Respondent-Driven Sampling and Time-Location Sampling: A Comparison of Implementation and Operational Challenges for HIV Behavioral Research in Guatemala

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ABSTRACT

Respondent-driven sampling (RDS) and time-location sampling (TLS) are used to recruit men who have sex with men (MSM) for HIV behavioral research. Two cross-sectional surveys, one using RDS and the other TLS, were conducted simultaneously among MSM in Guatemala City in 2010. The purpose of this study is to analyze the strengths and challenges associated with implementing each method based on data obtained from key informant interviews (n=10) and one focus group with field staff. Both RDS and TLS successfully and efficiently recruited the target sample size. RDS offered greater privacy and safety, required fewer human and financial resources, and presented fewer logistical challenges. TLS led to a greater understanding of the context in which MSM socialize and meet sex partners, providing important information for prevention efforts and data interpretation. We conclude with concrete recommendations for improving RDS and TLS implementation.

INTRODUCTION

HIV in Central America is primarily concentrated among men who have sex with men (MSM) (1,2). Reliable epidemiologic data for high-risk populations in Guatemala are scarce, but several studies have demonstrated HIV prevalence among MSM to be much higher than the 0.8% prevalence among adults aged 15-49 years (3). One cross-sectional study from 2002 estimated HIV seroprevalence among MSM aged 18 and older to be 12.1% (1). More recent studies estimated MSM HIV prevalence at 18.3% in 2006 (4) and 7.6% in 2010 (5). It should be noted that the generalizability of both of these estimates is limited by the fact that the studies used convenience samples. Identifying appropriate strategies to reach representative samples of MSM is crucial for effective HIV research.

Typically, the gold standard method for collecting HIV-related data is through a probability-based sample of the population. However, reaching the groups at highest risk for HIV (e.g., MSM, female sex workers, and injection drug users) using traditional probability-based sampling methods presents a challenge for researchers (6). These individuals are often socially stigmatized for deviating from societal norms or for participating in illegal behaviors (7). Because MSM constitute a relatively small proportion of the male population, there is no practical way of constructing a sampling frame that permits random selection and eliminates recruitment bias (8). Two sampling methods that have been used to reach MSM for HIV research are respondent-driven sampling (RDS) and time-location sampling (TLS).

RDS is a social network-based strategy that uses an incentivized chain referral system in which recruiters refer their peers to the study (9,10). This method has been used for HIV research in many U.S. cities (8) and in more than 28 countries (11,12). RDS corrects for some of the statistical limitations of other chain referral systems, such as snowball sampling, through recruitment limits, longer recruitment chains, and the collection of data used to mitigate the biases associated with different network sizes (8,9,11,13,14). TLS entails systematically recruiting at places and times where members of a target population congregate (15,16). TLS has been used in the United States since the early 1990s to recruit

MSM for HIV research (15-18) and outside the United States in Brazil (13,19), Mexico (20), Belgium (21), China (22), and Kenya (23).

Using data from a simultaneous comparison study of these 2 methods with MSM in Guatemala City, this paper aims to identify the operational strengths and limitations of each method and recommend best practices for the effective implementation of RDS and TLS in similar populations.

METHODS

Parent Study: Two cross-sectional surveys, one using RDS and the other TLS, were conducted simultaneously among MSM in Guatemala City from October through December 2010. Eligibility criteria required that participants be male or transgender residents of Guatemala City over the age of 18 who had anal sex with another man in the past 12 months and were not under the influence of drugs or alcohol at the time of the interview. After obtaining informed consent, interview staff administered a 126-item, face-to-face questionnaire using a handheld-assisted personal interview (HAPI) instrument. The questionnaire discussed social networks, demographic information, sexual history and behavior, HIV/STI knowledge, experiences of stigma and discrimination, alcohol and drug use, and health services access. The sample size was 507 in the RDS survey and 609 in the TLS survey; sample size calculations are described in detail elsewhere (24).

RDS survey recruitment began with the selection of a demographically-diverse and socially-connected group of 8 MSM called “seeds.” Each seed received 2 coupons to be distributed to his peers as part of the first recruitment wave. This process continued until the final sample size was reached. Most of the RDS surveys were conducted at a local non-governmental organization that provides medical attention to vulnerable populations, including MSM and female sex workers. To expedite the recruitment process, alternate RDS survey interview sites were utilized. Alternate sites were chosen

based on information about where members of the target population congregated, especially those who possessed valid RDS coupons.

