

Targeted Sampling: Options for the Study of Hidden Populations*

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This paper describes some of the efforts of an interdisciplinary research team investigating the transmission of human immunodeficiency virus (HIV), the causative pathogen associated with the acquired immunodeficiency syndrome (AIDS) and related conditions. The risk groups studied were injecting drug users and their sexual partners. Due to the clandestine nature of illicit drug use, we were faced with two interrelated problems: developing a scientific method to monitor the spread of the HIV infection among these drug users and their sexual partners, groups generally thought to be especially difficult to reach; and creating a health education intervention that would help stop the epidemic from spreading among this population and through them to other members of the community. The method we developed to sample injecting drug users is called targeted sampling. Although it incorporates some aspects of other well established sampling strategies, it is sufficiently different to be treated as a separate research method. Further, targeted sampling provides a cohesive set of research methods that can help researchers study health or social problems that exist among populations that are difficult to reach because of their attributed social stigma, legal status, and consequent lack of visibility.

In summer 1985 we were faced with a complex and compelling research task: monitoring the epidemic of HIV among intravenous drug users in San Francisco while simultaneously evaluating the impact of a new AIDS prevention program we had received funding to develop. Our research questions were as follows: 1) what is the nature of intravenous drug use in San Francisco in terms of the specific risk practices people engaged in and their beliefs about AIDS risk; 2) how are injecting drug users organized socially, and what are the implications of this social organization for developing education and prevention plans that would be effective in lowering participation in AIDS risk behaviors; and 3) what were the prevalence rates of HIV infection among various sub-populations of injecting drug users, how did this change over time, and what factors predict or account for infection? The project was complex because it involved the study of injecting drug users from intersecting categories of gender, race, drug use profiles, and neighborhood. It was compelling because of the dire reports of virulent and rapid spread of HIV among known risk populations (Centers for Disease Control 1982, 1983, 1985; Des Jarlais and Friedman 1987, Ginzburg 1984).

In 1983, when we began planning this project, there were few models for conducting combined epidemiologic and evaluative inquiry among injecting drug users. Those that existed were primarily the inchoate work of our colleagues in New York City and New Jersey, which were focused on clinical populations of injecting drug users enrolled in methadone maintenance treatment programs. Consequently, it was necessary for us to discover new

* The research reported in this paper was supported in part by grants from the National Institute on Drug Abuse (R01 DA04212) and (R01 DA03638) and the California Universitywide Task Force on AIDS (R88SF152). The opinions expressed are those of the authors and do not necessarily reflect those of funding agencies or their personnel. We are deeply indebted to our project officer at NIDA, Peter Hartsock. Acknowledged also are the contributions of Robert Broadhead, Craig Reinerman, and Jeanne Kleyn, whose suggestions and criticisms helped strengthen this paper. We also wish to credit the work of Harvey W. Feldman and John A. Newmeyer, who were members of the original research team and who helped define the shape and content of the research and intervention, and Patricia Case, who helped refine many of the sampling methods. Correspondence to: Watters, Department of Epidemiology and International Health, University of California, San Francisco, CA 94143-0560.

ways to meet our research objectives. This paper focuses on these methods, using specific examples drawn from our experiences.¹ Beginning in 1985 we synthesized various methods of inquiry and integrated them into the notion of targeted sampling as it is presented in this paper. The core of the data collection effort is a cross-sectional survey. Approximately 600 individuals are interviewed semi-annually in cross-sections collected in five field sites within San Francisco. In this way we acquire approximately 1,200 interviews and blood samples per year. Our first cross-section, which served as a pre-intervention base line was conducted in early 1986, prior to the implementation of a street-based outreach and AIDS prevention program for injecting drug users in high risk neighborhoods. While essentially a survey, both quantitative and qualitative data are being collected. The structured interviews included demographic data, medical history, knowledge of AIDS risk factors, participation in risk behaviors, drug use history, and sources of AIDS-related information. Interviews took between 30 and 60 minutes to administer (usually about 45 minutes). Approximately 30 ml. of blood was drawn from subjects using standard protocols. Serum samples were analyzed for HIV antibodies using duplicate enzyme linked immunosorbant assay (ELISA). ELISA-positive sera were confirmed using Western blot assay as described elsewhere (Carlson et al. 1985, The Consortium for Retrovirus Serology Standardization 1988).

