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Reaching Black Men Who Have Sex with Men: A Comparison between Respondent-driven Sampling and Time-location Sampling

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Abstract

Objectives—We explored whether respondent-driven sampling (RDS) can generate a more diverse sample of Black men who have sex with men (MSM) than time-location sampling (TLS) by comparing sample characteristics accrued by each method in two independent studies.

Methods—The first study exclusively recruited Black MSM through RDS (N=256) while the second recruited MSM through TLS including a subsample of Black MSM (N=69). Crude and adjusted point estimates and 95% confidence intervals were calculated for socio-demographic and behavioral characteristics, HIV prevalence, and prevalence of unrecognized infections, and were compared using the Z-test.

Results—The samples differed significantly regarding all socio-demographic and some behavioral characteristics. Compared to TLS, RDS estimated higher proportions of older, less educated, poorer, currently homeless and self-identified bisexual Black MSM. Participants in RDS were less likely to have a main partner, had fewer male partners, were more likely to have a female partner and have both male and female partners, and reported greater methamphetamine, crack and heroin use. Prevalence of HIV and unrecognized infections were slightly higher among RDS participants.

Conclusions—The RDS sample comprised Black MSM who were more diverse with respect to socio-demographic characteristics, and may also be at higher risk for HIV. Thus, RDS has advantages in reaching higher-risk Black MSM who are most hidden from intervention research and service delivery. Future studies of Black MSM using RDS could use steering strategies to

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CW conceptualized the study, conducted the analyses and led the writing of this manuscript. WM and HFR designed the original studies, supervised data collection, and contributed to the writing of this manuscript. GNC and VF contributed to the design of the BMT study and provided input of this manuscript.

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recruit younger participants and other sub-groups of greatest interest to public health and prevention.

Keywords

Men who have sex with men; African American; sampling; HIV/AIDS; hidden population

INTRODUCTION

Obtaining a diverse and representative sample of key populations at risk for HIV infection for HIV surveillance and research presents many challenges. In most settings and cultures, key populations are groups of individuals whose behaviors and/or identities are socially stigmatized and/or illegal, e.g., men who have sex with men (MSM), and may therefore be hidden and hard to reach. As such, using population-based probability sampling methods, e.g., random-digit dialing or census methods, to recruit key populations is often not feasible considering the costs associated with these approaches and the likelihood of acknowledging stigmatized behaviors in household surveys.

Quasi-probability sampling methods have been developed to sample key populations to improve scientific rigor and to expand the diversity of enrollment in studies beyond the most visible segments. Amongst them, time-location sampling (TLS) and respondent-driven sampling (RDS) have been two methods applied frequently in recent years, in the US and worldwide to access hidden populations. Through creation of a sampling frame that comprises the universe of venues, days, and time periods where and when the population congregates, the TLS methodology systematically samples potential participants at randomly selected venue-day-time periods. In the US, TLS is the method used to recruit MSM participants in 21 cities in the National HIV Behavioral Surveillance (NHBS) System.¹ However, a notable limitation of TLS is that it cannot reach MSM who do not attend physical venues frequented by MSM such as those who are non-gay identified. RDS was developed as a long-chain peer referral recruitment method which through statistical adjustments could be applied to make population-based inferences.²³ RDS has become a popular method to recruit MSM around the world including countries in Africa and Asia, many of which have high levels of stigma towards MSM and where MSM venues may be very rare.⁴

In the US, RDS has notably been used to recruit minority MSM and specifically Black MSM in various contexts.⁵⁻⁷ While studies using TLS obtain samples that include Black MSM, it is unclear if these samples adequately represent all Black MSM in a given geographic area. TLS tends to generate samples of MSM who are mostly gay-identified and of higher socio-economic status.⁸ Compared to White MSM, Black MSM are more likely to self-identify as bisexual or have sex with both men and women, have lower educational level and are poorer.⁹¹⁰ Furthermore, Black MSM appear less likely to attend MSM venues because few MSM venues specifically cater to Black MSM or they do not feel welcomed at White MSM oriented places.¹¹ Thus, the RDS methodology may be especially relevant to recruiting more diverse samples of Black MSM (i.e., other than those who attend more mainstream gay-identified venues), and could compensate for limitations and biases of TLS. Experiences suggest that RDS is able to recruit MSM who are more diverse in terms of socio-demographics.⁸¹²

Whether or not RDS can generate a more diverse or equivalent sample of Black MSM as compared to TLS is a question that can be explored by comparing the sample characteristics accrued by each method. We had the unique opportunity to make such a comparison with two independent San Francisco-based studies conducted nearly contemporaneously. The

first study exclusively recruited Black MSM through RDS while the second was a study of MSM recruited through TLS which included a subsample of Black MSM. In this analysis, we compare socio-demographic and behavioral characteristics, HIV prevalence, and unrecognized infections between Black MSM participants in the RDS and TLS samples.

