimates for smaller geographical areas.

Data for the MPSE may be collected directly from the HRG or from the general population (WHO/UNAIDS 2010). Accordingly, MPSE methods are grouped into two broad categories: Direct method and Indirect method (Table 3). In the direct method, data is collected from the HRG. In the indirect method, data is collected from the general population.

There are various methods of MPSE in each category. The methods under each category have been described in the subsequent sections.

Table 3: Categories of MPSE methods

Direct method (data from/on key populations)	Indirect method (data from general population)
Wisdom of the crowds	General population survey
Census/comprehensive mapping	Network scale-up
Enumeration	
Multiplier (programme/service/ unique object)	
Capture-recapture	

3.1 Direct methods

This section briefly describes the methodology for each of the direct methods mentioned in the table above. For further details on any of these methodologies, the guidelines and publications referenced in this document should be consulted.[7]

3.1.1 Wisdom of the crowds

The "wisdom of the crowds (WOTC)" considers that aggregate predictions from a large crowd can be accurate and produce results which will be comparable to those obtained from experts. As a size estimation method, WOTC assumes that HRG/ KPs are familiar with the size of their population. One of the ways to implement WOTC is to ask survey participants during a survey among HRG as to how many of their members live in a specific geographical area. Then the mean or median of their responses is taken as an estimated size of the population.

The WOTC method is based on a couple of key assumptions: (a) the people who are sampled have unique information or perspectives about the population in question, and (b) individual responses to the question are independent of each other so that in the aggregate, extreme values tend to cancel each other out.

The strength of this method is that it is very simple to implement, requiring only the addition of a few questions to an already planned survey, thereby adding very little cost. The weakness of the method is that it tends to produce low estimates with extremely wide plausible ranges, possibly because people are knowledgeable about the sizes of their own networks, but beyond those, their estimate is mostly conjecture.

Review of the literature indicates that this method has been used, along with other popular MPSE methods, in a number of African countries including Ghana, Kenya and Tanzania. Box 1 highlights their experiences with the WOTC method.

3.1.2 Census/comprehensive mapping

Through the census or comprehensive mapping methods, an attempt is made to count every member in a population. This direct mapping and size estimations takes place by visiting every hotspot and collecting information on the number of members of HRG/ KP associated with that hotspot. Generally, the field assessment team talks to several key informants (including members of key populations and other key informants who are knowledgeable of the local context and presence of vulnerability and risk behaviours) to arrive at an estimated population size for each hotspot. Efforts are made to complete the exercise in a short period of time to minimise the effects of migration or mobility between areas.

However, these mapping methods must still account for double or multiple counting among hotspots and sometimes adjust for other factors such as the frequency with which HRGs visit hotspots and movements across different hotspots.

[7] It is also important to mention that there are other direct MPSE methods described in the literature. For example, MPSE methods like Reverse Tracking Method (RTM), Proxy Respondent Method (PRM), Respondent Driven Sampling (RDS), successive sampling and Crosswise Method (CM) have been used in a few countries but are still under development. The suggested reading after the reference section includes some of the papers on evolving methods of size estimation.

Box 1 Wisdom of the crowd

In Ghana, the WOTC method was utilised as part of the 2011 Ghana Men's Study (Quaye et al. 2015). It was used in combination with other MPSE methods including mapping, unique object multiplier, service multiplier and modified Delphi. These different methods were employed in different stages involving an Integrated Bio-Behavioural Survey (IBBS), preceded by literature review and a formative pre-assessment, and stakeholder consultations. Compared to the other methods, WOTC produced significantly lower estimates of the number of MSM and the confidence intervals of the estimates were abnormally wide across all study sites.

The WOTC method was also used in Nairobi, Kenya (Okal et al. 2013) and in Zanzibar, Tanzania (Khalid et al. 2014) to estimate the size of FSW, MSM and IDU. In both cases, the method was also used in combination with multiplier and other MPSE methods and integrated into an already planned IBBS survey among key populations. Like in Ghana, the estimates in Kenya and Zanzibar, using WOTC were significantly lower than those produced by using other MPSE methods, and the confidence intervals of the estimates were very wide.

In all three cases, the WOTC method was used in a survey among HRG, as this is a necessary precondition for its application.

Wherever the population of interest is well-defined and visible, census or comprehensive mapping is thought to provide better results than other methods. It specifically works well for relatively smaller geographical areas. It is not that suited for geographically large or diverse areas where HRGs are more scattered. One of the major limitations of census or comprehensive mapping method is that its implementation is costly and time consuming.

The method is also not well suited for estimation of the size of populations that are more 'hidden' and do not frequent physical venues or hotspots much.

In the past, a number of countries in Asia including India, Bangladesh and Nepal carried out MPSE among various HRGs using various mapping methods. Box 2 highlights their experiences.

3.1.3 Enumeration

Whereas census or comprehensive mapping aims to map all the locations and estimate all the members of a given population group at these locations, enumeration develops a sampling frame and estimates all the members within selected units (preferably randomly selected with stratifications) of the sampling frame. For example, in a city, a small number of brothels, bars, lodges or other hotspots can randomly be selected to arrive at the average number of FSW per brothel, per bar and per lodge to estimate the total number of FSW in the city by extrapolating it to the entire sampling frame of FSW for the city.

The enumeration method has the advantage of involving a simple calculation which is easy to understand, but it may not perform well for the hidden components of HRG. Enumeration shares similar advantages and disadvantages with census and comprehensive mapping. The additional benefit however is that, as it tends to cover a smaller fraction of the population, it requires fewer people and lesser time to implement. The experience with use of the enumeration method in India and Rwanda is illustrated in Box 3.

Box 2 Mapping

India carried out a large-scale comprehensive mapping exercise in 2008-09 among HRG including FSW, MSM and IDU across 17 major States. A similar exercise in selected States including Andhra Pradesh and Karnataka was undertaken in 2010-11. In 2013, a comprehensive mapping among hijra/ transgender (male-to-female) people was carried out across 17 major States. These mapping studies covered only "visible" HRGs.

Bangladesh carried out a mapping exercise in 2015 (NASP, 2016) covering all the major HRGs including FSW, MSM, male sex worker (MSW), hijra/TG and IDUs. It covered 21 districts of the country and extrapolated estimates for the remaining 43 Districts. One of the major challenges was the significant hidden component of HRGs, particularly among MSM and IDU. Efforts to account for the missing component using an adjustment factor was challenging.

Nepal undertook a similar mapping exercise in 2016 (NCASC, 2017) among FSW, MSM, MSW, Hijra/TG and IDU across 44 selected districts (out of a total 75 Districts). Districts were selected in a way to ensure representation from different epidemiological as well as ecological zones so it could be extrapolated for the remaining 31 Districts. Nepal also faced challenges in estimating the size of hidden sub-groups in MSM, IDU and FSWs, especially home-based FSW who mainly operate through mobile phones.

Box 3 Enumeration

As part of a collaborative study on "Heterogeneity of the HIV Epidemic in North-Eastern States of India" in 2002-03, NACO carried out a population size estimation exercise among injecting drug users (IDUs) in five North-Eastern States. Enumeration was used to estimate the size of this HRG in two cities including Imphal (Manipur) and Shillong (Meghalaya). Injecting sites were mapped and listed and nearly one-third of these were randomly selected for visits by field enumeration teams. The total number of IDUs at each site was estimated through direct observation and key informants interviews. The mean number of IDU per site was calculated and applied to the entire list of injecting sites to arrive at the total estimated size of IDUs in the city. The main challenge of using this method was to reach out and enumerate IDUs who were not frequenting known injecting sites.

In Rwanda, enumeration was used in 2010 to estimate the size of FSW across all provinces of the country (Mutagoma, 2014). Each province was divided into three separate strata: bars, brothels and streets. A sample of bars, brothels and streets from each stratum was randomly selected and visited by the field teams. They identified and counted FSW at each randomly selected physical hotspot. The average number of FSW was then calculated for each stratum and applied to the entire province to estimate the size of FSW in a province. The stratification process helped improve the accuracy of the size estimates however, FSW not frequenting physical venues or hotpots were not covered.

