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Accessing a diverse sample of injection drug users in San Francisco through respondent-driven sampling

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ABSTRACT

Aims: Injection drug users (IDU) are the second most affected population by HIV in San Francisco and the United Stated after men who have sex with men (MSM). Behavioral surveillance data that include the diversity of the population at risk are necessary to develop effective programs for IDU.
Design: We conducted a cross-sectional behavioral survey of IDU using respondent-driven sampling (RDS) in San Francisco. The present analysis focuses the performance of the sampling method in reaching the diversity of the population as a pre-requisite for representative data.
Participants: Over 32 weeks, 571 eligible IDU were recruited, of whom 477 (83.5%) with complete records were included in analysis.
Findings: The age range was 18–70 years, with 36% age 50 years or older. The majority (56%) were homeless. Male, MSM, African-Americans and Non-Hispanic Whites comprised 71%, 28%, 36% and 35% of IDU, respectively. Twenty-two percent had "ever shared needles in the past 12 months," and 57% reported that they had "shared drugs" in the past 12 months. Peer referral chains were able to cross-recruit IDU by diverse demographic characteristics, drug use related behaviors, program access and use, and other factors relevant to reaching and conducting prevention research on this population.
Conclusion: RDS appears to be an effective sampling tool that reaches diverse populations of IDU, including many who may be missed by drug treatment and HIV prevention services in San Francisco and potentially in other urban areas.

1. Introduction

Effective planning for HIV prevention and care programs requires the ongoing collection of surveillance data with samples that are representative of the population being studied (Pisani et al., 2003; Rehle et al., 2004). Although true population-based sampling is the gold standard for public health surveillance surveys, it may not be feasible for hidden populations whose behaviors are illegal and stigmatized. These populations include "most-at-risk populations" (MARPs) such as injection drug users (IDU) (Abdul-Quader et al., 2006; Cooper et al., 2005; Des Jarlais et al., 2001). As a result, the development of effective and representative sampling methods has proved to be an ongoing challenge in the study of IDU (Heimer, 2005; Muhib et al., 2001).

The sampling methods employed by early surveys of IDU used institutional settings (e.g., hospitals, jails or drug treatment centers) or certain venues (e.g., shooting galleries, public parks, or street corners) for the recruitment of subjects (Magnani et al., 2005). Targeted sampling (TS), for example, has been one method employed to study IDU in the United States (US) during the past few decades (Kral et al., 1998, 2003). The challenge remains in rigorously sampling those segments of the population not accessing programs or facilities, not present at institutions, and who are less visible in venues and public spaces.

In answer to this challenge, Heckathorn used mathematical modeling and data simulation to show that a peer referral sampling method, "respondent-driven sampling" (RDS), can theoretically generate population-based estimates from a networked sample of IDU given certain assumptions (Heckathorn, 1997). In recent years, RDS has been used for HIV surveillance surveys worldwide to sample MARPs, including IDU in the US (McKnight et al., 2006; Johnston et al., 2006, 2008a,b; Kendall et al., 2008; Malekinejad et al., 2008; Platt et al., 2006; Robinson et al., 2006; Stormer et al., 2006; Yeka et al., 2006). Whether RDS can generate a sample that can be used to make inferences about the population from which it was drawn will likely prove a central topic of research in the foreseeable future (Heimer, 2005).

The theory and implementation of RDS has been described elsewhere (Abdul-Quader et al., 2006; Heckathorn, 1997; Ramirez-

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Valles et al., 2005). In brief, RDS is a chain-referral sampling method, the mathematical underpinnings of which originate in the theory of Markov chains. A population must satisfy two basic requirements before it can be considered for an RDS study. First, it must be socially networked, meaning that there must be social ties between members of the population under study. Second, members of the population should be willing to refer their peers to the study. In addition to these global considerations, the underlying theory of RDS analysis makes six assumptions that may be difficult to meet: that potential participants know each other as members of the population of interest and have reciprocal social ties, that the social network is ultimately one large network through generations of social ties and not many isolated networks, that sampling occurs with replacement, that participants can accurately report their network size, that recruitment occurs from a participant's social connections randomly, and that each recruit in turn recruits at least one peer.

To implement RDS, methodological steps must be followed. Subject recruitment begins with the purposeful selection of a few individuals from the population of interest as "seeds." The seeds are trained in recruiting a fixed number of other members of the population from their social networks for participation in the survey. Once these "recruits" have completed the survey, they are trained to become "recruiters." This process creates a sequence of recruiter–recruit chains called "recruitment waves." Over time, the chains grow and the composition of the sample stabilizes with respect to key variables. A stable sample is said to have reached "equilibrium" and that sufficient data have been collected to adjust for recruitment biases. Recruitment is monitored throughout the course of participant accrual, ensuring that subsequent waves of recruitment do not substantially change the overall makeup of the sample and to identify any potential "bottlenecks" between segments of the population. The social network size of each participant is also recorded. Adjustments are made to survey results using the network-size data and characteristics of participants to account for probability of inclusion and the cluster effects of a network-based sample resulting from persons of similar characteristics associating with each other (Heckathorn et al., 2002).

