

TECHNICAL PAPERS ON HEALTH AND BEHAVIOR MEASUREMENT

TECHNICAL PAPER 62

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Reference Citation

Braine N, Des Jarlais DC, Ahmad S, Purchase D, Turner CF. (2004) Long-term effects of syringe exchange on risk behavior and HIV prevention. *AIDS Education and Prevention*, 16: 264-275.

LONG-TERM EFFECTS OF SYRINGE EXCHANGE ON RISK BEHAVIOR AND HIV PREVENTION

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The purpose of this study was to assess stability of population-level injection risk behavior over time among participants in a syringe exchange program and compare factors affecting syringe sharing at two points in time. Participants of the Tacoma Syringe Exchange Program were interviewed in 1997 and 2001 using audio computer assisted self-interviewing technology. In each wave of data collection, a random cross section of participants was recruited and interviewed, with no attempt made to follow respondents over time. Rates of injection risk behavior remained stable across the 4-year period, despite increases in factors associated with syringe sharing. Homelessness, rates of depression symptoms, and injection of amphetamines all increased from 1997 to 2001. The central factors associated with syringe sharing in both 1997 and 2001 were depression symptoms and the interaction of younger age with amphetamine injection. The data indicate that the exchange has been able to stabilize risk among a high-risk population for a substantial period of time. This study confirms previous findings that SEPs can play a significant role in the prevention of HIV in marginal and impoverished communities in the United States.

Injection drug users (IDUs) continue to be at risk for HIV infection although many have adopted safer sexual and drug use behaviors during the past decade (Des Jarlais, Dehnej, & Casabonda, 2001; Neumann et al., 2002). In the United States IDUs account for nearly one third of the cases of AIDS, either directly or indirectly (Vlahov & Junge, 1998). In the absence of a cure, controlling the HIV epidemic requires reducing risk behavior, particularly within high risk populations, and then maintaining these reductions over the long term. Evaluation of the effectiveness of an intervention model requires first documenting reductions in risk, then examining whether these changes are sustained over time and what factors are associated with persistent risk behavior among intervention participants. Identifying factors associated with persistent risk behavior among persons already participating in a risk reduction intervention will

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further our understanding of HIV risk and enable development of additional interventions.

HIV prevention programs need to be evaluated over time at both the individual level and the population at risk level. Evaluation over time at the individual level can show whether the risk reduction effects of the program decrease over time. It is possible, however, for the individual-level risk reduction to be maintained over time while the population-level risk reduction changes dramatically. New persons entering the population receiving program services may include many who are intrinsically at higher levels of risk behavior or who are less responsive to the services of the program. Population-level evaluation over time can provide insight into how programs do (or do not) adapt to changes in the populations they serve or in their larger environments. Failure to evaluate HIV prevention programs over time at the population level can lead to unexpected resurgence of high-risk behavior.

The use of syringe exchange programs (SEPs) has led to substantial reductions in injection related HIV risk behavior. Multiple studies have found substantial decreases in injection risk behavior associated with use of syringe exchange programs (Bluthenthal, Kral, Gee, Erringer & Edlin, 2000; Des Jarlais et al., 1996; Gibson et al., 2002; Hagan & Thiede, 2000; Heimer, Khoshnood, Bigg, Guydish, & Junge, 1998; Longshore, Bluthenthal & Stein, 2001; Monterroso et al., 2000; Paone, Des Jarlais, Gangloff, Milliken, & Friedman, 1995; Vlahov & Junge, 1998). Although it is clear that individual participation in SEP leads to initial reductions in risk behavior, it is less clear whether these changes have been sustained over time at either the level of individual behavior or the rates of risk in the intervention population overall. In the United States, studies that have examined changes in risk behavior over time have not recruited at SEPs (e.g., Beardsley et al., 1999; Maslow, Friedman, Perlis, Rockwell, & Des Jarlais, 2002) or have focused on specific subpopulations of injectors (e.g., Bluthenthal et al., 2001). In terms of controlling an epidemic, the question of sustaining reduced rates of risk in the population is more important than sustaining changes in individual behavior over time.

Although risky injection practices have decreased overall, certain groups of IDUs continue to report elevated rates of syringe sharing. IDUs under 30 years old were more likely to report sharing syringes in the past month than older IDUs (Kral, Lorvick, & Edlin, 2000). Among IDUs under 30, females were more likely to share syringes than males (Evans et al., 2003; Montgomery et al. 2002). High levels of depression symptoms were also associated with increased risk of syringe sharing (Johnson, Yep, Brems, Theno, & Fisher, 2002; Mandell, Kim, Latkin, & Shuh, 1999; Perdue, Hagan, Thiede, & Valleroy, 2003). A study of SEP participants in New York City found that respondents who injected cocaine daily were more likely to share syringes (Paone et al. 1997).