3.1.4 Programme multiplier

In general, programme multiplier methods rely on having information from at least two data sources that overlap in a known way. More specifically, in the case of the programme multiplier, the first source should be a count or listing from programme data (e.g., number of FSW who visited the programme STI clinic in the last month, number of MSM who visited the programme Drop-in Center in the last one month). The second source should be a representative survey among members of the key population whose size is being estimated (e.g. BSS, IBBS). In the survey, each respondent will be asked whether they received the specific service. Several alternative programme multipliers can be considered for a size estimation exercise depending on availability and quality of programme data.

Calculation of the estimated size, based on the programme multiplier, is mathematically very simple. The size is derived by multiplying "number of members of a given population who attend a specific programme service" over a defined period of time by "inverse of the proportion of the same population group who responded (in the survey) that they attended the same service" during the same period of time.

Estimated size = n *(1/p)

where:

n is the number of HRG members who accessed a specific service during a defined period of time.

p is the proportion of members of key populations who reported having accessed the same service during the same time period in a representative survey among that population.

Programme multiplier method is one of the most popular and widely used methods in the recent past, particularly after the publication of the last size estimation guideline by UNAIDS/WHO in 2011 (Wesson, 2017). Its popularity is mainly due to its simplicity and straightforwardness. However, this method requires good quality programme data (first source) as well as appropriate questions inserted into a good quality, representative survey with a well-designed survey instrument (second source).

One of the major challenges in implementing the programme multiplier method correctly is finding data for the two sources that correspond with one other. One of the important factors behind successful use of the multiplier method is the need to have clear, consistent definitions between different data sources. First, the population definitions must be clear and consistent. Second, the time reference period must be the same in both data sources. Third, the age range of the populations to be compared must be similar. Finally, the catchment area for the services or institutions must be clear and should ideally be the same as that covered in the sub-population survey from which multipliers are derived.

3.1.5 Unique object multiplier

In the case of the unique object multiplier method, the first source should be a count of unique objects (e.g., unique key ring, hand band etc.) distributed among the members of a given HRG whose size is being estimated shortly before the survey (e.g. one week before). The second source should be a representative survey (e.g., BSS, IBBS) of the population. In the survey, each respondent is, then, asked whether they received the unique object during the week before the survey.

Estimated size = n *(1/p)

Where:

n is the number of unique objects distributed among members of the relevant population group during a defined period of time.

p is the proportion of members belonging to that same population who report in a representative survey having received the same unique object during the defined period.

Like the programme multiplier, the unique object multiplier method is one of the most popular and widely used methods in recent years, particularly in areas where there is no programme intervention and no opportunity to use a programme multiplier approach. Applying the method requires a survey among HRGs but is, in this case, quite cost effective. This method is dependent on: good record keeping of distribution of unique objects through different channels, as well as use of a "unique object" that will memorable to the recipient, and that will unlikely be mistaken for any other object or passed on to another person because it is attractive.

Box 4 Programme multiplier

In India, the programme multiplier method was used as part of the Integrated Bio-Behavioural Assessment (IBBA) implemented under the Avahan Project in 2006-07. This method was used for estimation of the size of FSW in five districts in Maharashtra, five districts in Tamil Nadu and three Districts in Andhra Pradesh. For MSM, this method was used in four Districts in Andhra Pradesh, three Districts in Tamil Nadu and one District in Maharashtra. Based on participatory consultations with programme staff and a review of existing programme monitoring data, indicators for "exposure to Avahan interventions" were selected to be used as programme multipliers including (1) registration with the project, (2) contacted by peer educator or outreach worker in the past one month, (3) received a new health card in the last three months and (4) visited Avahan clinic in the past three months. Although the survey instrument was sufficiently specific in asking respondents if they had been exposed to specific Avahan interventions, some respondents were not aware as to who had provided the services they had received. This was due, in part, to the varying intensity of branding of project activities by the State level and NGO partners, and that in some Districts, various NGOs were providing the same type of service, which made it difficult for clients to differentiate between services provided by different providers (Vadivoo, 2008).

In Myanmar, the programme multiplier method was utilised in 2013-14 to estimate the size of IDU/PWID in 10 townships spread across the country including in Yangon, the capital city. This was a population size estimation effort undertaken in connection with Myanmar's first ever IBBS. Three different "exposure to interventions" indicators were used as programme multipliers: (1) received an HIV test from a specific NGO in the past three months, (2) visited Drop-in Center of a specific NGO in the past three months, and (3) received methadone treatment from a specific health facility in the past three months. The main challenge was to explain the differences in estimates produced by using the three different programme multipliers as well as other size estimation methods such as unique object multiplier and Delphi method. Consensus on final size estimation for each township was reached through triangulation and analysis of results and consultations among various stakeholders. Furthermore, an extrapolation method was applied to estimate the size of IDU/PWID at national scale by using results from the 10 townships covered by the IBBS (Myanmar MoH, 2014).

One of the major challenges in implementing the unique object multiplier is the inability to track the exact number of unique objects distributed to members of a given population. There are many possibilities for over- or under-estimation related to the distribution of the objects. For example, individuals receiving more than one object, not recalling receiving the object, passing the object on to another person as well as fewer objects distributed than thought, or objects distributed to people who are not eligible for the survey can all lead to over-estimation of HRG size. People reporting having received the object, when they did not, or people who received the object being more likely to have participated in the survey than those who did not which is particularly an issue when peer outreach workers recruit regular clients as recipients of the unique object, can all lead to under-estimation. The last is a common reason for under-estimating the population size when the multiplier method is used, because it violates the assumption of independence of the two sources used for the calculation. It happens when the survey is not random and there is a greater likelihood of inclusion of Other people exposed to programme interventions challenges with the unique object multiplier method include differences in definition, reference period, or catchment areas used for the two data sources.

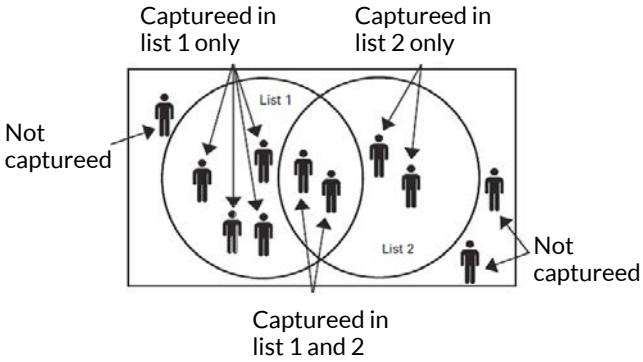
3.1.6 Capture-recapture method

Like the multiplier method, the capture-recapture (CR) method also involves tagging people in two overlapping data sources. Based on a method first used to estimate sizes of animal populations (such as the number of fish in a pond), this method is sometimes referred to as 'mark and capture' or 'capture and release'.

The standard steps for implementing CR method are as below:

- Prepare an exhaustive list of the sites where the population can be found, based on information collected during mapping or sampling frame development exercise of BSS.
- Visit all the sites and tag all members of the population found at the site. Keep a count of the persons tagged (C1).
- Re-visit all the sites one week later and tag all the members encountered during the second visit.
- Keep a count of the persons tagged during the second visit (C2).
- Identify and count the persons who were tagged twice, both in the first and second visit (R).

The three key counts mentioned above i.e. total number of persons captured during the first visit (C1), total number of persons captured during the second visit (C2) and total number of persons captured twice (R)–in both first as well as second captures - are used to estimate the population size using the following simple mathematical formula:



N = (C1 * C2)/R

Where:

N is the estimated total population size.

C1 is the total number of persons captured on the first visit.

C2 is the total number of persons captured on the second visit.

R is the total number of persons captured on both the visits.

