Population Size Estimation of

Men Who Have Sex with Men in Georgia, 2014

Study Report

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Acronyms

AIDS	Acquired Immune Deficiency Syndrome
BBS	Biomarker Behavior Surveillance
CI	Confidence Interval
CIF	Curatio International Foundation
FSWs	Female Sex Workersri
GEL	Georgian Lari
GFATM	Global Fund to fight AIDS, Tuberculosis and Malaria
HH	Household
HIV	Human Immunodeficiency Virus
MSM	Man who have Sex with Man
NSU	Network Scale-Up
PSE	Population Size Estimation
PSU	Primary Sampling Unit
PWID	People Who Inject Drugs
RDS	Respondent Driven Sampling
STI	Sexually Transmitted Infections
UNAIDS	Joint United Nations Programme on HIV/AIDS
USD	United States Dollar
VCT	Voluntary Counseling and Testing
WHO	World Health Organization

Executive summary

Background and objectives

Estimates of the number of people at risk for HIV infection, including men who have sex with men (MSM), are crucial for prevention, treatment and care planning. The Georgia Population Size Estimation of MSM is the second study of its kind (the first one conducted in 2010) to estimate the size of this population in Georgia, 2014. The primary objectives of the study was to estimate MSM population size in Tbilisi and Batumi by using different estimation methods and triangulating the findings to provide the most plausible estimates for the population size of MSM in Georgia.

Methods

Given the well-accepted international definition of MSM, in this study we defined MSM as those:

1. being male

2. having (anal or oral) sex with another men in the past 12 months

3. being of at least 18 years old

4. holding Georgian nationality

5. residing or working in Georgia

For MSM population size estimation, seven methods were used to produce a range of estimates for two geographic areas, Tbilisi and Batumi; including the "network scale-up method", "capture-recapture method based on network links", "service Multiplier method", "Unique object multiplier method", "Gay Mobile apps and websites service multiplier", "Handcock's RDS network based method" and "wisdom of crowd" in Tbilisi and "network scale-up method" in Batumi. To adjust the NSU estimates for its two known biases, information transparency bias and popularity ratio, a group of 210 MSM were recruited by a respondent-driven sampling (RDS) method in Tbilisi through peer-referrals. The study was entirely anonymous with verbal informed consent.

The median of the various estimates and their boundaries were hypothesized to be the most plausible size estimates for Tbilisi. Since the NSU population size estimates (both point and confidence bounds) for MSM in Batumi were at surprisingly low level, we used the overall number of MSM whom already registered at the prevention centers in Batumi as the lower bound for PSE. For calculating the PSE upper bound, we applied the MSM prevalence value (estimated for Tbilisi) to the size of adult population in Batumi. For the PSE point estimate, we reported the average of lower and upper bounds for Batumi.

Together, prevalence of MSM in Tbilisi and Batumi were used to produce a MSM population size estimate for other areas in Georgia. And then all estimated numbers were added up together to provide the overall prevalence and size of adult MSM in Georgia.

Key findings:

Tbilisi

Taking into account the different MSM population size estimated by various methods in Tbilisi, the median estimates for size of MSM population are 5,100 (acceptable interval 3,243-9,088). This is the 1.42% (acceptable interval 0.9 - 2.53%) of adult male population in Tbilisi.

Batumi

Based on NSU findings and ad hoc corrections, the size of MSM population is 450 (acceptable interval 344-566) in Batumi. It means the prevalence of MSM in Batumi is 1.15% (acceptable interval 0.88-1.42%).

Georgia overall

After extrapolating for the remainder of Georgia based on specific assumptions such as:

- If the % of MSM more than 18 years old in other areas in Georgia is the same as the mean of Tbilisi and Batumi estimates
- If the proportion of MSM who are hidden in other areas in Georgia is the same as the mean of Tbilisi and Batumi estimates
- If the number of all adult male estimated accurately in other areas in Georgia is the same as the mean of Tbilisi and Batumi estimates
- If other urban as well as rural areas in Georgia have an equal % of MSM

There are approximately 17,200 MSM in Georgia, with lower acceptable bound of 11,700 MSM and an upper acceptable bound of 27,600 MSM. This overall estimate suggests that the prevalence of MSM in Georgia is only 1.32% (acceptable interval 0.89-2.11%) of the adult male population.

Recommendations

Although our estimates were less than the international accepted level, we found a sizeable proportion of men in Georgia engaging in same sex relationship. Given the number of registered MSM in prevention services, it looks like the coverage of services is very low. More need be done to get such people linked into prevention services, which is the starting point of prevention and treatment cascade for HIV.

By applying various methods we were able to provide a more acceptable range for MSM in Tbilisi and Georgia overall and recalculate other urban areas prevalence. To provide more accurate local and national estimates in future PSE studies, we recommend to apply various methods in other cities.

It's highly recommended that such methods to be integrated into coming surveillance surveys going to be conducted among this and other key populations at risk for HIV in Georgia.

Introduction

Georgia is among the countries with low HIV/AIDS prevalence, but with a high potential for developing a widespread epidemic. The estimated prevalence of HIV among the adult population is 0.3%.(UNAIDS 2013) By the end of 2013, there was a total of 4,131 HIV cases were registered by the national HIV surveillance system. During the early stages of the HIV epidemic in Georgia, injecting drug use was the major mode of transmission. During the last two years heterosexual transmission was found among newly registered cases   44.8% in 2012 and 49% in 2013. However, we cannot judge about change in transmission route unless more detailed analysis of new infections is done. According to the national HIV surveillance system, HIV infections acquired through homosexual contact account yet for a small proportion of all HIV cases. In 2012, the homosexual route of transmission contributed to 9.3% and in 2013 13% of all newly registered cases, indicating an upward trend.(UNAIDS 2014)

The latest Bio-Behavior Surveillance (BBS) study among MSM in Tbilisi (2012) suggests that MSM have the highest HIV prevalence rates (13%) compared to other risk groups, with an increasing trend over recent years. This risk group, characterized by unsafe sexual behavior and multiple partners, creates the ideal environment for the transmission of HIV among the MSM population and their female partners.

Preventive interventions targeting this high-risk group are currently being implemented in Georgia. However, to determine the coverage of such services, and so better planning and scaling-up of preventive interventions, it is vital to have an acceptable estimate of the size of MSM population, even if it is a challenge to measure accurately the exact population size.

The lacks of a gold standard for size estimation of hidden populations, including MSM, make it difficult to assess which among these methods is most accurate. There are a number of methods available to estimate the size of hidden populations. Selection of a method depends on factors such as networking patterns, the visibility of the population, data accuracy of service providers, cultural factors, budgetary issues, etc.(WHO et al. 2013) Each method has its own strengths and weakness,

therefore use of multiple methods along with the triangulation of estimations allows for validation of findings when arriving to the most acceptable size estimation.

Study Objectives

The proposed study objectives were to estimate the MSM[1] population size in 2014 in Georgia by using different estimation methods and triangulating the findings to provide the most acceptable estimates.

Methods

In the absence of a gold standard for estimating the population size of a hidden and hard to reach population, estimates are empirically imprecise and prone to potential biases. The present study proposed seven mythologies (Network Scale-Up, Service Multiplier, Unique Object Multiplier, Mobile Apps Multiplier, Network based Capture-Recapture, Handcock's RDS based method and Wisdom of Crowd methods) to provide a range of estimates for population size of MSM in Georgia. The estimates were later presented to a group of experts and stakeholders to triangulate and synthesize the most rigorous estimate of the MSM population size in Georgia. The use of multiple methods strengthened confidence in estimates, provided upper and lower acceptability bounds, and reduced the likelihood that biases of any single method would have substantially alter results. The following describes the methods used in this study.

Method 1: Network Scale-up

One of the most promising approaches among size estimation methods is network scale-up (NSU) that has its roots in anthropology and social network analysis. The general concept behind network scale-up method is that an individual's social network is representative of the whole population. That is, one person's group of friends somehow reflects the characteristics of the whole community. Therefore, we can ask members of the general population whether their acquaintances, or alters, have high risk behaviors (such as having anal sex between men, or injecting drugs, or buying and/or selling sex). By asking questions about an acquaintance – a person other than the respondent – the interview takes on some anonymity allowing the responses to be honest without fear of stigma or other negative consequences for the respondent or his/her friends.

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[1] MSM refers to a diverse population that includes any men who have had sex with other men. It is an inclusive term that is based solely on behavior and does not take into account sexual identity. The term includes MSM who consider themselves to be gay, bisexual, heterosexual, are questioning their sexual orientation, or do not identify their sexual orientation in any way.

For example, if a respondent knows 100 men, and he knows that 2 of those acquaintances have sex with other men, then we can estimate that 2 out of 100 people in the general population are MSM. If we multiply that proportion by the total population of the country, say 5 million, we could estimate that there are 100,000 MSM in the country. The more respondents we have, the better the estimate becomes.

Estimating the hidden population size requires:

1. Estimating the number of people in the respondent's personal network (how many people does s/he know?)
2. Asking how many people they know in the hidden population
3. Dividing the number in the hidden population by the total network size
4. Multiplying that proportion by the total population
5. Adjusting the results for known and measurable biases.

Averaging these calculations over many respondents would create the following maximum-likelihood estimator:

$$\hat{N}_t = \frac{\sum_i y_i}{\sum_i \hat{d}_i} N$$

Where,

$\hat{N}_t$ is the estimated size of the hidden population

d is the estimated personal network size of respondent i

y is the number of people in the hidden population known by respondent i

N is the total population of the country

To estimate the number of acquaintances a respondent has, the active network size, we applied "known size populations" approach. Known population means that size of this sub-population is known e.g. number of women who gave birth.

The concept is simple; reconfiguring the above formula suggests we can estimate personal network size (d), by asking how many people the respondent knows among populations with known sizes and comparing that to the proportion of that population in the total population. For example, we have statistics on the number of women that gave birth in a year or the number of doctors. Using these "known populations" we will back-estimate a respondent's network size.

In this study, to improve the estimate of social active network size, we asked study participants on how many they knew from the 19 known size groups. The nineteen groups were:

Ten groups with specific "first names":

- How many people do you know with the "first name of **Luka**"?
- How many people do you know with the "first name of **Mamuka**"?
- How many people do you know with the "first name of **Zurab**"?
- How many people do you know with the "first name of **Vazha**"?
- How many people do you know with the "first name of **Sofio**"?
- How many people do you know with the "first name of **Manana**"?
- How many people do you know with the "first name of **Shorena**"?
- How many people do you know with the "first name of **Nino**"?
- How many people do you know with the "first name of **Maya**"?
- How many people do you know with the "first name of **David**"?