Certain populations of IDUs have persistently high levels of HIV infection, in some cases reflecting multiple sources of risk. Although HIV prevalence and risk behaviors have been reduced among all racial/ethnic group of drug injectors, Black and Hispanic injectors continue to show higher levels of HIV infection than White injectors (Friedman et al., 1999). Men who have sex with men and who are also IDUs (MSM-IDUs) continue to show high HIV seroprevalence, reflecting a combination of sexual and injection risks (Bluthenthal et al., 2001; Maslow et al., 2002; Shafer et al., 2002). MSM-IDUs show similar rates of injection risk behavior as other IDUs, although their HIV seroprevalence rates are higher due to the addition of significant sexual risk. Among MSM, including MSM-IDUs, there is evidence of a resurgence of

unsafe sexual behavior starting in the late 1990s, following a sustained decline in unsafe sex in the 1980s and early 1990s (Bluthenthal et al., 2001; Ekstrand, Stall, Paul, Osmond, & Coates, 1999; Huebner & Gerend, 2001; Stall, Hays, Waldo, Ekstrand, & McFarland, 2000; Stolte, Dukers, de Wit, Fennema, & Coutinho, 2000). The advent of highly active antiretroviral treatment (HAART) has been identified as one factor contributing to this resurgence of sexual risk, as some MSM come to view HIV as a manageable condition (Huebner & Gerend, 2001). There are indications that drug injectors who perceive HIV as a manageable condition may also be more likely to engage in risky sex and drug injection behaviors (Tun, Celentano, Vlahov, & Strathdee, 2003).

This article examines interview data collected from participants at the Tacoma Syringe Exchange Program at two points in time, 1997 and 2001. Cross-sectional data from two waves of interviews, 4 years apart, enables us to address both the sustainability of population level behavior change, and stability in factors affecting persistent risk among SEP participants. In addition, it is possible to look at how changes in the larger social environment have affected SEP participants, and identify any changes in participant characteristics over time.

The Tacoma Syringe Exchange started operating in Tacoma, Washington, in 1988. Program participants reported significant reductions in injection risk behavior after starting to use syringe exchange, compared with the 30 days prior to first contact with the program (Hagan, Des Jarlais, Purchase, Reid, & Friedman, 1991). A 1995 study found that use of the exchange led to significant reductions in hepatitis B and hepatitis C in the county, and may have also prevented a substantial proportion of HIV infections in injection drug users (Hagan, Des Jarlais, Friedman, Purchase, & Alter, 1995). A comparative study of five cities found that in low seroprevalence areas, including Tacoma, it appears possible to limit transmission of HIV among IDUs, despite continuing risk behavior among a substantial proportion of the population (Des Jarlais et al., 1995).

From 1997 to 2001, there were several changes in the larger public health and policy environment that potentially affect needle exchange programs. Welfare reform legislation was passed in 1996 and implemented during the period from 1997 to 2001. Significant elements of the legislation were implemented gradually, which may have resulted in a greater impact on the 2001 cohort than the 1997 cohort. For example, states were required to have 25% of families engaged in work activities in 1997, rising to 50% by 2002; minimum work participation for single parents increased from 20 hours per week in 1997 to 30 hours per week by 2000. A study of clients at a food pantry found a higher proportion of individuals with neither benefits nor work in 1999 than in 1997, and an increase in punitive sanctions for noncompliance with welfare rules (Oggins & Fleming, 2001). The new work requirements and tightened eligibility standards affect impoverished drug users as other low-income populations. In addition, the legislation includes drug testing and mandatory treatment provisions that have the potential to affect access to welfare for drug users. In addition, there were significant changes in the treatment of HIV/AIDS, as protease inhibitors and combination therapy became widely available between 1997 and 2000. The availability of these new, more effective HIV/AIDS treatments has been identified as a factor in the resurgence of sexual risk among gay men during the late 1990s (Huebner & Gerend, 2001; Stolte et al., 2000). These environmental circumstances are outside the control of public health programs but may affect risk behavior through increasing

circumstances associated with high risk practices and/or decreasing perceptions of threat.

Data from this study show that there were substantial increases in multiple factors often associated with HIV risk but no increases in syringe sharing. Depression, crack smoking, and injection of amphetamines increased significantly. Homelessness and unstable housing also increased. In spite of this, injection risk behavior among participants at the Tacoma Syringe Exchange Program remained stable across the 4-year period. In addition, the primary factors affecting syringe sharing were similar over time. Our data indicates that HIV risk behavior has remained stable among a high risk population of SEP participants for a substantial period of time, and identifies factors associated with persistent risk behavior.