In the following discussion, we examine the assumptions and methodological underpinnings of targeted sampling and provide specific and concrete examples of problems encountered and strategies developed to reduce their impact. Our goal is to provide the reader with a cohesive set of methodological tools that can be used in the conduct of inquiry into social phenomena among hidden populations that are not amenable to study through more traditional sampling strategies.

The Problem of Sampling Hidden Populations

Frequently, the study of social and public health problems requires access to populations that are outside existing institutional or clinical settings. Such populations are socially invisible or "hidden" in the sense that their activities are clandestine and therefore concealed from the view of mainstream society and agencies of social control. The individuals who comprise hidden populations become more visible when they enter institutional settings (e.g., hospital emergency rooms, drug treatment programs, jails, prisons, mental hospitals, and the criminal and juvenile courts). Consequently the social science and public health literatures are replete with studies of captive, institutional and clinical populations. This is especially true in the study of illicit drug use (Watters, Reinarman, and Fagan 1985). By comparison, studies of non-institutional populations are rare. Classic studies of deviance have depended largely or wholly on populations captured in the nets of institutions of social control (e.g., Becker 1963). Some observers (Waldorf and Reinarman 1975, Preble and Casey 1969) have commented on the need for studies, especially of drug users, that depend less on institutional populations and more on individuals who have not been recruited through their contact with institutional settings such as drug treatment programs, courts, and prisons.

While institutional settings provide relatively easy access to many hidden populations, there is limited generalizability of research findings to larger non-institutional populations that may not share important attributes of their institutional counterparts. The bias introduced by sampling research subjects only in methadone treatment clinics, for example, could lead to the erroneous conclusion that all injecting drug users are heroin addicts whose primary drug use involves daily heroin injection. Sampling strategies that do not rely on clinic-based populations may lead to other conclusions. For example, Zinberg (1984) recruited re-

1. The research described in this paper is still in progress as of this writing (July 1989).

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search subjects outside institutional settings and developed a sample of injecting drug users who used heroin but were not addicts or habitual users in the sense that heroin injection was routine, frequent, and dominated their lives. In our research with injecting drug users recruited in field sites not connected to institutions, we discovered considerable variation in drug use patterns, frequency of drug injection, and drugs of preference (Watters 1988).

Thus, the differences between approaches to the problems of sampling difficult to study populations are not trivial and could impact public health policy developed to control the spread of AIDS in the United States. For example, research based primarily on clients enrolled in methadone clinics might lead policy makers to the conclusion that the expansion of methadone treatment capacity by itself would be an adequate response. On the other hand, policies based on observations from a broader cross-section of injecting drug users would more likely address the great variability in frequency of drug use, drug preference profile, and behavioral practices found to exist in this population. Research based on broader cross-sections of drug users might inform policy makers about the disinclination of many injecting drug users to enter treatment (Hunt et al. 1985-86, Watters 1987, 1988). This, in turn, might give rise to a more varied and appropriate public policy response. In other words, research conclusions and the policies based on them will be affected by the choice of sampling strategy employed.

For these reasons, and because the activities that transmit HIV tend to occur outside of the clinic environment, we felt obliged to conduct our inquiry in the neighborhoods where these activities in fact took place. This avoided the bias inherent in convenience samples drawn exclusively or predominantly from institutional populations. This strategy yielded data that guided us in designing and implementing an AIDS prevention program in San Francisco for injecting drug users. This same set of data also provided us with guides for revising and improving the ongoing collection of data for both evaluative and epidemiological purposes.

One result of this work was the creation of the MidCity Consortium to Combat AIDS: a street-level, health education project that places trained "community health outreach workers" (CHOWs) into neighborhoods with high concentrations of injecting drug users. Using a variety of strategies, CHOWs penetrate social networks of injecting drug users, develop roles of health educator and advocate, and promote the use of safe needle-hygiene practices and safe-sex techniques. CHOWs distribute one ounce plastic vials of bleach labeled with needle-cleaning instructions and free condoms and AIDS information in English and Spanish, act as advocates for their clients, and make referrals to drug treatment, family planning, medical, and social service providers. The impact of this project in terms of lowered risk behavior has been encouraging to date (Chaisson et al. 1987; Watters 1987, 1988; Watters et al. 1988). Nevertheless, this project might have been delayed or might never have come to pass had we limited ourselves to the study of institutional populations of drug users in drug treatment clinics and jails.