Nine additional groups of subpopulations:

- How many people do you know, who got **married** in 2013 year?
- How many **teacher**s do you know?
- How many people do you know, who **gave birth** in 2013 year?
- How many people do you know, who **died** in 2013 year?
- How many people do you know, who **died due to cancer** in 2013 year?
- How many people do you know, who were **injured or died** in road accidents in 2013?
- How many higher educational **students** do you know?
- How many **lecturers** in higher education institutions do you know?
- How many people do you know, who are currently **imprisoned**?

"Known size" subgroups were selected based on feasibility (the size is measured by some organization and seems to be accurate enough) and the general recommendation that the prevalence of every known size group should be between 0.1% to 4% (WHO, Regional Knowledge Hub for HIV/AIDS Surveillance, & Kerman University of Medical Sciences 2013). This is to prevent from over-recalling prevalent subgroups and under-recalling rare subgroups. We collect the size of above listed subgroups from the National Statistics Office of Georgia (National statistics office of georgia 2014) and Public Service Hall of the Ministry of Justice.(Public Service Hall of the Ministry of Justice 2014)

To estimate personal active network size, a random sample of the general population from households in Tbilisi and Batumi were surveyed. The sample size was comprised of 1015 and 150 participants in Tbilisi and Batumi, respectively. A two-stage stratified sampling was used. The National Statistics Department election list for 2010 year was used as a sampling frame. According to the list Tbilisi and Batumi is divided by municipalities (strata) and election areas. Election areas were selected as primary sampling units (PSU) and households as the second. Number of households in each PSU was defined as five. Within each municipality number of PSUs were selected based on probability proportion to size method. PSUs were selected from the list by system random method. Within each PSU the random walk method was used to select households. Within each selected household one person (aged 18-49 years) was selected to be interviewed (based on last birthday). If there were no response at the household after 3 visits (on different day and different time) the next household was selected.

The study participants were from the adult population ranging 18-49 years of age, who provided verbal informed consent to participate in the study. Final sample comprise of 1012 Tbilisi and 149 Batumi residents.

A structured questionnaire was developed to collect information on demographic characteristics, on personal network size and on the number of acquaintances representing high risk groups. The questionnaire and the three types of data collection (self-administered, interviewer-based administered or mixed) were piloted among 20 households in Tbilisi. Based on feedback from interviewers, the proportion of missing data, and the internal consistency of responses, the interviewer-based questionnaire was the most appropriate method. Data collectors were trained prior to the field work.

The data was collected through anonymous face-to-face interviews. (See Annex 1 for demographic characteristics of the NSU sample).

In the study, we used the below internationally accepted definition of "know" to provide a comparable personal network size to other studies/settings:

- [People that you know them by sight and name, and who also know you by sight and name]

  AND

- [People that you had some contact with either in-person, over the phone or internet(e.g.: e-mail, Skype, chat through social networks) in the last 2 years]

  AND

- [People of all ages who lives in Georgia].

In addition to questions about the number of people they know among a certain group of people (known size populations), we also asked if they know any (and then how many) people in their network who are MSM, female sex workers, clients of female sex workers, or injecting drug users:

- How many people do you know who inject drugs?
- How many men do you know who are clients of female sex workers?
- How many men do you know who have sex with other men?
- How many female sex workers (women who exchange sex for money) do you know?

Questions about high risk-group populations were asked with caution. The sequence of questions was as follows: IDUs, clients of FSW, MSM and FSW and each question included definitions of these groups. Injecting drug users were defined as "Injecting drug user is a person who injects narcotic drug without medical indication", clients of sex workers was defined as "those men who pay for having sex with female sex workers", MSM was defined as "men have sex with women, but there are some men who have sex with men." Here in this report we only present MSM findings.

The household survey fieldwork took place from April 10th to May 05th and for the barbershop fieldwork took place during June 5th to 12th 2014. See Figure 1 for timeline of all methods applied.

We applied bellow population size of Tbilisi, Batumi and Georgia in 2014(National statistics office of georgia 2014) to estimate the prevalence of MSM in those regions and Georgia overall (Table 1)

Table 1-Population size Tbilisi, Batumi and Georgia, 2014

	Male		Female		Total	
Area	**Total**	**18-59y**	**Total**	**18-59y**	**Total**	**18-59y**
Tbilisi	508,862	359,611	666,338	379,590	1,175,200	739,201
Batumi	57,472	39,168	70,528	41,344	128,000	80,512
Whole Country	2,198,300	1,307,580	2,401,500	1,382,360	4,490,500	2,689,940

Even with a high response rate in NSU this method has the following biases:(UNAIDS and The US Office of the Global AIDS Coordinator 2012)

- "Information Transmission effect or Transparency Bias"– A respondent may know someone, but not be aware of all of their behaviors (e.g. homosexual behavior).
- "Relative Network size" or "Popularity Ratio "–Members of the key populations may have a personal network size that is different from the general population.
- "Barrier effect" - The position of a respondent (e.g. physical barriers such as geographical or social barriers) may cause him/her to know fewer members of the population than would be expected. In addition, there could be barriers between the key populations and the

respondents that affect the likelihood that a respondent knows someone in the key populations.

- "Reporting bias" - People may fail to accurately report the populations in question or may be reluctant to do so because of the stigma surrounding the behavior of the population.

Transmission Bias and Popularity ratio can be corrected by directly contacting members of the high-risk populations and asking them questions about their acquaintances and how many of them know about the respondents sexual behaviors. For this purpose, the MSM study was conducted (see below).

The barrier effect is minimized when known populations satisfy "scaled-down" condition. In our case, for known population groups those names were selected that have minimal variations, whenever available all variations of the name were provided.

Reporting bias (which might be a case in our study due social desirability bias during face-to face interviewing) was not possible to correct.

The MSM study was conducted using RDS methodology. Initially 10 seeds were recruited from different income categories. This was to ensure adequate representation of MSMs from various income levels. The seeds were then recruited a total of 200 peers ages 18 years and more into the study in Tbilisi. The MSM study also served as a second source of data for multiplier method, a modified capture-recapture which was based on network links and also the wisdom of the crowd method (more details on these methods provided below).

RDS uses coupons with unique numbers to link who recruited whom and applied incentives for participating in a survey and for recruiting others to participate in the survey. In our study, participants were provided with a cash incentive of 25 GEL (roughly equal to 14 USD) upon completing of the interview. They were given an additional incentive of 5 GEL for every successful recruitment. They were able to recruit maximum three of their peers into the study.

Coupons with specialized ID numbers were used to keep track of this recruitment process. The chain-referral was continued until the whole sample of MSM (200) was recruited. Anonymous face-to-face interviews were conducted with a structured questionnaire.

Apart from the demographic profile (age, education, marital status, ethnicity, income) a short version of the Game of Contact method was also applied (Salganik et al. 2011). It involved asking recruited MSM about the number of people they know from the 19 "known population" groups. Following these questions, the respondents were asked about how many persons from each known population know that they have sexual contacts with other men.

Method 2: Multiple Multiplier

In the RDS survey, we integrated several methods to estimate the size of the MSM population, collectively known as "multiplier methods".

In this method two sources of data are needed:

- The first source should be a count from programme data including only the population whose size is being estimated (such as the number of MSM who attended the STI clinic or the number of persons who used mob/web apps during a defined time period, or the number of MSM reached by outreach team or were given a unique objective).

- The second source should be a representative survey of the populations whose size is being estimated.

The accuracy of estimated size from this method is highly dependent on the quality of the sources of existing data.

Method 2.1: Mobile/Web Apps Multipliers

Given the inputs from the two focus groups we conducted among MSM, we determined the most popular websites and mobile phone applications used by Georgian MSM population. We found that the most popular websites are Mamba.ru, Gayromeo.com; the most popular mobile application are: Grindr and Hornet. And then we implemented the bellow two steps:

1. Obtaining the unduplicated counts of the MSM using the above mobile and web apps over the course of two weeks prior to the interview and three weeks during MSM survey (1.5 month in total).
2. Estimating the proportion of MSM (in the RDS survey) who have used of the mobile applications or websites over the course of 1.5 months prior to the interview.

Using these two data sources, the multiplier method provides a population size estimate by the formula:

$$N = \frac{n}{p}$$

Where N is the MSM population size, given by n as the number of MSM using the mobile and web apps in the specified time period and p as the adjusted proportion of MSM reporting using the mobile/web apps in the time period collected in the RDS survey.

We used several mobile application and websites as multipliers simultaneously to minimize the potential biases of any one multiplier and produced median, upper and lower plausible bounds.

Method 2.2: Unique Object Multiplier

This method is similar to the Mobile/Web apps Multiplier method (explained above) but uses a "tag" of the target population shortly prior to the survey as the unduplicated MSM count.

The kind of unique objects that would be applicable by the target population was discussed during the focus group, which revealed that leather bracelets would be the most suitable objects for marking. Venues (streets, bars) where MSM population could be reached and gathering hours were identified in the focus group. At the end, outreach workers distributed 96 bracelets to eligible MSM during 5 working days.

The MSM study questionnaire included questions regarding the study participants having received the bracelet. These questions included:

1. In the previous 2 months, did you receive a bracelet?
2. Can you show it to me?
   (if not available)
3. Can you describe it to me? (if the bracelet is described properly, show it to them)
4. Is this the bracelet you received?
5. How many bracelets did you receive?
6. When did you receive this bracelet?
7. Where did you receive this bracelet?
8. Who did you receive this bracelet from?

To strengthen accuracy and recall, the outreach workers provided instructions to the MSM not to give the object to anyone else and to hold on to the object for at least three months.

Method 2.3: Service multiplier

This is one additional multiplier method. A health center in Tbilisi ("Health Cabinet") maintains records of MSM service users by unique code. The number of beneficiaries who used these services during last 6 months was obtained from the health center. The study participants were asked whether they received service in this health center during the last 6 months or not. The question was formulated as follows:

"Did you receive service in "health cabinet located at …" during last 6 months?

