The Young Men's Survey: Methods for Estimating HIV Seroprevalence and Risk Factors Among Young Men Who Have Sex with Men

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SYNOPSIS

TRADITIONAL SAMPLING METHODS ARE UNSUITABLE for determining the levels of human immunodeficiency virus type 1 infection and related behavioral risk factors among young men who have sex with men. Most surveys of this hard-to-reach population have used nonprobability samples of young men in clinical or public settings. While these studies have revealed high rates of HIV infection and risk behaviors, their findings are not generalizable to broader populations of young men who have sex with men. To better understand the epidemiology of HIV within this population, the Centers for Disease Control and Prevention, in collaboration with state and local health departments, has developed a venue-based probability survey of young men who have sex with men.

Conducted in seven metropolitan areas in the United States, the Young Men's Survey combines outreach techniques with standard methods of sample surveys to enumerate, sample, and estimate prevalence outcomes of a population of young men who frequent public venues and who have sex with other men. Venues where young men who have sex with men are sampled include dance clubs, bars, and street locations. At sampled venues, young men are enumerated, consecutively approached, and offered enrollment if they are determined eligible. Young men who agree to participate in the Young Men's Survey are interviewed, counseled, and tested for human immunodeficiency virus, hepatitis B, and syphilis in vans parked near sampled venues.

The Young Men's Survey provides data on the locations and times at which demographic and behavioral subgroups of young men who have sex with men may be targeted for prevention activities. Behaviors and psychosocial factors associated with human immunodeficiency virus infection can be used to design culturally relevant and age-specific prevention activities for young men who have sex with men.

Previous epidemiologic studies have reported substantial reductions in the incidence of and risk factors for human immunodeficiency virus type 1 (HIV) among men who have sex with men *(1-9)*. Most of these studies, however, included cohorts of men with median or mean ages above 30 years, and their findings may

not apply to younger men who have sex with men *(1, 4, 10, 11)*.

Although a growing body of research indicates that young men who have sex with men are at high risk for HIV *(3-5, 8, 12-23)*, the levels of HIV infection and related risk behaviors in this population remain largely unknown. Nearly all surveys reporting high rates of HIV infection and risk behaviors among young men who have sex with men used variable definitions of "younger" age and nonprobability samples of men in clinical or public settings *(1, 4,5, 8,12, 13, 15, 17, 19, 20, 21)*. Those surveys that employed population-based sampling methods either did not sample or substantially underrepresented men under 23 years of age who have sex with men and, consequently, did not estimate prevalence outcomes for this subgroup *(18, 22, 23)*.

YMS combines outreach techniques with standard methods of sample surveys to enumerate, sample, and estimate prevalence outcomes of a population of young men who frequent public venues and who have sex with other men.

To better describe the epidemiology of HIV infection among young men who have sex with men, we have developed a probability-based method to sample this hard-to-reach population. Implemented in seven metropolitan areas in the United States, the Young Men's Survey (YMS) combines outreach techniques with standard methods of sample surveys to enumerate, sample, and estimate prevalence outcomes of a population of young men who frequent public venues and who have sex with other men. This paper describes our sampling and analytical techniques and discusses the strengths and limitations of our approach.

Survey Objectives

The objectives of YMS are to estimate the prevalence of HIV infection and related risk behaviors among young men who frequent public venues and who have sex with other men, and to discern factors predictive of HIV risk and precautionary behaviors within this population.

Survey Methods

Eligibility. Young men between 15 and 22 years of age are eligible for YMS provided they meet site-specific county residence requirements.

Sample size. A minimum sample size of 500 is required from each survey site. This sample size is expected to provide a reasonably precise estimate of HIV seroprevalence among young men who attend sampled venues and who have sex with other men.

Overview of methods. Throughout the survey, YMS teams (a) identify all public venues within a defined area that are frequented by young men who have sex with men; (b) from this universe, build monthly sampling frames of venues that yield sufficient numbers of young men who have sex with men; and (c) sample young men from venues randomly selected from monthly sampling frames. These activities are discussed in sequence in subsequent sections.

