HEALTH RESEARCH UNION

Population Size Estimation of People Who Inject Drugs in Georgia

Study Report
Tbilisi, Georgia
2022

Prepared by „Health Research Union“

THE GLOBAL FUND

NeoLab

NCDC NATIONAL CENTER FOR DISEASE CONTROL AND PUBLIC HEALTH

ACKNOWLEDGEMENTS

The present study was conducted with financial support from The Global Fund to Fight AIDS, Tuberculosis, and Malaria in Georgia.

Health Research Union expresses its sincere appreciation to all governmental agencies and NGOs who provided data and support: Ministry of Internally Displaced Persons from the Occupied Territories, Health, Labour and Social Affairs of Georgia; Ministry of Internal Affairs of Georgia; National Centre for Disease Control and Public Health; National Statistics office of Georgia; Georgian Harm Reeducation Network; Alternative Georgia; National Drug Observatory.

We also gratefully acknowledge all addiction treatment facilities in Georgia for data provision.

Contents

Working group:

Maia Butsashvili MD, MS, PhD

George Kamkamidze MD, MS, PhD

Emeli Anderson MSPH, PhD(c)

Maia Kajaia MD, MS, PhD(c)

Lasha Gulbiani MPH

Marika Kochlamazashvili MPH, PhD(c)

Tinatin Abzianidze MD, MPH, PhD

Giorgi Kanchelashvili MPH, PhD(c)

Sopio Adamia MPH

Giga Abashidze, MD, MPH

Irma Kirtadze MD, PhD

Maka Gogia MD, MPH

Nika Vashakidze

Giorgi Khachvani, MD

ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
AIDS Center	Georgian AIDS and Clinical Immunology Research Center
CI	Confidence interval
DEFF	Design effect
EMCDDA	European Monitoring Centre for Drugs and Drug Addiction
GHRN	Georgian Harm reduction network
HCV	Hepatitis C
HIV	Human Immunodeficiency Virus
HRU	Health Research Union
IBBS	Integrated Bio-Behavior Surveillance
IDU	Injection drug use
ITB	Information transparency bias
LEPL	Legal Entity under Public Law
LLC	Limited Liability Company
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
UNAID	The Joint United Nations Programme on HIV/AIDS
PLWH	People living with HIV
PWID	People who inject drugs
MBM	Multiplier Benchmark Method
MBM-MOD	Multiplier Benchmark Method – modified
MIA	Ministry of Internal Affairs
MPHA	Center for Mental Health and Prevention of Addiction
NCDC	National Center for Disease Control and Public Health
NSU	Network Scale-Up
PSE	Population Size Estimation
PSU	Primary Sampling Unit
R	The R project for statistical computing
RDS	Respondent Driven Sampling
RDS-MOD	Respondent Driven Sampling – modified
SSU	Secondary Sampling Unit
STI	Sexually Transmitted infections
SPSS	Statistical Package for the Social Sciences
TSU	Tertiary Sampling Unit

EXECUTIVE SUMMARY

Monitoring and estimating the prevalence of intravenous drug use are very important tasks for governmental bodies and non-governmental organizations to develop agendas. This includes evaluating the effectiveness of injection drug use-related healthcare services and the outcomes of prevention programs and determining the finances needed to implement interventions at the country, regional, and international levels. In Georgia, injection drug use (IDU) is considered a driver of infectious disease transmission. Therefore, an accurate estimate of the population size of people who inject drugs (PWID) is necessary to tackle both the behavioral and social aspects associated with drug use as well as prevent disease transmission of pathogens such as HIV and hepatitis C virus.

In this report, we present results of the project implemented by Health Research Union (HRU). We conducted the IBSS survey among PWID in seven urban areas of Georgia using Respondent Driven Sampling (RDS) and the household survey using special questionnaire. Our objective was to estimate the size and prevalence of the PWID population in Georgia in 2021.

In the report we describe results from two methods used to estimate the population size of PWID and the prevalence of IDU in Georgia: The Network Scale-Up (NSU) method and the Multiplier Benchmark Method (MBM). Both methods have been used previously to estimate the population size of hidden populations, where individuals are engaged in stigmatized behavior, such as IDU. The NSU method relies on estimating the network size of survey participants, whereas the MBM method uses external benchmark data in addition to survey data. For both methods, we utilized data from the 2021 Integrated Bio-Behavior Surveillance (IBBS) survey.

At the final stage a triangulation meeting has been organized, where professionals and service providers in addiction and HIV/AIDS fields attended the meeting. The goal of data triangulation is the synthesis and interpretation of data collected from different sources. The knowledge and experience of the professionals in these fields are of major importance in the final decision-making process, especially during the evaluation of those measures without a “gold standard” for estimation. The size of the PWID population is one of those measures.

To address the probable overestimation by MBM method, we have applied also a modified approach (MBM-MOD) to generate alternative estimates.

PWID population size estimates by different approaches are summarized the table below:

Method	PWID mean	PWID PSE 95% CI		PWID prevalence	PWID prevalence 95% CI	
NSU	47417	42078	52441	2.13%	1.89%	2.35%
MBM	74670	58754	101962	3.34%	2.64%	4.58%
MBM-MOD	36959	29700	43600	1.65%	1.13%	1.96%

The final consensus estimates are as follows:

Estimated number of PWID in Georgia per 18–64-year-old population
49 700 (44 900 – 54 400)

National prevalence of PWID in Georgia per 18–64-year-old population
2.23 % (2.02 % - 2.44 %)

Estimated number of PWID in Georgia per general population
51 000 (45 400 – 57 700)

National prevalence of PWID in Georgia per general population
1.39 % (1.23 % - 1.56 %)

1. INTRODUCTION

Georgia is considered a low HIV prevalence country, according to the 2020 Country Progress Report from the Joint United Nations Programme on HIV/AIDS (UNAIDS, 2020). In 2019, the estimated HIV prevalence was about 0.4%, equating to approximately 9,300 people living with HIV (PLWH). However, it is estimated that over one-third of PLWH are unaware of their HIV infection. Furthermore, the number of registered cases has decreased since the start of the SARS-CoV-2 pandemic began in 2020, similar to other countries in the region (ECDC, 2021). This is likely due to a lack of testing among those at most risk of HIV rather than a true decrease in cases (AIDS Center, 2022). In Georgia, this includes people who inject drugs (PWID). The high risk of HIV among PWID makes them a priority population to identify and target for HIV prevention efforts.

An accurate estimate of the population size of PWID is necessary to evaluate the impact and reach of potential HIV interventions targeted to PWID. This information is also crucial for monitoring injection drug use (IDU) at the local and national levels and identifying regions with a high prevalence of IDU. However, obtaining this information is challenging due to the hidden nature of IDU. Various methods can be employed to estimate hidden population sizes. Here we used two such methods, the Network Scale-Up (NSU) (Bernard et al., 2010) method and the Multiplier Benchmark Method (MBM) (EMCDDA, 2022), to obtain an accurate estimate of the population size of PWID in Georgia. For both methods, we utilize data from the 2021 Integrated Bio-Behavior Surveillance (IBBS) survey.

The project was implemented by non-governmental organization "Health Research Union" with support from Global Fund to Fight AIDS, Tuberculosis and Malaria. Bio-Behavioral Surveillance Survey (IBSS) was conducted using Respondent Driven Sampling (RDS) in seven cities of Georgia in order to study trends of risky behaviors and spread of HIV infection among PWID. IBSS was conducted in parallel to household survey of the general population. The goal of the study was to estimate the size of PWID population in Georgia in 2021.

2. METHODOLOGY

2.1. Objectives

The study objective was to estimate the population size of PWID in Georgia in 2021.

2.2. Target Population

Injection drug use was defined as the injection of any psychoactive drug into muscles or veins in a non-medical context.

2.2.1. Inclusion Criteria

Eligibility for the IBBS sub-study on IDU was defined as follows:

1. Aged 18 or older
2. Lived in one of the following cities/districts or neighboring villages:
   a. Tbilisi
   b. Rustavi
   c. Telavi
   d. Zugdidi
   e. Batumi
   f. Kutaisi
   g. Gori
3. Had not previously participated in the current study
4. Capable of completing the interview in Georgian
5. Provided a valid study recruitment coupon at the study site
6. Provided informed consent
7. Reported currently injecting drugs (defined as a reported drug injection in the month before the survey date)
8. One of the following:
   - Physical evidence of recent injection (including fresh track marks, scabs, or abscesses)
   - Knowledge of drug prices, preparation, injection, etc.