Analysis: The following analysis was performed for each multiplier method. The confidence intervals (CI) around the population size estimates was calculated using the Taylor-linearized variance estimation.(Johnston et al. 2013) The uncertainty around the number of individuals who

logged into the mobile/web apps was estimated by a normal distribution as a good approximation of the Poisson distribution with equal mean and variance to M:

M: Number of MSM who received the unique objective and its variance

α = Type I Error. Set at a maximum 0.05

$Z_{1}-\alpha/2$ = the normal standard transformation. When the Type I Error is 0.05, $Z_{1}-\alpha/2$ is equal to 1.96

The variances for M and P were combined by using the following formula (delta method):

$$Var(N) = \frac{Var(M)}{[E(P)]^2} + \frac{[E(M)]^2}{[E(P)]^4} Var(P)$$

$$95\% CI \; for \; N = N \; \pm 1.96 \times \sqrt{Var(N)}$$

Method 3: Capture-Recapture based on network sampling

Using the standard RDS protocol, we took this advantage to apply a new method proposed by Dombrowski (Dombrowski et al. 2012) to estimate the population size of MSM. The method is a modified capture-recapture method, which addresses traditional problems associated with the capture-recapture technique:

- The need for two distinct samplings of the population.
- The need for subject anonymity throughout the matching process when dealing with highly stigmatized behaviors (like MSM).

The proposed method depends on data captured during a single survey and involves a reliable way to recognize matches while maintaining anonymity, as well as a method for estimating the number of false matches.

In our study, in addition to demographic characteristics, network size, and questions about their social network size and information transparency ratio, every participant was asked to provide their own personal information (height, approximate weight, hair color, eye color, and ethnicity) and "telefunken code". The telefunken code derived from the last four digits of their own mobile phone number. To arrive at the code, each of the four digits is encoded as being either even or odd, and low or high (with 4.5 being the threshold). For example, the telefunken code for any phone numbers which ends with 1234 (or 3435, or 3235) is odd-even-odd-even-low-low-low-high, while for phone numbers ending in 7012 (or 5233) the code is odd-even-odd-even-high-low-low-low.

In addition to their own personal information and telefunken code, each respondent was asked to select up to five MSM contacts whose phone number they currently had in their mobile phone's directory. This selection was carried out by choosing initial letters of last names from a randomized list of alphabet letters. If they had five or less MSM contacts in their phone, all of these contacts were selected. The respondent was then questioned about the randomly selected contacts, in order to obtain data on the contacts' personal characteristics (approximate height, approximate weight, hair color, and ethnicity) and telefunken code.

The coded phone number (telefunken) together with height, approximate weight, hair color, and ethnicity produced (almost) an unique anonymized code for each respondent that serve in matching the respondent to contacts reported by other respondent interviews.

For purposes of the population estimate, study participants were treated as the "capture" population, while each of the contacts provided during the interviews ("reports") were considered a "recapture assay". Given the number of original respondents discovered via recapture assays (as a proportion of the total number of assays), we had a basis for estimating the overall size of the MSM population. As an illustrative example, let's assume we ended up with 198 respondents (n = 198) who have provided 487 "reports" (s=487). By considering six categorical variables (telefunken code, height, weight, hair color, and eye color) as the unique code, we will find the repeated cases (t=9) between the capture (study participants) and recapture (reports).

Using the Lincoln-Peterson method yields

$$P = \frac{n \times s}{t} = \frac{198 \times 487}{9} = 10,714$$

Where,

    P is the total population size

    n is number of captures

    s is number of recaptures

    t is matches

In brief, using 9 matches between 487 reports, and an initial sample of 198 respondents, yields a population estimate P = 10714.

Analysis: For the sake of having the study fully anonymous, we did not collect the exact names and phone contacts of participants and those MSM they have contact with (reports). This makes the matching process complex and poses some errors in the estimation. Using the marginal and joint probability of the six items used to build the unique code; we estimated the plausible range of error

in distinguishing the matched cases and did a sensitivity analysis to reproduce a range for the population size of MSM.

We also applied the following formula to estimate the standard error for the population size:

$$\text{SE}_{\text{P}} = \sqrt{\frac{n \times s \times (n - t) \times (s - t)}{t^3}} = \sqrt{\frac{198 \times 487 \times 189 \times 478}{9 \times 9 \times 9}} = 3457$$

For our illustrative example, the SE for p is equal to 3457 which leave us a 95% confidence interval for P as 3938 to 17489.

CI95% for P = 10714 $\pm$ 1.96 x 3457 = 3938 to 17489

Method 4: The Wisdom of the Crowd Method

The participants in the RDS survey were asked about their best estimate and range for the number of MSM in Tbilisi. Such an approach produces a measure of the perception of community members of the population size of MSM. Using the Giles' estimator (in RDS analyst software), we calculated the median for the point, minimum and maximum number of MSM reported by study participants.

Method 5: Handcock's RDS based method

This approach uses a successive sampling approximation to RDS to leverage information in the ordered sequence of observed personal network sizes. The inference uses the Bayesian framework, allowing for the incorporation of prior knowledge. (Handcock et al. 2014)

West (West 1996) proposed a model for estimating the number of oil fields based on the sizes of the known fields. Under successive sampling, larger units (i.e. oil fields) tend to be sampled earlier. The same concept applies to RDS sampling where participants with higher social connections had a higher chance to be recruited earlier than others who are more isolated. This is of course dependents on the total number of people in the community. This approach leverages the information in the decreasing size of sampled units (in RDS, it is called degree or social connectedness) over time to make inference about population size. It uses a super-population model-based formulation within a Bayesian inferential framework by positing a prior distribution over population size.

Here, we used the estimates from the network scale-up method as the prior knowledge on the size of MSM in Tbilisi. Given such prior and the likelihood of observed successive decrease in degree of recruited participants in the RDS data, we developed the posterior distribution of MSM population size in Tbilisi. The calculation was done by RDS Analyst Software (v. 04).

Study time-line

The study has several steps. Some were overlapped and others were implanted in an order. The time line of the study is presented bellow:

Figure 1 - MSM PSE study Time line
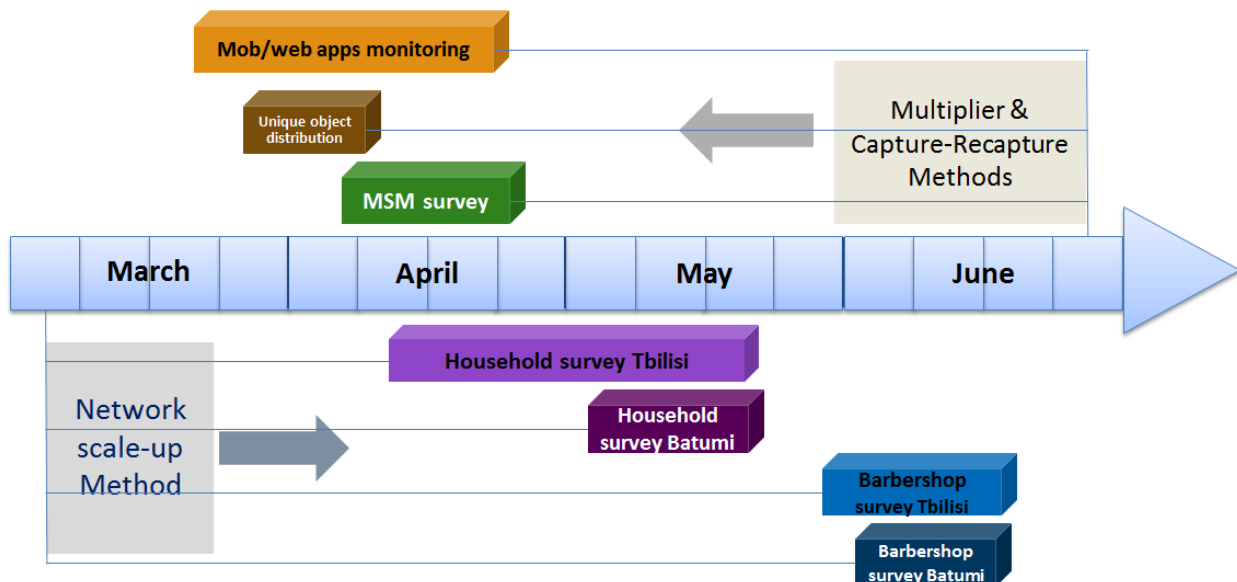
Ethical Issues

The study protocol and procedures were reviewed and approved by the Ethical Committee of the HIV/AIDS Patients Support Foundation (03/28/2014 - Certificate N719/820).

The basic principles of ethics in human research as stated by the Declaration of Helsinki were followed throughout this project. The ethical issues that have been taken into consideration were:

- Participation in these surveys was voluntary. Participants were free to withdraw at any time and were informed that refusal or withdrawal would not affect services they would normally receive.

- No names were recorded. All documentation is anonymous, linked only by a study code.

- The data collectors conducting the survey were trained in discussing sensitive issues and protecting participants' confidentiality and human rights.

Results

Network Scale-Up estimates

Active Social Network Size

Although we recruited participants from both houses and barbershops, we only report the results from household survey. This was decided based on the unacceptable bias ratio between the real and estimated size of "known size" populations we observed in the barbershop survey. Out of the 24 "known size" population groups used to estimate the social network size, only 4 remained eligible. This means that participants in the barbershop survey did not provide accurate responses to the questions. Field workers also noted that participants answered to the questions without enough attention and concentration. Due to all of the above limitations, the barbershop survey data was excluded from the analysis.

To calculate the average size of an active social network, we used a back calculation method using twenty-four "known size" populations. The lists of the populations used and their known (real) size are demonstrated in Table 2. (Table 2). Based on the ratio between the predicted and real size, we found four subpopulations ineligible (Rows marked as bold in the table).

Table 2 - the twenty four "known size" populations used for back-calculating the average active social network size, Georgia 2014

	List of populations with "known size"	Real size	Estimated size	Estimate to Real Ratio	Included in final calculation
1	Male first name – Mamuka	22293	27630.92	0.806814	yes
2	Male first name – Luka	32739	25859.57	1.266031	yes
3	Male first name –Zurab	32944	44404.1	0.741913	yes
4	Male first name –Vajha	13504	16117.13	0.837867	yes
5	Male first name - David	72304	76386.86	0.94655	yes
6	Female first name - Sopos	31372	43441.88	0.72216	yes
7	Female first name –Manana	34698	27237.29	1.273916	yes
8	Female first name – Shorena	15671	19036.58	0.823205	yes
9	Female first name – Nino	124108	85866.88	1.445354	yes
10	Female first name – Maya	47859	38521.46	1.242399	yes
11	married in 2013	34693	33601.04	1.032498	yes
12	teachers in 2012/2013	68670	78169.15	0.87848	yes
13	male teachers in 2013	10346	12104.25	0.854742	yes
14	**birth in 2013**	**57578**	**27084.21**	**2.125888**	**no**
15	died in 2013	49348	37318.69	1.32234	yes
16	male died in 2013	25453	20895.4	1.218115	yes
17	died due to cancer in 2013	5214	5937.313	0.878175	yes
18	male died due to cancer in 2013	2939	3378.692	0.869863	yes

	List of populations with "known size"	Real size	Estimated size	Estimate to Real Ratio	Included in final calculation
19	accident in 2013	6738	5521.81	1.220252	yes
20	male accident in 2013	2385	4351.842	0.548044	yes
21	higher education student 2012/2013	109533	137028.4	0.799346	yes
22	**professors and lecturers in high education 2012/2013**	**14753**	**53862.25**	**0.2739024**	**no**
23	**male lecturer in high education 2012/2013**	**6359**	**27138.88**	**0.234313**	**no**
24	**prisoner 31.01.2014**	**7728**	**18577.34**	**0.4159906**	**no**

After excluding the four ineligible subpopulations, the ratio between the estimated size and real size of all populations ranged between 0.54 to 1.44, with the R square of 0.8666 (Figure 2).