METHODS

Time-location sampling and recruitment

Between December 2007 and October 2008, to obtain baseline data for a longitudinal study (ASSORT!), a cross-sectional survey was conducted of men attending MSM venues in San Francisco previously described in detail.¹³¹⁴ TLS was used to recruit participants. To start, a formative research phase, including ethnographic mapping and key informant interviews, constructed an up-to-date universe or sampling frame of venues frequented by MSM, and the days and time periods of attendance in San Francisco. From the roster of all possible venue-daytime (VDT) periods, a random sample of VDT was drawn. At the randomly selected VDT, the attendance of all potentially eligible subjects was recorded and individuals entering or exiting the venue or crossing a predetermined line are intercepted, assessed for eligibility, and invited to participate.

During assessment, recruiters briefly described the study. Men who had not previously participated and willing to participate were screened for eligibility. Eligibility criteria included being male gender at birth (not transgender), age 18 years and older, a resident of one of ten Bay Area counties, were able to complete the interview in English or Spanish, and had to be consecutively approached by the staff at the randomly selected VDT. Of note, reporting male-to-male sex or gay-identity were not eligibility criteria, thus allowing non-gay identified MSM to participate. However, participants who did not report sex with another man in the past 12 months *and* did not identify as gay or bisexual were excluded from analysis.

Once participants were determined to be eligible, staff obtained written informed consent. Participants then completed the computer-assisted self-administered interview. On-site pre-testing counseling was conducted and oral fluid specimens were collected for HIV testing. Specimens were tested for HIV using standard laboratory-based methods at the San Francisco Public Health Laboratory. Participants received \$25 for completing the survey and \$25 for taking the HIV test. The study was approved by the University of California San Francisco's Committee on Human Research.

Respondent-driven sampling and recruitment

Between February 2009 and September 2009, the San Francisco Department of Public Health's HIV Prevention Section undertook a pilot HIV testing program focusing on Black MSM (Black Man Testing [BMT]).⁷ The pilot program employed RDS to reach Black MSM through their social and sexual networks. Through key informative interviews, seed participants were selected to reflect the diversity of Black MSM in San Francisco (e.g., by age, neighborhood of residence, educational level). After completing a pre-HIV test risk assessment and HIV testing, seed participants were given three referral coupons to recruit other Black MSM, who were 18 years old or older and residents of San Francisco, regardless of their current HIV status. The referral coupon described the purpose of the project, contact information and working hours of the testing site, and a unique tracking code. Men receiving referral coupons either called for a HIV test appointment or dropped in during testing hours at the Department of Public Health. Upon redeeming the coupon, men were screened for eligibility. Eligible participants completed an anonymous computer-assisted interviewer-administered risk assessment and confidential HIV testing. A temporary linking form was

used to ensure HIV results were properly matched with risk assessment data. After merging the HIV result and risk assessment data, the link was destroyed. All participants, regardless of HIV status or risk behavior profile, were invited to recruit up to three other Black MSM. Men received \$40 for taking part in the risk assessment and HIV testing and could receive \$10 for up to three referrals. The study used detailed screening questions, subjective assessment by trained staff, and post survey validation of responses to verify group membership.

HIV testing was conducted using a standard ELISA rapid-test among all participants. Those testing HIV- negative on the initial test were given the HIV-negative result. For those participants who self-reported being HIV-positive, we performed the rapid-test similarly with all other participants, as well as standard blood collection for conventional HIV testing to confirm their HIV-positive status. For those who self-reported being HIV-negative or HIV-unknown but whose rapid test result was preliminarily-positive we performed the same confirmation testing. Standard testing was performed at the San Francisco Public Health Laboratory. All participants received pre and post-test counseling and referrals regardless of their HIV status.

The pilot project aim was to bring HIV testing to a high-risk population and as such was determined to be a non-research activity. Analysis of secondary anonymous risk assessment data was approved by the University of California San Francisco's Committee on Human Research.