Box 5 Unique object multiplier

Bill and Milind Gates Foundation (BMGF) funded 'Avahan Project' integrated the unique object multiplier method as one of the MPSE methods in the IBBA conducted in 2006 and 2009 as part of the overall evaluation framework of the Avahan Programme. This was implemented in the following five States of India: Andhra Pradesh, Maharashtra, Tamil Nadu, Manipur and Nagaland. The method was used for estimating the size of FSW in 16 Districts, for MSM in 10 Districts, and for IDUs in three districts in the North-East region. The main challenge was to keep track of the number of unique objects Distributed. Also, some respondents could not remember correctly in the survey whether they had or had not received the unique the object as the uniqueness of the object was questionable (Vadivoo, 2008).

Myanmar used the unique object multiplier method in 2013-14 as part of an IBBS conducted among IDU in 10 townships of the country including the capital city. Plastic bracelets in different colors with a "Getting to Zero" label were used, because of their uniqueness and simplicity. The distribution took place just one week before the survey and the unique objects were distributed in a way that tried to avoid survey participants to receive more than one bracelet. However, there was still a major challenge in documenting the exact number of bracelets distributed. There were also challenges in explaining why the size estimates of IDU was smaller by this method than for the other MPSE methods used in the same survey, in most of the townships (Myanmar MoH, 2014).

In the CR method there are four key assumptions that need to be fulfilled to produce rigorous results:

1. **Samples are independent from each other and not correlated.**
2. **Each member of the population has an equal probability of being captured.**
3. **The individuals identified in both captures are correctly identified as recaptures, and no one else is identified as a recapture.**
4. **There is no major in-migration or out-migration from the population between the first and second captures.**

A simple two-stage sample capture-recapture method is relatively easy to use, because it does not require much data or statistical expertise. However, it is difficult to see all of the four underlying assumptions fulfilled when this method is used to estimate the size of populations at higher risk, for HIV infection. Fulfilling the last assumption is particularly challenging as most of the HRG populations are prone to mobility and migration. These factors undermine the ability to perform good capture-recapture exercise. These same limitations also apply to the programme and unique object multiplier methods.

Box 6 Capture-Recapture

In Thailand, an exercise using the Capture-Recapture method was carried out in 2015 to estimate the size of MSM in Chiang Mai–the second largest city in Thailand, located in the northern part of the country. Overall, eight key venues (i.e., two boy bars, two men massage parlours, two public parks and two pubs frequented by MSM) were selected for two capture-recapture exercises. A very short gap of one week was built in between the two captures and a brooch was used as a tag. The main challenge in implementing the method was to satisfy all assumptions. Also, one week between the capture and the recapture rounds was found be too short (Surit, 2016).

Capture-recapture method was also used in 2003-04 in Imphal, the capital of Manipur State of India to estimate the size of the IDU population present in this major city of the North-East Region of India. Nearly one-third of all injecting sites were randomly selected for the first capture. Each of these sites were visited and all IDU present were tagged. Another random selection of one-third of all injecting sites was performed independently from the first, for involvement in the second capture after two weeks of the first tagging. Each of the selected sites was visited and all the 'matches' were identified and counted. All other necessary information was recorded. The main challenge was fulfilling the four key necessary conditions for the capture-recapture method to work, particularly the second one. It was very difficult to ensure an equal probability of being tagged for every IDU in each of the two rounds.

3.2 Indirect methods

Indirect methods collect data from the general population. Population survey and network scale-up methods are two of indirect methods of MPSE using data collection from the general population.

3.2.1 General population surveys

Indirect methods of MPSE are used primarily for producing MPSE of key populations in relatively small geographical areas. However, in countries where large-scale representative sample surveys involving the general population are regularly done (e.g., Demographic Health Surveys), this method can also be used for the same purpose. This method use the proportion of respondents who respond "yes" to questions of whether they have engaged in particular risk behaviours (i.e., paying for sex, having anal sex and/or injecting drugs).

3.2.2 Network scale-up

A second method, using general population surveys, is network scale-up method (NSUM), in which questions about High-risk behaviours among acquaintances of respondents are asked as part of general population surveys. The biases include respondents' social isolation or their ignorance of High-risk behaviours (transmission error) among their acquaintances. Also, estimating their personal network size is not always straightforward and can be complicated for some respondents (Abu abdul-quader 2014). There is mixed acceptance of the utility of network scale-up methods, as these methods appear to consistently produce estimates that are considered too high (Wesson, 2017).

3.3 Summary of MPSE methods and lessons learnt

Critical review of experience and lessons learned in designing and implementing MPSE using different methods underscores the point that there is no gold standard or flawless methodology for MPSE. Each method has its own strengths and limitations, and the estimates generated by different methods can vary substantially. Some methods are better for capturing HRG population members who are often present in public venues. Others are more apt for situations where a large number of them are either not present nor easily identifiable at public venues. The strengths and weaknesses of various methods have been summarised in Table 4 (Abdul-Quader 2014). In addition, the relevance of some of the methods has become increasingly limited in the context of the changing dynamics, where High-risk contacts and interactions increasingly occur outside of physical locations through chatting and dating tools and apps, via the internet or smartphones.

Besides the well-established methods as recommended by United Nations documents, there are few other methods which has been implemented in one or other ways for population size estimation. For example, the successive sampling (SS) size estimation method relies on a Bayesian model that uses prior knowledge from local experts or population size estimates from previous studies, in conjunction with observed data from a respondent driven sampling (RDS) study to estimate likely population sizes. The population sizes estimated through this method are presented as a distribution with means, median and probability intervals, rather than a point estimate and confidence intervals.

As there is no gold standard, experts have recommended that multiple methods be used to generate multiple estimates, and then triangulated, in order to reach a point estimate. The Delphi method has usually been used to synthesize the results of the various methods resulting in some midpoint or median among the available estimates. While estimating the size of the HRG population in Kenya, Okal et al. used modified Delphi during the analysis phase. For this, they convened a workshop with a variety of stakeholders to synthesise the new information and the estimates gathered during the study to interpret results. At the workshop, preliminary point estimates for population sizes, were presented, median estimate of all methods used identified and feedback and expert opinions elicited. In addition, upper and lower plausibility bounds for the estimates were established based on the shared local and international data.

Table 4: Strengths, limitations and context of various mapping & population size estimation methods

Sn	Methods	Strengths	Limitations	Context
1	Census (mapping)/Enumeration: involves visiting all known sites in a defined geographic area, developing estimates for each individual site and then summing those estimates to create a total across all the sites. This may involve conducting a head count of key population members at each site, as observed by the team conducting the mapping, or it may involve estimates given by key informants or a combination of both.	Straightforward, direct estimate/count for the visited location; Can produce credible lower limit; Can be used to inform other methods.	Usually do not account for hidden population; shift from a venue-based system to virtual platform further enhance the possibility of underestimation.	Most suitable when programme implementation is the main objective.
2	Capture–recapture: Size estimate is based on two independent captures (samples): Capture 1: 'tag' and count number tagged; Capture 2: 'tag' and count who is 'retagged' and who is 'first time tagged'.	Relatively easy to do with access to population; Does not require much data.	Relies on 4 conditions that are hard to meet: The two captures must be independent and not correlated; Each population member should have equal chance of selection; Each member must be correctly identified as 'capture' or 'recapture'; No major in/out migration.	Use this method when census/ enumeration is not feasible, or no or poor quality service data.
3	Multiplier method: Apply a multiplier (e.g., number receiving particular service/ having membership or number receiving a unique object distributed prior to a survey) to survey estimate (proportion of survey sample sharing same characteristic).	Uses data sources already available; Flexible in terms of sampling methods; first source need not be random, but second source should be representative of population.	The data sources must be independent; The data sources must define population in the same way; Time periods, age range, geographic areas must be aligned; Data collected from existing sources may be inaccurate.	Use when a behavioral survey is being planned or undertaken; the multiplier can be based on either accurate service provider data or results of distributing unique objects by outreach worker before the survey.
4	General population-based survey: Ask respondents if they engage in the behavior of interest (e.g., male–male sex, money for sex, inject drugs).	Surveys are common and familiar; Easy to implement if a survey is underway; Straightforward to analyze; Sampling is easy to defend scientifically.	Low precision when the behaviors are rare; Respondents may be reluctant to admit to stigmatized behaviours; Only reaches people residing in households (mobility); Privacy, confidentiality, risk to respondents.	Consider using with already planned general population based surveys.
5	Network scale-up is based on the assumption that people's social networks reflect the general population sampled in a survey.	Can generate estimates from general population rather than hard-to-reach populations; Doesn't require survey respondent to disclose stigmatizing behaviors about him/herself.	Average personal network size is difficult to estimate; Some subgroups may not associate with members of the general population; transmission error: respondent may be unaware someone in his/her network engages in the behavior of interest; Reporting bias (i.e., social desirability) may arise.	Consider adding to already planned general population-based surveys.