Figure 2 - The estimated and real population size of the twenty "known size" populations included in back-calculating the average active social network size, Georgia 2014
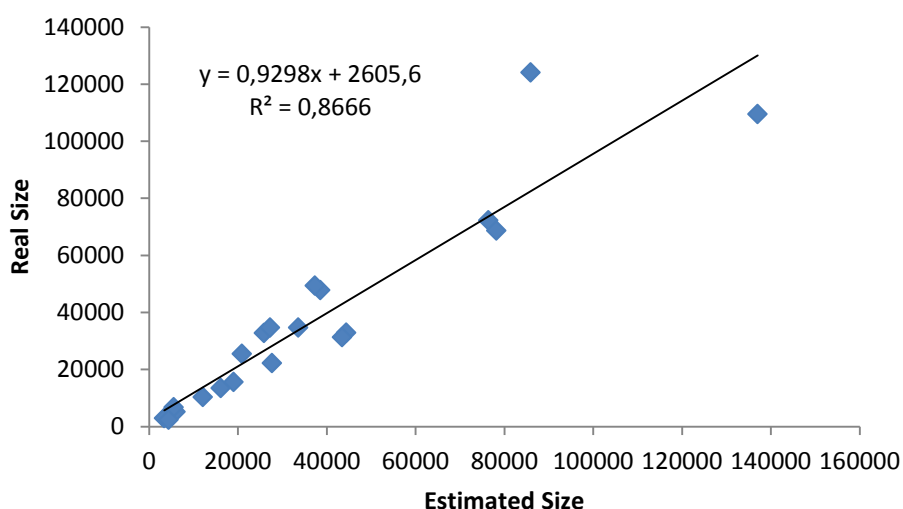
Using the twenty "know size" populations, we back calculated the social network size of study participants. Overall, the network size of people living in Georgia was estimated at 355 (95%CI, 342-366). Using the male/female and adult ratio of population in Tbilisi, Batumi and the whole country, we calculated the social network size of all and adult populations (Table 3).

Table 3 - The average active social network size of people living in Tbilisi and Batumi, Georgia 2014

	Male		Female		Total	
Living Area	Total	18-59y	Total	18-59y	Total	18-59y
Tbilisi	154 [148-158]	108 [105-112]	201 [194-208]	115 [110-118]	355 [342-366]	223 [215-230]
Batumi	159 [154-164]	108 [105-112]	196 [188-202]	115 [110-118]	355 [342-366]	223 [215-230]
Georgia	174 [167-179]	104 [100-106]	190 [183-196]	109 [105-113]	355 [342-366]	213 [205-219]

Numbers in [ ] are plausible intervals.

Transparency and popularity bias

From the MSM RDS survey, transparency bias and popularity ratio were estimated. Transparency bias for MSM was estimated as 26% (95%CI, 23-29%). This is equal to a correction factor of 3.83.

Popularity ratio for MSM was 6.7; which means MSM in Tbilisi had a 6.7 times larger social network than MSM.

In other studies, the range for the overall correction factor (including two types of biases such as transparency bias and social desirability bias) varies from 1.4 for MSM study in Japan (Ezoe et al. 2012) to 1.94 for the MSM population size estimation study in Ukraine(Paniotto et al. 2009). None has reported the amount of bias due to population mixing (popularity bias). Given the exiting literature and the estimates we got from the MSM survey, we applied the correction factor of 3.83 to NSU crude estimates.

NSU population size estimates

The population size estimates of different key populations at risk for HIV is presented in Table 4.

The total number of adult MSM (aged 18-59 years old) in Tbilisi was estimated as 5,816 (95%CI, 4,972 - 6,859). This means 1.62% (95%CI 1.38-1.91%) of adult men in Tbilisi have sex with other men. In Batumi, the prevalence of MSM among adult men (18-59 years old) was considerably lower and estimated as 0.5% (95%CI, 0.43-0.59%).

Table 4 - Population estimate size of different key populations at risk for HIV, using network scale-up method, Georgia 2014

Regions	MSM		
	Age Group	Frequency	%
Tbilisi	Total	6,014 [5,197 - 7,176]	1.18% [1.02-1.41%]
	18-59y	5,816 [4,972- 6,859]	1.62% [1.38-1.91%]
Batumi	Total	205 [177 -243]	0.36% [0.31-0.42%]
	18-59y	197 [168-232]	0.5% [0.43-0.59%

Numbers in [ ] are plausible intervals.

MSM survey findings

Socio-demographic characteristics

The median age of the recruited MSM was 27 years with the age range from 18 to 70 years (Figure 3).

Figure 3 - Age distribution
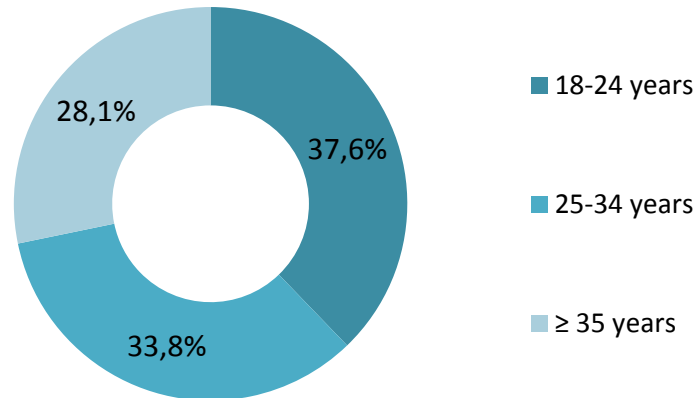
The median duration of living in Tbilisi was 20 years, while 57.6 % of participants moved into Tiblisi some time in the past. Regarding the education, a few (5.7%) had not completed secondary education level, almost half (49.1%) were at higher education level (Figure 4).

Figure 4 - Education distribution
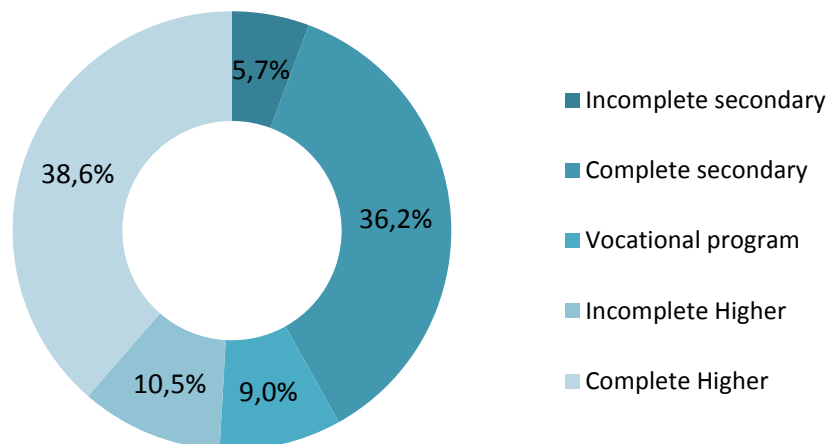
The majority (88.6%) of the respondents had Georgian nationality. More than 75% have never married, while only 12.4% were currently married. More than half (53.3%) reported their employment status as permanent or temporary employment, while 37.2% had no occupation. About

9.5% were students. Monthly incomes of 37.2% of study participants was reported as less than 300 GEL, while 24.8% have reported their monthly salary more than 500 GEL (Figure 5).

Figure 5 - Monthly income in GEL
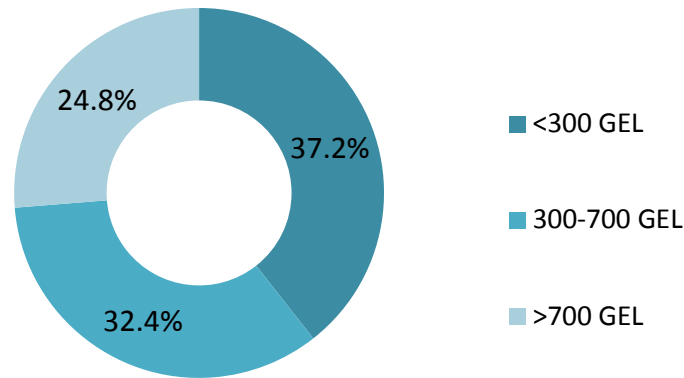
We illustrate the MSM recruitment chain in Figure 6 In the figure, squares represent seeds, circles represent recruited respondents. One seed did not recruit any participants, while one of the seeds has recruited more than half of study participants. Each circle or node represents one study participant. The size of the node is relative to the network size reported by the participant, while different colors yield to different monthly income. Recruitment pattern showed that MSM with low and high income are well connected among each other and so the RDS method was able to recruit MSM from different socioeconomic levels.