Measures

For this analysis, we included measures that were the same across the two studies. Basic socio-demographic information, including age, annual income, educational attainment, and sexual orientation, was collected. Participants were also asked if they were currently homeless. A partner-by-partner sexual activity matrix was used to collect data on sexual behaviors. Participants reported on the gender, partner type, and counts of episodes of unprotected insertive and receptive anal intercourse with each of the most recent five partners in the preceding six months. Recreational drug use in the past six months, including methamphetamine, crack, cocaine, ecstasy, heroin, and marijuana, was assessed. Participants were also asked if they used alcohol and drug(s) before or during sex. Data on the dates and results of participants' most recent and last HIV tests were also collected. Unrecognized infection was defined as those who tested HIV-positive at the time of the study but who self-reported that they never previously tested, previously tested but did not obtain their results, or that their most recent test was HIV-negative. The measure has epidemiological relevance for unmet need for care as well as for the potential spread of infection.¹⁵

Statistical analysis

Crude sample estimates, adjusted population-based estimates and their 95% confidence intervals (CIs) were computed for all variables in both samples. TLS data were weighted according to the sampling fraction obtained at the VDT and adjustments were made to standard errors to account for clustering. Point prevalence estimates and 95% CIs were computed using Stata version 12.

RDS data were analyzed using RDS Analysis Tool (RDSAT) version 6.0, which adjusts for each individual's social network size and for differential recruitment patterns within a given characteristic.³ To test statistical differences between the two samples we used point estimates and their 95% confidence intervals to calculate a proxy z-score.

RESULTS

Over a 10-month period, the ASSORT! team enumerated 24,333 men at 153 randomly selected venue-day-time periods. They consecutively approached 2,558, screened 2,186 (85%) for eligibility, and found 1,769 (81%) eligible. Of the 1,769 eligible men, 1,321 (75%) agreed to participate in the study and 1,305 (99%) completed the interview. During the interview, 92 men self-identified as heterosexual and did not report any male partners in the past 12 months or were duplicate enrollments, leaving 1,213 unique participants. Of these, 69 self-identified as Black and resided in San Francisco.

Over a 6-month period, the BMT study distributed 832 recruitment coupons, 391 men returned with recruitment coupons (47% coupon return rate) and were screened for eligibility. All 10 seeds recruited at least one wave of recruits while the longest recruitment chain reached 18 waves. Of the 391 recruits, 256 (65%) met the eligibility criteria, agreed to participate, and completed the interview and HIV testing.

Table 1 compares socio-demographic characteristics and self-reported HIV status between the TLS and RDS samples. The samples differed significantly regarding many socio-demographic characteristics. While TLS estimates a more uniform distribution of age, RDS estimates higher proportions of older Black MSM in the population (e.g., 43.0% vs. 20.8% are between 41–50 years old, $z = 2.51$, $p = 0.02$). RDS also estimates that Black MSM have lower educational attainment (e.g., 57.6% vs. 15.3% have a high school degree or less, $z = 6.12$, $p < 0.01$), are poorer (e.g., 47.0% vs. 19.5% have an annual income of less than 10,000, $z = 3.76$, $p < 0.01$), and are more likely homeless (33.3% vs. 0.7%, $z = 7.80$, $p < 0.01$). RDS estimates that Black MSM are more likely to self-identify as bisexual than does TLS (45.3% vs. 12.0%, $z = 5.24$, $p < 0.01$).

Table 2 compares estimated HIV-related risk behaviors, HIV prevalence, and unrecognized HIV-positive cases between the samples. Compared to TLS, RDS estimates that Black MSM are less likely to have a main partner (39.0% vs. 60.8%, $z = 2.24$, $p = 0.02$) in the past 6 months. While RDS estimates that Black MSM have fewer male partners than TLS does (e.g., 48.4% vs. 74.1% had 2 or more, $z = 2.87$, $p < 0.01$), RDS estimates that Black MSM are more likely to have a female partner (e.g., 11.1% vs. 0.3% had one, $z = 3.71$, $p < 0.01$) and to have both male and female partners (18.9% vs. 7.3%, $z = 2.20$, $p = 0.02$) in the past 6 months, which is consistent with differences in estimated sexual identity across the two sampling methods. Estimates of drug use also differed. RDS estimates greater methamphetamine use (27.3% vs. 10.4%, $z = 2.72$, $p < 0.01$), crack use (37.0% vs. 5.7%, $z = 6.80$, $p < 0.01$), and heroin use (11.3% vs. 0.5%, $z = 4.09$, $p < 0.01$) in the past 6 months compared to TLS. By serological testing, estimated prevalence of HIV and the proportion previously unaware of their infection were somewhat higher Black MSM in RDS compared to TLS but not significantly so (34.0% vs. 27.7%, $z = 0.56$, $p = 0.58$; 14.8% vs. 12.7%, $z = 0.27$, $p = 0.78$; respectively). Estimates of unprotected anal intercourse (insertive or receptive), drug or alcohol use before sex, and history of HIV testing did not differ between the two methods.