4 Mapping and population size estimations under NACP

The National AIDS response in India has a long history of undertaking MPSE for HRG. Broadly, these size estimates are derived from periodic direct mapping methods where all the potential hotspots (places where the HRG population may congregate) are listed and then visited to estimate the size associated with each of them. Estimates obtained from direct mapping methods have been aggregated bottom-up /extrapolated to derive the district, State and national estimates. National level population size estimates were produced in 2004 and 2009-11 for HRGs, including female sex workers (FSW), men who have sex with men (MSM) and injecting drug users (IDU). Population size estimations for hijras /transgender (H/TG) people were generated at a National and State level in 2012-13.

Since then, there has not been another major population size estimation exercise. However, NACO in collaboration with State AIDS Control Societies (SACS) and Technical Support Units (TSU) has carried out programmatic 're-validations' which have also served the purpose of updating size estimations for setting targets to measure prevention programmes coverage. The evolution of HRG size estimates under NACP has been summarised in the sub-sections below.

4.1 Evolution of MPSE under NACP

4.1.1 MPSE in era of NACP II

The history of size estimations under NACP can be traced back to the second phase of NACP-II. Targeted interventions (TI) were initiated in this era, to prevent HIV infections in HRG. These interventions were located in areas where concentration of High-risk groups was perceived to present a higher risk of HIV transmission. However, during the implementation of NACP II, it was realized that a more systematic approach was needed, and several initiatives were started such as situation assessments in high prevalence Districts, needs assessment of local communities and groups etc. to strengthen size estimates. Between 2002 and 2005, many SACS had completed mapping studies. These studies attempted to map the locations and estimate the size of population sub-groups at these locations. However, the mapping exercises were not uniform in methodology, definition and rigour. The other major limitations of these studies were that they were urban-centric except for States like Kerala where the urban and rural divide is merging, or studies done in rural areas of Gujarat, Karnataka etc.

4.1.2 Population size estimates developed by expert group in NACP-III planning stage using existing information

An early attempt to develop national size estimates for core HRGs took place during the planning stages of NACP-III in 2006 by means of a desk review of existing data and consultations (similar to a Delphi method). The estimates, developed by an expert group, were based on a review of available MPSE data collected within the framework of the programme under NACP-II. It also used evidences generated by other HIV prevention initiatives implemented in India at that time including, AVERT, ICHAAP, UNODC, HUMSAFAR, FHI, AVAHAN and other projects. The National level estimates from the expert group have been summarized in Table 5.

For FSW, the expert group reviewed the available mapping data from the SACS as well as the data available with other implementing partners. The review revealed that majority of the mapping data was from urban/peri urban areas and also many districts did not have any data on HRG size. Accordingly, adjustments were made to include: the a) Districts which were not covered and b) for rural areas. The under estimation was also adjusted by classifying States by prevalence and also based on regions.

Table 5: National level HRG size estimates (2004)

Population group	2004
Female sex workers (FSW)	8,31,677 to 12,50,115
Men who have sex with men (MSM) (more than 5 partners) Male sex workers (MSW)	23,52,133 2,35,213
Male injecting drug users (IDU)	96,463 to 1,89,729
Female injecting drug users (IDU)	10,055 to 33,392

The expert group estimated the MSM size by making certain assumptions on sexual behaviour patterns after a thorough secondary review. The method assumed that 65% of total male population (ages 15 onwards) were sexually active, 5 % of the sexually active male had same sex activity (anal exposure), 20% of homosexually active men had 5 or more partners in the previous month and 10% of these were Male Sex Workers (MSW).

For IDU population too, the expert team did extensive literature review. Finally, two data sources were used for estimating the population size. The first source was the MPSE results as carried out by select States. The second data source used was from the addiction treatment centre run by the Ministry of Social Justice and Empowerment (MSJE). It was assumed that that 5- 10% of the total admission in an addiction treatment centre run by MSJE comprise of IDUs and 10% of the IDUs in the community at any point of time would report being admitted to treatment centres within the past one year. This assumption was applied to all States in the north east region where quality of mapping data was assumed to be good. Further, to estimate the size for female IDUs, it was assumed (based on the available literature), that female IDU comprise 5-15% of the total IDU and accordingly lower and upper estimated figure for female IDUs were arrived at.

Source: *Strategy and Implementation Plan, National AIDS Control Programme Phase III (2006-2011), National AIDS Control Organization, MoHFW, GoI*

4.1.3 MPSE under NACP III

After the launch of the third phase of National AIDS Control Programme in 2007, efforts were initiated for systematic mapping of core HRGs i.e., FSW, MSM, H/TG and IDU, as well as High-risk single male migrants and long-distance truckers considered as 'bridge populations'. This was different from previous size estimates in two key aspects. First, the effort was to use one standardized method across all the States. Second, the mapping was expected to be carried out by trained HRG members themselves using participatory methodologies.

The exercise started with a 'broad mapping' to identify locations and populations in the catchment area covered under the programme. Locations and HRGs beyond TI coverage, where evidence showed their likely concentrations were mapped as well.

The information was then used to designate the number of required TIs for the HIV prevention programme. One of the first activities of the NGOs and CBOs running the TIs was to conduct participatory site assessments (PSAs) in their assigned catchment areas to collect information from key informants including members of HRG. Mapping was thereafter expanded to identify key locations with concentrations of HRGs that were beyond TI coverage.

During 2008-09, 17 States were covered under this mapping and size estimation exercise.[8] This mapping exercise was followed by a revalidation exercise conducted by International Institute for Population Sciences, Mumbai. Over the next two years, few more States were covered through this direct mapping approach. Finally, the numbers from the mapping exercise across 21 States were aggregated as national estimates; of 8,68,000 FSW; 4,12,000 MSM; 1,77,000 IDU; 73,00,000 destination single male migrants and 20,00,000 long distance truckers. These estimates are used as current official estimates for core and bridge population under NACP except for H/TG . For H/TG people, a size estimation activity was carried out separately in 17 States during 2012-13.[9] While the above-mentioned direct size estimates focussed largely on urban and peri-urban areas, size estimates for rural areas were also available as a part of mapping activities under Link Worker Scheme (LWS). Overall, estimates for High-risk group population were available for 54 Districts across 18 states[10] (90,300 FSW, 12,000 MSM and 7,900 IDU).

4.1.4 2009: National, State and District level size estimates under Mid mid-term review of NACP-III

A mid-term review (MTR) of NACP-III was conducted from 16 November- 3 December 2009 that included representatives from World Bank, DFID, UN and other development partners. The mission carried out a comprehensive evaluation of strategies, plans, resources and activities undertaken in the first half of NACP-III. Many exercises were implemented as a part of MTR on the effectiveness and impact of strategies, progress against the set targets and areas that need mid-course corrections. Size estimation for HRG at Districts, State and National level estimates was one among them.