Figure 6 - Recruitment chain of Tbilisi MSMs by network size and monthly income
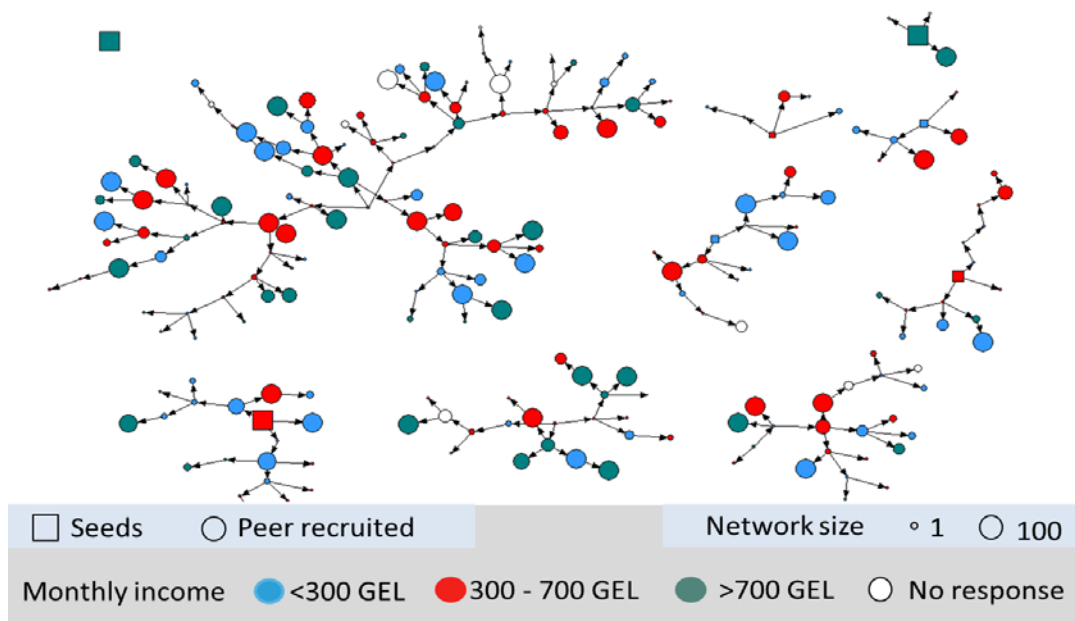
Multiplier population size estimates

As presented in Table 5, the most popular mobile application, among MSM, was Gayromeo (25.3%), followed by Mamba, and the least popular was Hornet (0.7%).

Using the multiplier method, the MSM estimated size ranged from 988 for "unique object" to 22,859 for "Hornet". The median of all estimated multiplier sizes was 4,541 with the plausible range of 2,700 to 15,809.

Table 5 - MSM size estimation from multiple multipliers in Tbilisi, Georgia 2014

Different mobile/web apps; services	Percentage of users			Number whom were counted	Population Size Estimates		
	Point Est.	95% Lower Bound	95% Upper Bound		Point Est.	95% Lower Bound	95% Upper Bound
Grindr mobile app	4.1%	1.3%	6.9%	394	9,636	5,701	31,097
Mamba web app	10.4%	2.7%	18.1%	611	5,881	3,372	22,961
Hornet mobile app	0.7%	0.7%	1.4%	162	22,859	11,362	22,859
Gayromeo web app	25.3%	10.7%	39.9%	809	3,201	2,029	7,589
Service use	16.8%	3.8%	29.8%	333	1,980	1,116	8,759
Unique objects	9.7%	3.6%	15.8%	96	988	607	2,648
Median of all					4,541	2,700	15,809

Capture-recapture estimates

Using the six-identifier categorical variables and the telefunken code, we identified 36 matches between the two rounds. This led to the population size of 4,385 (CI95% 3,115-5,654). See Table 6

Table 6 - Population estimate size of men who have sex with other men in Tbilisi using capture-recapture method, Tbilisi, Georgia 2014

		Population Size Estimate	
Number of telefunken code matched	36		
Number of captured telefunken	205	Point Est.	4,385
Number of telefunken Recaptured	770	95%CI Lower Limit	3,115
Var (N)	419,681.5	95%CI Upper Limit	5,654

Wisdom of the Crowd

MSM participant in the RDS survey, on average, estimated the adult MSM population size as 15,000 with a range from 5,000 to maximum 30,000 (Table 7).

Table 7 - Population size of MSM IN Tbilisi using Wisdom of the Crowd Method, Georgia 2014

	Average	Min	Max
MSM >18y in Tbilisi	15,000	5,000	30,000

Handcock's method estimates

The Handcock's RDS based method, having the NSU estimates as the prior distribution of population size, estimated the size of adult MSM in Tbilisi as 2,665 (Median = 1,764, Percentile 3% = 344 and Percentile 98% = 9,417). The results presented as number (Table 8) and distribution (Figure 7) bellow.

Table 8 - Prior and posterior knowledge about the population size of adult MSM in Tbilisi, Georgia 2014

	Mean	Median	Mode	Perc90%	Perc3%	Perc98%
Prior knowledge	6004	5314	4230	9736	4022	7222
Posterior knowledge	2665	1764	747	6118	344	9417

Figure 7 - Prior and posterior distribution on the population size of adult MSM in Tbilisi, Georgia 2014
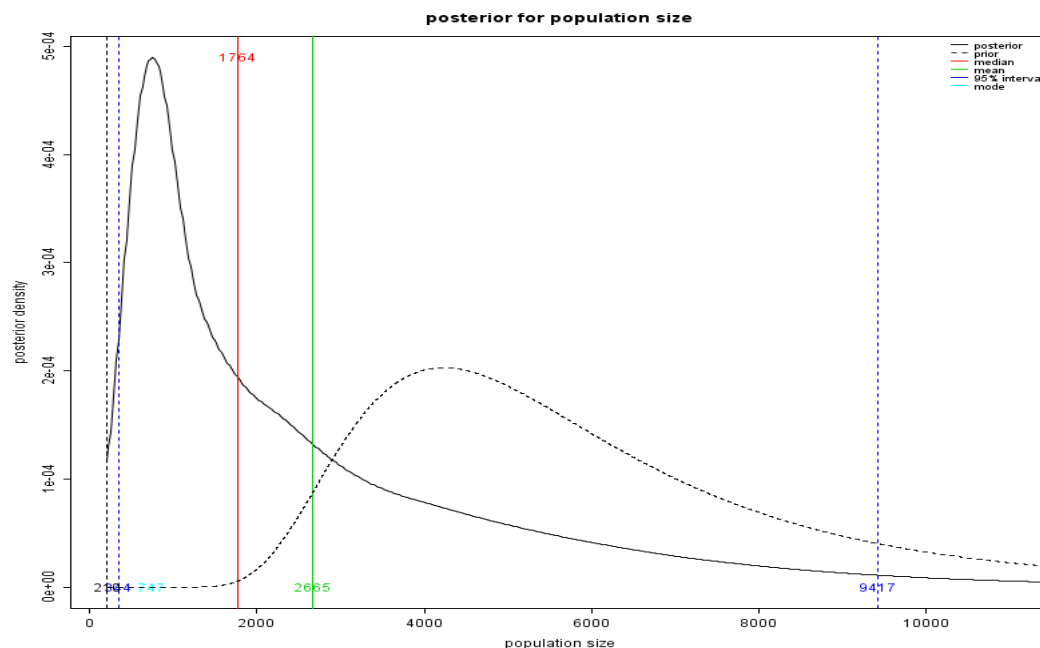
Data Synthesis and Triangulation

As presented in Table 9, NSU has estimated the prevalence of adult MSM in Batumi as 0.5%. It means that the total number of MSM in this city is about 197, which seems to be unrealistic. We looked for the current number of registered MSM in Batumi prevention programs and we found 344 registered cases, even more than the upper bound of the NSU estimates.

Table 9 - Population size for MSM estimated by Network Scale-up in Batumi 2014

PSE methods	Point		Lower Bound		Upper Bound	
	18-59y	**Total**	**18-59y**	**Total**	**18-59y**	**Total**
Network Scale-up						
MSM size	197	205	168	177	232	243
MSM Prevalence	0.50%	0.36%	0.43%	0.31%	0.59%	0.42%

This under estimation could be either due to transparency or popularity biases that both lead to understating the PSE. We only measure those biases in Tbilisi MSM study, not in Batumi. In future studies, these biases should be measure in other regions as well as Batumi to make sure the PSE results are valid.

To overcome this problem, we considered the total number of MSM whom already registered at the prevention centers in Batumi as the lower bound for PSE. For calculating the PSE upper bound, we applied the MSM prevalence value (estimated for Tbilisi = 1.42%) to the size of adult population in Batumi. For the PSE point estimate, we reported the average of lower and upper bounds for Batumi. Such data synthesis approach led to the MSM prevalence of 1.15% (0.88-1.42%) in Batumi (Table 10).

Table 10 - Batumi population size for MSM estimated by data synthesis, 2014

PSE methods	Point	Lower Bound	Upper Bound
	18-59y	**18-59y**	**18-59y**
Network Scale-up			
MSM size	450	344	556
MSM Prevalence	1.15%	0.88%	1.42%

The median of the various estimates and their boundaries were hypothesized to be the most plausible size estimates for Tbilisi (Table 11).

Table 11 - Different MSM population size estimates from various methods implemented in Tbilisi, 2014

Various PSE methods	Point		Lower Bound		Upper Bound	
	18-59y	Total	18-59y	Total	18-59y	Total
Network Scale-up	5816	6014	4972	5197	6859	7176
Multipliers						
Grindr	9636		5701		31097	
Mamba	5881		3372		22961	
Hornet	22859		11362		22859	
Gayromeo	3201		2029		7589	
Service	1980		1116		8759	
Unique Object	988		607		2648	
RDS-based Handcock	2665		344		9417	
Wisdom of Crowd	15000		5000		30000	
Capture-Recapture	4385		3115		5654	
MSM size - Median of all above estimates	5100		3243		9088	
MSM Prevalence in adult population	1.42%		0.90%		2.53%	

Together, prevalence of MSM in Tbilisi and Batumi were used to produce a MSM population size estimate for other cities in Georgia. And then all estimated numbers were added up together to provide the overall prevalence and size of adult MSM in Georgia.

A summary of key findings is presented in Table 12.

Tbilisi

Taking into account the different MSM population size estimated by various methods in Tbilisi, the median estimates for size of MSM population are 5,100 (acceptable interval 3,243-9,088). This is the 1.42% (acceptable interval 0.9 - 2.53%) of adult male population in Tbilisi.

Batumi

Based on NSU findings and ad hoc corrections, the size of MSM population are 450 (acceptable interval 344-566) in Batumi. It means the prevalence of MSM in Batumi is 1.15% (acceptable interval 0.88-1.42%).

Georgia overall

After extrapolating for the remainder of Georgia based on specific assumptions, such as:

- If the % of MSM more than 18 years old in other areas in Georgia is the same as the mean of Tbilisi and Batumi estimates

- If the proportion of MSM who are hidden in other areas in Georgia is the same as the mean of Tbilisi and Batumi estimates
- If the number of all adult male estimated accurately in other areas in Georgia is the same as the mean of Tbilisi and Batumi estimates
- If other urban as well as rural areas in Georgia have an equal % of MSM

There are approximately 17,215 MSM in Georgia, with the lower acceptable bound of 11,677 MSM and an upper acceptable bound of 27,577 MSM. This overall estimate suggests that the prevalence of MSM in Georgia is only 1.32% (acceptable interval 0.89-2.11%) of the adult male population.