2.3. Methods Overview

For this report, we used two methods for estimating the size of hidden populations: (1) the network scale-up method (NSU) and (2) the multiplier benchmark method (MBM) (Bernard et al., 2010; EMCDDA, 2022). We applied these methods to estimate the population size of PWID and the prevalence of IDU in Georgia.

2.4. Method 1: Network Scale-Up

The NSU method uses information from respondents' social networks to make inferences about the characteristics of individuals in the general population (Bernard et al., 2010). Here, we use this method to identify the proportion of the population engaged in IDU by asking respondents about the IDU behavior of their acquaintances. We expect this approach to reduce bias in the responses related to the stigmatizing behavior (IDU), compared to if we asked respondents directly about this behavior (Feehan et al., 2016).

2.4.1. Household survey & data collection

The household portion of the survey was conducted in seven cities across Georgia, using a multi-stage sampling approach.

The Primary Sampling Units (PSU) were the seven largest cities in Georgia. The Secondary Sampling Units (SSU) were the election areas for these cities. The Tertiary Sampling Units (TSU) were the households selected by a systematic random sampling approach. Finally, we used the Kish methodology to identify respondents (aged 18-64) within the selected households (Gaziano, 2005).

The sample size calculation was performed using the methodology for descriptive studies (*www.openepi.com*) for the expected proportion 0.50 (maximizing the sample size), degree of accuracy (margin of error) +/- 0.05, 95% confidence level, and the corresponding population size (approximately 2.5 million). The estimated design effect was set at 1.5. A non-response rate of 15 % was also considered for the calculation of the total number of study subjects for inclusion in the study (Table 1).

Data were collected through face-to-face interviews with specially designed questionnaires. In total, 680 individuals agreed to participate in the survey. Our sample was distributed across the seven cities as follows: Tbilisi 170 (2x85) and 85 in each of the rest of the cities.

Table 1. Sample size estimation for the household survey.

Parameter	Explanation	Value
Target population size:	*Target population size (Rounded)*	**2 500 000**
Estimated percentage in the target population with the event of interest:	*50 % - the value maximizing the sample size estimation has been considered*	**50 %**
Confidence interval width	*Sample percentage to be within +/- 5 % of the target population value*	**5 %**
Confidence coefficient	*95 % confident that the confidence interval around the sample percentage captures the target population value.*	**95 %**
Number of clusters	*7 clusters (cities)*	**7**
Estimated Design effect (*DEFF*)	*Sample variance could be 1.5 times bigger than it would be if the survey were based on the same sample size but selected by simple random sampling*	**1.5**
Minimum sample size	Minimum number of participants to be studied	**577**
Non-response rate	Not more than 15% is expected to fail to adequately participate	**15 %**
Sample size	Planned number of households to be approached	**680**

2.4.2. Analysis

Average Network Size Estimation

The first step of the NSU method is to estimate the average network size of respondents in the household survey. First, we asked respondents how many people they knew or had a meal with during the last two years from 21 pre-specified groups. Using questions about "how many X's do you know" in each group can reduce potential bias in network size estimation and is based on an adapted game of contacts (McCormick et al., 2010; Salganik et al, 2011). This method has been successfully applied to estimate the size of hard-to-reach populations (Rastegari et al., 2013; Wang et al., 2015; Sulaberidze et al., 2016).

The definition of a "Person you know" was as follows: [People that you know 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 live in Georgia].

The definition of a "person you know with whom you shared meal" was as follows: [People that you know by sight and name, and who also know you by sight and name] **AND** [People that you shared a meal or drink with in the last 2 years, including family members, friends, coworkers, or neighbors, as well as meals or drinks taken at any location, such as at home, at work, or in a restaurant] **AND** [People of all ages who live in Georgia].

Next, using the 21 known population sizes (Table 2), we back-calculated the average network size for the residents of each of the seven cities (equations shown below). To account for implausible responses, we capped the responses at 15 for the total number reported known in each group.

The following steps were used to calculate the average network size in our data:

(1) First, we estimated the network size for each participant (i) using the populations listed in Table 1, with known size (j)

$$\widehat{c_i} = \frac{\sum_j m_{ij}}{\sum_j e_j} \times N$$

- Where $\widehat{c_i}$ is the estimated network size for person i
- m_{ij} is the number of people person i reports knowing in group j
- e_j is the population size of group j
- N is the size of the general population

(2) Next, we estimated the average network size across all participants ($\hat{c}$)

(3) and then calculate the population size of each group *j*, using $\hat{c}$

$$e_j = \frac{\widehat{e_j}}{\hat{c}} \times N$$

- Where $\widehat{e_j}$ is the average number of individuals known in each of the 21 groups reported by respondents

(4) We then calculated a bias factor as:

$$Bias\ factor_j = \frac{E_j}{e_j}$$

- Where E_j is the observed population size for group *j*

(5) If the bias factor was greater than 2.0 or less than 0.5, we removed the population from our calculations and repeated all steps until all bias factors were within the range of 0.5 to 2.0. We obtained our final estimate of the average network size for our participants from the remaining groups.

Table 2. List and population size of twenty-one "known size" populations in Georgia

Question	Known Size	Sex Category	Same-sex Population Size in Georgia	Total Population in Georgia	% of the same-sex category	% of total population
First name of "Mamuka" in 2021?	21807	Male	1770000	3688600	1.2	0.6
First name of "Luka" in 2021?	42689	Male	1770000	3688600	2.4	1.2
First name of "Zurab, or Zura, or Zuka or Zuriko" in 2021?	49877	Male	1770000	3688600	2.8	1.4
First name of "Vazha" in 2021?	11760	Male	1770000	3688600	0.7	0.3
First name of "Sophiko, or Sophio or Sopho" in 2021?	31380	Female	1918700	3688600	1.6	0.9
First name of "Manana" in 2021?	33610	Female	1918700	3688600	1.8	0.9
First name of "Shorena" in 2021?	15628	Female	1918700	3688600	0.8	0.4
First name of "Nino, or Niniko, or Nina" in 2021?	127439	Female	1918700	3688600	6.6	3.5
First name of "Maya" in 2021?	47442	Female	1918700	3688600	2.5	1.3
First name of "Davit, or Dato, or Datuna, or Datiko" in 2021?	100824	Male	1770000	3688600	5.7	2.7
Married in 2021	23155	Both	3688600	3688600	0.6	0.6
Teachers in 2021-2022	62981	Both	3688600	3688600	1.7	1.7
Male teachers in 2021-2022	8036	Male	1770000	3688600	0.5	0.2
Deaths in 2021	59906	Both	3688600	3688600	1.6	1.6
Male deaths in 2021	30156	Male	1770000	3688600	1.7	0.8
Deaths due to cancer in 2021	7389	Both	3688600	3688600	0.2	0.2
Male deaths due to cancer in 2021	4219	Male	1770000	3688600	0.2	0.1
Injured or deaths in road accidents in 2021	7705	Both	3688600	3688600	0.2	0.2
Male injured or deaths in road accidents in 2021	297	Male	1770000	3688600	0.0	0.0
Students in higher education institutions in 2021-2022	159842	Both	3688600	3688600	4.3	4.3
Male students in higher education institutions in 2021-2022	77483	Male	1770000	3688600	4.4	2.1

PWID Population Size Estimations

To estimate the population size of PWID, we asked respondents how many PWID they knew or had a meal within the past two years. Then, using the average network size across participants, we estimated the population size of PWID as follows (Killworth et al., 2006):

$$\hat{e} = \frac{\sum_i m_i}{\sum_i \hat{c_i}} \times N$$

- Where $\hat{e}$ is the estimated population size of PWID
- m_i is the number of PWID participant i reported knowing,
- $\hat{c_i}$ is the estimated personal network size of participant i, and
- N is the total 2021 adult population size in each of the seven cities

We used bootstrap resampling to estimate uncertainty in our estimate of m, the number of PWID reported by each participant. We used 1000 replications to estimate the point estimate and 95% confidence interval for m.

Bias Adjustment

We adjusted our population size estimates for two biases: (1) transparency bias and (2) popularity bias (Maghsoudi et al., 2016). Transparency bias occurs when PWID do not openly discuss their IDU because it is a stigmatized behavior. Popularity bias occurs because PWID may have smaller network sizes than the general population. Therefore, they may be less likely to be included in estimates of the participant's personal network sizes. To adjust for these biases, we collected data from PWID residing in each of the seven cities listed above using respondent-driven sampling (RDS). Questions included the number of individuals each participant knew in the 21 groups in Table 2 and the number of people in the participant's network who knew they injected drugs.

Information transparency bias was calculated as the number of people in the participant's network (i.e., the number of people known in the 21 groups) who knew the participant injected drugs divided by the total number of people in each group that the participant reported knowing. This represented the proportion of the participant's network aware that the participant injected drugs.

