



Research paper

Activity spaces among injection drug users in San Francisco

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ABSTRACT

Background: Representations of activity spaces, defined as the local areas within which people move or travel in the course of their daily activities, are unexplored among injection drug users (IDUs). The purpose of this paper is to use an activity space framework to study place and drug user health.

Methods: Data for this analysis is from an epidemiological study of street-recruited IDUs in San Francisco ($N = 1084$). Study participants reported geographic intersections of where they most often slept at night, hung out during the day, and used drugs during a 6 month time period. We used GIS software to construct and map activity space routes of street-based network paths between these intersections. We further identified if syringe exchange program (SEP) locations intersected with, participant activity space routes. We used logistic regression to estimate associations between activity space variables and HIV serostatus, syringe sharing, and non-fatal overdose, after adjusting for individual and Census tract covariates.

Results: Mean activity space distance for all participants was 1.5 miles. 9.6% of participants had a SEP located along their activity space. An increase in activity space distance was associated with a decrease in odds of being HIV positive. An increase in residential transience, or the number of different locations slept in by participants in a 6 month time period, was associated with higher odds of syringe sharing. Activity space distance was not independently associated with overdose or syringe sharing.

Discussion: Research that locates individuals in places of perceived importance is needed to inform placement and accessibility of HIV and overdose prevention programs. More attention needs to be given to the logistics of collecting sensitive geospatial data from vulnerable populations as well as how to maximize the use of GIS software for visualizing and understanding how IDUs interact with their environment.

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Background

Activity spaces refer to the local areas within which individuals habitually move about in the course of their daily activities (Sherman, Spencer, Preisser, Gesler, & Arcury, 2005). Previously described as an experience of place, activity spaces have been extensively theorized and studied across multiple disciplines and traditions, with a particular focus on the utility for understanding healthcare accessibility across a diversity of populations (Fryer et al., 1999; Graves, 2008; Guagliardo, 2004; Nemet & Bailey, 2000; Newsome, Walcott, & Smith, 1998; Parker & Campbell, 1998; Townley, Kloos, & Wright, 2009). Though place is an expanding area of interest in the intersecting fields of substance use, harm reduction and HIV/AIDS research, approaches to studying its influence on health outcomes often rely on static measures of individual residence. (Kwan, 2013) The spatial accessibility of health services,

such as syringe exchange programs, is one promising area in which activity space research could impact health outcomes of mobile populations at high risk for injection-related morbidity and mortality.

Research in the field of primary medical care and cancer screening has shown that if a health care service is located within an individual activity space, utilization will increase (Dulin et al., 2010; Elkin et al., 2010; Engelman et al., 2002; Fryer et al., 1999; Kwan, 2013; Lian, Struthers, & Schootman, 2012; Mei-Po Kwan & Weber, 2003; Smith et al., 2013). Activity space methods have not been used to examine accessibility of prevention programs among street-based injection drug users (IDUs), a mobile population at high risk for HIV infection and overdose (Brouwer, Rusch, et al., 2012; Cooper, Bossak, Tempalski, Des Jarlais, & Friedman, 2009; DiMaggio, Bucciarelli, Tardiff, Vlahov, & Galea, 2008; Green et al., 2009; Stopka et al., 2012). Geospatial analyses of HIV and overdose have the potential to inform drug-related policy and prevention programs, such as where to place new syringe exchange programs, HIV testing sites, or drug treatment programs (DiMaggio et al., 2008; El-Bassel et al., 2011; Goldenberg, Strathdee, Perez-Rosales, & Sued, 2012; Richardson et al., 2013; Taylor et al., 2011). A previous study of all heroin-related overdoses in San Francisco from 1997 to

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2000 showed geographic clustering in one small central area of the city. (Davidson et al., 2003) These findings contributed to the development of government funded overdose response training targeted at heroin users. Among IDUs, migration and mobility have been linked to high risk injecting behaviors in Vancouver (Rachlis, Wood, Li, Hogg, & Kerr, 2008), San Francisco (Hahn, Page-Shafer, Ford, Paciorek, & Lum, 2008; Montgomery et al., 2012), and New York City (Deren et al., 2003). Researchers in Vancouver found that sex workers who moved their working areas away from main streets as the result of local policing efforts were more likely to be pressured into unprotected sexual intercourse (Shannon et al., 2008). In Tijuana, mobile IDUs, or those who injected drugs more than 3 kilometers from their residence, lived in neighborhoods with less drug activity and were more likely to share needles and get arrested for carrying syringes (Brouwer, Lozada, et al., 2012; Brouwer, Rusch, et al., 2012).