Table 12 - MSM population size and prevalence in Tbilisi, Batumi and Georgia 2014

Regions	MSM size	MSM prevalence
Tbilisi	5,100 [3,243 – 9,088]	1.42% [0.90 - 2.53%]
Batumi	450 [344 - 556]	1.15% [0.88 - 1.42%]
The remainder of Georgia	11,665 [8,089 – 17,934]	1.28% [0.89 - 1.97%]
Georgia - Overall	**17,215 [11,677 – 27,577]**	**1.32% [0.89 - 2.11%]**

We estimated number of MSM in major urban areas by applying prevalence rate 1.28% (0.89-1.97%). The figures are presented in the table below (Table 13). When we compared the preventive program administrative data for Tbilisi (410) and Kutaisi (309) the estimates are within the range.

Table 13 - MSM population size and prevalence in different cities

City	All male 18-59	Prevalence	95% CI		MSM size		
		Point - estimate	Lower bound	Upper bound	Point -estimate	Lower bound	Upper bound
Tbilisi (capital)	**359,611**	**1.42%**	**0.90%**	**2.53%**	**5,100**	**3,243**	**9,088**
Batumi	39,168	**1.15%**	**0.88%**	**1.42%**	450	344	556
Kutaisi	54,500	**1.28%**	**0.89%**	**1.97%**	700	485	1,075
Telavi	6,277	1.28%	0.89%	1.97%	81	56	124
Poti	14,307	1.28%	0.89%	1.97%	184	127	282
Zugdidi	19,988	1.28%	0.89%	1.97%	257	178	394
Rustavi	35,053	1.28%	0.89%	1.97%	450	312	692
Gori	14,297	1.28%	0.89%	1.97%	184	127	282
Total other cities w/t Tbilisi	**183,590**				**2,304**	**1,629**	**3,406**
Total all cities	**543,201**				**7,404**	**4,873**	**12,494**

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Discussion

Population size estimates suggest between 0.9% and 2.1% of adult males in Georgia are MSM: 17,200 (11,700 – 27,600) from which 5,100 MSM are estimated in Tbilisi, 450 in Batumi, and 11,700 in other areas of Georgia. Taking into account the estimate of HIV prevalence among MSM reported in 2012 Tbilisi study (RDS 2012) as 13% (CI95%.8.5-18.7%), it is estimated that 663 (434-954) HIV-infected MSM are living in Tbilisi. Prevalence in other areas is not known, however if we apply the low bound of HIV prevalence rate to the population size it is estimated that 1,462 MSM are infected in Georgia. Given the number of identified HIV-infected MSM in Georgia, more need to be done to identify and link such vulnerable key populations into treatment services and also further reduce the transmission of HIV infection in their community. More details presented below in the recommendation section.

In compare to global and regional estimates for the prevalence of MSM, the Georgia estimate is comparable to Ukrainian(Paniotto, Petrenko, Kupriyanov, & Pakhok 2009) estimated prevalence as 1.7% which was calculated by applying NSU and multiplier methods. Estimates from other regions as well as the UNAIDS recommended level of 2-5% for our region is presented below(UNAIDS 2005). It looks that the Georgia PSE for MSM is almost comparable to international figures. (See Figure 8)

Figure 8 - MSM population size estimates in different countries, regions

(Shokoohi et al. 2012),(Adam et al. 2009),(Marcus et al. 2009),(Ukrainian Centre for Prevention and AIDS Ministry of Health of Ukraine et al. 2012),(H Fisher Raymond et al. 2013),(UNAIDS 2005)
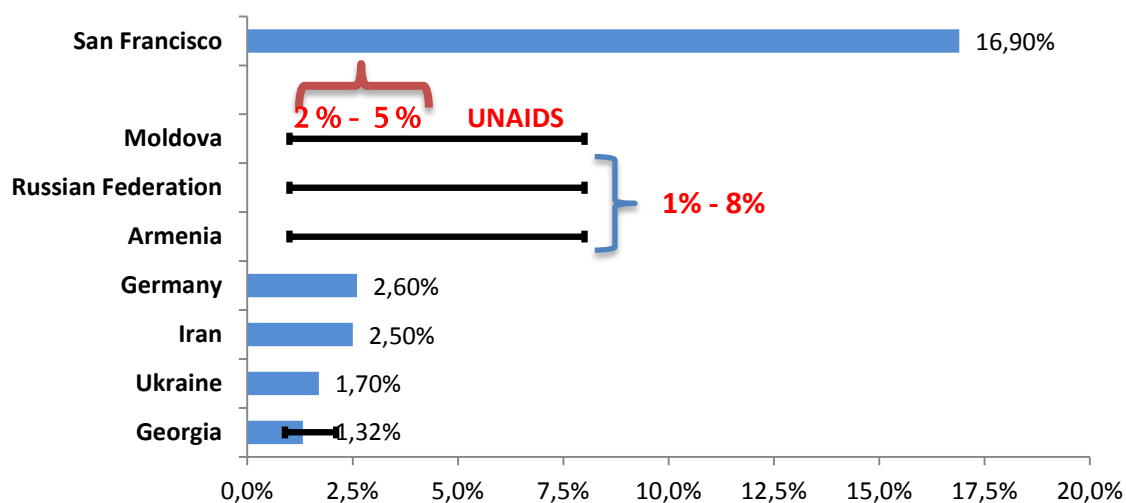
Estimating the size of any population that is not inherently countable is a challenging task. Although the estimates are robust and have been validated by key stakeholders, they come with limitations and cautions that are described below.

First, size estimation exercises generally cannot estimate the proportion of MSM who are truly hidden and/or MSM who do not even acknowledge that they are MSM. These MSM may not be counted in any data source, including data collected through this study. In this sense, these estimates are likely an underestimation of the MSM population size in Georgia.

Second, this study was limited to MSM 18 years and older and therefore these estimates do not include MSM younger than 18. Given this, these estimates are likely an underestimation of the MSM population size in Georgia.

Third, adult male population denominators from Census projections by the National Statistical Department were used. These are not actual census numbers; actual census numbers may vary from projections and thus would influence the estimates.

Fourth, size estimates from only two areas (Tbilisi and Batumi) of Georgia were available. Because the MSM population size in a large urban area of Georgia was estimated using data from very few areas (the two cities), the estimates presented here come with additional assumptions and therefore greater uncertainty.

Fifth, the quality of the estimate derived from the website and mobile applications is only as good as quality of data that was used to produce that estimate.

Finally, the accuracy of NSU estimates is very dependent on the accuracy of responses we got from the study participants, the quality of the data source for the real size of known population sizes, the transparency of MSM behaviors among the networks and the random mixing of MSM in the community. We tried to adjust for some of the biases while some of the bias parameters were hard to measure.

Recommendations

The national response to HIV/AIDS currently needs better information on the number of people at risk to appropriately plan interventions, allocate resources and track preventive program coverage. The MSM population is considered to be hard to reach group globally and is very well hidden in Georgia. The latest estimates suggest that worldwide from 12% to 43% could be reached by HIV prevention services.(UNAIDS 2009) It is critical to understand that different MSM sub-populations could not be reached with the standard HIV preventive package due to different factors including

stigma, homophobia and fear of public exposure. At present, in Georgia, MSM are considered to have been reached by preventive programs if a person receives a standardized preventive package defined by condom, lubricant, informational material and counseling on HIV/AIDS at least once during a year. It is worth mentioning that this package was defined to measure coverage of preventive interventions for Global Fund supported programm, while there is no national standard that defines a list of services for MSM population. Distribution of condoms and lubricants is an immediate and effective strategy, although less tailored to all sub-groups of the MSM population. Those MSM, who do not gather into communities and do not identify or disclose their sexual behavior with other men, will be impossible to reach with an intervention that implies condom/lubricant distribution and counseling. Alternatively, these populations could be targeted with innovative context tailored interventions e.g. Internet / mobile application based interventions, however estimation of coverage of such interventions is challenging. Therefore, defining the target for coverage of MSM population with preventive programs should be done carefully.

Since the MSM population are not homogenous and differ in terms of social and sexual characteristics and vulnerability, preventive programs should target first those who have higher needs and risks. Currently, MSM targeted preventive program activities are implemented in three of the largest cities in Georgia: Tbilisi, Batumi and Kutaisi. The effectiveness of the geographic expansion of preventive programs (with the GF defined package described above) into smaller cities needs to be further evaluated. In a given context, when fear of public exposure is high among MSM, program coverage could be more effectively increased through scale up of activities in large cities and with more innovative approaches.

And lastly from the different PSE methods unique object and venue multiplier estimates provide more close estimates of MSM who could be more effectively reached with the outreach activities. Multiplier estimates are not available for the other two big cities such as Batumi and Kutaisi. Use of multiple methods would allow arriving at more acceptable estimates. In addition multiplier is a relatively low cost method among other PSE methods. This should be taken in future BBS studies among MSM population in other cities of Georgia.