Identifying venues. Public venues that are frequented by young men who have sex with men include dance clubs, bars, parks, street locations, business establishments, and social organizations. Strategies used to identify public venues and the days and times they are frequented by young men include examining local publications for venues catering to the gay community; interviewing HIV prevention workers, venue proprietors, gay alliance leaders, and representatives of community-based organizations; conducting focus groups of young men who have sex with men; briefly interviewing young men sampled at various types of public venues; and, finally, asking young men who are recruited into YMS. After the universe of public venues is identified, a subset is selected to serve as the initial YMS sampling frame.

Building YMS sampling frames. YMS sampling frames are monthly lists of YMS venues and their associated sampling periods. Sampling periods are standard 4-hour periods on specific days that are expected to yield a minimum of seven eligible men (for example, a dance club has the following three sampling periods: Thursday evenings from 6:00 p.m. to 10:00 p.m., and Friday and Saturday nights from 9:00 p.m. to 1:00 a.m.). Only venues with at least one sampling period are included in YMS sampling frames. The criterion of seven eligible men per sampling period is necessary to enroll 500 men within a 9-month survey. This estimate is based on a 60 percent enrollment rate yielding an average of four interviews per sampling event, and 14 sampling events conducted each month for 9 months.

To determine sampling periods, YMS teams enumerate young men attending identified venues at various times and days. Typically, two persons work in tandem to systematically count and interview young men. One person uses a "clicker" to count young men who enter a defined intercept area at the venue during a 30- to 60-minute period. Only men who appear to be between 15

and 22 years of age are counted; duplicate visits are not counted. Using a standardized form, the second person briefly interviews a sample of counted men to collect demographic, eligibility, and venue-attendance data.

To estimate attendance, at least two enumerations are conducted at different times within each 4-hour period. The attendance estimate is the product of the average number of persons counted and the percentage of persons counted who are eligible, standardized to a 4-hour period. Thus, a list of 4-hour periods with specific attendance estimates is constructed for each venue. Only periods with estimates of at least seven eligible men are considered sampling periods, and these are used to select venues for YMS sampling frames. Depending upon the metropolitan area, YMS sampling frames have averaged between 10 and 50 venues composed primarily of street locations, dance clubs, bars, and businesses.

Sampling plan. YMS uses a three-staged plan to sample venues, sampling periods, and young men. In the first and second stages, a set of venues and their associated sampling periods are randomly selected from the sampling frame each month. This set is then used to schedule sampling events on a calendar for the upcoming month. In the third stage, participants are enrolled from venues in accordance with the sampling-event calendar.

Stage 1: Selection of venues. Each month, 12 to 14 venues are randomly selected without replacement from the YMS sampling frame. After venues are selected, they are arranged in order of increasing number of sampling periods. This list of venues is then used for stage 2 sampling.

Stage 2: Selection of sampling periods. One sampling period is randomly selected for the first venue listed in stage 1 (the venue with the least number of sampling periods). This venue and sampling period are scheduled on a calendar for the upcoming month. For example, if the first venue and sampling period selected is a dance club on Fridays from 9:00 p.m. to 1:00 a.m., this venue, day, and time is scheduled as a sampling event on the first available Friday of the upcoming month. After this sampling event is scheduled, a sampling period is randomly selected for the next venue with the least number of sampling periods. This venue and sampling period are also scheduled on the calendar, and the process is repeated until one sampling period is selected for each venue chosen in stage 1.

Resolving schedule conflicts. As the calendar is filled, scheduling conflicts may occur when randomly selected sampling periods fall on days already scheduled for sampling. If no other days are available during the month for a selected sampling period, then the remaining sampling periods of that venue are randomly selected until that venue is scheduled. Selecting sampling periods from venues arranged in increasing order of sampling periods maximizes the probability of scheduling all venues chosen in stage 1. If a venue cannot be scheduled using this procedure, a replacement is randomly selected from the set of venues not chosen in stage 1. After 12 to 14 of these primary venues are scheduled on the calendar, alternate venues are then randomly selected from the YMS sampling frame.