Likewise, where comparative studies of institutional and non-institutional populations have been attempted, differences have been marked. For example, Rounsaville and Kleber (1985) compared treatment-seeking opiate addicts with an untreated community sample. Community addicts were found to differ with respect to key behavioral domains (e.g., severity of addiction, risks taken in association with drug and money acquisition, and level of social and psychological functioning). Preble and Casey (1969) found that addicts who remained out of methadone treatment programs led lives that reflected more active levels of social functioning. Similar findings were reported by Hanson et al. (1985) and Hunt et al. (1985-86). Watters and Cheng (1987) reported differences between in-treatment and not-in-treatment injecting drug users in San Francisco with respect to HIV seroprevalence. Injecting drug users who were enrolled in treatment programs had a seven percent HIV infection rate compared to a community sample with a 16 percent seroprevalence rate.

Methodology and Practice

Both qualitative and quantitative methods have been used in the study of hidden populations. Each type of method possesses different strengths and weaknesses. Qualitative methods (such as ethnography) have the potential to lay bare the social organization of hidden group activities, uncover their meanings to group members, and reveal how interactions and actors are organized within a social context. Results so obtained are enormously rich in their descriptive power and are particularly well suited to developing theory (Glaser and Strauss 1967, Strauss 1987) and guiding survey researchers in both sample construction and research question development. Qualitative data are nonetheless limited in the degree to which they enable generalizations about groups and contexts other than those studied. Since ethnography and related qualitative methods tend to rely on small samples, this limitation is not trivial. Qualitative methods also have limited evaluative utility, and quantitative research, especially the use of quasi-experimental designs, is typically required to evaluate social or educational programs (Campbell and Stanley 1963, Weiss 1972, Struening and Guttentag 1975).

Quantitative studies can be constructed to maximize the generalizability of results. Modern methods of sample size estimation can insure a high degree of external validity even in complex stratified or cluster sample designs. Survey sampling defines the sampling frame prior to data collection and adheres rigorously to predetermined quotas within it. Therefore, it is necessary to obtain sufficient numbers of respondents within sample strata to achieve a specified level of statistical power (Cohen 1977). Nevertheless, surveys frequently under-represent hidden populations since very large numbers of subjects can be required to reveal "low incidence" phenomena in populations. Moreover, any method that depends on published lists or official records (e.g., telephone directories, voter registration, addresses) as the basis for selecting probability samples has already introduced class and lifestyle biases that may seriously compromise the results of research directed at hidden populations (e.g., the homeless) or at low incidence behaviors (e.g., intravenous drug use). In order to avoid such bias in their study of Chicago's homeless populations, Rossi et al. (1987) developed a survey strategy that relied on direct enumeration of homeless persons without reliance on a "dwelling-based" sampling frame. By contrast, O'Donnell et al. (1976) encountered considerable difficulty in obtaining a sufficiently large sample of admitted intravenous drug users from a national random sample of young men in the United States. Stratified, cluster, and quota sampling techniques may help reduce some of the problems associated with measuring low incidence behaviors and related phenomena. However, to be effective, considerable a priori knowledge about the distribution of the phenomena of interest in the study population is required. Unfortunately, this knowledge is usually acquired in the course of doing the research, leaving the researcher with whatever fish have been snagged in the locations where the stratification or cluster sampling designs have led the net to be cast. This often results in unrepresentative samples or samples containing too few of the "right kind" of research subjects. The products of such efforts are seldom illuminating because they fail to penetrate the core of the object of study. Quota sampling can help further reduce some of these problems by establishing parameters for the number of targeted individuals to be included in the study. However, quota sampling is particularly sensitive to the researcher's selection of groups to be sampled and the vagaries of subject selection within quota groups (Kalton 1983).

Another major problem in sampling rare and elusive populations is that of cost. Since unpopular behaviors, such as intravenous drug use, occur with low frequency in the general population, many individuals or households must be screened before members of the population of interest are located and can be interviewed. The cost of this screening is always many times the actual cost of interviewing subjects that are members of the population of interest. These costs can be reduced by identifying geographically clustered samples (Sudman, Sirken,

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and Cowan 1988). However, in the case of intravenous drug users, many do not have telephones or addresses. Thus, even cluster methods that identify geographical areas that have relatively dense populations of intravenous drug users can fail to produce unbiased samples unless methods for gaining access to the more difficult to sample users are incorporated.