Annex 1- Data tables – Tbilisi and Batumi

Table 14 –NSU Demographic Characteristics of HHs

Demographic Characteristics	Tbilisi		Batumi	
	Tbilisi %	n/N	Batumi %	n/N
Age				
18-24	26.3	266/1012	18.1	27/149
25-34	32.3	327/1012	34.9	52/149
35-44	25.7	260/1012	32.2	48/149
≥45	15.5	157/1012	14.8	22/149
No response	0.2	2/1012	--	0/149
Mean (Min-Max)		32.63(18-50)		33.74(18-49)
Median		32.00		33.00
Education				
Never attended school	0.1	1/1012	--	0/149
Incomplete primary education	0.2	2/1012	--	0/149
Completed primary education	0.2	2/1012	--	0/149
Incomplete secondary education	2.3	23/1012	2.7	4/149
Completed secondary education	35.9	363/1012	27.5	41/149
Initial vocational program	0.4	4/1012	--	0/149
Secondary vocational program	9.2	93/1012	12.8	19/149
Bachelor	31.6	320/1012	28.2	42/149
Master	18.8	190/1012	27.5	41/149
Doctor	1.3	13/1012	0.7	1/149
No response	0.1	1/1012	0.7	0/149
Students	16.1	163/1012	4.7	7/149
Ethnicity				
Georgian	87.5	885/1012	92.6	138/149
Armenian	3.8	38/1012	2.7	4/149
Azeri	1.0	10/1012	0.7	1/149
Other	3.8	38/1012	4.0	6/149
No response	4.1	41/1012	--	0/149
Gender				
Male	34.1	345/1012	38.9	58/149
Female	65.9	667/1012	61.1	91/149
Occupation				
Occupied	40.0	405/1012	48.3	72/149
Employed	74.3	303/408	85.1	63/74
Self employed	25.0	102/408	14.9	11/74
No response	0.7	3/408	--	0/74
Unemployed	59.8	605/1012	51.7	77/149

Housewife	48.4	293/605	62.3	48/77
No response	0.2	2/1012	--	0/149
Marital Status				
Single	34.6	350/1012	28.9	43/149
Married	57.7	584/1012	66.4	99/149
Divorced	4.7	48/1012	3.4	5/149
Widowed	2.4	24/1012	0.7	1/149
No response	0.6	6/1012	0.7	1/149

Table 15 - NSU Demographic Characteristics of BSHs

Demographic Characteristics	Tbilisi		Batumi	
	Tbilisi %	n/N	Batumi %	n/N
Age				
18-24	31.3	163/520	25.0	20/80
25-34	30.8	160/520	36.3	29/80
35-44	24.8	129/520	30.0	24/80
≥45	13.1	68/520	8.8	7/80
No response	--	0/520	--	0/80
Mean (Min-Max)		31.66 (18-49)		32.03 (18-49)
Median		30.50		31.00
Education				
Never attended school	--	0/520	--	0/80
Incomplete primary education	--	0/520	--	0/80
Completed primary education	0.2	1/520	1.3	1/80
Incomplete secondary education	0.4	2/520	1.3	1/80
Completed secondary education	34.6	180/520	31.3	25/80
Initial vocational program	--	0/520	7.5	6/80
Secondary vocational program	3.5	18/520	13.8	11/80
Bachelor	45.2	235/520	27.5	22/80
Master	15.0	78/520	17.5	14/80
Doctor	1.2	6/520	--	0/80
No response	--	0/520	--	0/80
Students	16.3	85/520	11.3	9/80
Ethnicity				
Georgian	86.5	450/520	86.3	69/80
Armenian	5.6	29/520	6.3	5/80
Azeri	0.2	1/520	--	0/80
Other	2.1	11/520	6.3	5/80
No response	5.6	29/520	1.3	1/80
Gender				
Male	37.1	193/520	22.5	18/80
Female	62.9	327/520	77.5	62/80

Occupation				
Occupied	64.0	333/520	55.0	44/80
Employed	73.8	251/340	77.8	35/45
Self employed	25.0	85/340	22.2	10/45
No response	1.2	4/340	--	0/45
Unemployed	36.0	187/520	86.1	36/80
Housewife	69.0	129/187	62.3	31/35
No response	--	0/520	--	0/80
Marital Status				
Single	45.4	236/520	31.3	25/80
Married	48.3	251/520	66.3	53/80
Divorced	5.6	29/520	1.3	1/80
Widowed	0.8	4/520	1.3	1/80
No response	--	0/520	--	0/80

Table 16 –MSM Survey Demographic Characteristics

Demographic Characteristics	Tbilisi	
	Tbilisi %	n/N
Age		
18-24	37.6	79/210
25-34	33.8	71/210
$\geq$35	28.1	59/210
No response	0.5	1/210
Mean (Min-Max)		30.14 (18-70)
Median		27.00
Education		
Primary education 4 grades	0.5	1/210
Incomplete secondary education 8-9 grades	5.2	11/210
Complete secondary education 10-11-12 grades	36.2	76/210
Vocational program	9.0	19/210
Incomplete Higher	10.5	22/210
Higher	38.6	81/210
Ethnicity		
Georgian	88.6	186/210
Other	11.4	24/210
No response	--	0/210
Years of living in a given city		
Mean (Min-Max)	19.95 (0-70)	(210)
Median	20.00	
Arrived from another place	57.6	121/210
Occupation		

Occupied	53.3	112/210
Employed	64.5%	80/210
Self employed	32.3%	40/210
No response	3.2%	4/210
Unemployed	37.1	78/210
Students	9.5	20/210
Marital Status		
Married	12.4	26/210
Divorced/Separated	12.4	26/210
Has never been married	75.2	158/210
Years of living in a given city		
Mean (Min-Max)		19.95(0-70)
Median		20.00
Arrived from another place	57.6	121/210
Income		
Less than 100Gel	6.2	13/210
100-300 Gel	31.0	65/210
300-500 Gel	21.4	45/210
500-700 Gel	11.0	23/210
700-1000 Gel	12.9	27/210
1000 Gel and more	11.9	25/210
No response	5.7	12/210

Annex 2- NSU survey questionnaire

Interviewers code: _____ City: _____

Date of interview: ____/____/_____ (dd/mm/yy)

Interview started:_____(hr:m)interview finished:_____(hr:mm)

Section B. Demographic Data

1. How old are you? .... (year)

2. Sex male- 1 female - 2

3. Ethnicity Georgian - 1Armenian - 2Azeri- 3other-4   no response- 99

4. What is the highest level of education you attended?

Never attended school..........................1   →go to 14

Uncompleted primary education…….2   →go to 14

Completed primary education……….3   →go to 14

Uncompleted secondary education….4→go to 14

Completed secondary education.........5   Bachelor or equivalent 8

Initial vocational program..................6   Master or equivalent 9

Secondary vocational program............7   Doctor or equivalent 10

5. Are you a student?

Student of secondary professional program 1

Student of higher professional program 2

Undergraduate student...3

Masters student 4

Doctoral student.. 5

6. What is your current marital status?

 Single 1   Divorced 3

Married 2   Widowed 4

no response 99

7. What is your current occupation?

Occupied 1   if yes: Employed..........1.1   Self employed.......1.2

Unemployed............... 2   if yes: housewife......... 2.1

no response.................. 99

8. Do you use barbershop service?

Yes……………………………. 1   if yes: How many times per year _____

No…………………………….. 2   →**go to Section C**

No response ………………… 99   →**go to Section C**

9. In which district do you use barbershop services mostly?

Vake …………………………… 1	Samgori …………………………… 6
Saburtalo ………………………… 2	Gldani …………………………….7
Mtatsminda ……………………3	Didube ……………………………8
Nadzaladevi …………………… 4	Isani ………………………………9
Chughureti …………………………5	Krtsanisi ………………………… 10

Section C. Number of people you know with specific name

Now, I want you to recall and write down the number of people with specific namethat you know.These people should be

- [People that you know them by sight and name, and who also know you by sight and name]

    AND

- [People that you had some contact with either in-person, over the phone or internet(e.g.: e-mail, Skype, chat through social networks) in the last 2 years]

    AND

- [People of all ages who lives in Georgia].

Example: Suppose we are asking you to recall the number of people you know with the "first name of Elena" in last 2 years? Take your time and try to recall the overall number of people you know, having "Elena" as a first name. Let's say you recall/count 11 people with the first name of Elana. Perfect! First, you should exclude famous people that you know about, but who do not know about you. So, you should not consider Elena Satine, as she doesn't know about you! ☺. Then, exclude those who are not living in Georgia. Here, as all Elena that you know are living here in Georgia, you should not exclude anyone. And last, of those 10 people with the fist name of Elena, exclude anyone (let's say 3) whom you did not contact with over the last 24months either in-person, phone or internet. So, the number of people you may write down is 7 (11 – 1 – 3 = 7).

Important notes:

- We know it is not an easy task. Please do your best to recall as much as you can.
- If at the end, you could not recall anyone from the mentioned group, write 0.

Groups	description	answer
1.	How many people do you know with the "first name of Mamuka"?	_____ person(s)
2.	How many people do you know with the "first name of Luka"?	_____ person(s)
3.	How many people do you know with the "first name of Zurab"?	_____ person(s)
4.	How many people do you know with the "first name of Vazha" ?	_____ person(s)
5.	How many people do you know with the "first name of Sophiko, or Sophio or Sopho"?	_____ person(s)
6.	How many people do you know with the "first name of Manana"?	_____ person(s)
7.	How many people do you know with the "first name of Shorena"?	_____ person(s)
8.	How many people do you know with the "first name of Nino"?	_____ person(s)
9.	How many people do you know with the "first name of Maya"?	_____ person(s)
10.	How many people do you know with the "first name of Davit"?	_____ person(s)

Section D. Number of people you know by groups

Now I will ask you the number of people you know.

Again, I am asking about

- [People that you know them by sight and name, and who also know you by sight and name]
    AND
- [People that you had some contact with either in-person, over the phone or the internet (e.g. e-mail, Skype, chat through social networks) in the last 2 years]
    AND
- [People of all ages who lives in Georgia].

Groups	Question	answer	
		overall	Only male

1.	How many people do you know, who **were married in2013 year?**	_____ persons	
2.	How many **teachers** do you know?	_____ persons	_____ male
3.	How many people do you know, who**gave birth in 2013 year?**	_____ female	
4.	How many people do you know, who **died in 2013 year?**	_____ persons	_____ male
5.	How many people do you know, who**died due to cancer in 2013 year?**	_____ persons	_____ male
6.	How many people do you know, who **were injured or died in road accidents in 2013?**	_____ persons	_____ male
7.	How many **higher educational students**do you know?	_____ persons	_____ male
8.	How many **lecturers in higher education institutions** do you know?	_____ persons	_____ male
9.	How many people do you know, who **are currently imprisoned?**	_____ persons	_____ male

Section E. Number of people you know who are at high-risk of HIV, by groups

- [People that you know them by sight and name, and who also know you by sight and name]
    AND
- [People that you had some contact with either in-person, over the phone or the internet (e.g: e-mail, Skype, chat through social networks) in the last 2 years]
    AND
- [People of all ages who lives in Georgia].

grou ps	description	Answer (write the number of people you know)					
		overall	Sex		Age group (year)		
			male	female	<18y	18-30y	>30y
1	Some people use drugs, some of them use drugs by injection. How many people do you know who inject drug? (Injecting drug user is a person who inject narcotic drug without medical indication)	____	____	____	____	____	____

2	How many men do you know who are clients of female sex workers? **(those men who pay for having sex with female sex workers)**		____		____	____	____
3	In general men have sex with women, but there are some men who have sex with men. How many men do you know who have sex with other men? **(They may also have sex with women)**		____		____	____	____
4	How many female sex workers do you know? **(Women who exchange sex for money)**			____	____	____	____

Annex 3 - MSM survey questionnaire

Interviewers code: _____ Coupon code: _____

Date of interview: _____/_____/_____ (dd/mm/yy)

Interview started:_____(hr:m)   interview finished:_____(hr:mm)

| Section B. Demographic Data |

10. How old are you?/_____/_____/ (please specify an exact age) ; No response99

11. What is your nationality?

Georgian	1
Other (please specify)_____	2
No response	99

12. What is the highest level of education you have achieved?

No education	0
Primary (4 grades)	1
Incomplete Secondary (8-9 grades)	2
Complete Secondary (10-11-12 grades)	3
Vocational school	4
Incomplete higher	5
Higher	6
No response	99

13. How long have you lived in Tbilisi?

Number of years	/_____/
Record 00 if less than 1 year	
Don't know	88
No response	99

14. What is your marital status?

Married	1
Divorced/Separated	2
Widower	3
Has never been married	4
Other (please indicate)_____	5
No response	99

15. Are you employed?

Yes	1
If yes, please indicate	
Employed	1.1
Self-employed	1.2
Student	2
No	3
Other (please indicate)_____	4
No response	99

16. What is your monthly income?

100 GEL and less	1
100-300 GEL	2
300-500 GEL	3
500-700 GEL	4
700-1000 GEL	5
1000 GEL and more	6
No response	99

Now, I want you to recall and write down the number of people with specific name that you know. These people should be

[People that you know them by sight and name, and who also know you by sight and name]

      AND

[People that you had some contact with either in-person, over the phone or internet(e.g.: e-mail, Skype, chat through social networks) in the last 2 years]

      AND

[People of all ages who lives in Georgia].