The TLS study arm began by creating a list of potential venues frequented by MSM, identified through interviews and focus groups, an existing list of venues from a 2008 population size estimation study, and an online survey on www.gayguatemala.com. The preliminary list of venues was edited for eligibility based on safety criteria, venue owner consent, and ability to yield at least seven eligible men during a 4-hour venue-day-time (VDT). Each month, a total of 40 eligible venues were randomly selected without replacement and one VDT was randomly selected for each selected venue. At each VDT, field staff systematically approached every fifth person and screened for eligibility. If eligible, participants were recruited into the study.

Current Study: In this paper, we present the operational and implementation strengths and challenges of RDS and TLS based on the study team's experiences. In May 2011, a focus group was conducted with 7 supervisors and interviewers from the RDS and TLS teams. Focus group content was coded in Microsoft Excel to identify important topics related to implementation strengths and challenges. Code reports were reviewed to characterize patterns and prominent themes. The most salient results were incorporated into a presentation that was used to inform the findings of this paper.

Additionally, in May 2012, the first author conducted 10 interviews with members of the study team who did not participate in the first focus group. These included investigators (n=3), study coordinators (n=3), RDS and TLS field supervisors (n=2), and RDS and TLS interviewers (n=2). A semi-structured interview guide, developed by the research team, included questions about RDS and TLS implementation and operational strengths and challenges. Additional questions focused on solutions and recommendations for addressing challenges associated with each method. Interviews lasted between 45 and 60 minutes and were conducted in Spanish or English according to the participant's preference. The first author took detailed notes during the interviews. Interviews were also audio-

recorded so that the accuracy of notes could be verified. After initial review of the interview notes, the research team developed topical and interpretive codes for analysis (25). Topical codes mirrored the themes in the semi-structured interview guide (e.g., strength, challenge, recommendation). For the purposes of this analysis, a *challenge* was defined as an implementation-related concern or problem associated with RDS or TLS. Facilitators to implementation or operational advantages associated with each method were considered to be *strengths*. After reviewing interview notes, interpretive codes were developed to capture inductive ideas that emerged from the data (e.g., trust, safety, bias). We coded interview notes using topical and interpretive to systematically document themes and patterns within the data. Specifically, we compared the primary operational strengths and challenges associated with each method, organized according to the following themes that emerged from the data: time, recruitment, resources, logistics, safety, confidentiality, bias, additional information for prevention and data interpretation, and analysis. In addition to focus group and interview data, descriptive statistics and cost information were incorporated from the main study results paper into the results section to provide additional support and explanation of findings. The methodology for these analyses is described in the main study results paper (24).

RESULTS

In this section, we present a comparison of the implementation and operational challenges and strengths associated with RDS and TLS, organized by theme. Key findings are also summarized in Table 1.

Time: Both RDS and TLS successfully reached the desired sample size within the pre-determined 3-month data collection period. The total time required for RDS formative research was approximately 4 weeks, and the sample size of 507 was achieved within 11 weeks. TLS formative research required twice as much time as RDS (8 weeks), but implementation took less time, reaching the final sample size of 609 in 7.5 weeks.

Recruitment: Seven of the 8 RDS seeds were active in recruiting peers into the study, and 58% of participants recruited at least 1 peer into the study. Fewer than 10 men were screened as eligible and initiated the interview but were later deemed ineligible either during the interview or as part of the data cleaning, demonstrating that the coupon distribution process and eligibility criteria were effectively communicated to participants.