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In our studies of injecting drug users we began by initiating concurrent lines of inquiry: a serological and socio-behavioral survey of injecting drug users enrolled in 21-day drug detoxification outpatient clinics and a formal ethnography of injecting drug users in San Francisco's Tenderloin district, a neighborhood with very high concentrations of injecting drug users and the geographical intersection of the drug and sex trades. The ethnographic work in the Tenderloin suggested that the out-of-treatment populations might vary significantly in a number of key domains. However, the ethnography could not provide us with data on a broad cross-section of injecting drug users within that neighborhood. This was the basis of our decision to move our survey data collection into a street setting in the Tenderloin and recruit injecting drug users using a "modified chain referral" technique. In this technique, injecting drug users known to the ethnographic team would serve as initial links in the chain and be asked to introduce persons they knew to be injecting drug users to the study. At first we were concerned that such a strategy might not give us the minimum of 100 subjects we needed to recruit at that site. However, after we explained the purpose of the study to key opinion leaders in several networks of injecting drug users, word that anonymous HIV testing was going to take place and an \$8 stipend would be paid to the participants went on the grapevine.

When the research team arrived at the field site on the first day of data collection, a line of potential study respondents stretched down the street. We numbered our business cards sequentially and passed them out to the potential subjects to keep order and insure maximum participation. Respondents were then accepted into the study in the order of their number after verification of recent drug injection and the reading and initialing of the informed consent form. The results of this first cross-section of data collection pointed to significant differences in sexual preferences, drug use profiles, and infection rates between the in-treatment and out-of-treatment injecting drug users (cf. Watters and Cheng 1987). These differences provided additional evidence that neither traditional qualitative nor survey research methods would meet the requirements of our study of HIV infection and risk factors among injecting drug users. If we were to succeed in meeting our objectives and answering our research questions, we would have to devise alternative methodological strategies.

Targeted Sampling

To reach the hidden populations that were the focus of our study in adequate numbers, we adapted aspects of street ethnography (Weppner 1977), theoretical sampling (Glaser and Strauss 1967, Strauss 1987), stratified survey sampling (Rossi, Wright and Anderson 1983, Babbie 1973), quota sampling (Kalton 1983), and chain referral sampling (Biernacki and Waldorf 1981, Biernacki 1986). This combination of methods yielded a flexible procedure for sampling hidden populations in urban settings and provided a valuable strategy for the study of HIV infection and AIDS risk behaviors among injecting drug users. We call this research strategy "targeted sampling." It is a purposeful, systematic method by which controlled lists of specified populations within geographical districts are developed and detailed plans are designed to recruit adequate numbers of cases within each of the targets. While they are not random samples, it is particularly important to emphasize that targeted samples are not convenience samples. They entail, rather, a strategy to obtain systematic information when true random sampling is not feasible and when convenience sampling is not rigorous enough to meet the assumptions of the research design. Such was the case in our efforts to understand the specific

risk practices, AIDS knowledge, and HIV infection rates among injecting drug users in San Francisco. In the following section we discuss the key elements in this sampling process using examples from this research.

Developing Targeted Samples

Research strategies that combine multiple methodologies have been used and advocated in the social science literature. Denzin (1970) describes the application of "between or across method triangulation" as an effective way to increase the validity of social science research by comparing the results of several separate research methods applied to the same object of study. In targeted sampling, methods are integrated in the very formulation of the research question and construction of the sample in an ongoing and interactive process in which data are constantly analyzed and used to adjust the recruitment and sampling techniques. This can be distinguished from triangulation, which compares the separate results of the different studies as distinct perspectives on the object of inquiry. The following discussion describes how we developed the sample, the critical process of feeding back data and modifying the sample as we proceeded, together with selected examples of how this worked.

Initial mapping. Initial mapping began by defining districts in which to conduct the research. Geographical maps were developed on the basis of existing data and our direct observations rather than the "popular wisdom" regarding drug trends and high-risk neighborhoods. Our initial mapping in San Francisco led us to conclude that only 20-25 percent of injecting drug users in San Francisco had been in treatment during 1985, the year we began the study. Based on data obtained from the San Francisco Department of Public Health (SFDPH) and estimates of the numbers of injecting drug users in the city, we estimated that there were approximately 12,000 injecting drug users active in San Francisco (Newmeyer et al. 1989), about ten percent of whom were receiving drug treatment services on any given day. We had no reason to assume that the in-treatment population constituted a representative cross-section of injecting drug users. For example, we knew from our earlier ethnographic research that methamphetamine and its isomers were popular among a sizable minority of the city's injecting drug users (Feldman and Biernacki 1988). Our analysis of the SFDPH intake and discharge data showed us that the vast majority of drug treatment episodes (over 80%) in the city occurred in 21-day methadone detoxification programs. Federal regulations and California law require a medical diagnosis of heroin addiction to enter methadone treatment. Therefore, we could not rely on drug treatment programs to obtain a representative sample of persons whose drug use profiles were not dominated by heroin. Finally, we wanted to include injecting drug users active in the communities where our outreach efforts were to be focused in order to evaluate the impact and effectiveness of the intervention. Again, we had to look beyond the treatment system to recruit subsamples of injecting drug users who did not routinely interact with drug treatment programs.