METHODS

Data were collected at the Tacoma Syringe Exchange Program at two points in time, using the same methodology. Interviews with program participants were conducted first in 1997 and then again in 2000 to 2001. The questionnaire covered sociodemographic characteristics, drug use, sexual behaviors, and HIV risk behavior for 30 days prior to the interview. The program director was interviewed in each time period to document basic organizational structure and function, including number of syringes distributed and range of services offered. In addition, oral fluid samples were collected for HIV testing in 2001.

Research participants were randomly selected from among SEP participants exchanging syringes on any given day. The only inclusion criterion was active participation in the exchange, and respondents were recruited after conducting an exchange. There were no identified variations in recruitment seasonally or across SEP sites. Interviewers used a table of random numbers between 1 and 5 to select subjects from among individuals waiting to exchange syringes. For example, if the first number selected from the table was 3, then the third person in line was selected for possible recruitment. If the random selection procedure selected someone who had already participated in the study, we allowed that person to participate again. This analysis excludes repeat interviews, however, utilizing only the first interview from each respondent within each wave of data collection. A unique code number was generated for each person, using a formula that enabled identification of repeat participants and linkage of multiple interviews with the same respondent within each wave of data collection. No attempt was made to link respondents across waves of data collection. Use of the random number tables prevented selection bias by either potential participants or interviewers.

Reasons for refusal were documented in both years of data collection, and the majority involved scheduling constraints. In 2001 only 15% of documented refusals (approximately 4% of all persons approached) stated that they did not want to participate in the study, and all other refusal reasons were situational (e.g., "I have a doctor appointment"). Given the recruitment methodology, a person who refused at one point in time might be approached again and complete the survey at a later date.

All interviews used in this analysis were conducted using audio computer assisted self-interviewing technology. This interviewing method has been demonstrated to increase reporting of stigmatized and/or sensitive behaviors, including reports of HIV risk behavior among IDUs (Des Jarlais et al., 1999). Oral fluid samples were collected using a new collection device under development at Epitope, Inc. Replicate ELISA tests were performed on each sample, with confirmation of positives with Western

TABLE 1. Sociodemographic Characteristics of SEP Participants

	1997 N = 197 (%)	2001 N = 326(%)
Gender		
Males	141 (72)	230 (71)
Females	56 (28)	96 (29)
Race		
White	124 (63)	218 (67)
African American	38 (19)	51 (16)
Latino/a	10 (5)	18 (6)
Asian, Pacific Island, Native	23 (12)	29 (9)
Other	2 (1)	10 (3)
Average age	39	40
Marital status		
Married	28 (14)	47 (14)
Widowed	9 (5)	10 (3)
Divorced or separated	66 (34)	124 (38)
Living with a partner	28 (14)	28 (9)
Never married and single	64 (32)	117 (36)

None significant $p < .05$.

blot assays. As this collection device is not yet FDA licensed, these results were used for research purposes only. Participants were referred to free voluntary HIV counseling and testing conducted at the programs if they wished to know their HIV status.

Changes in risk behaviors from 1997 to 2001 were assessed using chi-square tests for differences in proportions. Logistic regression was used to identify factors associated with injection risk behavior at the two time periods. Multivariate logistic regression with backward elimination was then used to identify factors most strongly associated with risk behavior in each time period. Factors that were significant at $p < .05$ in the initial regression were included in the multivariate equations for each year. In addition, two interaction terms were also tested in the multivariate equations for both points in time, Amphetamine Injection \times Depression and Amphetamine Injection \times Age (35 and younger). The Amphetamine Injection \times Depression interaction was tested as amphetamine use can have a strong affect on depression. Initial cross tabs indicated a potential interaction around age, stimulant use, and injection risk, so an interaction term was developed and tested. In both cases, the main effects were also included in the equation with the interaction term. In the case of Amphetamine Injection \times Age the interaction term was significant but the main effects were not. Depression was assessed using two questions based on criteria from the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders*, assessing frequency of feeling sad/depressed or loss of interest in normal activities over the preceding 30 days. The items are highly correlated (Spearman's coefficient = .748, $p < .01$). Responses were coded into a binary variable of "any depression symptoms" or "no depression symptoms." As unstable housing is very widespread among respondents, we use a narrow definition of "homeless" in our data analysis, limited to those respondents who report living on the street. SPSS (Version 10) was used for data analysis.