Alternate sampling events. Because unproductive sampling events may occur due to unforeseen venue closures, unpredictable social mixing patterns, inclement weather, or other factors, a maximum of two alternate venues are selected for each primary sampling event. Alternate venues are randomly selected from the set of venues with sampling periods that overlap those of the primary venue. After the alternate venues are scheduled, the sampling calendar is ready for use in stage 3 sampling.

Modification to sampling frames. YMS sampling frames are dynamic; as attendance patterns change during the survey, venues and venue-specific sampling periods are added or deleted in accordance with attendance criteria stated previously. Sampling frames are updated each month before stage 1 and 2 sampling.

Stage 3: Enrollment of participants. In accordance with the sampling calendar, YMS staff count, recruit, and interview young men who attend sampled venues. To conduct each sampling event, a four-person survey team uses a van modified to accommodate two simultaneous interviews. During the entire sampling event, one team member systematically counts young men as they enter the defined intercept area. Only young men who appear to be between 15 and 22 years of age are counted. Two other staff members consecutively intercept and briefly interview young men who are counted. Those young men who are determined eligible are asked to participate in YMS. Recruiters use standard forms to collect basic demographic characteristics and to record eligibility and enrollment outcomes. Recruiters also routinely ask and record whether young men have ever previously accepted or declined enrollment in YMS. Previous YMS respondents are ineligible, while previous nonrespondents are eligible and are encouraged to enroll. Based on a previous survey using similar outreach methods, an enrollment rate (number enrolled divided by number asked to enroll) of approximately 60 percent is expected at each YMS site *(14)*. Preliminary data are fulfilling these expectations.

Consecutive recruitment of enumerated men who are determined eligible continues until all available interviewers are occupied (normally two), at which point recruitment is temporarily suspended. During this period, the fourth staff member may relieve the enumerator, conduct nonrecruitment intercepts, or keep watch over the interview van. As interviewers become available, enumerated men are once again consecutively approached and offered enrollment if determined eligible.

Data collected during sampling events. For each sampling event, the following data are collected: (a) the total number of young men who visited the venue; (b) of those counted, the number of young men intercepted and briefly interviewed; (c) the age, race, and county residence of young men intercepted; (d) of those intercepted, the number of young men who were determined eligible for the first time, and (e) the number of young men who enrolled in YMS. These data are used to determine enrollment rates and venue-specific sampling fractions used to calculate individual weights (see analyses in subsequent section).

Personal interviews and evaluation. Young men who agree to participate are taken to a van parked near the venue. As an added measure to screen out duplicates, recruited men are introduced to all available staff. In the van, trained staff administer a standardized questionnaire to consenting participants, perform HIV/AIDS counseling, draw blood for testing, provide referrals for social support or medical services as needed, and dispense participant stipends.

Questionnaire interviews. Using a standardized questionnaire, staff members conduct confidential face-to-face interviews with young men about their demographic characteristics, venue attendance frequencies, HIV-related risk behaviors, and factors potentially associated with these risk behaviors. In addition to standard demographic items such as age and race/ethnicity, young men are asked about their current household, school, and employment situations, and their parents' educational status.

Venue-attendance frequency questions gauge how often young men have gone to the following eight types of venues: bars, dance clubs, health clubs, social organizations, street locations, parks, businesses, and sex clubs. For example, a young man is given a list of dance clubs included in YMS sampling frames. Using the list, he estimates how frequently he attended the group of dance clubs in the past 6 months. For this and most behavioral frequency questions, a 6-month recall period is used.

