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Estimated Population Size of Men Who Have Sex with Men, San Francisco, 2017

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Abstract

Current population size estimates of communities at risk for HIV are needed to adequately plan interventions and care. We update the estimated number of men who have sex with men (MSM) living in San Francisco. Multiple data sources and approaches, including population growth, registered HIV cases, wisdom of the crowd, and a published estimate on the proportion of adults who are MSM were used for estimation. The several estimates were synthesized into a final figure with acceptable bounds using a Bayesian method. We project 69,974 (acceptable bounds 65,523–74,323) MSM are living in San Francisco as of the beginning of 2017. The population of MSM in San Francisco has increased by 19.4% since 2014.

Keywords Men who have sex with men · MSM · Population size · San Francisco

Introduction

Estimates of the size of populations at risk for HIV infection are needed to understand the magnitude of the epidemic, plan and evaluate prevention programs, and track engagement in HIV care. For example, progress towards achieving and sustaining the UNAIDS "90-90-90" goals for epidemic control (i.e., that 90% of persons living with HIV are diagnosed, of whom 90% are on antiretroviral treatment, of whom 90% are virally suppressed) requires knowing the denominator for the absolute number of persons living with HIV in the total population at risk [1]. In San Francisco, where MSM constitute the largest number of HIV infections, we last reported population size estimates for 2014 at 58,605 [2, 3]. Our city has undergone recent growth and changes in the make-up of its population. In this brief report we provide an updated size estimate for the number of MSM living in San Francisco as of the beginning of 2017.

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Methods

In the absence of a true census for populations at risk for HIV, who are often marginalized due to stigmatized or illegal behavior, available methods to estimate their numbers are prone to biases of unknown magnitude and direction. To avoid unwarranted confidence in a single method, recommendations call for employing multiple methods [4]. Methods and thus the resulting estimates are chosen based on the availability of current data points that can be used for a given method (e.g. recent MSM survey that asked about service use, a recent national size estimation publication). A central tendency of several results may provide a more robust point estimate than a single result; the accompanying variabilities of the several methods may provide a better sense of the uncertainty of the estimate. We therefore employed several size estimation approaches, incorporating diverse data sources, to update our previously published figure from 2014 [2] for the number of MSM living in San Francisco at the beginning of 2017. Of note, our estimate is for the beginning of 2017 as the point in time closest to the diverse sources of data. We further employed the recently described "anchored multiplier" method to produce a synthesized "consensus" estimate and plausible range [5, 6]. The Anchored Multiplier uses a Bayesian approach to fit the results of the several methods, their uncertainties, and an a priori estimate to arrive at the consensus estimate. Description of each method follows.

Roll-Forward

In the roll-forward approach we projected from the 2010 estimate of the number of MSM in San Francisco [2] to an estimate through the end of 2016 based on the overall growth in the general population [7]. The 2010 estimate was chosen to align with the most recent US census. The new population size is calculated by:

$$\text{Starting MSM population size} * \% \text{ growth in the city population during the period} = N.$$

For this method, we defined "acceptable bounds" (i.e., a plausible or likely range) as the previous estimate for the lower bound and an equal distance to the upper bound (i.e., the point estimate is the median of the bounds).

Components

The components approach is based on HIV prevalence and reported cases using a method described by Lieb et al. [8]. HIV prevalence and the proportion of MSM previously diagnosed with HIV originate from the National HIV Behavioral Surveillance (NHBS) survey conducted in San Francisco during 2017 and the HIV case registry for the city of San Francisco through the end of 2016. MSM population size is calculated by:

$$(\text{HIV cases in the registry} * \% \text{ undiagnosed HIV infection}) / \% \text{ HIV prevalence} = N.$$

For the acceptable bounds, we used the 95% confidence intervals for the estimates of HIV prevalence and undiagnosed HIV infection in the above formula.

Wisdom of the Crowd (WOTC)

The WOTC method is based on the assumption that the central tendency in the responses of a population queried on their perception on the number of members in the population will approximate the actual number [9]. The theory includes the assumptions that responses from a large sample tend to towards the correct response by synthesizing unique perspectives, that data are collected in a manner where individuals are not influenced by others' responses, and outliers tend to cancel out when taking the median and 25th and 75th percentiles. The method entailed adding the following question to the 2017 NHBS survey: "How many gay, bisexual, and other men who have sex with men live in San Francisco?" The point estimate was the median of all responses. We used the 25th and 75th percentile values as the acceptable bounds.