RESULTS

There was a substantial increase in the volume of syringes exchanged during the period of the study. Participants exchanged 987,000 syringes in 1997 and 1.44 million in 2001. The program does not enroll participants or record individual exchange

TABLE 2. Socioeconomic Factors, 1997 and 2001

	1997 N = 197 (%)	2001 N = 326 (%)
Education		
Less than 12 years	71 (36)	119 (37)
High school grad/GED	58 (29)	100 (31)
Some post-H.S.	44 (22)	79 (24)
College grad	23 (12)	23 (7)
Any graduate school	1 (1)	4 (1)
Where lived most, last 6 months**		
Own apartment	90 (46)	99 (31)
Other's apartment	51 (26)	86 (27)
Shelter or hotel	17 (9)	35 (11)
Street	21 (11)	82 (25)
Jail	11 (6)	9 (3)
Other	7 (4)	14 (4)
Ever homeless, last 6 months**	94 (49)	232 (71)
Employed, last 6 months	115 (58)	197 (60)
Received government benefits, last 6 months*	98 (50)	129 (40)

p* < .05. *p* < .01.

transactions, so it is not possible to determine exactly how many people were using the exchange in each year. In 1997 86% of respondents reported that they first used the exchange in 1996 or earlier, and in 2001 92% of respondents reported first use of the exchange before 2000. The program director attributes the growth in number of syringes distributed to a combination of a larger volume of exchange by program participants and some increase in the number of people utilizing the program. There were no changes in exchange site locations, exchange policies or outreach strategies during the study period from 1997 to 2001.

Demographic and social characteristics of respondents are summarized in Tables 1 and 2. There are no changes from 1997 to 2001 in such basic demographic characteristics as gender, race, age, or education. The proportion of respondents who report receiving government benefits has declined significantly, but there is no change in rates of employment.

There were significant changes in housing and homelessness from 1997 to 2001 (see Table 2). Housing was assessed in two ways. Respondents were first asked if they had lived in a variety of situations at any point in the previous 6 months. A separate question then asked where they had lived “most of the time” during the last 6 months, offering the same list of possibilities. The proportion of respondents who reported living on the street most of the time increased, with a similar decrease in the proportion reporting their own apartment. A majority of respondents in 2001 reported being homeless at some point during the last 6 months, in contrast to 1997.

Mental health and drug use show both stability and change during the period of the study (Table 3). Overall injection frequency and frequency of heroin injection have not changed significantly. Use of drug treatment services, currently or in the past, is also stable. There have been significant increases in stimulant use, and some shift in the specific drugs used; in 2001, respondents reported lower rates of cocaine injection, but higher rates of amphetamine injection and crack smoking. There has also been some increase in rates of depression symptoms.

TABLE 3. Mental Health, Drug Use and Injection Risk Behavior, 1997 and 2001

	1997 N = 197 (%)	2001 N = 326 (%)
Any anxiety symptoms, last 30 days	152 (77)	263 (81)
Any depression symptoms, last 30 days*	127 (65)	242 (75)
Frequency injected, last 30 days		
Never	9 (5)	10 (3)
Once a week or less	21 (11)	27 (8)
2-6 times per week	35 (18)	36 (11)
Once a Day	25 (13)	39 (12)
2 or more times per day	107 (54)	212 (65)
Inject heroin, last 30 days		
Never	19 (10)	39 (12)
Once a week or less	26 (13)	51 (16)
2-6 times per week	26 (13)	40 (12)
Once a day	26 (13)	39 (12)
2 or more times per day	100 (51)	156 (48)
Injected cocaine, last 30 days**	103 (52)	125 (38)
Injected speed, last 30 days**	49 (25)	117 (36)
Smoked crack, last 30 days**	90 (46)	221 (68)
Drug treatment		
Ever	148 (75)	234 (72)
Currently	15 (8)	21 (6)
Backload with used syringe	35 (18)	73 (22)
Gave a used syringe	45 (23)	97 (30)
Injected with a used syringe	46 (23)	89 (27)

* $p < .05$. ** $p < .01$.

Table 3 also shows rates of injection risk behavior by year. Three types of risk behavior are included in this analysis: using a syringe to divide a drug solution by squirting part of the solution into the barrel of a second syringe (backloading), giving someone a used syringe (distributive sharing), and injecting with a syringe already used by someone else (receptive sharing). All three forms of risk behavior are basically stable across this 4-year period. The slight increase in distributive sharing is not statistically significant. Analysis of factors affecting injection risk in both 1997 and 2001 will focus on receptive sharing, the behavior that places respondents most directly at risk.

Factors affecting receptive sharing at each point in time were first examined in bi-variate analysis, and the results summarized in Table 4. The experience of depression symptoms during the last 30 days is an important factor affecting receptive syringe sharing in both time periods. Other relevant factors vary by year of data collection. Injection of speed and/or cocaine were significant factors in 2001 but fall just below the significance threshold in 1997. Women were more likely to report sharing syringes in 1997 but not in 2001. In 2001 respondents who are 35 and under, have housing problems, or experience anxiety symptoms are more likely to report sharing syringes. In preliminary examination of the data, higher rates of injection risk were noticed among the younger amphetamine injectors. Statistically significant factors were then included in multivariate logistic regression equations, using backward elimination, done separately for each time period.