The following calculations were applied: **Information transparency bias (ITB)** = Total number of people in the 21 groups that knew the participants injected drugs divided by the total number of people in the 21 groups reported by the participants. **The correction factor (visibility factor)** = 1 / ITB.

The ***Popularity bias*** was calculated as the average number of people across the 21 groups that the RDS participants reported (i.e., PWID) divided by the same average among the household participants.

The following calculations were applied: **Popularity ratio** = Average number of people in the 21 groups teported by the RDS survey participants divided by the average number of people in the 21 groups teported by the household survey participants. **The popularity correction factor** = 1 / popularity ratio.

2.5. Method 2: Multiplier-benchmark Method with Synthetic Estimation

The multiplier-benchmark method uses external data sources with information on a subset of the target population (i.e., PWID) (Pisani E, 2003). A multiplier is estimated for each data source, which is used to generate an estimate of the total population size of PWID. The external data source should be specific to the population of interest. For example, here, that might be injection drug-related deaths. At a minimum, a count of PWID in each external dataset is required to estimate the multiplier. The external data is called the **benchmark**.

The **multiplier** is estimated from internal data as the proportion of the target population who has experienced the event in the external data. For example, using drug-related arrests, we would estimate the proportion of PWID in our RDS dataset who were arrested for IDU. The multiplier is calculated as one over this proportion. We can then apply the multiplier to the external data to estimate the population size of PWID.

Our internal data comes from a sample of PWID from seven cities in Georgia, described in section 2.2.1. Therefore, to estimate the total population size of PWID in all of Georgia, we used regression models to predict the prevalence of IDU in the remaining regions, described in more detail below.

2.5.1. Estimating Regional Prevalence

To estimate the population size of PWID and the prevalence of IDU in the seven cities, we used the following steps:

(1) **Obtain benchmark data** for IDU in Georgia in 2021. The "Benchmark Data Collection" section below describes this step in more detail.

(2) **Estimate the multiplier**. To estimate the multiplier (M), we first estimated the proportion of PWID experiencing the benchmark event (e.g., HIV testing). Then, M was estimated as one divided by this proportion. We did this separately for each city.

(3) **Estimate the number of PWID** for each city. For this step, we multiplied the number experiencing the event of interest in the benchmark times M.

(4) **Calculation of the prevalence of IDU**. To calculate the prevalence of IDU in each city, we divided the estimate in step (3) by the estimated population size in each

city (both total and adult population size). Estimates for population size were obtained from the National Statistics Office of Georgia (www.geostat.ge). The most recent age-stratified population size estimates for each city were from the 2014 census. Therefore, we calculated the proportion of the 18-64 age group from the total population of Georgia using 2021 data, which we estimated as 0.6. We applied this proportion to each city to obtain an estimate of the adult population. We used these estimates as the denominators for the prevalence estimates.

(5) **Two types of multipliers**. We used two approaches for the calculation of multipliers: 1) A "classic" approach, based on the nomination data, calculated as a proportion of PWID among the partners of the respondent experiencing the benchmark event over the total number of the partners (the network) of the respondent, 2) A "modified" approach, based on the data obtained directly from the respondents, calculated as the proportion of the respondents experiencing the benchmark event over the total number of respondents.

2.5.2. Benchmark Data Collection

To calculate the estimated size of the PWID population in the seven cities, we used the multiplier benchmark method. We collected the benchmark data from institutions providing drug addiction services and governmental organizations working in this field. The following sources were used to collect the data:

1. **Ministry of Internal Affairs (MIA).** In Georgia national anti-drug legislation relies on several basic framework laws and regulations, including the law of narcotic drugs, psychotropic substances and precursors and narcological assistance; Law of Georgia on combating drug-related crime (combat against drug-related crime, prevention of the spread of drug addiction, prevention of the use and spread of narcotic drugs) (Parliament of Georgia, Consolidated versions (2014 - 2017); Law of Georgia on new psychoactive substances (avoid potential threats to the health of the population related to the distribution of NPS, to prevent the illegal circulation of NPS and to ensure the coordinated work of respective responsible agencies). In addition, the administrative offences code of Georgia, Article 45 (Illegal manufacturing, purchase, storage, transportation, transfer and/or use of a small quantity of narcotic drugs, their analogues or precursors without a doctor's prescription) and Criminal code of Georgia (Chapter XXXIII – Drug-related Crime) are used to punish and detention of persons who used a small quantity of narcotic drugs, their analogues or precursors without a doctor's prescription;

In 2020, the National Drug Observatory at the Ministry of Justice of Georgia was established, which operates under the Inter-Agency Coordinating Council for Combating

Drug Abuse. The main tasks of the organization are monitoring and assessment of the drug situation in the country; collection and evaluation of information on drug distribution and consumption; and establishing evidence-based scientific-practical methods.

Clinical and/or laboratory examination is used to determine the facts of consumption of narcotic substances and/or substances subject to special control. Data on individuals in 2021 are submitted to the drug testing service of the Forensic-Criminalistics Department of the Ministry of Internal Affairs (MIA), according to different regions and age groups of Georgia, including the number of persons with positive results (Table 3).

Table 3. Benchmark data on individuals brought to the Drug Testing Service of the Forensic-Criminalistics Department of the MIA (2021)

Region	Total # of individuals tested	Total # of individuals with positive drug test result
Tbilisi	1347	992
Shida Kartli	480	229
Kvemo kartli	228	131
Kakheti	276	178
Adjara	459	223
Samegrelo	578	427
Imereti	325	164
Samtskhe-Javakheti	198	116
Guria	334	229
Total	**4225**	**2689**

Source: Ministry of Internal Affairs (https://info.police.ge/page?id=101).

Explanation: After the consensus-building meeting, which was held in Tbilisi on November 15, 2022, this benchmark data were excluded from our calculation. Currently, the Ministry of Internal Affairs of Georgia does not separately estimate injecting drug use among positively tested individuals. Accordingly, no data are available on PWID.

2. **National Center of Disease Control and Public Health.** The NCDC is a national agency that is responsible for the management of the national HIV/AIDS surveillance system. The NCDC provided information on the number of individuals tested for HIV in 2021, including the number of PWID and their partners, disaggregated by city (Table 4).

Table 4. HIV testing benchmark data (2021)

City	# of Persons tested	# of PWID	# of PWID Partners
Tbilisi	88152	13501	846
Gori	1791	2290	212
Rustavi	4355	2521	102
Telavi	8890	1753	103
Batumi	37552	2548	233
Zugdidi	13469	2379	365
Kutaisi	21808	3375	40
Rest of Georgia	192247	4782	427
Total	**368264**	**33149**	**2328**

Source: HIV/AIDS register, NCDC

The Hepatitis C Elimination Program has been conducted in Georgia since 2015. According to the Strategic Plan for the Elimination of Hepatitis in Georgia, the role of the NCDC is to identify HCV-infected individuals and to control and prevent disease transmission. Information on the number of people tested for hepatitis C virus in 2021, including the number of PWID and their partners, disaggregated by cities, was provided by the NCDC (Table 5).

Table 5. HCV testing benchmark data (2021)

City	# of Persons tested	# of PWID	# of PWID Partners
Tbilisi	90688	12370	781
Gori	8323	1854	210
Rustavi	6738	2452	102
Telavi	7714	1595	104
Batumi	17940	2374	234
Zugdidi	16288	1590	348
Kutaisi	15242	2443	38
Rest of Georgia	400803	3289	276
Total	**563736**	**27967**	**2093**

Source: NCDC

3. **Ministry of Internally Displaced Persons from Occupied Territories, Labor, Health and Social Affairs of Georgia.** LEPL (Legal Entity under Public Law) National Health Agency is an authority that implements the "State Program for the Treatment of Drug Addiction Patients." The goal of the program is to reduce the harm associated with drug use. Program services include inpatient detoxification and primary rehabilitation; implementation of replacement therapy and provision of replacement pharmaceutical product delivery (transportation, escort) in Tbilisi and other regions; provision of psycho-social rehabilitation; and the provision of short- and long-term detoxification with a

substitute pharmaceutical product in penitentiary institutions No. 2 and No. 8. In addition to public agencies which provide state opioid substitution therapy, there are private organizations working in the field (Table 6).