To accomplish this we had to determine which neighborhoods contained the highest concentrations of injecting drug users and drug related activity. We directly observed various city neighborhoods for easily identifiable signs of drug transactions (e.g., observable "copping" areas where drug transactions could be witnessed); had conversations with knowledgeable informants (drug treatment program staff, police, and residential hotel desk clerks and managers about the locations of injecting drug user activity); and reviewed police arrest and emergency room admission data. A computer tape of all publicly funded drug treatment admissions and discharges for Fiscal Year 1985-86 was obtained from the SFDPH and treatment program clients were sorted into reported census tract of residence. This procedure enabled us to identify those neighborhoods with the largest populations of treatment clients. We ranked neighborhoods in terms of their potential density of injecting drug users.

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We combined the list of neighborhoods obtained from knowledgeable informants, our own direct observations of candidate neighborhoods, and the distribution of detoxification clinic clients obtained from the database. Through this cross-method triangulation we were able to construct a map of the city depicting the communities within census tracts that were the principal sites for the sale and intravenous use of drugs (specifically heroin, cocaine, and methamphetamines). These neighborhoods were then ranked in terms of the density of injecting drug users. Our initial research and intervention focused on the highest risk communities, the Tenderloin and Mission districts. As funds became available, we expanded these research and intervention activities into other high-risk communities (e.g., the predominantly black Western Addition).

Ethnographic mapping. Once study areas were identified, extensive ethnographic mapping was necessary to uncover and analyze the social organization of target groups existing within the selected district. In theory, ethnographic mapping can be performed at varying levels of intensity. The minimum level provides sufficient data to formulate research questions and to provide necessary information on identities, locations, interaction styles, and social organization of groups of potential research subjects.

For example, we did extensive ethnographic mapping in the Tenderloin district (Biernacki and Feldman 1986, Feldman and Biernacki 1988). This enabled the investigative team to better understand the characteristics and social dynamics of populations in the targeted districts. This information proved vital to the framing of research questions and the development of subsequent survey items. The ethnographic map generated by this work also provided a typology of social contexts of needle use and social networks of needle users that could be characterized in terms of the drug use profiles, social customs, argot, needle-sharing customs, sexual relationships, preferences and habits, and geographical locations of groups and members. In addition, ethnographic mapping provided a pool of potential respondents by identifying opinion leaders within social groups. By gaining the trust of such persons, introductions to others were facilitated, as in "pure" snowball sampling (cf. Biernacki and Waldorf 1981, Biernacki 1986, Polsky 1969, Feldman 1977, Hanson et al. 1985). However, in this case the initial ethnographic investigation indicated that pure snowball sampling would not be adequate since different and non-overlapping social networks of drug users existed. Thus, starting a snowball in one such network might not result in connections to others. For example, members of one drug preference profile may not routinely interact with members of other groups with different drug, sexual, and cultural preferences (see Watters et al. 1988). Black male heterosexual heroin addicts and white methamphetamine-injecting transsexuals and drag queens, despite their close geographic proximity in the Tenderloin, are social worlds apart.

Developing an initial target plan for each district. After mapping had provided sufficient information to identify major sub-groupings, targets were identified and specific plans for recruiting group members were developed. Recruiting strategies differed not only between districts, but between targets within districts. Recruitment in the Mission district illustrates the way strategies had to take account of the particular details of the neighborhood and district involved.

Both census tract data and common knowledge held that the largest Latino population in San Francisco was located in the Mission district. Latinos were of special interest to us because, like blacks, they are disproportionately represented in AIDS cases among heterosexual injecting drug users, non-IV-drug-using females, and pediatric AIDS cases (Bakeman, Lumb, and Smith 1986, Centers for Disease Control 1989, Peterson and Bakeman 1989). Further, HIV seroprevalence of black and Latino injecting drug users is significantly higher than of whites in the New York metropolitan area (Des Jarlais and Friedman 1987, Selwyn et al. 1987). Also