We use activity spaces as an analytical framework to study intra-urban mobility among street-based IDUs in San Francisco and expand the conceptual focus of place from static residential spaces to habitually visited locations in people's everyday lives. Geographic information systems (GIS) software allows us to map individual level geographic data that includes habitually visited locations where study participants sleep, use drugs, and hang out during the day. Although there are multiple approaches to measuring activity spaces, which include the use of two dimensional ellipses, kernel densities and shortest paths networks, the calculation of distance traveled between locations of regularly visited geographic locations, such as where one sleeps, works, and socializes with family and friends, is central among all of them (Morency, Paez, Roorda, Mercado, & Farber, 2011; Paez, Mercado, Farber, Morency, & Roorda, 2010; Wong & Shaw, 2011).

To examine accessibility of syringe exchange programs (SEPs) using an activity space framework, we use street-based networks to identify the shortest path routes between participant locations. We further examine the associations between distances of activity space routes and health-related outcomes, including HIV serostatus, syringe sharing, and overdose.

Methods

Data collection procedures

The Urban Health Study (UHS) was a study of street-recruited IDUs in the San Francisco Bay Area (Kral et al., 2001). In this analysis, we used self-report data from a cross-section of IDUs interviewed in San Francisco between 2004 and 2005 ($N = 1084$). Recruiting and sampling procedures were based on targeted sampling procedures developed at UHS (Bluthenthal & Watters, 1995) and utilized in many National Institute on Drug Abuse (NIDA) funded studies of IDUs, including the 25-city NIDA Cooperative Agreement in the 1990s (Kral, Bluthenthal, Booth, & Watters, 1998). To summarize briefly, targeted sampling consists of mapping of county and city indicators to identify those areas with an increased prevalence of drug use, which is followed by ethnographic mapping of promising Census tracts, neighborhoods, or other geopolitical centers. Reliable and up-to-date information about IDUs in a community are obtained through ongoing observations and social contact with individuals knowledgeable about IDU social networks, "copping spots", shooting galleries, and other locales frequented by IDUs. Recruitment is conducted by outreach workers who are familiar with the communities.

Eligibility criteria for the study include being aged 18 years or older and drug injection within the past 30 days, as verified by self-report and physical examination for visible signs of recent venipuncture or dermapuncture consistent with drug injection (e.g.

"track marks"). The questionnaires were administered by trained and experienced interviewers, who used computer-assisted data collection on laptop computers in the field with Questionnaire Development System (QDS™) software (NOVA Research Company, Inc., Bethesda, MD).

Individual-level measures

Dependent variables. We examine three health-related outcomes: (1) HIV serostatus, (2) syringe sharing, and (3) non-fatal overdose in the past 12 months. Syringe sharing is a standard behavioral measure of HIV risk among IDUs and has been used extensively in socio-epidemiological studies (Kral et al., 2003; Kral, Bluthenthal, Erringer, Lorvick, & Edlin, 1999) Participants were asked to report the number of times they engaged in either distributive or receptive sharing in the past six months. These variables were recoded to a '1' if at least one occurrence of either distributive or receptive syringe sharing occurred in the time period and a '0' if IDUs reported zero occurrences of sharing syringes. Fatal and nonfatal overdose has been previously studied as a major cause of morbidity and mortality among injection drug users (Seal et al., 2001). We defined recent nonfatal overdose as a self-reported overdose that occurred in the past 12 months prior to being interviewed.

Independent variables. Individual-level covariates included categorical measures of gender (male and female), age (under 30 vs. older age), race/ethnicity (white, African American, Latino, other), sources of income (government assistance or illegal means) in the past 30 days, years of injection drug use, and homeless status. Homeless status was ascertained by asking if a participant reported being homeless at the time of interview. Six month dichotomous measures of arrest history, injection and non-injection drug use (heroin, methamphetamine, and crack smoking), trading sex for cash or drugs, and frequency of syringe exchange program use were also ascertained. Residential transience was measured by asking "In the last 6 months, how many other locations have you slept?" For statistical analysis, we added one to the number of additional locations reported in a 6 month time period and divided this total by 180, or the number of nights in a 6 month period.

Activity space variables

To document locations where participants sleep, hang out, and use drugs, the study questionnaire included the following three questions: (1) "In the last 6 months, what is the intersection nearest to where you most often hang out during the day" (2) "In the last 6 months, what is the intersection nearest to where you most often sleep at night?," and (3) "In the last 6 months, what is the intersection nearest to where you most often use drugs?." All reported street intersections were geocoded as points using the San Francisco street network. All geospatial analyses were performed using ArcGIS software (ESRI, Redlands). Locations where participants usually sleep were also geocoded to the level of the Census tract. We had 90% accuracy in successfully mapping and geocoding reported intersections.

Activity space routes

To calculate routes between each of the three locations reported by a participant, we used the New Route tool in the Network Analyst extension. Fig. 1 depicts the methodological steps involved in creating the routes. Circles labeled '1' represent geocoded locations where participants usually sleep at night. Circles labeled '2' represent geocoded locations where participants usually hang out during the day. Circles labeled '3' represent geocoded locations where participants usually use drugs. ArcGIS drew a route to connect each of the three locations. The route begins at the location where participants usually sleep and ends at the location where participants

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