[8]Assam, Bihar, Chhattisgarh, Goa, Gujarat, Jharkhand, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Odisha, Punjab, Rajasthan, Uttar Pradesh, Tripura and Jammu & Kashmir

[9]Andhra Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Kerala, Maharashtra, Manipur, Nagaland, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal

[10]Karnataka, Madhya Pradesh, Tamil Nadu, Andhra Pradesh, West Bengal, Nagaland, Manipur, Mizoram, Tripura, Kerala, Goa, Maharashtra, Gujrat, Bihar, UP, Odisha, Rajasthan, Chhattisgarh

The size estimation exercise during MTR used the data from the mapping exercise of 17 states, targeted interventions and link worker scheme. A three-step process was used to estimate the HRG size. In the first step, the size of rural HRG was estimated. This was done by arriving a rural-urban ratio for each HRG by using data from the LWS and mapping exercise. In the next step, a point estimate (urban + rural) for the total HRG size in each District and State was determined. In step three, uncertainty bounds around the point estimates were determined using the urban mapping point estimate and the TI programme data targets. The aggregated estimates from the MTR exercise has been summarised in Table 6. While MTR provided size estimates for 17 states, the estimates for all states/Union Territories (UT) were published subsequently as state/UT Fact Sheets under NACP III.

Table 6: National level HRG size estimates, MTR (NACP-III)

Population group	2009 (urban and rural from 17 states)	2009 (All states)
Female sex workers (FSW)	483,409 to 774,361	11,58,203
Men who have sex with men (MSM)	137,214 to 266,811	4,27,045
Injecting drug users (IDU)	68,540 to 131,972	1,63,162

Source: (i) Final PPT made during MTR of NACP III by Size Estimation Expert Group (2009) for 17 States (ii) National AIDS Control Programme Phase III, State Fact Sheets, March 2011

4.1.5 2013: MPSE for hijras/transgender people

A large-scale MPSE. exercise was commissioned by NACO with support of UNDP in 17 states of India from December 2012 to September 2013 to estimate the size of H/TGs (or trans-women) (Subramanian, 2015). The mapping was implemented by the National Institute of Epidemiology (ICMR- NIE). Interviews with key informants from the H/TG community and other persons having a good understanding of these groups were sought to identify hotspots and estimate the size of these groups frequenting them. Districts were randomly selected in each of the 17 states/UTs. A sub-set of sites were mapped which were visited for validation of the estimations through interviews and discussions with key informants.

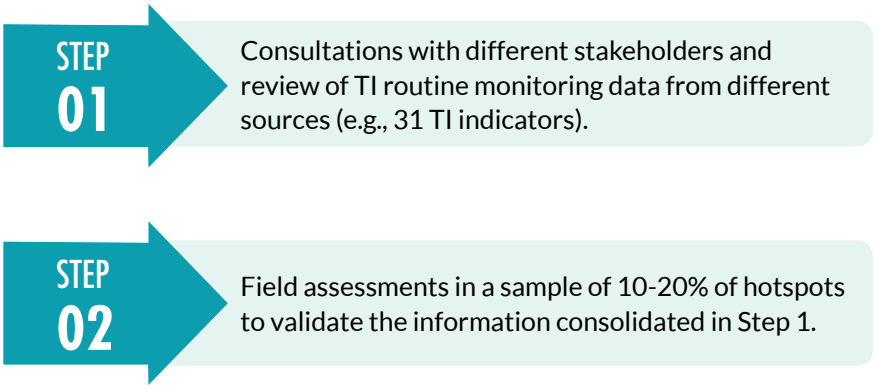
The population mapped was defined as "individuals who self-identify themselves as hijra, transgender or any other local/regional variations of these terms to refer to male-to-female transgender people (Shiv-shakthi, Yellamma, Jogappa/Jogta, etc.); and who access 'hotspots' (sites to meet potential sex partners—especially clients of sex workers); who are in brothels or brothel-like spaces (e.g., Hamams [bathing places] or massage parlours); or in other accessible places for intervention; and who are in woman attire - full- or part-time" (Thilakavathi et al., 2015).

Overall, a total of 5,821 sites were identified in the mapping exercise with 71.4% of them in urban and 28.6% in rural areas. The H/TG population in these locations was estimated in the range from 53,280 to 74,297. The point estimate was 62,137 of which 21% were found in rural and 79% in urban areas. Nearly two thirds of the estimated total number of H/TG population were accounted for in five states which in order of burden included Maharashtra, Uttar Pradesh, Odisha, West Bengal and Andhra Pradesh.

4.1.6 2014 onwards: Site re-validations in TI areas

After 2009-11, for all HRG and 2013 for H/TG, there have been no separate MPSE exercise pertaining to HRG and bridge population in the country. However, the number of HRGs and bridge populations (long distance truckers and single male migrants) have regularly been reassessed through 'site re-validations' done with the help of TSUs.

The 'Site re-validations' exercise is done in two steps:



'Site re-validations' are done by the TSUs periodically (every 3, 6 or 12 months) and consist of a review of various TI data and the verification of the numbers of HRGs recorded by the TIs in the line lists of HRG clients. HRG members who have not accessed any HIV related services in the preceding 6 months are sought so that they can be brought back into the programme. Those who cannot be found are dropped from the TI's HRG client line list. Information on newly enrolled HRG clients is also scrutinized and their number accounted for in the establishment of the up-to-date total number of HRGs in each TI area. The mapping data from TIs, in terms of confirmation of existing hotspots and identification of new hotspots and HRG numbers therein, is also assessed and re-validated.

A sample of hotspots is then visited by the TSU staff together with TI outreach workers and/or peer educators who help establish lists of potential key informants to interview. During the visits, a Hotspot Information Format (HIF) is filled with information from observation, interviews and review of records. A number of key informant interviews are usually also conducted with members of different HRG groups, a process in which strict confidentiality is expected to be maintained.

These regular 'site re-validations' have helped measure changes in the number of HRG benefitting from the TI prevention programme. They also have facilitated the setting of annual targets against which progress under the NACP-IV is measured.

4.2 Other size estimation activities in India

Avahan Project, by Bill and Melinda Gates Foundation, conducted two rounds of Integrated Behavioural and Biological Assessment (IBBA) in select States including Karnataka, Tamil Nadu, Andhra Pradesh, Maharashtra and Nagaland. The first round was carried out in 2006 and the second in 2009. In both rounds, sizes of FSW and MSM were estimated in the project areas using three different methods: capture-recapture, programme multiplier and an approach based on the Hansen and Hurwitz model, called reverse tracking. The results of application of these different methods are documented in various publications (Vadivoo et al., 2008; Adhikary, 2013). Authors concluded that use of multiple size estimation methods results in different estimations which need to be triangulated to identify the strengths and weaknesses of each single method and come up with a final adjusted estimate. The choice of methods needs to be done carefully taking contextual factors into consideration. Assumptions need to be addressed in each setting based on a good understanding of population dynamics and limitations of available data. Hence, assessment of the situation, including by use of qualitative methods, was recommended.

Another MPSE attempt was made in 2007 to estimate the size of IDUs in Punjab, Haryana and Chandigarh (Ambedkar, 2008). This involved use of a RDS and use of a specific software, the 'respondent driven sampling analysis tool' (RDSAT) as well as a multiplier technique. The study, which lasted three months, was carried out in a select number of districts and produced estimates of the prevalence of IDU in the general male population in each district. This measure was then used to calculate the total estimated number of IDUs in the state. The exercise allowed to establish a lower and upper limit of the number of IDUs. The authors of the report concluded that the methods used were fit for producing robust size estimations.

5 Mapping of population operating through web-based platforms

With an increasing number of HRG populations, especially MSM and FSW, seeking sexual partners through mobile phones and the Internet, the virtual space has been characterized as a newly emerging risk environment for HIV transmission. As per the national IBBS 2014-15, three fourth of FSWs reported to use mobile phones to contact clients. A study by Delhi State AIDS Control Society (DASCS) and India Health Action trust (IHAT) has documented the shift of venue-based locations into virtual network as a result of the entry of mobile phone-based communication into the female sex work.[11] Another qualitative study in the States of Tamil Nadu, Kerala, Maharashtra and Goa concluded that FSWs, irrespective of their enrolment in targeted HIV prevention interventions (TIs), have already started using Internet-based mobile apps (WhatsApp), dating sites, online classifieds (for example, Locanto) to solicit, pick-up clients and negotiate rates.[12] Among MSM, there is growing literature documenting use of social networking apps/dating sites/online classifieds (e.g., Grindr, Scruff, Badoo, Planetromeo, Whatsapp, Facebook, Locanto, etc.) for meeting with casual and paying partners. [13, 14, 15]

This changing dynamic has been appropriately noted in both the MTA and NSP under NACP-IV. While this shift from earlier venue based systems to now increasing use of virtual network presents challenges for HIV prevention service provision, it has also put greater limitations on direct MPSE which require contact with the population.