located in the Mission district, however, are two low-income housing projects populated predominantly by blacks. One project is situated six blocks from our Mission district field site. The large number of black injecting drug users in the Mission and the close proximity of a predominantly black housing project meant that we had to establish a quota on black male research subjects when operating at the Mission district field site. A sample drawn in another field site (the Western Addition) was consistently about 90 percent black, and we had targeted the Mission district in part to increase the number of Latinos in our study. Moreover, our Mission District field site is located in a large, multi-use facility, the San Francisco Women's Building, that provides space for numerous community oriented projects, most of which are directed toward and of special interest to women (e.g., a local office of a national women's organization, women's aerobic classes, rape crisis counseling, and a social service organization for women over forty years of age). We found that some male Latinos were reluctant to come to the Women's Building since it was perceived by them as exclusively for white women, many of whom were perceived to be lesbians. Therefore, a specific plan for recruiting Latinos had to be devised.

This plan involved hiring a Latino male familiar with the drug use patterns among several groups of younger Latinos in the Mission's barrio. His job was to enter different social networks of injecting drug users approximately two to four weeks prior to scheduled data collection. Teamed with a Latino outreach worker from the AIDS prevention program (the MidCity Consortium to Combat AIDS), potential research subjects were identified and the information about the nature of the study (dates, times, and location of the field site) was circulated among the targeted population. On data collection dates, the outreach worker drove research subjects to and from the field site, resulting in greatly improved access to Latino injecting drug users. In the first and second cross-sections taken we had relied on a more passive referral mechanism (for example, we did not transport people to the interview site). These samples were, respectively, 11 percent and 13 percent Latino. In the two subsequent cross-sections we employed the more aggressive techniques described above, yielding 21 percent and 20 percent Latino representation.

Revising the target plans. It was usually necessary to revise the target plans once in the field in order to meet social conditions and enrollment rates. Flexibility and attention to how the sample was developing were the keys to adjusting the location and composition of targets. A strategy to increase the number of women in our study illustrates how plans might profitably be revised.

Women from all ethnic groups were difficult to recruit for the study. From our ethnographic mapping, we knew this resulted from several factors. First, the street is a male-dominated setting, and there are relatively few acceptable roles open to females within the drug using sub-cultures we observed (cf. Fields 1984). Thus, recruiting based solely on street contacts and word of mouth resulted in an over-representation of males. A second source of difficulty in recruiting women was that some female injecting drug users who did actively participate in the street scene were likely to be involved in prostitution. Since participating in our study could mean much time waiting to be interviewed or to have blood drawn, it was difficult to recruit these women. This was due in part to economics. Women who work in the sex trades, like individuals with conventional jobs, can scarcely afford to miss a half day or more of work to participate in our research. In order to improve this situation we implemented a "ladies first" policy at all three field sites. This meant that female research subjects were always given precedence over male subjects in the intake process. While this strategy brought some complaints, most of our research subjects accepted the policy. In addition, research team members emphasized to potential women respondents the importance of their participating in the study and asked them to refer their friends and associates. This strategy of starting smaller "snowballs" within the target also helped increase female participation. We

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also hired a young woman who had been a respondent in previous research who was a former drug user. She knew many women drug users and helped organize groups of women whom she would then bring to the field site at an appointed time. In addition, where possible, child care was provided to respondents during interviews. These efforts substantially increased and maintained the participation of women in the project.

Interim findings shape research questions and instruments. One feature of targeted sampling that distinguishes it from other forms of inquiry is its interactive nature. Unlike surveys, the sampling frame, the research questions, and measures are not set inflexibly for the duration of the project. We have stressed the importance of modifying and adjusting the sampling frame as new information becomes available. This updating process is equally important in other areas of the research plan. When conducting research, the investigator may discover that some of the chosen research questions are irrelevant or insensitive to the population under study. Likewise, the chosen measures of social, psychological, or health phenomena also may be irrelevant, inappropriate, or insensitive. The targeted approach emphasizes scrutinizing the relevance of research questions and measures as well as sampling tactics throughout the data collection process.

For example, we wanted to assess the impact of learning positive versus negative HIV antibody test results on our research population. This was important because the psychological and behavioral sequelae of learning HIV test results in populations of injecting drug users were unknown. Some researchers and clinicians had speculated that drug users might react to HIV test results in ways that were substantially different from gay men. Some speculated that injecting drug users testing positive might respond with anger and try to infect others or that they would become so depressed that they would sink into a drug "binge" or attempt suicide. These issues continue to be of great importance in developing adequate protection of human subjects involved in AIDS related research. Further, answers to such questions have important implications for HIV testing and counseling as routine HIV screening becomes more common in drug treatment, criminal justice, and medical settings (Andrus et al. 1989, Cates and Bowen 1989, Judson 1989, Potterat et al. 1989).