Table 6. Addiction treatment facilities in Georgia

Opioid replacement therapy	
Organizations	**Cities**
Center for Mental Health and Prevention of Addiction LTD	Tbilisi, Telavi, Ozurgeti, Poti, Kutaisi, Zestafoni, Sachkhere, Batumi, Kobuleti, Zugdidi, Gori, Borjomi, Penitentiary N8 in Tbilisi and N2 in Kutaisi
LLc "AMMC-Addiction Medical Management Center"	Tbilisi
Medical Center Uranti	Tbilisi, Batumi
Georgian Addictology Medical Corporation	Kutaisi, Gori, Senaki, Marneuli
LTD "G+G"	Tbilisi, Kobuleti, Batumi, Kvareli
Detox Treatment program	
Center for Mental Health and Prevention of Addiction LTD	Tbilisi
Addiction clinic NISHATI	Tbilisi
Medical Center Uranti	Tbilisi
Georgian Addictology Medical Corporation	Kutaisi
LTD B. Naneishvili Mental Health National Center	Khoni
John chanturia medical centre	Tbilisi
Neogeni	Tbilisi
Batumi Medical Center	Batumi
Hospital service	Kutaisi
LLC Tsinamdashvili Cardiology Center (German-Georgian Clinic)	Tbilisi

Source: National drug observatory, Drug report 2020

Table 7. Opioid substitution benchmark data, by cities

City	# of PWID according MPHA	# of PWID according private services	# of PWID Total
Tbilisi	9423	2033	11456
Gori	311	393	704
Rustavi	-	-	-
Telavi	393	-	393
Batumi	1469	778	2247
Zugdidi	1061	-	1061
Kutaisi	1581	811	2392
Total for only relevant regions	14238	4015	18253
Rest of Georgia	2051	847	2898
Total	**16289**	**4862**	**21151**

Source: MPHA (Center for Mental Health and Prevention of Addiction); Medical Center Uranti. Georgian Addictology Medical Corporation. LLC "AMMC-Addiction Medical Management Center"; LTD "G+G".

4. **Georgian Harm Reduction Network (GHRN).** To prevent the spread of infections (HIV, hepatitis B and C, tuberculosis, STIs) among PWID and to reduce deaths caused by overdose, various programs are operating in the country, offering a diverse package of services. Currently, there are 14 Georgian harm reduction service centers in the following cities across Georgia: Tbilisi (5 centers, including the one at the main office, providing only screening services), Gori, Kutaisi, Samtredia, Batumi, Ozurgeti, Poti, Zugdidi, Rustavi, Telavi. Harm reduction centers also provide outpatient services via nine mobile clinic vans, covering 55 cities. In addition, there are ten vending machines (Sigma) in Tbilisi. The network reaches approximately 9, 000 (8,000-10,000) PWID per month (Table 8).

Table 8. Benchmark data from Georgian harm reduction programs in Georgia

City	# of Persons	# of Overdose	# of mortality from overdose
Tbilisi	12824	230	7
Gori	4158	7	
Rustavi	3230	213	1
Telavi	1658	4	
Batumi	2534	31	1
Zugdidi	2427	60	
Kutaisi	3135	34	
Rest of Georgia	7249	187	
Total	**37215**	**766**	**9**

Source: GHRN(Georgian Harm Reduction Network)

2.5.3 Estimating National Prevalence

To estimate the national prevalence of IDU, we applied the **multiple indicator method** (Smit et al., 2003). This method uses the regional prevalence estimates of IDU in the seven cities for which we have data (**anchor points**) and **indicators** of IDU to estimate the national prevalence. Specifically, regression methods were used where the prevalence of IDU was the dependent variable, and the indicators were the independent variables. Prevalence was modeled as the prevalence rate per 100,000 population. The predictors can be directly related to IDU (e.g., drug-related arrests) or indirectly related (e.g., house density).

We used two *indirect* indicators for this analysis as predictors: population density and a prevalence rate coefficient (Table 21). We used these indicators because the drug-specific indicators are not available for all regions. Population density was derived from the National Statistics Office of Georgia (www.geostat.ge). For the prevalence rate coefficient, we used rankings of IDU prevalence for each region provided by addiction experts for the previous study (2017) and transferred unchanged to our study (2021) by agreement with field experts at the consensus meeting on 15.11.2022 (see below).

Regression Models

We fit three models to the prevalence rate per 100,000 population in the seven cities for which we had benchmark estimates, using linear, Poisson, and Negative Binomial regression. We then used these models to estimate the prevalence in the remaining regions in Georgia. We included two predictors in each model, one for each indicator (population density and prevalence rate coefficient, described above). The models were defined as follows:

$$f(x) = \beta_0 + \beta_{den} \times population\ density + \beta_{prev} \times prevalence\ rate\ coefficient$$

- Where $f(x)$ was the outcome, modeled using the Gaussian, Poisson, or Negative Binomial distribution
- β_0 was the intercept
- β_{den} was the parameter estimate for the association between population density and prevalence per 100,000 population, and
- β_{prev} was the parameter estimate for the association between the prevalence rate coefficient and prevalence per 100,000 population

We evaluated model fit using the *F*-statistic for the linear model and residual deviance for the Poisson and Negative Binomial models. For each model, we estimated the predicted

prevalence and 95% confidence intervals in the seven cities for which we had data and the remaining cities in Georgia.

Finally, to estimate the population size of PWID and the prevalence of IDU in Georgia, we applied the predictions from the model to the regions for which we had no data. We then added those estimates to the mean and median estimated population size for the seven cities estimated from the benchmark data.

Statistical calculations were performed in R version 4.2.2., Tidyverse package was used for the for general coding., Boot package - for bootstrapping and MASS package - for the negative binomial model construction.

3. RESULTS

3.1. Network Scale-up estimates

Average social network size

We estimated the average network size for the adult (18-64 years) population living in seven cities (Tbilisi, Gori, Rustavi, Telavi, Batumi, Zugdidi and Kutaisi) in Georgia, shown in Table 9 below.

Table 9. Average social network size of people living in seven cities of Georgia in 2022

Year 2022	Average Network	Excluded Populations
Tbilisi	327	Male teachers
Gori	239	Mamuka, Vazha, Sophiko, Shorena, married, teachers, male teachers, died of cancer, males died of cancer, injured, male injured
Rustavi	249	Mamuka, Vazha, married, teachers, male teachers, died of cancer, injured
Telavi	376	Married, teachers, male teachers
Batumi	300	Mamuka, Vazha, Sophiko, Shorena, married, male teachers
Zugdidi	381	Mamuka, married, teachers, male teachers, died of cancer, males died of cancer, injured
Kutaisi	252	Mamuka, Vazha, Sophiko, Shorena, Manana, Mayam married, male teachers, injured, injured males

PWID population size by NSU

The estimated prevalence of PWID in the seven cities per 18-64 age group population, shown in Table 10 below, was 3.44% (95% CI: 2.77%-4.09%), with the highest rates in Rustavi (9.55%, 95% CI: 7.93%-11.23%) and Kutaisi (6.11%, 05% CI: 4.63%-7.49%) and the lowest in Telavi (0.74%, 95% CI: 0.52%-0.90%). In Tbilisi, the PWID prevalence was estimated as 2.73% (95% CI: 2.19-3.23). We estimated the total 2021 prevalence of PWID in Georgia in the 18-64 age-group population as 2.13% (95% CI:1.89%-2.35%).

The weighted mean of the popularity correction factor for 7 cities was equal to 1.1. The information transparency bias correction factor (visibility factor) was the lowest for Telavi (1.73), the highest for Gori (3.69) and for Tbilisi it was equal to 2.23.

Table 10. Population size estimation of people who inject drugs in Georgia by different locations in 2022 using Network Scale-up Method (adult population).