Clearly acknowledging the existence of populations which operate on the virtual platform, the national AIDS response has been exploring options to deliver a comprehensive package of services as well as estimating the size of HRG operating

[11]Changing Female Sex Work Patterns in Delhi: Geographical to Virtual Network , Delhi State AIDS Control and India Health Action trust;2015.

[12]Changing Dynamics among Female Sex Workers in India: A Rapid Assessment. The HIV/AIDS Partnership: Impact through Prevention, Private Sector and Evidence-based Programming (PIPMPSE) Project. Public Health Foundation of India (PHFI) Technical Brief 03, 2017.

[13]Rhoton, Jayson, et al. "Sexual Preferences and Presentation on Geosocial Networking Apps by Indian Men Who Have Sex With Men in Maharashtra." JMIR mHealth and uHealth 4.4 (2016).

[14]Ferguson, Heather. "Virtual Risk: How MSM and TW in India Use Media For Partner Selection." (2016).

[15]Changing Dynamics among MSM in Sex Workers in India: A Rapid Assessment. The HIV/AIDS Partnership: Impact through Prevention, Private Sector and Evidence-based Programming (PIPMPSE) Project. Public Health Foundation of India (PHFI) Technical Brief 03, 2017.

through these platforms. While direct methods of census/enumeration as well as multiplier/capture can all be adapted to virtual social environments, a well-established methodology estimating reliable methods of population size estimation in virtual environments is still under development. However, FHI360 has been testing multiple methods for estimating the size of MSM population operating through the virtual network via its LINKAGE project in select locations of India.

The first method, named as Outreach 2.0, is a model for virtual peer outreach. In essence, it is a census mapping of all virtual spots and their characterization, which includes estimating the size of key population at each of the virtual hotspots. The second method, named as Outreach 3.0, is an adaption of capture-recapture method in the virtual world. The method uses marketing data to estimate the market size (social media profiles which have the attribute of interest), then assess the rate at which the HRG typology expresses this attribute on social media as well as the rate at which those expressing this attribute are the HRG typology. In the next step, it estimates the duplicates and finally provides the estimates for the key population on virtual platform.

Separately, a 'density mapping' was undertaken by the project, using data collected through use of MSM dating apps such as Grindr, Hornet, Scruff and Blued. As these apps have an in-built GPS system, it is possible to measure the density of app use and map it graphically at different times of the day and week. For instance, experiments were made to count the number of online Grindr users within 500-1000 meters of certain points across the cities of Mumbai, Pune and Vijayawada. The mapping of large urban areas was made possible by the development of a new app allowing collection and display of data obtained from use of dating apps. Maps and tables produced allow measurement of the density of virtual and physical presence of HRGs in specific areas. This is proving helpful to guide HIV prevention outreach workers to reach out physically and online, to high density areas and to raise HIV awareness through adverts and relevant information when there is a large audience.

While all of these methods are promising, they are still in the initial stages of development. Potential biases and representativeness issues also need to be studied and addressed. Assumptions for geo-tagging a HRGs member in the virtual world is complex as the members operating in the virtual space may be based nearby or in more faraway locations within India or abroad. In using social media and apps, determining the physical location of HRG groups remains a challenge. Further, it is not always easy to identify an exhaustive list of online hotspots and determine the number of people interacting therein. A HRG member may have multiple virtual identities which pose further challenges to the size estimation process in virtual domain.

6 Discussion

6.1 There are limitations with every method

Available evidences clearly indicate that nearly all the standard methods of MPSE have their own strengths and limitations with no gold standards for MPSE. Independent census and enumeration exercises are relatively straightforward but are costly. They mostly miss out hidden or hard to reach populations and thus usually provide lower-limit HRG size.

The methodological prerequisites for the capture-recapture method (closed population, independence of sources, equal likelihood of capture etc.) are difficult to establish and implement in the real world. The multiplier method has been used extensively across the globe, however, different multipliers can yield vastly different results. Also, the multiplier method is often used as part of surveillance surveys and implementing a large-scale representative survey is resource intensive and will be difficult to implement every 2-3 years. Even so, the approach presents a significant opportunity to validate the size estimates, whenever such surveys are planned.

Use of general population surveys to estimate the size of key populations by addition of direct questions about high-risk behaviours, has been limited. This is because these surveys are designed to generate acceptably precise estimates of reproductive, maternal and child health indicators. In such designs, there is a potential of under reporting, with participants usually denying engaging in stigmatized or illegal behaviours. Asking such questions poses significant challenges in household settings. Further, household-based sampling does not reach locations where people either solicit or engage in High-risk behaviours and thus has a tendency to underestimate the prevalence of people engaging in high-risk behaviour. The network scale-up method is a relatively new method, and while it can produce a population size estimate at the National and State level, but it needs a large-scale population-based survey as well as adjustments to address issues emanating from low social visibility of HRG.

6.2 Combination methods help us understand the range

In view of the complexities, use of a combination method may help to interpret the range of estimates. The use of multiple methods and careful triangulation and interpretation of estimation results allows us to off-set the limitations of a single approach. An important aspect in any size estimation exercise is consensus on a numeric range defining the minimum and the maximum estimated sizes of each HRG. Triangulating the results from various estimates and then applying a Delphi method can also help in arriving at a median among the available estimates. As explained previously, the Delphi method relies on a panel of experts assuming that consensual opinion of a group of experts can provide a reliable population size estimate of HRG.

6.3 Definitions of HRG for MPSE will have considerable implications

The definition of HRGs will have a significant impact on the estimated size. Choice of a broader definition vis-a-vis a narrowly constructed definition or something in between, will result in significantly different estimates. For example, UNAIDS estimates of MSM in Asia and the Pacific range from 0.9%-4.06% of adult males. In all likelihood, this variability does not represent true differences between the countries but rather a difference in the way the HRG has been defined.

However, the definition issue needs to be worked out and clearly defined from a MPSE perspective. Ideally, the definition shall be broader to account for all the people to be engaged in a particular risk behaviour. This is especially useful when the purpose is advocacy (i.e. providing evidence that such a population exists) or resource mobilization (applying for programme funding). However, a broad definition may lead to overestimating the number of HRGs in need of HIV prevention services which may ultimately reflect as programmes not being able to meet outreach service provision targets (e.g. condom distribution, HIV testing, needle and syringe exchange programme etc.). Therefore, it is best to adopt a definition in consultation with programme managers and as per the objectives of the population size estimation. However, it is critical to define the HRG clearly and explicitly and document well, so that stakeholders are aware of the populations groups being referred to, during estimations.

6.4 HRG do operate in virtual space but methods to estimate their size is still evolving

As technology has evolved and become more widely available, more and more HRGs (especially MSM and FSW) have started using social media apps to find partners rather than (or in addition to) going to physical venues. These developments pose greater challenges for direct methods of MPSE. However, HRG do exist and operate through the virtual world and hence there is a fundamental need to estimate the size of this population from epidemiological, advocacy, as well as programmatic perspectives. Methods which are standard for venue-based mapping and size estimates (physical mapping, multiplier, etc.) have the potential for adaptation on virtual platforms and there are ongoing pilots to explore this. However, much work remains to develop and establish reliable methods of population size estimation in virtual environments.

6.5 Challenges in MPSE get amplified in large scale settings such as in India

In a country such as India, with a population of around 1.3 billion people, and with 36 States/ UTs, the choice of population size estimation methods is more challenging than in smaller countries. There are important time-related and financial implications that need to be taken into consideration. The National AIDS Control Programme has largely relied on independent, straightforward direct MPSE methods, especially during the second and third phase of NACP implementation. Besides having the standard limitations described earlier, and being costly, they have been done only in selected locations covering urban/ peri-urban areas. The extent of mapping in rural areas has been limited to only about 60 districts, covering the most populous villages. Also, other issues pertaining to double counting, hidden populations or populations which operate through virtual platforms, remain unanswered by this method.