In order to assess these potentials, Karen Huang, a clinical psychologist on our research team, assembled a battery of standard psychological tests to assess anxiety, depression, and hopelessness. The results failed to distinguish persons who were told they were seropositive from those told they were seronegative. Despite what the psychological tests told us, we had observed markedly different affective responses from people in these two categories during notification counselling and follow-up sessions (Huang, Watters, and Case 1988). We speculated that the psychological tests used were not appropriate measures. These tests, like many psychological instruments, had been developed and standardized on predominantly white, middle-class populations. These groups, with their distinctive family ties, focus on work and careers, daily work or homemaking routines, and future orientation, differ both qualitatively and quantitatively from our underclass population of injecting drug users. Moreover, the ability of these instruments to accurately measure psychological states was seriously compromised by drug intoxication and/or withdrawal. Thus, the basic instrumentation had to be largely abandoned and new instruments selected and alternative interpretations of responses developed.

Sources of Bias: Time, Location, and Recruitment Strategies

The characteristics of the sample will be shaped by the location and activity patterns of potential respondents and the recruitment strategies selected. Researchers using targeted sampling of course must be alert to these potential sources of bias and consider them in sampling frame adjustments and in the interpretation and analysis of the research findings.

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Time. The time of day when respondents are recruited and data collected will almost certainly bias the sample in particular directions. Failure to be aware of the "pulse" and routines of the districts under study can result in an atypical sample of people whose schedule for wakeful activities matches that of the investigator rather than the larger population under study. For example, we typically collected data at the field sites Monday through Friday between 10:00 a.m. and 5:00 p.m. This means that we only recruited research subjects whose schedules roughly matched our own. Our ethnographic work confirmed the common-sense assumption that a rich street life exists after dark. The character of the neighborhoods in which we worked changed substantially during different periods of the day. As mentioned, some female injecting drug users who work in the sex industry may sleep during the day and are thus not accessible then. In addition, our targeted sample is consistently about 85 percent unemployed, but this does not mean that only 15 percent of injecting drug users in San Francisco work. Because our sample was drawn during normal business hours, individuals who work might have found it difficult or impossible to participate. Moreover, working or more middle-class drug injectors might wish to avoid any situation (including our study) where their illicit activities might become known to others. Thus, our sample is biased in the direction of recruiting unemployed and under-class injecting drug users.

While it is in principle possible to alter the times and places when and where we collect data and to pursue more working and middle-class respondents, this cannot be accomplished at our current level of support. Likewise, the time of day bias could be controlled to a greater degree by staggering hours of operation to include evening recruitment. However, the activity on the streets of San Francisco in the sex and drug trades increases during these hours, especially on week-ends. This increased activity presents additional logistical and security problems that could not be adequately addressed within the limitations of the project described here.

Location. The locations where targeted samples are recruited also can have a profound influence on the demographics of the sample and resultant data. We discussed how Latino men hesitated to come to the "Women's Building" where our field site is, and how we had to develop a new recruitment plan for them. Locations should be carefully selected for their proximity to desired populations and should be geographically and culturally accessible to them. The researcher must also consider how multiple targets within a location will affect the developing sample and the data obtained from respondents.

There are other potential sources of location bias. For example, the Tenderloin field site is located in a large residential hotel. This hotel is one of several that has a disproportionately large number of transsexual persons as well as gay and bisexual male residents, many of whom engage in prostitution. While this location provided excellent access to injecting drug users targeted in the Tenderloin, we discovered that the HIV seroprevalence rates also were highest at this location. In addition, our data revealed that the Tenderloin sample contained the highest percentage of males who admitted same-sex anal intercourse. In 1986, there was a six percent HIV seroprevalence rate among heterosexual injecting drug users in our sample city-wide. By contrast, gay and bisexual injecting drug users in our 1986 sample had a 33 percent HIV seroprevalence rate. In another study, Winklestein et al. (1987) estimated a 49 percent HIV seroprevalence rate among gay and bisexual males in San Francisco. Thus, the overall HIV seroprevalence rate for the Tenderloin was higher than in other locations in 1986 due, in part, to the sexual demographics of the community and the particular site chosen to conduct field operations.