DISCUSSION

To accurately characterize the epidemiology of HIV among key populations at risk for HIV, robust methods must be used to enable researchers to estimate population parameters of key indicators. Through the examination of the results from two sampling methods, we conclude that RDS allows for estimation of more diverse characteristics than does TLS in terms of including larger proportions of key sub-groups, such as low socio-economic status, the non-gay identified, and bisexual Black MSM. The socio-economic make up (i.e., education and

income) of the RDS sample more closely mirrors the African American population of San Francisco than that of the TLS sample.¹⁶ Estimates of sexual risk behaviors, including unprotected insertive anal intercourse and unprotected receptive anal intercourse, did not differ between the two sampling methods, with the exception that the RDS estimates suggest that Black MSM have fewer male sexual partners and are more likely to have female partners compared to the estimates from TLS. The non-difference in estimates in prevalence of unprotected anal sex could help explain the similar HIV prevalence estimated between the two methods. However, it should be noted that HIV prevalence is estimated to be almost 7% higher among Black MSM from the RDS sample than by the TLS sample. Although the difference was not significant statistically, it can have important implications for HIV surveillance. Finally, the RDS sample estimated higher levels of substance use, including methamphetamine, crack and heroin, than the TLS sample did.

In addition to sampling rigor for tracking the HIV epidemic, there is also a need for increased inclusion of Black MSM in research. RDS may have the potential to enroll Black MSM into clinical trials on at least three levels. First, RDS may be more efficient than convenience sampling methods (such as outreach at venues) in reaching large numbers of Black MSM for screening for clinical trials. Secondly, using social networks of Black MSM may penetrate deeper into the Black MSM community and reach men that would otherwise not be reached by traditional clinical trial recruitment schemes. Our results show that compared to TLS, the RDS study was able to reach a more hidden segment of Black MSM. Lastly, using the social networks of Black MSM themselves to recruit for clinical trials may increase the acceptability (i.e. street credibility of the clinical trials) of participating in clinical trials if peers endorse such behavior.

Recruiting Black MSM for surveillance and research in the US has been challenging due to Black MSM being more closeted and hidden, Black communities being more homophobic and the tragic history of abused trust by the medical research establishment.¹⁷¹⁸ Yet, with extremely high HIV prevalence and incidence observed among Black MSM,¹⁵¹⁹ it is crucial that methods be employed that allow for population inference and where more diverse samples of Black MSM are obtained for clinical trial research or to establish cohorts of research participants. We wish to be clear that sampling methods in and of themselves do not ensure trust for how the data will be used and severe biases in recruitment may persist unless this confidence is garnered by researchers.

There are several other limitations to this study. The TLS study did not specifically target Black MSM. It was designed to sample all MSM in the area and did not oversample the subgroup of Black MSM. As a result, we had a small subsample of Black MSM, which could have limited our power to detect some significant differences between the samples and introduced bias in some weighted estimates. In addition, we could not assess if either of our samples was truly representative of the Black MSM population in San Francisco since no gold-standard sampling method exists to sample Black MSM.

However, our findings have important implications for HIV prevention and research among Black MSM. It appears that participants in the RDS sample were not only socio-demographically diverse, but may also be at higher risk for HIV infection. Thus, this could be an especially valuable tool to reach higher-risk Black MSM (e.g., substance users) and those who are most hidden (e.g., non-gay identified) for intervention research and service delivery. Several studies have already shown that social-network based HIV testing was effective to reach Black MSM and identify previously unknown HIV-positive cases.⁷²⁰ In theory, successful implementation of TLS requires existence of sufficient numbers of venues where the target population congregates and those who attend such venues. Extensive formative research, including ethnographic mapping and enumerations of venue attendance,

is needed beforehand. However, in most places (e.g., mid- or small-size cities), few venues cater to Black MSM only and most regular MSM venues have sparse Black MSM attendance. Thus in such settings, using TLS to recruit Black MSM may not be a pragmatic sampling option. Our study showed that it was feasible to recruit a sizable sample of Black MSM through RDS within a short period of time. Future studies of Black MSM using RDS could use steering strategies to recruit younger MSM participants.