Cities	Population size in 2022	PWID PSE	PWID PSE 95% CI		PWID prevalence	PWID prevalence 95% CI	
Tbilisi	721080	19703	15790	23272	2.73%	2.19	3.23
Gori	71280	2923	2411	3457	4.10%	3.38	4.85
Rustavi	77280	7378	6133	8676	9.55%	7.93	11.23
Telavi	32400	240	170	309	0.74%	0.52	0.9
Batumi	104220	3226	2495	3974	3.09%	2.39	3.81
Zugdidi	58260	1165	972	1365	2.00%	1.66	2.34
Kutaisi	77580	4741	3589	5814	6.11%	4.63	7.49
All 7 cities	1142100	39377	31700	46731	3.44%	2.77	4.09
Rest/Georgia	1084956	8040	5711	10377	0.74%	0.52	0.95
Georgia	**2227056**	**47417**	**42078**	**52441**	**2.13%**	**1.89**	**2.35**

3.2. Multiplier-benchmark estimates

Calculation of the estimated size of the PWID population in the surveyed cities revealed the following figures (mean and median estimates):

Table 11. Estimates of the number of PWID in 7 cities in 2021

City	Median Estimated size	Mean Estimated size	95% CI	
Tbilisi	30773	40760	40481	41039
Gori	3047	3410	3399	3421
Rustavi	3474	3912	3900	3926
Telavi	2354	2383	2374	2392
Batumi	3947	3946	3930	3964
Zugdidi	6192	5871	5834	5907
Kutaisi	9466	9221	9177	9265

Table 12. Estimated Prevalence of PWID in 7 cities in 2022

City	Median Estimated Prevalence	Mean Estimated Prevalence	95% CI	
Tbilisi	4.3	5.7	3.4	7.8
Gori	4.3	4.8	2.8	6.7
Rustavi	4.5	5.1	4.1	6.0
Telavi	7.2	7.3	6.0	8.7
Batumi	3.8	3.8	2.6	4.9
Zugdidi	10.5	10.0	6.7	13.3
Kutaisi	12.1	11.8	7.6	16.1

Multiplier Benchmark Estimates of the number of PWID by cities in 2021

Table 13. MBM estimates of the number of PWID in Tbilisi in 2021

Tbilisi					Adult population (18-64)			
Characteristics	Benchmark	Multiplier	95% CI		Estimated size	95% CI		Prevalence
HIV testing data	13501	3.41	3.39	3.43	46011	45741	46281	0.064
Needle/syringe data	12824	2.36	2.35	2.37	30303	30162	30444	0.042
Opioid substitution	11456	2.22	2.21	2.23	25512	25409	25615	0.035
HCV testing data	12370	5.76	5.71	5.80	71202	70602	71797	0.099
Treatment	2852	10.79	10.69	10.89	30773	30488	31058	0.043
				Mean	40760	40481	41039	0.057
				Median	30773			0.043

Table 14. MBM estimates of the number of PWID in Gori in 2021

Gori					Adult population (18-64)			
Data	Benchmark	Multiplier	95% CI		Estimated size	95% CI		Prevalence
HIV testing	2290	1.494	1.49	1.50	3421	3410	3433	0.048
Needle/syringe	4158	1.345	1.34	1.35	5593	5576	5609	0.078
Opioid substitution	704	2.77	2.76	2.78	1954	1945	1961	0.027
HCV testing	1854	1.442	1.44	1.45	2673	2664	2681	0.037
				Mean	3410	3399	3421	0.048
				Median	3047			0.043

Table 15. MBM estimates of the number of PWID in Rustavi in 2021

Rustavi					Adult population (18-64)			
Data	Benchmark	Multiplier	95% CI		Estimated size	95% CI		Prevalence
HIV testing	2521	1.378	1.37	1.38	3473	3463	3486	0.045
Needle/syringe	3230	1.507	1.50	1.51	4867	4851	4883	0.063
HCV testing	2452	1.385	1.38	1.39	3396	3384	3408	0.044
				Mean	3912	3900	3926	0.051
				Median	3474			0.045

Table 16. MBM Estimates of the number of PWID in Telavi in 2021

Telavi					Adult population (18-64)			
Characteristics	Benchmark	Multiplier	95% CI		Estimated size	95% CI		Prevalence
HIV testing data	1753	1.722	1.72	1.73	3019	3008	3029	0.093
Needle/syringe data	1658	1.372	1.37	1.38	2275	2268	2281	0.070
Opioid substitution	393	4.594	4.57	4.62	1805	1796	1815	0.056
HCV testing data	1595	1.525	1.52	1.53	2433	2424	2442	0.075
				Mean	2383	2374	2392	0.074
				Median	2354			0.073

Table 17. MBM estimates of the number of PWID in Batumi in 2021

Batumi						Adult population (18-64)		
Characteristics	Benchmark	Multiplier	95% CI		Estimated size	95% CI		Prevalence
HIV testing	2548	1.549	1.54	1.56	3947	3932	3962	0.038
Needle/syringe	2534	1.734	1.73	1.74	4394	4376	4414	0.042
Opioid substitution	2247	2.571	2.56	2.58	5777	5755	5802	0.055
HCV testing	2374	1.511	1.51	1.52	3586	3573	3599	0.034
Treatment	167	12.14	12.06	12.23	2027	2014	2042	0.019
				Mean	3946	3930	3964	0.038
				Median	3947			0.038

Table 18. MBM estimates of the number of PWID in Zugdidi in 2022

Zugdidi						Adult population (18-64)		
Characteristics	Benchmark	Multiplier	95% CI		Estimated size	95% CI		Prevalence
HIV testing data	2379	3.454	3.43	3.48	8217	8162	8269	0.038
Needle/syringe	2427	2.713	2.70	2.73	6584	6546	6623	0.042
Opioid substitution	1061	2.717	2.70	2.73	2883	2867	2899	0.055
HCV testing data	1590	3.647	3.62	3.67	5799	5761	5837	0.034
				Mean	5871	5834	5907	0.100
				Median	6192			0.105

Table 19. MBM Estimates of the number of PWID in Kutaisi in 2022

Kutaisi							Adult population (18-64)
Characteristics	Benchmark	Multiplier	95% CI		Estimated size	95% CI	Prevalence
HIV testing data	3375	4.312	4.29	4.33	14553	14482 14621	0.188
Needle/syringe	3135	3.447	3.43	3.46	10806	10762 10853	0.139
Opioid substitution	2392	2.038	2.03	2.04	4875	4865 4884	0.063
HCV testing	2443	3.875	3.86	3.89	9466	9422 9510	0.122
Treatment	335	19.12	18.96	19.28	6405	6352 6459	0.083
				Mean	9221	9177 9265	0.118
				Median	9466		0.121

Table 20. Estimates of the number of PWID according to cities

Indicator / City	Estimated size						
	Tbilisi	Gori	Telavi	Zugdidi	Batumi	Kutaisi	Rustavi
HIV testing	46011	3421	3019	8217	3947	14553	3474
Opioid substitution	25513	1954	1805	2883	5777	4875	-
Needle/syringe	30303	5593	2275	6584	4394	10806	4868
HCV testing	71202	2673	2433	5799	3586	9466	3396
Treatment	30773	-	-	-	2027	6405	-
Mean	**40760**	**3410**	**2383**	**5871**	**3946**	**9221**	**3912**
Median	**30773**	**3047**	**2354**	**6192**	**3947**	**9466**	**3474**

Table 21. Summary of PWID size estimation by NB regression model for MBM

Method	Estimate	PWID PSE	PWID PSE 95% CI		PWID prevalence	PWID prevalence 95% CI	
MBM	Mean	74670	58754	101962	3.34%	2.64%	4.58%
	Median	68994	53078	96286	3.10%	2.38%	4.32%

Table 22. National Estimation of PWID prevalence in 2021 predicted by Negative binomial model

Cities	Population	Density of the population per 1 km^2	Prevalence coefficient	Prevalence per 100 000	Prevalence %	Estimated Number
Tbilisi	1201800	2383.57	5	2300	2.30%	27641
Batumi	173700	2110.57	5	2300	2.30%	3995
Keda	16600	36.72	0.5	1846	1.85%	306
Kobuleti	70700	99.39	5	2387	2.39%	1687
Shuakhevi	14800	25.17	0.5	1846	1.85%	273
Khelvachauri	52700	147.86	0.5	1842	1.84%	971
Khulo	26800	37.74	0.5	1846	1.85%	495
Lanchkhuti	29400	55.14	0.5	1845	1.84%	542
Ozurgeti	58300	89.32	2	2010	2.01%	1172
Chokhatauri	17600	21.33	0.5	1846	1.85%	325
Kutaisi	129300	1909.89	5	2300	2.30%	2974
Baghdati	17600	21.58	0.5	1846	1.85%	325
Vani	20500	36.8	0.5	1846	1.85%	378
Zestaponi	54300	128.15	0.5	1842	1.84%	1000
Terjola	30400	85.15	0.5	1844	1.84%	561
Samtredia	42200	115.9	1	1896	1.90%	800
Sachkhere	34100	44.37	0.5	1845	1.85%	629
Tkibuli	17200	35.92	0.5	1846	1.85%	317
Tskhaltubo	44600	63.7	0.5	1845	1.84%	823
Chiatura	37600	69.62	0.5	1844	1.84%	693
Kharagauli	18300	20.02	0.5	1846	1.85%	338
Khoni	20500	47.84	0.5	1845	1.85%	378
Akhmeta	27800	12.59	0.5	1846	1.85%	513
Gurjaani	51000	60.28	1	1898	1.90%	968
Dedoplistskaro	20400	8.05	0.5	1847	1.85%	377
Telavi	54000	49.88	8	2800	1.85%	1512
Lagodekhi	40700	45.72	1	1899	1.90%	773
Sagarejo	52000	33.46	1	1899	1.90%	988
Sighnaghi	28700	22.94	0.5	1846	1.85%	530
Kvareli	30300	30.3	0.5	1846	1.85%	559
Dusheti	26100	8.75	0.5	1847	1.85%	482
Tianeti	10200	11.25	0.5	1846	1.85%	188