During the fourth phase of NACP, the national programme has relied more on in-built site re-validation activities as a mapping modality for programmatic purposes. As they are done through institutions established as a part of national programme, they have been relatively cost-neutral and effective for ensuring accountability of programme implementers and in assessing progress and needs in TI coverage areas. However, re-validation does not provide adequate information to estimate the size of HRGs outside of TI areas.[16] The nation-wide Integrated Bio-Behaviour Surveillance (IBBS) Survey conducted by NACO in 2014-15, wherein a population-based sampling frame was developed through mapping of hotspots, showed that almost 25-30% of all hotspots mapped were not covered by the TI Programme. Further, as the site-validation exercise uses a venue list provided by Targeted Interventions which are mostly urban/peri-urban, it does not take into account hidden populations, or provide sufficient information allowing for estimation of the total size of HRGs in the districts or at state and national levels.

Representative surveillance surveys among HRG, such as the 2014-15 IBBS, require vast human and financial resources, as well as time in such a large country and hence cannot be regularly repeated. This means that in India, commonly recommended methods such as the Programme Multiplier, Unique Object or other methods that hinge on the implementation of a representative survey, are not necessarily a feasible option. Low-cost and sustainable alternatives need to be adopted.

In this regard, the 2016 Mid-Term Appraisal (MTA) of the NACP-IV suggested the adoption of a wider and more systematic approach to map hotspots and estimate the size of key populations using data from multiple sources (NACO, 2016). The NSP (2017-2021) also recommended more systematic efforts to update population size estimates, comprising HRGs inside and outside of the TI coverage areas, on a more regular basis.[17]

[16]Mid-Term Appraisal of National AIDS Control Programme, Phase IV, NACO, 2016.

[17]National Strategic Plan for HIV/AIDS and STI 2017 – 2024 "Paving Way for an AIDS Free India", NACO, 2017.

7 Recommendations

Despite the complexities, there is significant potential for the National AIDS Response to systematically undertake MPSE exercises for HRG. The interventions among the high-risk groups have matured over the years with well-established institutional arrangements for technical support. The country has vast experience of implementing mapping and size estimations. Learnings from the previous initiatives are rich and valuable. Additionally, there are institutional arrangements in place which can ensure robust technical rigour for such critical exercises.

The next section of this document presents specific recommendations on how to proceed with important aspects of HRG size estimation in India, and how to address some of the most important challenges. The recommendations are based on past experiences and evidences which already exist. This is an attempt to establish a system which is scientifically robust and easy to implement, cost efficient to the extent possible, uses existing data systems and institutions, and can be updated periodically.

7.1 Objectives

Establishing the objectives of the MPSE is the most fundamental aspect to consider as it will have a bearing on all other considerations. There are two recommended primary objectives of the mapping and population size estimates in India. The first objective is to facilitate programme planning that includes geographic prioritization, local service delivery and target setting (local, district, State and national). The second objective is to inform epidemiological description and projections of the epidemic.

7.2 Definitions

Definitions of HRG to be used for the purpose of MPSE is another critical consideration. The term HRG refers to a group of people who are at increased risk of being exposed to HIV because they frequently engage in risky behaviour rather than the individual identity. It is not possible to state with absolute certainty that a person who engages in HIV/AIDS related risk behaviour on a less frequent basis will have less risk for HIV infection and should not be covered under prevention programmes. However, there is no perfect answer for an ideal definition. Still, from a public health programme perspective, focussing on people who have a higher risk of HIV infection with access to HIV with prevention services will always have a better return on investments.

In line with programmatic and epidemiological perspective, it is recommended that for this purpose the definition of HRG population should aim to represent people who engage in High-risk behaviours. The definitions adopted under the targeted interventions of the National AIDS Control Programme have been in line with these objectives. Table 7 summarizes the various definitions used under the programme and surveillance, vis-à-vis United Nations definitions.

Table 7: Definitions of High-risk population group

Population group	UN definition	Targeted intervention definition (NACP)	HIV sentinel surveillance definitions (NACP)
Female sex workers	Consenting adult (aged 18 years or older) females who regularly or occasionally receive money or goods in exchange for sexual services.	Adult woman who engages in consensual sex for money or payment in kind, as her principal means of livelihood.	Women, 15-49 years old, who engaged in consensual sex in exchange for money/payment in kind as a means of livelihood in the last six months.
Men who have sex with men	Males who have sex with males regardless of whether or not they have sex with women or have a personal or social gay or bisexual identity.	Men having sex with other men who can be self-identified and anal receptors with multiple sexual partners. Includes transgender people, kothis (receptive partner) and double deckers (both receptive & penetrative partner) and exclude panthis (penetrative partner).	Men, 15-49 years old, who had anal or oral sex with a male/hijra partner in the last one month.
People who inject drugs	Men or women who have injected any time within the previous 12 months (not including for medical purposes).	Injecting drug users are defined as those who used any drugs through injecting routes in the last three months.	Men and women, 15-49 years old, who use addictive substances or drugs for recreational or non-medical reasons, through injections, at least once in the last three months.
Hijra/transgender people	Transgender is an umbrella term to describe people whose gender identity and expression does not conform to the norms and expectations traditionally associated with their sex at birth.	-	Person whose identity does not confirm unambiguously to conventional notions of male or female gender roles but combines or moves between these.

As evident, the definitions used under the National AIDS Control Programme has been focusing on people who are at highest risk of HIV infections. However, there is a room for revisiting the definitions of HRG as HIV risk behaviours are changing in the context of increased use of modern communication technologies. For example, the definition for FSW under the targeted interventions focuses on sex work as the principle means of livelihood. However, as the national IBBS 2014-14 indicated, while 46% of the FSW had sex work as their only source of income, others reported engaging in other activities to earn income. Similarly, for MSM, defining only the self-identified and anal receptors is a restrictive definition in the current ecosystem in which they operate.

Determining the age groups in the definitions is another key consideration. While TIs under National AIDS Control Programme aim to cover only adults HRG, surveillance activities have always defined ages15-49 as the age group of the HRG for epidemiological monitoring purposes. It is important to note that around 10% of FSW in national IBBS 2014-15 reported age at first commercial sexual intercourse before 18 years. Similarly, the median age of first sexual intercourse by a MSM with a male/hijra partner was 17 years indicating that half were already engaged in sexual activity with a male partner before they became an adults. Similarly, 11% of male IDU had their first injection before they attained the age of 18 years. In view of these evidences, it is recommended to include 15-17 years old as part of the population group under consideration if they engage in high-risk behaviour in the context of the epidemiological estimation perspectives.

The other critical consideration while defining the population is the frequency and duration of the behaviour to be considered as a significant exposure for HIV transmission. There are no hard and fast rules, or standard guidelines. Some definitions suggest considering life time exposure, while some suggest one year. Some also narrowly define the duration of exposure as the last one month. Having a broad definition of life time exposure or at least one exposure in the last 12 months may lead to a very large size of population which may not be extremely relevant to the HIV epidemiological transmission perspective, and also will become unrealistic from programmatic settings. On the other hand, limiting the definition to at least one exposure in the last one month may include only those who are at extremely High-risk of HIV but may exclude a number of people who are at High-risk for HIV infection. In view of this, it is recommended to determine the frequency as at least once in the last six months as a part of the definition of high-risk group population from size estimation and mapping perspective.

In view of the above considerations, the recommended definitions of the various high-risk group for size estimations purposes are as below:

Female sex workers

Women who engaged in consensual sex in exchange for money/ payment in kind at least once as a means of livelihood in the last six months.

Men who have sex with men

Men who had anal or oral sex with more than one male/hijra partner at least once in the last six months.

People who inject drugs

Men and women who use addictive substances or drugs for recreational or non-medical reasons, through injections, at least once in the last six months.