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KEY MESSAGES

- Respondent-driven sampling (RDS) may be especially relevant to recruiting Black MSM for HIV prevention and research, and could compensate for limitations of time-location sampling (TLS).
- Compared to the TLS sample, the RDS sample comprised Black MSM who were more diverse with respect to socio-demographic characteristics, and may also be at higher risk for HIV.
- Future studies of Black MSM using RDS could use steering strategies to recruit younger participants and other sub-groups of greatest interest to public health and prevention.

Table 1

Comparison of socio-demographic characteristics between Black MSM recruited through time-location sampling (TLS) and respondent-driven sampling (RDS) in San Francisco

	ASSORT - TLS (N = 69)		BMT - RDS (N = 256)		
	Crude n (%)	Adjusted % (95% CI)	Crude n (%)	Adjusted % (95% CI)	Z (p-value [*])
Age					
18 – 25	17 (24.6%)	27.3% (12.3, 42.2)	15 (5.9%)	7.5% (3.3, 13.2)	2.46 (0.02)
26 – 30	14 (20.3%)	21.0% (3.1, 38.9)	17 (6.6%)	6.8% (2.9, 10.8)	1.52 (0.12)
31 – 40	14 (20.3%)	19.7% (7.0, 32.4)	42 (16.4%)	16.1% (11.6, 22.0)	0.51 (0.60)
41 – 50	17 (24.6%)	20.8% (5.6, 36.1)	116 (45.3%)	43.0% (32.9, 49.3)	2.51 (0.02)
51 +	7 (10.1%)	11.2% (5.2, 27.6)	66 (25.8%)	26.6% (20.8, 35.7)	2.24 (0.02)
Education					
High school or less	13 (18.8%)	15.3% (4.6, 26.0)	136 (52.7%)	57.6% (49.8, 66.4)	6.12 (<0.01)
Some college	33 (47.8%)	59.0% (41.6, 76.3)	89 (34.8%)	33.1% (25.0, 40.6)	2.67 (<0.01)
College	13 (18.8%)	12.9% (3.7, 22.2)	24 (9.4%)	8.4% (4.6, 11.9)	0.89 (0.38)
Post graduate	10 (14.5%)	12.8% (3.0, 22.7)	8 (3.1%)	1.0% (0.2, 2.2)	2.34 (0.02)
Income					
< 10,000	16 (23.2%)	19.5% (7.4, 31.6)	107 (42.1%)	47.0% (39.4, 54.8)	3.76 (<0.01)
10,000 – 29,999	21 (30.4%)	28.8% (10.2, 47.5)	104 (40.9%)	42.1% (34.2, 49.6)	1.29 (0.20)
30,000 – 49,999	13 (18.8%)	19.6% (2.9, 36.4)	25 (9.8%)	6.9% (4.1, 9.4)	1.47 (0.14)
50,000	19 (27.5%)	32.0% (14.6, 49.4)	18 (7.1%)	4.1% (1.4, 8.0)	3.09 (<0.01)
Sexual orientation					
Gay	52 (75.4%)	85.9% (76.7, 95.2)	142 (55.7%)	52.2% (43.1, 61.4)	5.08 (<0.01)
Bisexual	15 (21.7%)	12.0% (3.4, 20.6)	101 (39.6%)	45.3% (36.4, 54.4)	5.24 (<0.01)
Straight/other	2 (2.9%)	2.1% (1.0, 5.1)	12 (4.7%)	2.5% (0.8, 4.5)	0.28 (0.78)
Currently homeless	1 (1.5%)	0.7% (0.7, 2.3)	82 (32.0%)	33.3% (25.6, 41.9)	7.80 (<0.01)
Self-reported HIV status					
HIV-negative	48 (69.6%)	66.5% (46.7, 86.4)	165 (64.4%)	68.1% (58.9, 76.6)	0.14 (0.88)
HIV-positive	14 (20.3%)	26.0% (5.9, 46.1)	68 (26.6%)	22.8% (14.9, 31.1)	0.29 (0.78)
Unknown	7 (10.1%)	7.4% (0.4, 15.3)	23 (9.0%)	9.1% (5.1, 13.8)	0.39 (0.70)