Cities	Population	Density of the population per 1 km^2	Prevalence coefficient	Prevalence per 100 000	Prevalence %	Estimated Number
Mtskheta	52200	88.05	1	1897	1.90%	990
Kazbegi	3800	3.51	0.5	1847	1.85%	70
Ambrolauri	10200	8.95	0.5	1846	1.85%	188
Lentekhi	3900	2.9	0.5	1847	1.85%	72
Oni	5400	3.97	0.5	1847	1.85%	100
Tsageri	8100	10.74	0.5	1846	1.85%	150
Poti	41100	624.62	2	1990	1.99%	818
Abasha	19000	58.91	0.5	1845	1.84%	351
Zugdidi	97100	144.79	8	2800	2.80%	2719
Martvili	30900	35.08	0.5	1846	1.85%	570
Mestia	9400	3.08	0.5	1847	1.85%	174
Senaki	33100	63.56	0.5	1845	1.84%	611
Chkhorotskhu	21000	33.9	0.5	1846	1.85%	388
Tsalenjikha	22600	34.94	0.5	1846	1.85%	417
Khobi	27100	40.08	0.5	1845	1.85%	500
Adigeni	15900	19.88	0.5	1846	1.85%	294
Aspindza	10500	12.72	0.5	1846	1.85%	194
Akhalqalaqi	40100	32.46	0.5	1846	1.85%	740
Akhaltsikhe	39100	39.19	0.5	1845	1.85%	722
Borjomi	24700	20.77	0.5	1846	1.85%	456
Ninotsminda	17900	13.22	0.5	1846	1.85%	330
Rustavi	128800	2125.41	8	2700	2.70%	3478
Bolnisi	55900	69.52	0.5	1844	1.84%	1031
Gardabani	79300	65.41	0.5	1845	1.84%	1463
Dmanisi	20900	17.43	0.5	1846	1.85%	386
Tetri Tskaro	22500	19.15	0.5	1846	1.85%	415
Marneuli	107500	114.91	1	1897	1.90%	2039
Tsalka	19600	18.65	0.5	1846	1.85%	362
Gori	118800	88.9	2	2000	2.00%	2376
Kaspi	41100	51.17	0.5	1845	1.85%	758
Kareli	40300	58.6	0.5	1845	1.84%	743
Khashuri	50300	85.95	1	1898	1.90%	954

4. DATA TRIANGULATION AND THE FINAL CONSENSUS ESTIMATE

4.1 Consensus estimate of PWID prevalence

With the support of the Global Fund Project, the ***consensus-building meeting*** was held in Tbilisi on November 15, 2022. Professionals and service providers in addiction and HIV/AIDS fields attended the meeting.

The goal of data triangulation is the synthesis and interpretation of data collected from different sources. The knowledge and experience of the professionals in these fields are of major importance in the final decision-making process, especially during the evaluation of those measures without a "gold standard" for estimation. The size of the PWID population is one of those measures.

As described in the methods section, for the analysis of 2021 data, two main methods were applied: 1) the Network Scale-Up (NSU) method and 2) the Multiplier-Benchmark method (MBM). According to the results obtained through both of the NSU and MBM, the estimated number of PWID in 2021 is greater compared to previous years (2017 Report: Population size estimation of people who inject drugs in Georgia) (Table 23).

Several experts' opinion is that the MBM methodology overestimates the number of PWID, at least this does not correspond to the specialists' expectation regarding the prevalence of PWID in Georgia and that more "realistic" estimates for the country are generated by the NSU methodology. To address the overestimation problem, we have applied alternative approaches to the collected benchmark data and applied multipliers calculated from the IBBS variables which corresponding to the variables in the PSE survey tool (Section 2.5.1). The lowest estimate is presented in the table 23, obtained from the data on HCV testing self-reported by the respondents and cross-checked with the STOP-C database for exclusion of the previous HCV positive cases. The overall methodology was identical to the usual MBM technology described in the methods section. Summary of PWID size and prevalence estimates is presented in the table 24.

Table 23. PWID population size estimated using different approaches and their comparison to 2016 and 2014 data.

Methods	2021	Methods	2016	2014
Method N1 (NSU) Using Network Scale-up method – mean estimate	47 417		36 500	43 800
Method N2 (MBM) Using multiplier benchmark method with demographic indicator – including two indicators- population density and prevalence ratio simultaneously in regression model - using **mean** indicators for 7 cities. Multiplier calculated using **nomination** data.	74 670	Using multiplier benchmark method with demographic indicator (population density) using mean indicators for 7 cities	62 300	52 800
		Using multiplier benchmark method with prevalence rate coefficients by mean indicators for 7 cities	58 900	52 494
Using multiplier benchmark method with demographic indicator – including two indicators- population density and prevalence ratio simultaneously in regression **model** – using median indicators for 7 cities Multiplier calculated using **nomination** data.	68 994	Using multiplier benchmark method with demographic indicator (population density) by median indicators for 7 cities	53 000	33 390
		Using multiplier benchmark method with prevalence rate coefficients by median indicators for 7 cities	50 000	34 937
Method N3 (MBM-MOD) Multiplier calculated using answers to the **"direct"** question (HCV testing) by respondents, cross-checked with the HCV testing "STOP-C" database.	36 959	-	-	-

Table 24. Summary of PWID size estimation by MBM-MOD

Method	Estimate	PWID PSE	PWID PSE 95% CI		PWID prevalence	PWID prevalence 95% CI	
MBM-MOD	Mean	36959	29711	43674	1.65%	1.13%	1.96%

As agreed, on in the consensus meeting, we used a weighted mean derived from the mean prevalence estimated using the described three approaches for the final estimate of the number of PWID in Georgia.

Similar to the previous consensus meeting (2017), attendees at the November 15, 2022, meeting agreed that the number of PWID has likely increased since 2017. However, it is possible that the previous and current estimates by MBM method were overestimating the real PWID prevalence. The experts' recommendation was to explore further on the modification of the MBM method to get more adequate estimates.

During the previous triangulation meeting, there was some disagreement on whether to use mean or median indicator-based estimates. Proponents of the median-based estimates argued that mean indicator-based estimates are skewed and lead to an overestimation of the number of PWID. The most of the consensus meeting participants agreed that the mean of estimates should be used, similar to the estimated size of the PWID population in Georgia in 2016.

In the previous report, data obtained from the ministry of internal affairs were used to estimate the benchmark event related to police involvement. For 2021, data stratifying the PWIDs and non-injection drug users were unavailable, so the police benchmark data were removed from the analysis based on the experts' decision.

For the calculation of the mean, we used the weighted mean estimation approach, where the weights were assigned based on the experts' opinions. Nine experts participated in the scoring process of the three methods. They could assign weights to each method as follows: 3 – highly probable, 2 – intermediate probability, 1 – low probability, and 0 – the estimate should not be included in the calculations of the final estimate.

Using the above scores, we calculated the weighted means and the lower and upper 95% confidence intervals. To Estimate the PWID prevalence among the general population, the estimates for the 18-64 age group were multiplied by the coefficient 1.038, the estimate obtained from our survey data for the proportion of the PWID proportion in the age group < 18 years.

The final consensus estimate is as follows:

Estimated number of PWID in Georgia per 18–64-year-old population
49 700 (44 900 – 54 400)

National prevalence of PWID in Georgia per 18–64-year-old population
2.23 % (2.02 % - 2.44 %)

Estimated number of PWID in Georgia per general population
51 000 (45 400 – 57 700)

National prevalence of PWID in Georgia per general population
1.39 % (1.23 % - 1.56 %)

5. LIMITATIONS

5.1 General Limitations

The most recent Census data available for our analyses were from 2014. Therefore, we calculated the proportion of the 18-64 age group from the total population of Georgia using 2021 data, which we estimated as 0.6. We applied this proportion to each city to estimate the corresponding adult population. We used these estimates as the denominators for the prevalence estimates.

We could not use the police data for the multiplier benchmark estimation because the data were not PWID-specific and included only general drug-related statistics.

We did not have datasets from the previous studies and thus were restricted it conducting comparative studies with the previous data.

5.2 NSU Limitations

First, PWID may not disclose their IDU to others because of stigmatization. Therefore, respondents may be unaware of their acquaintance's injecting behavior. This could result in an underestimate of the proportion of PWID in a respondent's network and, therefore, underestimate of the population size of PWID. This bias is defined as information transparency bias. To account for this bias, we adjusted our population size estimates using data reported by PWID in our IBSS sub-study.