TABLE 4. Analysis of Factors Affecting Receptive Sharing, Last 30 Days

	1997 OR (95% CI)	2001 OR (95% CI)
Female	1.9 (0.95, 3.83)	1.1 (0.67, 1.93)
White	1.5 (0.72, 2.97)	0.8 (0.50, 1.40)
35 years old or younger	0.8 (0.38, 1.69)	1.9 (1.13, 3.20)
Married	1.2 (0.50, 2.99)	1.3 (0.66, 2.53)
Did Not have own apartment	1.0 (0.51, 1.97)	1.7 (1.03, 2.78)
Homeless	1.2 (0.60, 2.25)	1.7 (0.95, 3.03)
Employed	0.9 (0.46, 1.76)	1.1 (0.65, 1.78)
Did not receive government benefits	1.2 (0.63, 2.40)	1.1 (0.65, 1.78)
Less than high school diploma/GED	1.1 (0.53, 2.08)	1.6 (0.99, 2.68)
Inject daily	0.9 (0.44, 1.80)	1.1 (0.63, 2.05)
Inject heroin daily	0.8 (0.42, 1.66)	1.1 (0.63, 1.72)
Injected cocaine	1.0 (0.51, 1.92)	1.8 (1.07, 2.89)
Injected speed	1.9 (0.91, 3.85)	2.7 (1.60, 4.38)
Smoked crack	1.8 (0.90, 3.44)	1.5 (0.88, 2.61)
Currently in Drug Treatment	1.2 (0.36, 4.00)	0.6 (0.19, 1.86)
Anxiety symptoms	1.5 (0.66, 3.59)	1.9 (0.96, 3.94)
Depression symptoms	2.4 (1.09, 5.14)	2.1 (1.13, 4.06)

The primary factors affecting receptive sharing are comparable across time periods, as can be seen in Table 5. Depression and the interaction of amphetamines and age are the central factors affecting risk behavior. In 1997 gender is also a significant factor, with women reporting higher rates of receptive syringe sharing. All other variables that were significant in univariate analysis dropped out during backward elimination. The highest rates of receptive sharing, during both waves of data collection, are among younger (35 and under) amphetamine injectors (1997, 41%; 2001, 58%). In contrast, amphetamine injectors over 35 report levels of receptive sharing that are elevated, but much closer to the norm for the population as a whole (1997, 28%; 2001, 30%).

HIV seroprevalence data was collected in 2001, using saliva samples. HIV prevalence was 12/315 (3.8 %, exact binominal 95% CI = 2.1- 6.4%). We also examined HIV prevalence among new injectors, participants who had been injecting for 5 years or less, as an indicator of HIV incidence. None of the 12 new injectors among the Tacoma respondents were HIV seropositive.

DISCUSSION

The data indicate that injection risk behavior among participants at the Tacoma Syringe Exchange Program has remained stable at the population level over a 4-year period. The nonsignificant increase in distributive sharing (passing along used syringes) may indicate a need for further investigation and monitoring in the future. Recent studies of MSMs indicate that the availability of new HIV treatments have contributed to a resurgence of risk during this same time period, from 1997 to 2001, as some MSMs begin to view HIV as a manageable condition and know few (if any) people with AIDS (Huebner & Gerend, 2001; Stolte et al., 2000). A study of IDUs in Baltimore also found a relationship between risk behavior and perceptions of HIV as manageable (Tun et al., 2003). There are no indications of a similar process happening

TABLE 5. Factors Affecting Receptive Syringe Sharing (Multivariate with Backward Elimination)

	1997 OR (95% CI)	2001 OR (95% CI)
Any depression symptoms	2.2 (1.02, 4.94)	2.1 (1.12, 4.14)
Amphetamine Injection × Age (35 and younger)	4.9 (1.22, 19.47)	4.7 (2.38, 9.19)
Female	2.1 (1.01, 4.35)	N/A

among Tacoma SEP participants, even though low HIV seroprevalence suggests that injectors in Tacoma may have little direct contact with the disease.

The 2001 HIV prevalence of 3.8% is consistent with previous studies conducted in Tacoma. HIV prevalence never exceeded 5% among Tacoma IDUs, with a consistently low incidence rate (Des Jarlais et al., 1995). This trend continues in 2001, with no HIV infection found among new IDUs injecting for 5 years or less. The elevated rates of injection risk behavior found in younger amphetamine injectors, especially in 2001, do not appear to have resulted in new HIV infections. However, there was a hepatitis B outbreak in April 2000 (Purchase et al., 2001), providing a reminder that persistent injection risk behavior facilitates transmission of viruses other than HIV.