Recruitment strategies. At the heart of targeted sampling lie the various methods used to recruit respondents. The creative application of deliberate recruitment activity is one of the more obvious distinctions between targeted samples and the asystematic recruitment of re-

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search subjects in convenience samples on the one hand and the more rigid cluster and stratified samples on the other. Unlike convenience samples, research subjects are selected for specific attributes that preliminary research has defined as targets for study. This means, however, that response rates are impossible to calculate since one can never know and, therefore, enumerate the total number of qualified respondents who became aware of the study by word of mouth. In our study, the majority of respondents were not referred directly by research staff.

In targeted sampling, the sampling frame is not predefined as in probability sampling. Nor is the sampling frame defined simply by the characteristics of the volunteer respondents that comprise convenience samples in institutional settings. The direction of recruitment, its intensity, and location are defined as the research unfolds. In each of our field sites, as described, we developed plans that, while similar in some ways, reflected the particular qualities of each site and our need to develop adequate numbers of particular groups of respondents. This differs substantially from traditional research based on convenience samples in drug clinics. In these studies, only individuals who are motivated or coerced to enter treatment can be studied. This recruitment strategy infuses its own bias, since these respondents may not represent the vast majority of injecting drug users in society. For example, the National Institute on Drug Abuse states that only one in ten injecting drug users is in treatment in the United States. Since those individuals in treatment may differ in terms of important behavioral and motivational characteristics, research portfolios that depend heavily on such non-targeted convenience samples may not generalize to the vast majority of injecting drug users.

Our decision to pay respondents for their participation is another example of how a recruitment strategy can introduce bias in samples and research. In our study, an initial payment of \$8.00 was made for the interview and phlebotomy procedure. Because of the small size of our staff, recruiting was intensive during scheduled times. This meant that up to 150 research subjects were recruited at a field site within a five-day period. At some field sites, a queue of individuals waiting to enroll began to form before 8:00 a.m. although active screening did not begin until 10:00 a.m. Depending on the site logistics and available staff, a maximum of 40 "tickets" for admission to the study (each with a sequential number and an approximate time to be seen) were given to qualified research subjects. Approximate appointment times were spread over the entire working day through 4:30 p.m. Persons who were qualified, but who were queued behind the 40th person, were told they could return to be interviewed and tested the next day. They also were told that if they missed an appointment and had a ticket, or if there was time at the end of the day, an attempt would be made to admit them.

This always resulted in a small group of individuals who milled about outside the field site all day, regardless of the weather, in the hope of obtaining the \$8.00 respondent stipend. Even for those who received numbered tickets, the process required considerable purposeful effort and time. It is safe to assume that for most of our research subjects, \$8.00 is a significant amount of money, worth at least one full day's time. Persons for whom \$8.00 was a marginal or paltry amount would not tolerate the rigors of the intake process unless motivated by a powerful desire to receive a free and anonymous HIV test (and such persons do in fact appear at our field sites). Nevertheless, the decision to pay subjects a token amount for participation had a profound and definite effect on the characteristics of the sample developed. Thus, our sample is dominated by underclass individuals and is not representative of middle-class injecting drug users, a group that would require different recruiting strategies to successfully target.

Discussion

Targeted sampling provides a potentially powerful mechanism for researching hidden

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populations. It has broad application to the study of numerous complex public health and social problems and the impact these problems have on individuals, groups, and society. We do not, however, advocate the naive or uncritical application of targeted sampling. While highly flexible, targeting samples can reduce the analytic freedom available to the researcher. For example, survey researchers may find that they have violated the assumptions that must be met in order to use many statistical procedures. This limitation needs to be weighed carefully before the procedures for selection of a sampling frame are finalized.

Targeted sampling is not a substitute for formal ethnography or for standard surveys. It draws from both survey and qualitative research methods. Nearly all studies of hidden populations are carried out in circumstances that do not permit true random sampling. Under these conditions, and if properly conducted and tied to what is known or can be learned about population parameters, targeted sampling provides a more powerful sampling mechanism than convenience sampling and a more feasible approach than random sampling. Where population parameters are unknown, the dynamic character of targeted sampling can help establish estimates if successive samples can be drawn, with each new sample building on what was learned from those taken previously. Both its weaknesses and its strengths lie in its flexibility. This flexible approach provides a systematic means for addressing some of the more vexing research problems associated with sampling hidden populations. Rigid adherence to conventional procedures simply cannot serve researchers engaged in the study of such populations. However, through an interactive process of adjusting research targets, recruitment methods, and research questions and instruments, inquiry can be focused on the most appropriate subjects for study.

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