A second potential bias is related to popularity. The general population may have a lower chance of knowing hidden population members if members have smaller network sizes, on average. This bias can also result in an underestimate of the population size of PWID if they are less likely to be included in the general population's social networks. To adjust for this bias, we calculated popularity ratios as the ratio of the general population's network size to PWID's average network size in each city.

Our population size estimates are based on data from seven cities. We used this data to estimate the prevalence in the remaining regions. However, it is possible that our data from the seven cities are not representative of all of Georgia.

5.3 Multiplier-Benchmark Limitations

We used external data sources for the multiplier benchmark method, which may be of varied quality. The detox program data was only available for three cities (Tbilisi, Batumi, and Kutaisi). Additionally, there are no opioid substitution therapy programs offered in Rustavi. Therefore, to obtain an estimate of Rustavi PWID who engaged in these programs, we assumed that they would attend Tbilisi-based programs. Because we did not

have access to individual-level data, it is also possible that PWID were counted more than once in a given benchmark dataset.

Additionally, we assume that those included in the benchmark data represent all PWID in Georgia and that PWID have an equal chance of being included in both the IBSS survey and the benchmark data (Pisani, 2003). For example, drug treatment program data only include PWID trying to stop IDU. Furthermore, the direction of the bias is not clear if these assumptions do not hold. Because of these potential biases, we only used benchmark data in which PWID were clearly defined.

The benchmark data were only available for the seven cities we included in our survey. Therefore, for the regression models, we used a set of indirect benchmark data sources (population density and prevalence rate coefficients). These indicators might have less predictive power than if we had access to drug-related indicators for all regions. However, using indirect indicators has been used in previous studies and was shown to be a reasonable approach for population size estimation (Smit et al., 2003).

The benchmark data were obtained as disaggregated data by cities. For regression models, we had to re-calculate proportion of PWID for 7 cities using proportion coefficient 0.51 (calculated as a proportion of the total adult population in 7 cities / total adult population in whole Georgia) to get estimates for 7 cities vs the rest of Georgia. Another coefficient 1.18 was applied to correct for the portion of reported PWIDs in the rest of Georgia (mean proportion = 15% calculated from the HIV and HCV testing and harm reduction benchmark data). Such an adjustment could lead to the underestimation of PWID population size in 7 cities and its overestimation in the cities in the rest of Georgia (Table 22).

6. CONCLUSION AND RECOMMENDATIONS

Final consensus estimates of PWID size and prevalence was very close to the estimates generated by NSU methodology.

In our study we applied the Multivariate Indicator Method (MIM) differently than in previous years using a modified method. In previous years, the following indicators were used in separate analyses: 1) population density and 2) prevalence ratio. The methodology proposed by the EMCDDA for the previous study was of limited use in estimating PWID prevalence in the other urban areas because the model generated negative values for a large proportion of the most of the cities. For our analyses, we used both indicators as predictors in a single model. We based this analysis on previously published work. Specifically, a 2003 study in the Netherlands extrapolated data from seven Dutch provinces to estimate national statistics (Smit et al., 2003). Using this approach, the models predicted no negative estimates of PWID prevalence. We estimated national prevalence using models fit to data from the seven cities included in our IBSS survey (the anchor points). We evaluated several multivariate models: linear, Poisson, and negative binomial. The mean and median estimates presented in this report our based on estimates from the negative binomial model, which fit the data best.

We expanded the survey to seven cities in 2021, compared to only two cities in 2016. To improve future estimates, we recommend that additional regions are included in the survey, especially those with a low estimated prevalence of injection drug use. This will allow for more precise estimates of the prevalence of IDU in regions not included in the study using the MIM. It would also be useful to conduct an additional analysis using the upcoming census data because the most recent data were only available from 2014.

Further development and validation of novel approaches are needed to better estimate PWID population size, as far as none of the methods currently available for this task is highly reliable, especially taking into consideration the country-specific contexts.

The PWID population size estimates reported here will aid with the planning and evaluation of activities for substance abuse, HIV and viral hepatitis prevention, treatment and care programs.

REFERENCES

AIDS Center. Retrieved November 9, 2022 from https://aidscenter.ge/epidsituation_eng.html

Bernard HR, Hallett T, Iovita A, et al. Counting hard-to-count populations: the network scale-up method for public health. *Sex Transm Infect*. 2010;86(Suppl 2):ii11-ii15. doi:10.1136/sti.2010.044446

Curatio International Foundation. Population Size Estimation of People who Inject Drugs in Georgia 2016.(2017). Retrieved November 3, 2022 from http://curatiofoundation.org/wp-content/uploads/2018/02/PWID-PSE-Report-2017-ENG.pdf

Estimating the prevalence of problem drug use in Europe | www.emcdda.europa.eu. Accessed November 9, 2022. https://www.emcdda.europa.eu/html.cfm/index34027EN.html_en

Feehan DM, Umubyeyi A, Mahy M, Hladik W, Salganik MJ. Quantity Versus Quality: A Survey Experiment to Improve the Network Scale-up Method. *Am J Epidemiol*. 2016;183(8):747-757. doi:10.1093/aje/kwv287

Gaziano, Cecilie. "Comparative Analysis of Within-Household Respondent Selection Techniques." *The Public Opinion Quarterly* 69, no. 1 (2005): 124–57. http://www.jstor.org/stable/3521607.

HIV/AIDS surveillance in Europe 2021 (2020 data). European Centre for Disease Prevention and Control. Published November 30, 2021. Accessed November 9, 2022. https://www.ecdc.europa.eu/en/publications-data/hiv-aids-surveillance-europe-2021-2020-data

Killworth PD, McCarty C, Johnsen EC, Bernard HR, Shelley GA. Investigating the Variation of Personal Network Size Under Unknown Error Conditions. *Sociol Methods Res*. 2006;35(1):84-112. doi:10.1177/0049124106289160

McCormick TH, Salganik MJ, Zheng T. How Many People Do You Know?: Efficiently Estimating Personal Network Size. *J Am Stat Assoc*. 2010;105(489):59-70. doi:10.1198/jasa.2009.ap08518

Maghsoudi A, Baneshi MR, Neydavoodi M, Haghdoost A. Network Scale-Up Correction Factors for Population Size Estimation of People Who Inject Drugs and Female Sex Workers in Iran. Rezza G, ed. *PLoS ONE*. 2014;9(11):e110917. doi:10.1371/journal.pone.0110917

Pisani E. *Estimating the Size of Populations at Risk for HIV: Issues and Methods : Updated July 2003*. 2003 ed. Family Health International; 2003.

Rastegari A, Haji-Maghsoudi S, Haghdoost A, Shatti M, Tarjoman T, Baneshi MR. The Estimation of Active Social Network Size of the Iranian Population. *Glob J Health Sci*. 2013;5(4):p217. doi:10.5539/gjhs.v5n4p217

Salganik MJ, Mello MB, Abdo AH, Bertoni N, Fazito D, Bastos FI. The game of contacts: Estimating the social visibility of groups. *Soc Netw*. 2011;33(1):70-78. doi:10.1016/j.socnet.2010.10.006

Smit F, Toet J, van Oers H, Wiessing L. Estimating Local and National Problem Drug Use Prevalence from Demographics. *Addict Res Theory*. 2003;11(6):401-413. doi:10.1080/1606635021000030061

Sulaberidze L, Mirzazadeh A, Chikovani I, Shengelia N, Tsereteli N, Gotsadze G. Population Size Estimation of Men Who Have Sex with Men in Tbilisi, Georgia; Multiple Methods and Triangulation of Findings. Yuhua R, ed. *PLOS ONE*. 2016;11(2): e0147413. doi:10.1371/journal.pone.0147413

UNAIDS. *Country Progress Report - Georgia*.; 2020.

Wang J, Yang Y, Zhao W, et al. Application of Network Scale Up Method in the Estimation of Population Size for Men Who Have Sex with Men in Shanghai, China. Khudyakov YE, ed. *PLOS ONE*. 2015;10(11):e0143118. doi:10.1371/journal.pone.0143118

Annex. Questionnaire

1. Network scale-up method survey questionnaire

(Form must be completed by the interviewer)

Coupon Number: _____

#	Question	Response
1	How many PWIDs **living in your city** (name the research city) do you know?	
2	How many of them do you know **personally** (those, whose names you know, know who they are and at the same time, they know you too)?	
3	How many of them are **18 years or over**?	
4	How many of them have injected drugs during **the last month**?	
5	How many of them have you seen during **the last month**?	