Hijra/Transgender people

Sexually active person having more than one sexual partner in the last six months andwhose identity does not confirm unambiguously to conventional notions of male or female gender roles but combines or moves between these.

7.3 Geographical units

As evident by the description of the history of mapping and size estimation activities in India, the system right now is stronger at the local level. These estimates are important for planning, implementation and monitoring of local programs. However, district, State and national level estimates are also required not only from a programmatic perspective, but also from an epidemiological perspective.

7.4 Approaches to population size estimation

In a large and heterogeneous country such as India, with a total population of around 1.3 billion and 36 States/Union Territories, it is impossible to obtain local area estimates (city, towns, villages) for all geographical areas across the country, no matter which methodology is used. Such an endeavour would be too time consuming and costly. Therefore, collecting local area estimates using direct MPSE methods in strategically selected locations, and then using extrapolation procedures to make inferences about areas which do not have direct estimates, is recommended for India. The critical part of extrapolation involves deciding from where to collect direct MPSE data and how to use those data for extrapolation. Direct MPSE methods are generally implemented in high epidemic areas and hence a simple extrapolation using them as a base may result in over estimation. Hence, stratified mapping will be helpful for reliable extrapolation. Further, at every stage, it is recommended to always describe the resulting estimate as a range. State and National level estimates from such extrapolation can also be used in SPECTRUM models for estimates and projections of incidence and prevalence at the State and National level.

It is important to note that higher level estimates, when based on direct mapping and population size estimations in high priority locations, can still underestimate the size of High-risk populations which are either hidden or operate through virtual networks only. While efforts are still ongoing to develop an accepted method for estimating the size of HRG operating only through virtual platforms, it is recommended that their size be estimated at least at the national and State level using assumptions based on available evidences. It is further recommended that the final size estimates thus arrived give a break-up of HRGs available only in physical locations, HRGs available at both physical and virtual locations, and HRGs available only at virtual locations. This differentiation will be required by the programme for designing a tailored services and targets for different sub-groups of the population, based on their location and availability.

7.5 Mapping as a preferred direct size estimation

Building on India's long history of conducting venue-based mapping to identify hotspots and estimating the sizes of HRGs/KPs, as well as programmatic and institutional efforts of using the information to update targets and guide micro-level planning, it is recommended to establish "Mapping" as the direct MPSE method at the heart of a standardised approach. The method is straightforward, easy to implement and does not require an independent sample survey as required in the multiplier or capture-recapture methods.

There are four critical aspects to establishing 'Mapping' as the preferred method of direct MPSE under NACP: (i) who shall do it, (ii) where it shall be done, (iii) what shall be the frequency, and (iv) how to validate the estimates.

As the TI programme has matured over the years and institutional arrangements are in place for technical rigour, it is recommended that mapping and size estimation shall be integrated

with the programme implementation structures under the National AIDS Control Programme with an objective to repeat the exercise biennially. This will enable community-based mapping of high technical rigour in a relative cost neutral but highly time efficient manner. To facilitate this process, a systematic and standard MPSE application document shall be developed, clearly mentioning the methodology as well as outcomes, for high quality implementation with comparable results. The method shall explicitly establish the mechanisms to respond to known issues associated with the direct MPSE method, especially that of double counting.

It is recommended that the whole exercise have a biennial cycle. This will be consistent with various activities under the National AIDS Control Programme. Surveillance has a biennial cycle with PLHIV burden estimation as a product which uses MPSE data extensively. However, while the cross-sectional mapping shall be designed and implemented biennially, neither the location nor the population is static and hence an in-built periodic revalidation between mapping years will help the programme plan for course-correction and re-calibration of HIV interventions as and when required. As mentioned earlier, it is recommended that since direct mapping cannot be done for every locality of India, data will be collected for local area estimates using this method in strategically selected locations and then using extrapolation procedures, make inferences about areas where mapping is not done. The strategic locations will be selected in a way so as to facilitate extrapolation for unmapped localities at a later stage. Accordingly, local areas shall be stratified according to expected higher, medium and lower concentrations of HRGs and direct size estimation data from a diverse set of locations used to make inferences. The priority areas will be decided in consultation with programme divisions after considering both epidemiological and programmatic needs.

This direct mapping will be further complemented by other direct methods such as multiplier and capture-recapture methods, as and when opportunities arise. The National AIDS Control Programme has a rich history of implementing periodic behavioural surveillance surveys. Having a size estimation component in-built into these surveys will enrich the programme's understanding of the population size. It is therefore recommended that MPSE mapping be considered as an additional objective for future behavioural surveillance surveys that may be planned under the National AIDS Control Programme. In addition to such large-scale behavioural surveillance surveys, studies shall be encouraged to include size estimation in local level data collection efforts subject to objective alignment and resource availability. It is also recommended to explore the possibility of complementing direct mapping estimates with integration of appropriate questions under relevant household surveys such as the National Family Health Survey. While household surveys have a tendency to underestimate the prevalence of people engaged in high-risk behaviour, it will still help in providing a minimum estimated size of the relevant populations. In order to prepare for the possibility of using NFHS data, a matrix can be established, listing questions which are already included in the NFHS and listing those that may be added in the next survey round.

7.6 Establish a working estimate based on the available resources

While a full-fledged MPSE exercise will take a minimum of 6-9 months from designing to outcome, it is recommended to develop an interim working estimate for the country on a priority basis. Calculating estimates in this manner is not a new concept and has been done in the past to inform the programme, e.g. during the planning stage of NACP-3, or during the mid-term review of NACP-3. These estimates not only help the programme understand the larger perspective but also help the explanatory power of the direct MPSE results.

8 Way forward

Mapping and population size estimations are a critical component of any National AIDS Response. However, there is no gold standard method. The issue has been a challenging one for multiple reasons across the globe. Besides the inherent strengths and limitations of each method, the issues of definition, location, population and intended utilisation pose significant challenges. A changing ecosystem, where HRGs/KPs shift from physical locations to virtual spaces, further complicates this equation. This white paper has provided a comprehensive review of the existing established systems of population size estimations, their evolution in India, and recommendations on the critical elements systematically updating the population size estimates in the country. With the above considerations, it can be concluded that direct MPSE in strategic locations, complemented with extrapolation for unmapped locations, can serve multiple purposes. Implementing this activity biennially in mission mode, with provisions of periodic revalidation between two rounds of update will provide quite a comprehensive and rigorous landscape for the exercise. Integrating the size estimation process within the programme ecosystem will help extract and maximize benefits from a very mature and stable implementation system which will not only facilitate high quality, community-led local area mapping but will also establish an inbuilt institutional practice for periodic size estimations.

As the immediate next step, it will be critical to develop an application document for implementing the periodic size estimation as recommended in this white paper. The National AIDS Control Programme has taken many initiatives to increase the coverage and quality of comprehensive package of services being offered to high-risk groups. Strategies are being revamped and the ecosystem for implementation of these revamped strategies are being worked out. These developments offer a very conducive environment to undertake size estimations, in line with recommendations of this white paper and thus developing a specific application document which outlines a clear approach, steps and tools will be critical.

The programme needs to continue to explore suitable methods to estimate the size of people who engage in high-risk behaviour exclusively on virtual platforms. There are ongoing pilots which can provide a way forward in this aspect. Although these methods being piloted can provide estimates up to the specific location of the user, using appropriate technology, it would be of great utility to the programme even if these methods can provide a reliable estimate at a higher level, i.e. up to the State and national levels.

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'Know your epidemic, know your response' is fundamental to a successful public health response. In context of HIV/AIDS, knowing the size of population who are at risk of contracting the HIV infection is a core component of knowing your epidemic.

This White Paper on 'Mapping and Population Size Estimation of High-risk Groups for HIV' in India aims to further augment the 'know your epidemic' under the national AIDS response by describing various methodologies used globally to estimate sizes of different high-risk groups as well as highlighting their strengths and weaknesses. It also reviews the India experience and recommends the framework for producing size estimates beneficial for HRG programming in the Indian context.

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