Literature Review

We used published estimates of the size of the overall population of adult men, and the proportion of adult men who are MSM in San Francisco [10] to calculate the total number of adult MSM in San Francisco:

$$\# \text{ adult men} * \text{ proportion of adult men who are MSM} = N.$$

For the underlying population, we used two available sources: one from the US Census [7] and one from the California Department of Finance [11]. We defined acceptable bounds by taking 50% of the estimate as the distance between the lower and upper bounds.

Anchored Multiplier

To synthesize the results of the above methods, we used a recently described Bayesian approach called the "anchored multiplier" [5, 6]. A user-friendly tool is available at http://globalhealthsciences.ucsf.edu/resources/tools. The anchored multiplier synthesizes prior belief about the population size with results from new empirical data to generate a single "consensus" estimate. The prior belief can be based on local knowledge or past research, the new empirical estimates can originate from diverse methods. The approach also incorporates probability distributions that reflect the uncertainty of each new estimate (i.e., each estimate's 95% confidence interval or acceptable bounds). The probability distributions are then combined using a Bayesian framework to generate a posterior probability distribution of the population size. Estimates with greater certainty are given more weight than estimates with lower certainty when all estimates are synthesized into the single posterior distribution. From this posterior distribution, the mean is taken as the best estimate of the population size, and the 2.5th percentile and 97.5th percentile of the distribution bound the 95% credible interval (used here as the acceptable bounds). The anchored multiplier calculator can present results as counts or proportions of the total population. We entered 384,660 adult males as the general population size [7], 58,605 as the prior population size estimate using the year of the US census [3], and the results of each of the above calculations and corresponding acceptable bounds (Table 1).

Table 1 Population size estimation methods, calculations, and results for men who have sex with men, San Francisco, 2017

Method	Inputs	Inputs	Inputs	Calculation	Estimate (bounds)
Roll Forward	N in 2010	% increase in general SF population ACS estimate [7]			
	66,487 [2]	7.74		66,487 × 1.0774	71,633 (66,487, 76,779)
Components	Unrecognized HIV Infection (%)	HIV prevalence (%)	Reported living HIV cases (n)		
	4.0 (0.02, 1.6)	19.0 (15.8, 22.8)	11,536*	11,536/0.96 = 12,016 12,016/0.19 = 63,242 (11,536/0.9998 = 11,538 11,538/0.158 = 73,025| 11,536/0.984 = 11,724 11,724/0.228 = 51,421)	63,242 (51,421, 73,025)
WOTC			25 and 75th Percentile (40,000, 200,000)	Median	100,000 (40,000, 200,000)

	Estimate	Denominator			
Literature 1					
Grey et al. [10] US Census, 2016 ACS [7]	18.5% of adult males	374,779		374,779 * 0.185	69,334 (52,000, 86,667)
Literature 2					
Grey et al. [10] Census ACS proportion of pop adult male/CA Finance Office Population Estimate	18.5% of adult males Adult males = 44% of total pop	874,228*0.44 = 384,660		384,660 *0.185	71,162 (53,371, 88,952)
				Anchored multiplier size estimate	69,974 (65,523, 74,323)

*Allison Hughes, Personal Communication, 2018

Results

The roll-forward method produced an estimate of 71,633 (acceptable bounds 66,487–76,779) for the number of MSM at the beginning of 2017. The component method produced an estimate of 63,242 (acceptable bounds 51,421–73,025). The WOTC median response was 100,000 (acceptable bounds 40,000–200,000). The literature based estimate produced an estimate of 69,334 (acceptable bounds 52,000–86,667) using the US Census as the denominator, and 71,974 (acceptable bounds 53,371–88,952) using the California Department of Finance denominator. The anchored multiplier synthesized these estimates to a "consensus" of 69,974 (acceptable bounds 65,523–74,323) MSM living in San Francisco as of 2017.

Discussion

Our updated estimate of the number of MSM living in San Francisco (69,974) as of the beginning of 2017 suggests that there has been an increase of 11,369 MSM (19.4%)

living in San Francisco since 2014 [3]. Although this percent increase is greater than for the overall increase in San Francisco's population it is reasonable to believe that differential patterns of migration into San Francisco by MSM from around the country continue as they have in the past [12]. Moreover, our use of the anchored multiplier approach improves upon past methods for synthesis of multiple size estimates by down weighting mathematically size estimates with greater uncertainty. This approach can be implemented among any population and context where size estimates are needed.

Limitations to our analysis mainly concern the potential for biases in any one of the individual population size estimates. However employing the anchored multiplier approach to synthesizing a final estimate reduces the influence of any one individual estimates bias. Moreover the present synthesized estimate appears robust as it falls within the acceptable bounds of each individual calculated estimate. The number's stability, certainty, and size also bolster confidence that San Francisco, as a fast-track city, can sustain the UNAIDS 90-90-90 goals for eliminating HIV in our most severely affected population.

Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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