Number of people you know with specific name

Now I want you to recall all the people you know by specific name and write their number down. Please also take into consideration that

- You should know such person by face and name, and he/she should also know you by face and name;

And

- **Alternative 1** You should have had contact with such person during the last 2 years personally, by phone or by the Internet (e.g. via e-mail, Skype, correspondence on social networks);

Or

- **Alternative 2** You should have shared food or drink with such person anywhere during the last 2 years (e.g. at work, restaurant, home), this person might be a family member, coworker, neighbor, etc.;

And

- Such person should be of any age and should live in Georgia

For example: Imagine that I am asking you to recall the number of people whose name is "Manana". Let's recall the total number of people whose name is "Manana". Let's say you recalled and counted 11 such people. Excellent! Let's now exclude the number of people whom you know, although they do not know you (let's say there is 1 such person). Then exclude all the people named “Manana” who do not live in Georgia (in this case, let's assume that all the people named “Manana” you know live in Georgia). Also, exclude all the people named “Manana” whom you have interacted with neither personaly, nor by phone/the internet during the last 2 years (let’s say there are 3 such people). Therefore, the number of your acquaintances named “Manana” is 11-1-3 = 7 people. We know that this is not an easy task. Please try your best and recall. Finally, if you could not recall a single person with such particular name, please enter - 0.

Description	Answers	How many of them know that you inject drugs?
How many "**Mamuka**" do you know?	_____ people	_____people
How many "**Luka**" do you know?	_____ people	_____people
How many "**Zurab**", "**Zura**", "**Zuka**" and "**Zuriko**" do you know?	_____ people	_____people
How many "**Vazha**" do you know?	_____ people	_____people
How many "**Sophiko**", "**Sophio**" and "**Sopho**" do you know?	_____ people	_____people
How many "**Manana**" do you know?	_____ people	_____people
How many "**Shorena**" do you know?	_____ people	_____people
How many "**Nino**", "**Niniko**" and "**Nina**" do you know?	_____ people	_____people
How many "**Maias**" do you know?	_____ people	_____people
How many "**Davits**", "**Datos**", "**Datunas**" and "**Datikos**" do you know?	_____ people	_____people

Number of acquaintances by groups

Now I will ask you about other people you know. I will repeat once more and remind you that

- You should know such person by face and name, and he/she should also know you by face and name;

And

- **Alternative 1** You should have had contact with such person during the last 2 years personally, by phone or by the Internet (e.g. via e-mail, Skype, correspondence on social networks);

Or

- **Alternative 2** You should have shared food or drink with such person anywhere during the last 2 years (e.g. at work, restaurant, home), this person might be a family member, coworker, neighbor, etc.;

And

- Such person should be of any age and should live in Georgia

Question	Total	How many of them know that you are PWID?	Only men	How many of them know that you are PWID?
1 How many people do you know who **got married** in 2021?	_____ people	_____people	_____ men	_____ men
2 How many **school teachers** do you know?	_____ people	_____people	_____ men	_____ men
3 How many people did you know who **died** in 2021?	_____ people	_____people	_____ men	_____ men
4 How many people did you know who **died of cancer** in 2021?	_____ people	_____people	_____ men	_____ men
5 How many people do you know who **were injured or died in a road accident** in 2021?	_____ people	_____people	_____ men	_____ men
6 How many **higher education students** do you know?	_____ people	_____people	_____ men	_____ men

Thank the respondent for the collaboration and say goodbye.

2. Questionnaire for the nomination method

1. During the last year how many of your close friends (including the women) did you use (inject) drugs with or how many, you are sure, consumes/has consumed (injects/injected) drugs (Including those who died because of a drug overdose or any other cause)?
   Total ___ Women among them ___
2. Are you sure? Please think about it once more. It seems to me that (it is too much/it is too little/you answered me quickly/you rounded the number up). Please list their names (even if they are incorrect, invented) and count them together, if there are any women, definitely name them. Please tell us which one is the woman? To the interviewer: circle the code indicating a woman.
   Names:

I	VI
II	VII
III	VIII
IV	IX
V	X

Questions: During the last year	I	II	III	IV	V	VI	VII	VIII	IX	X
3. Has he/she been detained by police because of the drug use?										
4. Has he/she been tested for HIV/AIDS?										
5. Has he/she received treatment for addiction withdrawal symptoms (cold turkey symptoms) in hospital?										
6. Was he/she going to receive treatment for addiction withdrawal symptoms (cold turkey symptoms) in hospital? **(If no, go to 8)**										
7. Why did not he/she receive?										
8. Did he/she participate in methadone maintenance program?										
9. Did he/she participate in free prevention programs, like:										
9.a Syringes and needles program" (where sterile injection materials are given)										
9.b Voluntary consultation with doctors and psychologists and testing for hepatitis B and C, HIV/AIDS, syphilis?										
10. Did he/she die as a result of drug overdose?										

To interviewer: indicate the appropriate codes (1-"Yes"; 2-"No"; 88-"Don't know"; 99-"No response")

During the interview, the respondent was:

1. Interested 2. Indifferent 3. Irritated 4. Calm 5. Agitated 6. Under the influence of drugs

End time of interview / _/

The quality control of the interview was carried out

3. Household surveys questionnaire

(Form must be completed by the interviewer)

#	Question	Response
1	How many PWIDs **living in your city** (name the research city) do you know?	
2	How many of them do you know **personally** (those, whose names you know, know who they are and at the same time, they know you too)?	
3	How many of them are **18 years or over**?	
4	How many of them have injected drugs during **the last month**?	
5	How many of them have you seen during **the last month**?	

Number of People You Know by Specific Name

Now I want you to recall all the people you know by specific name and write their number down. Please also take into consideration that

- You should know such person by face and name, and he/she should also know you by face and name;

And

- **Alternative 1** You should have had contact with such person during the last 2 years personally, by phone or by the Internet (e.g. via e-mail, Skype, correspondence on social networks);

Or

- **Alternative 2** You should have shared food or drink with such person anywhere during the last 2 years (e.g. at work, restaurant, home), this person might be a family member, coworker, neighbor, etc.;

And

- Such person should be of any age and should live in Georgia

For example: Imagine that I am asking you to recall the number of people whose name is "Manana". Let's recall the total number of people whose name is "Manana". Let's say you recalled and counted 11 such people. Excellent! Let's now exclude the number of people whom you know, although they do not know you (let's say there is 1 such person). Then exclude all the people named “Manana” who do not live in Georgia (in this case, let's assume that all the people named “Manana” you know live in Georgia). Also, exclude all the people named “Manana” whom you have interacted with neither personaly, nor by phone/the internet during the last 2 years (let’s say there are 3 such people). Therefore, the number of your acquaintances named “Manana” is 11-1-3 = 7 people. We know that this is not an easy task. Please try your best and recall. Finally, if you could not recall a single person with such particular name, please enter - 0.

Description	Answers

How many "**Mamuka**" do you know?	_____ people
How many "**Luka**" do you know?	_____ people
How many "**Zurab**", "**Zura**", "**Zuka**" and "**Zuriko**" do you know?	_____ people
How many "**Vazha**" do you know?	_____ people
How many "**Sophiko**", "**Sophio**" and "**Sopho**" do you know?	_____ people
How many "**Manana**" do you know?	_____ people
How many "**Shorena**" do you know?	_____ people
How many "**Nino**", "**Niniko**" and "**Nina**" do you know?	_____ people
How many "**Maia**" do you know?	_____ people
How many "**Davit**", "**Dato**", "**Datuna**" and "**Datiko**" do you know?	_____ people

Number of Acquaintances by Groups

Now I will ask you about other people you know. I will repeat once more and remind you that

- You should know such person by face and name, and he/she should also know you by face and name;

And

- **Alternative 1** You should have had contact with such person during the last 2 years personally, by phone or by the Internet (e.g. via e-mail, Skype, correspondence on social networks);

Or

- **Alternative 2** You should have shared food or drink with such person anywhere during the last 2 years (e.g. at work, restaurant, home), this person might be a family member, coworker, neighbor, etc.;

And

- Such person should be of any age and should live in Georgia

Question	Total	Only men
How many people do you know who **got married** in 2021?	_____ people	_____ men
How many **school teachers** do you know?	_____ people	_____ men
How many people did you know who **died** in 2021?	_____ people	_____ men
How many people did you know who **died of cancer** in 2021?	_____ people	_____ men
How many people do you know who **were injured or died in a road accident** in 2021?	_____ people	_____ men
How many **higher education students** do you know?	_____ people	_____ men

Thank the respondent for the collaboration and say goodbye.

End time of interview _____/ _____/