The primary factors affecting injection risk behavior have not substantially changed from 1997 to 2001. Receptive syringe sharing was primarily affected by depression and the interaction of speed injection with age. There was no significant interaction of amphetamine injection and depression in relation to risk behavior.

The factors associated with persistent risk behavior among Tacoma SEP participants in this study overlap substantially with the findings of previous studies of IDUs recruited from multiple venues. Factors affecting risk behavior in previous studies include depression (Johnson et al., 2003; Mandell et al., 1999; Perdue et al., 2003), age (Kral et al., 2000), gender (Evans et al., 2003; Montgomery et al., 2002), and cocaine injection (Paone et al., 1997). In the current study, women were more likely to report syringe sharing in 1997 but not in 2001. Consistent with previous studies, depression increased risk behavior in both 1997 and 2001. The strong association found in this study among youth, amphetamine injection, and syringe sharing adds a new dimension to previous findings that young injectors (Kral et al., 2000) and cocaine injectors (Paone et al., 1997) are more likely to share syringes.

The elevated rates of risk among younger amphetamine injectors require further investigation, including comparison across multiple cities. Although the pattern of risk is consistent over time, actual rates of both amphetamine injection and risk behavior in the younger group are substantially higher in 2001 than 1997. In addition, use of multiple stimulant drugs was common among respondents. This phenomenon may be limited to Tacoma or may reflect a more general trend in which injection risk concentrates in particular age groups and/or subpopulations of drug users. It would be important for prevention planning and the development of targeted interventions to know whether there is a general trend towards elevated risk among young stimulant injectors. In a city with a higher overall HIV seroprevalence than Tacoma, this could lead to a partial resurgence of the epidemic among IDUs.

The consistent significance of depression across both time periods in this study and in previous studies in other cities suggests this is an important area for service development. It indicates a need for SEPs and other IDU-focused outreach to incorporate a stronger focus on mental health services or referral. Given the stigma and

ignorance surrounding mental illness in many communities, SEPs may find it useful to also provide health education programs on mental health issues, and to make this a focus for staff development.

The epidemiological stability of injection risk behavior during this time period is particularly striking given that factors associated with unsafe injection increased from 1997 to 2001. As already discussed, rates of both amphetamine injection and depression increased significantly from 1997 to 2001 and are central factors affecting risk behavior in this study. Homelessness is clearly endemic among Tacoma SEP participants, but had become substantially worse by 2001. Although the exact cause of this increase in homelessness is not clear from the current data, the higher rates of homelessness in themselves constitute both a decline in the social conditions of SEP participants and a challenge for maintenance of population-level HIV prevention. Other studies show a relationship between homelessness and injection risk behavior (Joseph & Paone, 1992), although homelessness becomes nonsignificant in this study when other factors are controlled. The stability of injection related risk is a significant accomplishment when factors associated with risk have substantially increased. This indicates that SEPs are able to maintain stable rates of risk among participants even under deteriorating social conditions; this is an important (and rare) accomplishment for any public health program.

Although rates of injection risk behavior remained constant, the larger context in which the SEP operated clearly changes over time. In the 4 years of this study, the Tacoma SEP experienced a substantial increase in the number of syringes exchanged per year. There were also important negative changes in the social circumstances of program participants, particularly in relation to housing, government benefits, and mental health. The decrease, from 1997 to 2001, in rates of receiving government benefits with no corresponding increase in rates of employment suggest that the impact of the 1996 Personal Responsibility and Work Opportunities Reconciliation Act (PRWORA) on this population may be problematic. The simultaneous increase in rates of both transient and longer term homelessness during this period add additional grounds for concern and may indicate a need for further research on the relationship between changes in the structure of income support programs and homelessness among IDUs. The 1996 termination of Social Security Disability coverage for addiction led to an increase in homelessness among former recipients in Chicago (Anderson, Shannon, Schyb, & Goldstein, 2002). It is still unclear how the work requirements, drug testing, and expanded sanctions of the PRWORA are affecting housing for drug users and other low-income populations. It is important to continue to study how SEPs respond to changes in the social environment and participant characteristics.

These data demonstrate that drug users can respond to education and resources, and sustain long-term behavioral change within their communities. SEP participants maintained epidemiologically stable levels of risk behavior under adverse conditions. The public health benefits of SEP participation persist despite changes in the larger service environment and have successfully prevented an upsurge of risk behavior in response to either stress or complacency. The identification of consistent key factors affecting persistent risk behavior among program participants indicates clear directions for the development of a second generation of risk reduction interventions. This study provides another indication that SEPs play a significant role in the prevention of HIV in marginal and impoverished communities in the United States.