Field staff generally preferred the TLS recruitment process because they had more control over recruitment and could approach participants instead of waiting for them to arrive at the study site as with RDS. TLS, however, experienced several challenges to recruitment. First, some of the VDTs failed to yield any eligible participants during data collection. The rainy season played a major factor in venue attendance and some MSM were afraid of being identified at mixed venues. During the formative phase, the number of MSM present in a 4-hour period was estimated by counting the number of eligible MSM in a half-hour block and multiplying by 8 to estimate the total number that could be encountered in 4 hours. In some venues, like shopping malls, it was challenging to recruit MSM because of the low proportion of MSM among the venue attendees. Additionally, several men who had already participated in the TLS study attempted to complete the survey multiple times in the hopes of receiving additional incentives; those recognized as having already participated were prohibited from enrolling. Because 2 different TLS field teams were working at multiple data collection sites, detecting repeat participants was more difficult in TLS than RDS, which only employed 1 field team. Finally, at many TLS field sites – especially bars and dance clubs – it was challenging to determine if a participant was under the influence of drugs or alcohol, and therefore ineligible, because the study protocol did not include objective methods of defining and assessing intoxication. Overall, 55% of men who were approached accepted the intercept and eligibility screening. Of these, 46% (n=738) were eligible and 83% of those eligible completed the interview (n=609).

Resources: RDS required fewer human and monetary resources than TLS. RDS employed 4 field staff members for 11 weeks, in comparison with TLS, which employed 16 field staff for 4 weeks of formative site verification and 8 staff for 8 weeks of data collection. RDS staff generally worked an 8-hour shift from 12pm until 8pm, whereas TLS staff worked irregular hours and in more challenging conditions, including late nights, on weekends, and in poor weather. Additionally, TLS was more costly than RDS due to the extensive formative research and planning required. RDS planning and implementation costs totaled $89USD per participant, whereas TLS cost $121USD per participant (24).

Logistics: The study team found RDS to be less logistically challenging than TLS. RDS required minimal formative work, involved only 1 data collection site (with the occasional use of alternate sites), and required only 1 field team. The primary RDS logistical challenge was managing the coupon numbering system. The installation of a coupon software program at the primary data collection site helped prevent complications associated with human error. The program, however, could not be used at alternate RDS sites, which created a few instances of confusion in the numbering system. TLS required substantial administrative effort in order to construct the sampling frame of venues, obtain permission from venue owners, accurately count the number of eligible men in each venue during the formative phase, update and coordinate the recruitment calendar on a daily basis, simultaneously supervise multiple field teams, and transport field teams from site to site. Even after owner permission had been obtained, TLS field teams were denied entry into certain venues when they attempted to begin data collection.

Safety: Guatemala has one of the highest violent crime rates in Latin America (26) and the study team consistently expressed that working conditions were more dangerous in TLS than RDS. Although the RDS study site was located in a dangerous area, the NGO provided a safe work environment and the RDS team did not report any threatening or dangerous incidents. In contrast, TLS field teams often worked in dangerous venues and city zones. Using the HAPI instruments attracted unwanted attention

when collecting data in public venues. Several interviewers reported feeling threatened by some of the individuals who attempted to enroll in the study. One field team witnessed a shooting at a TLS site and, consequently, the site was removed from the venue sampling frame. Eventually, the cooperation of the local police was enlisted to accompany field teams to TLS sites, improving TLS team members' sense of safety, but adding to logistical considerations. Field teams working at RDS alternate sites were also accompanied by a police escort.

Confidentiality: TLS participants tended to be less willing than RDS participants to sign the informed consent form after providing oral consent, presumably because they were afraid to be publicly identified as MSM. Ensuring confidentiality was easier in RDS than TLS because the RDS site allowed for private interviewing conditions. Several study team members, however, expressed that choosing a neutral RDS site not associated with MSM outreach and services would have better protected confidentiality and privacy. TLS sites, especially bars and dance clubs, posed challenging interviewing conditions, but field teams were generally able to claim a relatively quiet, private location within the venue or outside the entrance.

Bias: Alternate RDS study sites were implemented to facilitate participation in areas where coupons were circulating but potential participants did not feel comfortable visiting the main study site. Bias may have been introduced by the location of alternate sites since people from these areas may have been more likely to participate than from other areas in the city. Additionally, reliance on social networks for recruitment may have skewed the sample to mirror the characteristics of participants with stronger network ties and may have excluded MSM from higher income or education. Indeed, a higher proportion of TLS participants reported university level education compared to RDS (26.5% vs. 11.3%, respectively; $p<0.01$). Also, a higher proportion of RDS participants reported selling sex in the past six months than TLS participants (37.3% vs. 24.1%, $p=0.09$), which may reflect the particular social networks that were accessed through RDS (24). The fact that the primary data collection site was located in an