Example: Suppose we are asking you to recall the number of people you know with the "first name of Elena" in last 2 years? Take your time and try to recall the overall number of people you know having "Elena" as first name. Let's say you recall/count 11 people with the first name of Elana. Perfect! First, you should exclude famous people that you know about, but who do not know about you. So, you should not consider ElenaSatine, as she doesn't know about you! ☺. Then, exclude those who are not living in Georgia. Here, as all Elena that you know are living here in Georgia, you should not exclude anyone. And last, of those 10 people with the fist name of Elena, exclude anyone (let's say 3) whom you did not contact with over the last 24months either in-person, phone or internet. So, the number of people you may write down is 7 (11 − 1 − 3 = 7).

In the last column, we are asking about the number of people that already know that you have sexual contact with other men. For the above example, out of the seven, verify how many know that you are MSM (e.g. 3 persons) and write down the number of persons.

Important notes:

We know it is not an easy task. Please do your best to recall as much as you can.

If at the end, you could not recall anyone from the mentioned group, write 0.

Groups	description	answer	How many of those already know that you have sex with other men?
11.	How many people do you know with the "first name of Mamuka" ?	_____ person(s)	_____ person(s)
12.	How many people do you know with the "first name of Luka" ?	_____ person(s)	_____ person(s)
13.	How many people do you know with the "first name of Zurab" ?	_____ person(s)	_____ person(s)
14.	How many people do you know with the "first name of Vazha" ?	_____ person(s)	_____ person(s)
15.	How many people do you know with the "first name of Sophiko, or Sophio or Sopho" ?	_____ person(s)	_____ person(s)
16.	How many people do you know with the "first name of Manana" ?	_____ person(s)	_____ person(s)
17.	How many people do you know with the "first name of Shorena" ?	_____ person(s)	_____ person(s)
18.	How many people do you know with the "first name of Nino" ?	_____ person(s)	_____ person(s)
19.	How many people do you know with the "first name of Maya" ?	_____ person(s)	_____ person(s)
20.	How many people do you know with the "first name of Davit" ?	_____ person(s)	_____ person(s)

Section D. Number of people you know by groups

Now I will ask you the number of people you know.

Again, I am asking about
    [People that you know them by sight and name, and who also know you by sight and name]

        AND
    [People that you had some contact with either in-person, over the phone or internet(e.g.: e-mail, Skype, chat through social networks) in the last 2 years]
        AND
    [People of all ages who lives in Georgia].

Groups	Question	Overall	How many of those already know that you have sex with other men?	Only male	How many of those already know that you have sex with other men?
1.	How many people do you know, who **were married in2013 year?**	_____ persons	_____ persons	_____ male	_____ male
2.	How many **teachers** do you know?	_____ persons	_____ persons	_____ male	_____ male
3.	How many people do you know, who**gave birth in 2013 year?**	_____ female	_____ female		
4.	How many people do you know, who **died in 2013 year?**	_____ persons	_____ persons	_____ male	_____ male
5.	How many people do you know, who**died due to cancer in 2013 year?**	_____ persons	_____ persons	_____ male	_____ male
6.	How many people do you know, who **were injured or died in road accidents in 2013?**	_____ persons	_____ persons	_____ male	_____ male
7.	How many **higher educational students**do you know?	_____ persons	_____ persons	_____ male	_____ male
8.	How many **lecturers in higher education institutions** do you know?	_____ persons	_____ persons	_____ male	_____ male
9.	How many people do you know, who **are currently imprisoned?**	_____ persons	_____ persons	_____ male	_____ male

Unique Object

1. In the previous 2 months, did you receive a bracelet?	1. Yes 2. No *go to*→9 88. Don't Know *go to*→9 99. Decline to answer *go to*→9	
2. Can you show it to me?	1. Yes *go to*→5 2. I do not have it with myself 99. Decline to answer	
3. Can you describe it to me?	1. The description was correct 2. Incorrect description 99. Decline to answer	
4. Is this the bracelet you received? (show it to them)	1. Yes 2. No 99. Decline to answer	
5. How many bracelets did you receive?	_____ #	
6. When did you receive this bracelet?	_____weeks ago	
7. Where did you receive this bracelet?	_____	
8. Who did you receive this bracelet from? (only one answer)	1. Friend 2. Sex partner 3.social worker 4. Person from the same district 5. Co-worker 6. Stranger	

Service use

9. Have you received service in „health cabinet"during last 6 months? (specify: health room, which is located in ... Service use means, that you received VCT- Voluntary Counseling and Testing on HIV and/or STI testing and/or STI treatment)

    yes ----------------------------- 1

    no ----------------------------- 2

    don't know-------------------- 88

    no response-------------------- 99

Mobile / Web Apps Section

10. Do you use **Grindr** mobile apps?	1. Yes 2. No *go to→***11**
10.1. Did you logged into **Grindr** mobile apps for last two weeks?	1. Yes 2. No 88. Don't Know 99. No Response
11. Do you use **Hornet** mobile apps?	1. Yes 2. No *go to→***12**
11.1. Did you logged into **Hornet** mobile apps for last two weeks?	1. Yes 2. No 88. Don't Know 99. No Response
12. Do you use **Mamba.ru** website?	1. Yes 2. No *go to→***13**
12.1. Did you logged into **Mamba.ru** website during last month?	1. Yes 2. No 88. Don't Know 99. No Response
13. Do you use **Gayromeo.com** website?	1. Yes 2. No *go to→* **Section F**
13.1. Did you logged into **Gayromeo.com** website during last month?	1. Yes 2. No 88. Don't Know 99. No Response

Section F. Network size

Now I am going to ask you some questions about your social network. Please take your time to carefully think about these questions. I am going to ask you to give me some estimates about the number of men who have sex with men that there are in Tbilisi and the number of men who have sex with men that you personally know. Please give me your best estimate. You do not need to give me anyone's names.

#	Question	response
1	How do you think how many MSM is living in Tbilisi?	
2	How many of them do you know personally and the same time they know you by name?	
3	How many of them are above 18 years?	
4	How many of them have had homosexual contacts during last 12 months?	
5	How many of them have you seen during last 1 month?	
6	How many of them have you seen during last 3 months?	
7	How many of them do you think you can bring to participate in the research?	
8	Would you choose the same person for participation in the study who has given you the coupon? (In case he had not received it before)	1. yes 2. no
9	Why did you agree to participate in the study (More than once answer is allowed)	1. Monetary incentive 2. Influence of the person who gave the coupon to me 3. The study topic is interesting/ useful for me 4. I had plenty of free time 5. Other (indicate) _____

Now, I am going to ask you some questions about some appearance characteristics like height, weight, hair and eye color and also race. Moreover, I will ask you about your list 4 digits of your phone number (just last 4) and record it as coded number (telefunken). For example, for any phone numbers which end in 1234, it is Odd-Even-Even-Low-Low-Low (explain how you did it and why).

A mix of these six variables will be used to assign you a unique non-identifying code, which later will be used in analysis. Nobody can use this code to identify you or your friends.

Variables	response	0. The participant own info.
Telefunken Code	0; 1; 2; 3; 4 ....**L** 5; 6; 7; 8; 9 ....**H** 0; 2; 4; 6; 8 ....**O** 1; 3; 5; 7; 9 ....**E**	
Approximate height	High..............**H** Middle.........**M** Short............**S**	
Approximate weight	Obese............**O** Normal.........**N** Thin..............**T**	
Hair color	Dark.................**D** Light.................**L** Ginger/red.....**G** No hair...........**N**	
Ethnicity	Georgian.........**G** Azeri................**Z** Armenian.......**A** Other..............**O**	

I want to ask the same questions from five MSM contacts whose you have their phone number in your phone's directory. Using a randomized list of alphabet letters, I will help you to choose them by random among your entire contact list. Please tell me their approximate height, approximate weight, hair color, eye color, and race/ethnicity and telefunken code:

Variables		Contact 1	Contact 2	Contact 3	Contact 4	Contact 5
Telefunken Code	0; 1; 2; 3; 4 ....**L** 5; 6; 7; 8; 9 ....**H** 0; 2; 4; 6; 8 ....**O** 1; 3; 5; 7; 9 ....**E**					
Approximate height	High..............**H** Middle.........**M** Short............**S**					
Approximate weight	Obese..........**O**					

	Normal.........**N**					
	Thin.............**T**					
Hair color	Dark....................**D** Light.....................**L** Ginger/red.........**G** No hair................**N**					
Ethnicity	Georgian.........**G** Azeri................**Z** Armenian........**A** Other..............**O**					

Section H. Rough estimates for the number of MSM in Tbilisi

Now I am going to ask you some questions about size of men who have sex with men in Tbilisi. Please take your time to carefully think about these questions.

1. Earlier you mentioned that _____ men who have sex with men live in Tbilisi. What are minimum and maximum estimates?   Minimum: _____   Maximum: _____

2. How many of them are 18 year and over?
   Overall: _____

   Minimum: _____

   Maximum: _____

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