REFERENCES

- Anderson, T., Shannon, C., Schyb, I., & Goldstein, P. (2002). Welfare reform and housing: Assessing the impact to substance abusers. *Journal of Drug Issues*, 32(1), 265-296.
- Beardsley, M., Deren, S., Tortu, S., Goldstein, M.F., Ziek K., & Hamid, R. (1999). Trends in injection risk behaviors in a sample of New York City injection drug users: 1992-1995. *Journal of Acquired Immune Deficiency Syndromes*, 20, 283-289.
- Bluthenthal, R.N., Kral, A.H., Gee, L., Erringer, E.A., & Edlin, B.R. (2000). The effect of syringe exchange use on high-risk injection drug users: a cohort study. *AIDS*, 14, 605-611.
- Bluthenthal, R.N., Kral, A.H., Gee, L., Lorvick, J., Moore, L., Seal, K., et al. (2001). Trends in HIV seroprevalence and risk among gay and bisexual men who inject drugs in San Francisco, 1988 to 2000. *Journal of Acquired Immune Deficiency Syndromes*, 28, 264-269.
- Des Jarlais, D.C., Dehne, K., & Casabonda, J. (2001). HIV surveillance among injecting drug users. *AIDS*, 15(Suppl. 3), S13-S22.
- Des Jarlais, D.C., Marmor, M., Paone, D., Titus, S., Shi, Q., Perlis, T., et al. (1996). HIV Incidence among injecting drug users in New York City syringe exchange programmes. *The Lancet*, 348, 987-991.
- Des Jarlais, D.C., Paone, D., Milliken, J., Turner, C., Miller, H., Gribble, J., et al. (1999). Audio-computer interviewing to measure risk behavior for HIV among injecting drug users: a quasi-randomised trial. *The Lancet*, 353, 1657-1661.
- Des Jarlais, D.C., Hagan, H., Friedman, S.R., Friedmann, P., Goldberg, D., Frischer, M., et al. (1995). Maintaining low HIV seroprevalence in populations of injecting drug users. *Journal of the American Medical Association*, 274, 1226-1231.
- Ekstrand M.L., Stall, R.D., Paul, J.P., Osmond, D.H., & Coates, T.J. (1999). Gay men report high rates of unprotected anal sex with partners of unknown or discordant HIV status. *AIDS*, 13, 1525-1533.
- Evans, J.L., Hahn, J.A., Page-Shafer, K., Lum, P.J., Stein E.S., Davidson, P.J., et al. (2003). Gender differences in sexual and injection risk behavior among active young injection drug users in San Francisco (the UFO Study). *Journal of Urban Health*, 80, 137-146.
- Friedman, S.R., Chapman, T.F., Perlis, T.E., Rockwell, R., Paone, D., Sotheran, J.L., et al. (1999). Similarities and differences by race/ethnicity in changes of HIV seroprevalence and related behaviors among drug injectors in New York City, 1991-1996. *Journal of Acquired Immune Deficiency Syndromes*, 22, 83-91.
- Gibson, D.R., Brand, R., Anderson, K., Kahn, J.G., Perales, D., & Guydish, J. (2002). Two-to-sixfold decreased odds HIV risk behavior associated with use of syringe programs. *Journal of Acquired Immune Deficiency Syndromes*, 31, 237-242.
- Hagan, H., Des Jarlais, D.C., Friedman, S.R., Purchase, D., & Alter, M.J. (1995). Reduced risk of hepatitis B and hepatitis C among injection drug users in the Tacoma syringe exchange program. *American Journal of Public Health*, 85, 1531-1537.
- Hagan, H., Des Jarlais, D.C., Purchase, D., Reid, T., & Friedman, S.R. (1991). The Tacoma Syringe Exchange. *Journal of Addiction Disorders*, 10, 81-88.
- Hagan, H., & Thiede, H. (2000). Changes in injection risk behavior associated with participation in the Seattle needle-exchange program. *Journal of Urban Health*, 77, 369-382.
- Heimer, R., Khoshnood, K., Bigg, D., Guydish, J., & Junge, B. (1998). Syringe use and reuse: Effects of syringe exchange programs in four cities. *Journal of Acquired Immune Deficiency Syndromes*, 18(Suppl. 1), S37-S44.
- Hepatitis B vaccination for injection drug users—Pierce County, Washington, 2000. (2001). *Morbidity and Mortality Weekly Report*, 50, 388-390, 399.
- Huebner, D.M., & Gerend, M.A. (2001). The relations between beliefs about drug treatments for HIV and sexual risk behavior in gay and bisexual men. *Annals of Behavioral Medicine*, 23, 304-312.
- Johnson, M.E., Yep, M.J., Brems, C., Theno, S.A., & Fisher, D.G. (2002). Relationship among gender, depression, and needle sharing in a sample of injection drug users. *Psychology of Addictive Behavior*, 164, 338-341.
- Joseph, H., & Paone, D. (1992). The homeless. In J.H. Lowinson, P. Ruiz, R.B. Millman, & J.G. Langrod (Eds.), *Substance Abuse: A Comprehensive Textbook* (pp. 733-743). Baltimore: Williams & Wilkins.
- Kral, A.H., Lorvick, J., & Edlin, B.R. (2000). Sex- and drug-related risk among populations of younger and older injection drug users in adjacent neighborhoods in San Francisco. *Journal of Acquired Immune Deficiency Syndromes*, 24, 162-167.
- Longshore, D., Bluthenthal, R.N., & Stein, M.D. (2001). Needle exchange program attendance and injection risk in Providence,