* bold face indicates significant association

Table 2

Comparison of HIV-related behavioral characteristics, HIV prevalence and unrecognized infections between Black MSM recruited through time-location sampling (TLS) and respondent-driven sampling (RDS) in San Francisco

	ASSORT - TLS (N = 69)		BMT – RDS (N = 256)		Z (p-value) ^a
	Crude n (%)	Adjusted % (95% CI)	Crude n (%)	Adjusted % (95% CI)	
Sexual behaviors, past 6 months					
Had a main partner	27 (39.1%)	60.8% (44.2, 77.4)	94 (36.7%)	39.0% (29.7, 48.5)	2.24 (0.02)
Number of male partners					
0	13 (18.8%)	13.4% (3.5, 23.2)	46 (18.0%)	18.3% (12.9, 23.2)	0.86 (0.38)
1	7 (10.1%)	12.5% (1.4, 26.4)	70 (27.3%)	33.3% (26.1, 41.7)	2.77 (<0.01)
2	49 (71.0%)	74.1% (58.2, 90.1)	140 (54.7%)	48.4% (41.0, 55.6)	2.87 (<0.01)
Number of female partners					
0	61 (88.4%)	92.7% (85.7, 99.7)	192 (75.0%)	73.6% (64.2, 82.6)	3.24 (<0.01)
1	1 (1.5%)	0.3% (0.3, 0.9)	25 (9.8%)	11.1% (5.7, 17.1)	3.71 (<0.01)
2	7 (10.1%)	7.0% (0.2, 13.9)	39 (15.2%)	15.3% (8.8, 22.6)	1.79 (0.08)
Had both male and female partners	8 (11.6%)	7.3% (0.3, 14.3)	52 (20.3%)	18.9% (11.5, 26.7)	2.20 (0.02)
Engaged in any UIAI	25 (36.2%)	36.7% (18.4, 54.9)	126 (49.2%)	49.3% (41.0, 56.4)	1.25 (0.22)
Engaged in any URAI	15 (21.7%)	33.0% (12.3, 53.7)	70 (27.3%)	29.6% (21.9, 36.9)	0.30 (0.76)
Used alcohol before or during sex	34 (49.3%)	42.0% (23.1, 60.9)	144 (56.3%)	53.3% (45.3, 61.5)	1.08 (0.28)
Used drug before or during sex	28 (40.6%)	38.7% (19.6, 57.8)	146 (57.0%)	51.9% (44.1, 60.5)	1.25 (0.22)
Non-injection drug use, past 6 months					
Meth	9 (13.0%)	10.4% (0.3, 20.4)	75 (29.3%)	27.3% (20.5, 34.2)	2.72 (<0.01)
Crack	6 (8.7%)	5.7% (2.8, 14.2)	97 (37.9%)	37.0% (30.4, 44.4)	6.80 (<0.01)
Cocaine	18 (26.1%)	29.7% (10.9, 48.6)	47 (18.4%)	15.8% (9.9, 21.4)	1.38 (0.16)
Ecstasy	9 (13.0%)	10.2% (2.2, 18.1)	17 (6.6%)	3.9% (1.6, 6.6)	1.48 (0.14)
Heroin	2 (2.9%)	0.5% (0.2, 1.2)	18 (7.0%)	11.3% (6.8, 17.1)	4.09 (<0.01)
Marijuana	27 (39.1%)	40.1% (20.1, 60.2)	126 (49.2%)	47.6% (39.7, 55.0)	0.69 (0.50)
Ever tested for HIV	63 (91.3%)	92.8% (85.0, 100.0)	239 (93.4%)	92.6% (88.2, 96.4)	0.05 (0.96)
HIV test result ^a					
HIV-negative	51 (73.9%)	72.3% (52.4, 92.2)	168 (67.2%)	66.0% (56.7, 75.3)	0.56 (0.58)
HIV-positive	18 (26.1%)	27.7% (7.8, 47.6)	82 (32.8%)	34.0% (24.7, 43.3)	0.56 (0.58)

	ASSORT - TLS (N = 69)		BMT - RDS (N = 256)		Z (p-value [*])
	Crude n (%)	Adjusted % (95% CI)	Crude n (%)	Adjusted % (95% CI)	
Infected unaware	5/18 (27.8%)	12.7% (4.5, 29.9)	15/82 (18.3%)	14.8% (1.2, 17.5)	0.27 (0.78)

^{*} bold face indicates significant association;

^aFrom biological testing at the time of the study.