area known for sex work may also have contributed to the higher proportion of reported sex work in the RDS sample. Bias may have been introduced to the TLS study by the selection of venues and participants. When constructing the sampling frame of venues, approximately 24 business owners declined to participate in the study, the majority of which were shopping malls (n=11) or saunas (n=5). Because these sites were subsequently omitted from the sampling frame, individuals who only frequented excluded sites were not represented in the survey. Additionally, as a probability-based sampling method, TLS relies on the systematic selection of participants (15). Within the first 2 weeks of TLS data collection, field supervisors realized that some interviewers were approaching men based on physical characteristics that were believed to indicate sexual orientation. This subjective recruitment technique threatened to introduce bias in the sample. As a result, interviewers were re-trained in how to approach men in a systematic, unbiased manner.

Additional Information for Prevention and Data Interpretation: Because of the relatively isolated data collection environment, RDS provided little opportunity to learn about MSM behavior beyond what was gleaned from the survey. More so than RDS, TLS enabled the study team to build rapport with the MSM community in Guatemala City through coordination with community leaders, NGOs, and venue owners. TLS also helped the study team to gain an understanding of MSM social dynamics and connect with venues where MSM congregate and socialize. TLS presented a unique opportunity to map the universe of venues frequented by the target population and to identify venues with attendees with high risk behaviors or low HIV testing and prevention coverage, both of which are valuable for planning future HIV prevention and public health interventions. In addition, TLS led to a more nuanced understanding of the population of interest, which provided important contextual information useful for data interpretation.

Analysis: TLS is based on well-established survey methodology and offers more software choices for data analysis and construction of sampling weights. Any statistical package that includes a survey

procedure with cluster, strata and sampling weight options can be used to analyze TLS data. RDS data can be analyzed in RDSAT, a free software package that was designed for use in low-capacity settings with a point-and-click interface that until very recently did not include tools for saving script, analyzing multiple variables at a time, analyzing continuous variables or conducting multiple regression analysis. More recently, an updated version of RDSAT was developed that addresses some of these limitations but it is still not widely available. Analysts have developed add-in packages for STATA and R for RDS analysis but the new packages do not use the same estimation technique as RDSAT and consensus is lacking on the best technique to calculate the standard error for RDS estimates and on how to account for the sampling design in multivariate analysis (27).

Table I: Comparison of RDS and TLS Implementation Issues

Implementation Issue	RDS	TLS
Time	Formative research: 4 weeks Implementation: 11 weeks	Formative research: 8 weeks Implementation: 7.5 weeks
Recruitment	58% of participants recruited at least 1 peer into the study	55% percent of men who were approached accepted the intercept; of these, 46% were eligible and 83% of those eligible completed the study
Resources	$89 / participant 4 staff x 11 weeks	$121 / participant 8 staff x 8 weeks
Logistics	Logistically simple with the exception of managing the coupon numbering system	Logistically challenging due to extensive formative work, rotating study sites, and management of multiple field teams
Safety	Safe working conditions	Risky working conditions
Confidentiality	Private interviewing locations available; RDS site's association with MSM service provision may have limited participants' sense of privacy	Challenging to find a private interviewing location; participants were more hesitant to sign informed consent form than with RDS
Bias	Use of alternate sites located near known networks of MSM may have introduced bias, as those near the alternate sites were more likely to participate	Certain businesses declined to participate; some intoxicated participants were included in sample; a subjective method for approaching participants was used but later remedied
Additional information for prevention and data interpretation	Data collection occurred in a relatively isolated environment, with limited opportunity for gaining additional information about MSM networks	Collecting data in public venues allowed for rapport building, network mapping opportunities, and more nuanced and complex interpretation of data
Analysis	Cumbersome, lacking clear guidelines for multivariate modeling	Based on standard survey methods with various software packages available for analysis.