HIV-related risk behavior questions measure sexual behavior; condom use; and alcohol, drug, and needle-syringe use. Sexual behavior questions assess oral, vaginal, and anal intercourse occurrence with both male and female exchange, casual, and steady sex partners in the past 6 months. Frequency of condom use is asked for each type of intercourse with each type of sex partner. Responses to these questions include "never," "sometimes—less than half the time," "sometimes—more than half the time," and "always." In addition, both closed- and open-ended questions ask why condoms weren't always used during particular types of high-risk intercourse. Young men are also asked whether or not a condom was used the last time they had sexual intercourse. Alcohol and drug use are assessed for 12 types of drugs during the past 6 months. For each type, young men are asked how often the drug was used and whether it was used during sex in the past 6 months. Needle-syringe practices during drug use and piercing or tattooing behaviors are also assessed.

A fourth group of questions investigates a variety of factors potentially associated with HIV-related risk behaviors. Young men are asked their likelihood of current HIV infection and whether or not they personally have known anyone with HIV/AIDS. Personal history questions explore whether they have ever been homeless or runaway, forced to have sexual contact, or involved in exchange sex. Medical history questions investigate current medical care as well as lifetime sexually transmitted disease and HIV testing history. Psychosocial factors pertinent to young men who have sex with men also are part of the interview. These factors include perception of HIV risk, self-efficacy, perception of condom norms, social support, gay-identity salience, internalized homophobia, and perception of community homophobia. Each of these factors are measured with multiple items (attitude statements) using a 5-point scale ranging from "I do not agree at all" to "I strongly agree."

Testing of specimens. All blood specimens are screened for HIV-1 antibody by an enzyme immunoassay licensed by the Food and Drug Administration (FDA). Repeatedly reactive specimens are confirmed by indirect immunofluorescence or by an FDA-licensed Western blot kit. Western blot specimens are considered HIV-1 positive if antibody bands are detected for at least two of the three gene products: p24, gp41, and gp120/160 *(24)*. Serum specimens are tested for both hepatitis B and syphilis with FDA-licensed assays, in accordance with standard methods and interpretation criteria.

Protection of confidentiality. The Young Men's Survey is anonymous. Participant names are not linked to any YMS instrument, specimen, or test result.

Providing test results to participants. At the end of each interview, participants are provided appointment cards and are encouraged to obtain their test results from trained counselors at one or more community-based locations. Survey-identification numbers are affixed to appointment cards so that test results may be linked to participants. Young men who test positive for HIV, hepatitis B, or syphilis are referred for medical evaluation and, when necessary, case management and social support services.

Analyses

Ratio estimator. The prevalence of a certain characteristic (for instance, biologic marker, risk behavior, or psychological factor) in a population can be estimated from this study by using a combined ratio estimator *(25)*. This estimator and its standard error can be obtained using standard survey sampling methods, taking into account that a YMS participant might attend more than one of the sampled venues. (In this section, "venue" refers not only to a particu-

lar venue but also to the date and time period it is sampled.) This is in contrast to most sample surveys in which each person in the population sampled is encountered in only one sampling unit.

The combined ratio estimator has the form:

$$\hat{\rho} = \frac{\sum_{i=1}^{N} w_i x_i}{\sum_{i=1}^{N} w_i} \quad (1)$$

where N is the number of persons sampled during the study; x_i is 1 if this ith person sampled has the characteristic of interest and is 0 if the characteristic is absent; and w_i is a positive weight defined below. If x_i is replaced by a quantitative measure, such as the reported number of sexual partners, then equation (1) estimates the mean value of that quantity in the population sampled.

The variance of the estimate from (1) can be derived using a standard approach for ratio estimators *(25)*. Multivariate analysis (such as logistic regression) can be carried out with the SUDAAN software package, assigning the weight w_i/(sum of all w_i) to the ith person sampled *(26)*.