To test the validity of the RDS-generated estimates, ideally a true population-based survey would be needed for comparison. Given the absence of such a gold standard for most MARPs, in practice samples can be compared across two contemporaneous surveys of the same population using different methods. For example, a study of MSM in Fortaleza, Brazil compared RDS with time-location sampling (TLS) and snowball sampling (Kendall et al., 2008). RDS was better able to reach less accessible subpopulations of MSM, particularly those in lower socio-economic strata, compared with the venue-based method. In another experiment, RDS was effective in reaching certain subgroups of Latino gay, bisexual, and transgender (male-to-female) men in Chicago and San Francisco, compared to a simulated sample generated by TLS (Ramirez-Valles et al., 2005). In another example, Robinson et al. (2006) compared the results of RDS studies among IDU in three US cities (Houston, Detroit, and New Orleans) with the results of TS in those cities. The two methods generated similar samples in terms of demographic characteristics (e.g., age, race, and sex) and drug of choice, and findings were consistent with existing IDU HIV surveillance data.

However, two simultaneously implemented surveys of different methodology in the same population are rare. Therefore, alternative approaches are needed to determine the ability of RDS to generate an inclusive and diverse sample as one pre-requisite to achieving a representative sample. For example, it cannot be claimed that a sample is representative if it systematically omits known parts of the population under study. In cases where qualitative evidence suggests that the subpopulations may be confined to their own groups, one possible option is to measure the extent to which participants recruit across demographic or behavioral clusters. In a few surveys RDS has been shown to be less effective in crossing such clusters among subgroups of men who have sex with men (MSM) in the northeastern Brazil and in Tanzania, and among sex workers (SWs) in Porto Alegre, Brazil; Ho Chi Minh City, Vietnam; and Serbia and Montenegro (Dahoma, 2007; Germany, 2007; Johnston et al., 2008a,b; Mello, 2005; Simic et al., 2006).

Given successful RDS-based surveys of IDU in New York and elsewhere, in 2003 the Centers for Disease Control and Prevention (CDC) adopted RDS as the sampling strategy for studying IDU in the 25-city National HIV Behavioral Surveillance (NHBS) system on a 3-yearly cycle (Gallagher et al., 2007; Lansky et al., 2007). The present study examines data from the local NHBS RDS survey among IDU in San Francisco to empirically assess the effectiveness of RDS in recruiting a diverse sample, inclusive of hard to reach segments of the population. We specifically tested whether RDS would result in cross-group recruitments by key demographic characteristics, access to services, and drug of choice in an effort to evaluate whether the method would reach those IDU who do not typically access other points of contact. Findings have implications for local surveillance, prevention and care programs and will help to broaden the general understanding of the relative strengths of the RDS methodology.

2. Methods

2.1. Overview

We conducted a cross-sectional behavioral surveillance survey using RDS among IDU in San Francisco from May to December, 2005 following the standard NHBS protocol of the CDC as implemented in 25 other US metropolitan areas (Gallagher et al., 2007; Lansky et al., 2007). We report on the key demographic characteristics, HIV-related risk behavior and access to health care indicators. We compare the crude, equilibrium, and adjusted prevalence estimates of these indicators. In particular, we examine cross-group recruitment of IDU (e.g., when an IDU who is a member of a certain demographic group recruits an IDU from a different demographic group) using key demographic and risk-behavioral characteristics of IDU.

2.2. Study population

The eligibility criteria used to enroll the population were individuals who: (1) reported injecting illicit drugs within the past 12 months; (2) had visible sign of injection (e.g., track marks, scars, needle-sized scabs) or could correctly describe injection practices; (3) were residents of San Francisco; (4) were at least 18 years of age at the time of interview; and (5) were able to speak English. To be eligible, the participants were required to present a recruitment coupon to the San Francisco Department of Public Health (SFDPH) staff member who explained the study and obtained informed consent.

2.3. Sampling methods

Sampling started with the purposeful selection of a small group of eligible and diverse subjects called "seeds" who received monetary incentives in return for recruitment of three other IDU to take part in the survey, who in turn recruited up to three other IDU, and so on. Recruitment continued until the composition of the sample reached equilibrium for key demographic characteristics, including race, gender and age.