DISCUSSION

In our comparison of RDS and TLS implementation, we found that, in the context of Guatemala City, RDS offered greater privacy and safety, required fewer human and financial resources, and presented fewer logistical challenges than TLS. Both methods successfully recruited the desired sample size within the predetermined timeframe, but compared to RDS, TLS required more time for formative research and planning, and less time for survey implementation. Both methods faced distinct challenges related to bias. RDS assumes that the final sample is a representative picture of the underlying social network and uses data collected to calculate population estimates. Any event that would lead the recruitment patterns to deviate from the actual network could lead to biased estimates. Such biases could include: 1) certain groups being more likely to participate than others (due to valuing the incentive more, or having more time to participate or easier access to the field site), 2) certain groups being easier to recruit than others, and 3) concentration of recruitment in a sub-set of the population, due to stronger social ties (28). The TLS sample may have been affected by venue owners that declined to participate and initial non-systematic recruitment techniques. In terms of additional information for prevention and data interpretation, RDS data collection occurred in a relatively isolated environment, whereas TLS allowed the study team to build connections within and gain a better understanding of MSM communities, both of which are important facets for guiding future prevention efforts. Finally, TLS offers more choices for data analysis software than RDS and uses standard survey methods, unlike RDS.

Several of the identified operational and implementation strengths and challenges associated with RDS and TLS have previously been described in the literature (11,13,20,29-32). A recent study that used RDS to recruit MSM in Bangladesh arrived at similar conclusions about RDS, finding that the methodology required limited formative research, was easy to implement, and allowed for a relatively quick recruitment of the desired sample size (32). A 2006 study that used RDS to conduct an HIV behavioral survey with MSM and female sex workers in Papua New Guinea also reported safe and

private interviewing conditions and efficient recruitment of the target population (33). One key implementation challenge encountered in the Papua New Guinea study was the fact that some people tried to misrepresent themselves in order to be considered eligible (33); this challenge was experienced in both the RDS and TLS arms of this study.

The TLS literature supports our conclusion that TLS field conditions can create challenges related to both safety and privacy (10,15,30). A study that employed TLS in Mexico reported similar problems with interviewer bias when approaching potential participants. Interviewers tended to approach potential subjects based on subjective physical traits, which led to a selection bias against MSM who appeared "masculine" and against older subjects (20). This study also found that some owners or managers prohibited data collection in their venues, which may have prevented the inclusion of members of the target population that visit those venues (20).

Although some of the implementation challenges described in this paper are inherent characteristics of the methods, recommendations for RDS and TLS best practices may assist researchers in circumventing difficulties. Based on our study findings, we developed 3 recommendations for RDS implementation. First, to ensure participant confidentiality, select a neutral study site that is not associated with an organization that serves the population of interest. Second, determine the need for alternate study sites based on findings from formative research, which will help attract participants from different geographic areas. Finally, to reduce the likelihood of human error, use a coupon software program and designate 1 person to be in charge of coupon distribution. Similarly, we developed recommendations for TLS implementation. First, to facilitate systematic recruitment, provide hands-on training to field staff in how to systematically approach participants. Follow the training with a period of supervision to ensure that participants are recruited in an unbiased manner. Second, to gain access to venues and facilitate a representative sample, garner support for the study from community members and venue owners. Additionally, to promote safe working conditions among staff, enlist the cooperation

of the local police to accompany field teams to potentially dangerous data collection sites and exclude sites known to be dangerous from the sampling frame. Finally, the criteria to select venues for the sampling frame could be changed to venues where at least 75% of attendees are MSM; this threshold is used by large ongoing behavioral surveillance among MSM in the United States (34,35). This could improve the efficiency of recruitment during data collection but may exclude MSM who do not attend more openly gay venues.

Our study has 2 primary limitations. First, members of the study team were asked to describe challenges that occurred up to 18 months in the past, introducing the potential for recall bias. Second, these findings may not be generalizable to RDS and TLS implementation in different geographic areas or non-MSM populations. For instance, security issues associated with TLS might not be as great a concern in areas that offer safer working conditions. Similarly, levels of discrimination and stigma are likely to differ according to cultural context and the target population, which could influence various aspects of survey implementation.

CONCLUSION

Although RDS and TLS have distinct operational challenges, both methods hold promise for reaching MSM. It is important to note that both methods depend on theoretical assumptions that may not hold true in real-world scenarios. Our experience in Guatemala shows that RDS can effectively access social networks of hidden populations while providing safe and private field conditions. TLS is an appropriate sampling method when specifically working with populations who frequent public meeting places. TLS also provides a unique opportunity to map the universe of venues frequented by the target population, which can be useful for HIV prevention interventions. The comparison presented in this paper will help researchers to choose the most appropriate recruitment strategy to reach their target population and accomplish their public health objectives.

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