Weighting mechanism. A weighting mechanism is necessary for this survey to adjust for the fact that young men who attend venues more often have a greater chance of being enrolled in YMS. To make this adjustment, the weight w_i is calculated as the inverse of the probability that the ith person was enrolled during the study. Thus, the more frequently a person attends venues in the sampling frame, the lower the weight that person contributes to the estimate.

The enrollment probability depends upon three types of information. The first type is the person's pattern of attendance at venues included within YMS sampling frames. The second type is the probability of choosing each venue for sampling within this pattern of attendance. The third type of information is the sampling fraction obtained at venues where participants were enrolled in the study. Because a participant's specific pattern of attendance at venues in the sampling frame is unknown, each participant's enrollment probability is estimated from data collected in the study (see box).

Discussion

Methodological challenges. To estimate levels of HIV infection and risk behaviors, we wished to obtain the broadest possible sample of young men who have sex with men. Although convenient, clinic populations are by definition biased, and traditional population-based survey methods have been unsuccessful in sampling men under 23 years of age who have sex with men. Consequently, we chose to sample the population of young men who attend public locations. This venue-based approach, however, presents multiple challenges.

One challenge is to ensure that the maximum number of public venues within the community of interest are included in YMS sampling frames. Sampling few venues or venues of one particular type (for example, bars) may yield biased findings, as participants from one venue may not be representative of all venues of that type or others. Accordingly, YMS staff conduct extensive research for up to 2 months to identify the universe of public venues frequented by young men who have sex with men. Moreover, this research process is dynamic; as attendance patterns change during the survey, new venues are identified and included within monthly sampling frames. For economic and logistical reasons, venues that yield insufficient numbers of young men who have sex with men are excluded from sampling.

A second challenge is to estimate the unduplicated population of young men who attend venues (during sampling events) and who have sex with men. Accordingly, all young men intercepted are asked whether they have ever been previously approached for YMS. Only data on young men who are determined eligible for the first time are used to estimate attendance levels and sampling fractions.

A third challenge with a venue-based approach is to develop a statistical method to account for the possible confounding effects of venue attendance. For example, it may be true that young men who practice riskier behaviors and have higher HIV infection rates go out to venues more often. These young men have a greater enrollment probability and, without a weighting procedure, would substantially bias the findings. The weighting procedure, however, must take into account attendance patterns because individuals who attend two or more venues during the survey could be enrolled at any one of these locations. In order to estimate these venue-attendance patterns, we devote a section of the questionnaire to assessing how frequently respondents attended sampled venues and venues of particular types (such as bars) included within sampling frames.

Interpretation and Use of Data

Limitations. YMS findings are generalizable only to the population of young men who attend venues included in YMS sampling frames and who have sex with other men. Only those venues that are identified through research and meet attendance criteria are included in YMS sampling frames. Some young men who have sex with men may attend only very low-volume or unidentified venues. In addition, some young men who have sex with men may not frequent venues at all.

Representiveness. In spite of these limitations, YMS samples a large and important population of young men who have sex with men. While hard to quantify, the majority of young men who have sex with men within a community

Weighting Mechanism

The theoretical development of the weighting mechanism assumes that the pattern of attendance for each respondent is known. That is, we assume that we know what dates during the entire study respondents attended venues included in YMS sampling frames. (Throughout this section, "venue" means both the physical location and the time and date at which sampling can be conducted.) Since it is impossible to know specific venue-attendance dates, each participant's pattern of attendance is estimated from data collected during the survey, as described later.