- Rhode Island. *AIDS Education and Prevention*, 13, 78-90.
- Mandell, W., Kim, J., Latkin, C., & Suh, T. (1999). Depressive symptoms drug network, and their synergistic effect on needle-sharing behavior among street injection drug users. *American Journal of Drug and Alcohol Abuse*, 25, 117-127.
- Maslow, C.B., Friedman, S.R., Perlis, T.E., Rockwell, R., & Des Jarlais, D.C. (2002). Changes in HIV seroprevalence and related behaviors among male injection drug users who do and do not have sex with men: New York City, 1990-1999. *American Journal of Public Health*, 92, 382-384.
- Monterroso, E.R., Hamburger, M.E., Vlahov, D., Des Jarlais, D.C., Ouellet, L.J., Altice, F.L., et al. (2000). Prevention of HIV infection in street-recruited injection drug users. The Collaborative Injection Drug User Study (CIDUS). *Journal of Acquired Immune Deficiency Syndromes*, 25, 63-70.
- Montgomery, S.B., Hyde, J., De Rosa, C.J., Rohrbach, L.A., Ennett, S., Harvey, S.M., et al. (2002). Gender differences in HIV risk behaviors among young injectors and their social network members. *American Journal of Drug and Alcohol Abuse*, 28, 453-475.
- Neumann, M.S., Johnson, W.D., Semaan, S., Flores, S.A., Peersman, G., Hedges, L.V., et al. (2002). Review and meta-analysis of HIV prevention intervention research for heterosexual adult populations in the United States. *Journal of Acquired Immune Deficiency Syndromes*, 30, S106-S117.
- Oggins, J. & Fleming, A. (2001) Welfare reform sanctions and financial strain in a food pantry sample. *Journal of Sociology and Social Welfare*, 28(2), 101-123.
- Paone, D., Des Jarlais, D.C., Caloir S., Jose, B., Shi, Q., & Friedman, S.R. (1997). Continued risky injection subsequent to syringe exchange use among injection drug users in New York City. *AIDS Education and Prevention*, 9, 505-510.
- Paone, D., Des Jarlais, D.C., Gangloff, R., Milliken, J., & Friedman, S.R. (1995). Syringe exchange: HIV prevention, key findings, and future directions. *International Journal of Addictions*, 30, 1647-1683.
- Perdue, T., Hagan H., Thiede, H., & Valleroy, L. (2003). Depression and HIV risk behavior Among Seattle-area injection drug users and young men who have sex with men. *AIDS Education and Prevention*, 15, 81-92.
- Purchase, D., Mottram, K., Miron, C., Sharma, D., Cruz-Uribe, F., McInelly, S., & Kobayshi, J. (2001). Hepatitis B vaccination for injection drug users—Pierce County, Washington, 2000. *Morbidity and Mortality Weekly Report*, 50(19), 388-390, 399.
- Shafer, K.P., Hahn, J.A., Lum, P. J., Ochoa, K., Graves, A., & Moss, A. (2002). Prevalence and Correlates of HIV infection among young injection drug users in San Francisco. *Journal of Acquired Immune Deficiency Syndromes*, 31, 422-431.
- Stall, R.D., Hays, R.B., Waldo, C.R., Ekstrand, M., McFarland, W. (2000). The gay '90s: A review of research in the 1990s on sexual behavior and HIV risk among men who have sex with men. *AIDS*, 14(Suppl. 3), S101-S114.
- Stolte, I.G., Dukers, N.H., de Wit, J.B., Fennema, J.S., & Coutinho, R.A. (2000). Increase in sexually transmitted infections among homosexual men in Amsterdam in relation to HAART. *Sexually Transmitted Infections*, 77, 184-186.
- Tun, W., Celentano, D.D., Vlahov, D., & Strathdee, S. (2003). Attitudes toward HIV treatments influence unsafe sexual and injection practices among injection drug users. *AIDS*, 17, 1953-1962.
- Vlahov, D., & Junge, B. (1998). The role of needle exchange programs in HIV prevention. *Public Health Report*, 113(Suppl. 1), 75-80.