The expressions for the sampling weights require the following notation. Let k = 1, 2,..., K index the venues in the sampling frame which the respondent attended, ordered in time during the entire study. Let q_k be the probability that he was not enrolled at location k. Let p_k be the probability that venue k was selected for the study. Let f_k^M be the mean of the sampling fractions observed at all the times when the location of venue k was sampled during the study. Then

$$q_k = 1 - p_k f_k^M \qquad \text{(A1)}$$

Let π_k be the probability that this respondent was enrolled in the study at the kth venue in the sampling frame that he visited. Then

$$\pi_k = (q_1\, q_2 \cdots q_{k-1}) \times (p_k\, f_k^M) \qquad \text{(A2)}$$

The first term in (A2) is the probability that this respondent was not enrolled earlier; this term is defined to be 1 if k = 1. The second term is the probability that he was enrolled at the kth venue he attended. The weight associated with this respondent is

$$w = 1 / \sum_{k=1}^{K} \pi_k \qquad \text{(A3)}$$

The mean sampling fraction f_k^M in equations (A1) and (A2) is the mean value, for all sampling events at this location, of the number of young men enrolled at venue k who have sex with men, divided by the estimated number of young men who attended venue k and who have sex with men. For each sampling event, the numerator of this proportion is the number of men enrolled who reported during the interview of having had sex with men. The denominator is the product of the number of young men counted at venue k, the proportion of men intercepted who were determined eligible for the first time, and the proportion of men interviewed who reported having sex with other men.

The venue-selection probability p_k in equations (A1) and (A2) is the product of two probabilities: the probability of choosing the corresponding location during the given month, and the probability of selecting the specific sampling period given that this location was chosen. The probability for choosing each location in the sampling frame is n/N, where n is the number of locations selected for sampling in a given month, and N is the total number of locations available for sampling for that month. The probability for choosing a specific sampling period given that the location of venue k was chosen is the inverse of the total number of available sampling periods for this location.

Because a respondent's pattern of attendance is not known except on the date he enrolled, the probabilities π_k must be estimated by simulating each participant's pattern of attendance from data collected in the study. The types of venues each participant attended and how often he attended them are measured by ten venue-attendance questions in the YMS questionnaire. These questions assess how frequently within the past 6 months the respondent attended the location where he was enrolled and his frequency of attending types of venues (for example, street locations) included in YMS sampling frames. From this information, we compute α_d, the probability that the respondent attended a venue of each type for each date d on which YMS was conducted.

To compute the probability that the respondent attended each specific venue, we use the overall attendance pattern observed during YMS. The average attendance at location k, A_k, is known from enumerations conducted to build the sampling frame and enumerations conducted during sampling events. The probability of attendance at a specific venue, given that the respondent attended a venue of that type on that day, is assumed to be $\beta_k = A_k / \sum A_m$, where the denominator is the sum of all attendance averages of venues of one type.

Finally, the probability that the respondent attended venue k on day d is

$$\tau_{dk} = \alpha_d \beta_k$$

Based on the probabilities τ_{dk}, the attendance pattern for each respondent is simulated many times. For each simulated pattern, the respondent's weight w can be computed from equations (A1), (A2), and (A3). The mean value of these simulated weights is then used in equation (1) to compute estimates for the population of young men who have sex with men who attend venues in the sampling frame.

probably attend one or more public venues included in YMS sampling frames within a survey year. In a recent area-based, door-to-door survey in San Francisco, for example, 91 percent of male homosexual and bisexual respondents aged 18 to 23 reported that they attended a "gay" bar *(14, 27)*. Since many other venues besides bars are included in YMS sampling frames, it is reasonable to assume that, in San Francisco at least, a large majority of young men who have sex with men can be sampled at public venues.

Application of data. The Young Men's Survey provides baseline measures of HIV infection and related risk factors for a large and accessible population of young men who have sex with men. These measures may be used to allocate resources to meet HIV-related medical care, social services, and HIV/AIDS prevention needs for this population. Within the metropolitan areas conducting YMS, the data may be used to determine at which venues and times particular subgroups of young men who have sex with men may be targeted for prevention activities.

YMS data also may be used to develop prevention and education activities for young men who have sex with men. YMS analyses will estimate associations between behavioral and psychosocial factors and HIV-related risk-taking in the population as a whole and in particular demographic and behavioral subgroups—such as young men of color or behaviorally bisexual young men. Such findings may be used to guide prevention efforts tailored to meet the diverse needs of young men who have sex with men.

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