CHANGES IN INJECTION RISK BEHAVIOR ASSOCIATED WITH PARTICIPATION IN THE SEATTLE NEEDLE-EXCHANGE PROGRAM

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ABSTRACT We studied the influence of the Seattle, Washington, needle-exchange program on sharing of drug injection equipment (syringes, drug cookers, filtration cotton) to identify potential gaps in risk reduction and to understand in greater detail the lack of an association between exchange use and risk of hepatitis B or C virus transmission. In a cohort of 2,208 injection drug users who completed a 1-year follow-up visit, we measured the association between needle-exchange use at study enrollment (ever vs. never) and injection risk behavior at the follow-up. Control for confounding was carried out using both logistic regression and propensity score analytic methods to estimate the adjusted odds ratio (AOR). In both univariate and multivariate analyses, needle-exchange use was associated with a lower likelihood of injection with a used syringe (AOR = 0.7, 95% confidence limit 0.5, 0.9). There was no association between exchange use and cooker or cotton sharing (AOR = 0.8, 95% confidence limit 0.6, 1.1) or between exchange use and use of a common syringe to divide drugs (AOR = 0.9). This analysis suggests that risk reduction measures adopted by users of the Seattle exchange may not be sufficient to prevent transmission of all blood-borne viruses, including hepatitis C virus. Greater awareness of the infection risk associated with these practices may help curb this type of equipment sharing and ultimately prevent disease transmission.

KEY WORDS Behavior Change, HBV; HCV; HIV, Injection Drug Use, Needle-Exchange Program, Prevention, Substance Abuse, Syringe-Exchange Program.

BACKGROUND

Needle-exchange programs for injection drug users (IDUs) have sought to reduce transmission of blood-borne viral infections by exchanging sterile syringes for previously used, contaminated ones and by distributing other new equipment—such as drug cookers—used to prepare drugs for injection. Risk reduction coun-

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seling and referral to or direct provision of other social and health services are also typically provided at needle exchanges in the US and elsewhere.^{1,2} Several studies have reported that IDUs who participate in needle-exchange programs are less likely than others to use syringes and other equipment previously used by another injector.³⁻¹⁰ Others have reported lower rates of infection with HIV and hepatitis B virus (HBV) and hepatitis C virus (HCV).¹¹⁻¹⁴ However, three recent studies have also reported increased risk or no effect of needle-exchange participation on HIV transmission or infection with hepatitis B or C.¹⁵⁻¹⁷ This raises questions whether risk reduction among needle-exchange users is sufficient to prevent transmission of blood-borne viruses or whether "residual" risk behavior may lead to infection. Alternatively, extreme background risk differences between exchange users and nonexchangers may also affect comparison of outcomes between the two groups.^{18,19} Thus, control of confounding must be addressed thoroughly in study design and analyses to measure any existing needle exchange effect accurately, and gaps in risk behavior change must be identified.

In observational studies of voluntary risk reduction programs, investigators have no control over which individuals elect to participate. As a result, comparisons of treated and untreated subjects may be biased by the presence of substantial background differences between the groups. Stratification and adjustment are the analytic methods for reducing bias due to imbalance between groups. As an extension of the method of stratification, the propensity score is the probability of assignment to a treatment group, conditional on a set of covariates; stated another way, it is the estimated likelihood that an individual would participate voluntarily in a disease prevention program given their characteristics.^{20,21} The propensity score may be used to balance background characteristics between treated and untreated individuals. Subjects with the same propensity score will tend to have the same distribution of their background risk factors, so that adjustment for the propensity score can be expected to adjust for those risk factors included in the propensity score estimation. Calculation of the treatment effect within a subclass of the propensity score will remove the biasing influence of the covariate to the extent that balance in the distribution of the covariates is achieved within the subclass, and error in measurement does not exist. Studies have shown that approximately 90% of this bias may be removed when individuals are subclassified into propensity score quintiles.²² However, unlike random assignment, the propensity score will not balance unobserved covariates, except perhaps when they are correlated with the observed characteristics. In this paper, the association between participation in the Seattle needle exchange and subsequent injection risk behavior was estimated using both logistic regression and

the propensity score to adjust for background differences between IDUs who had ever versus never used the exchange. Significant associations were interpreted in relation to previous publications describing no effect of the Seattle needle exchange on hepatitis B and C transmission.

The Seattle needle exchange began operating in 1989 and has become one of the largest exchange programs in the US in terms of the volume of syringes exchanged per year.²³ Risk reduction education regarding avoidance of the use of any injection equipment used by another IDU is provided by one-to-one counseling and written materials. Throughout the period of this study, the health education message to exchange participants was, "Don't share any injection equipment," and syringes, drug cookers, filtration cotton, and rinse water were available at the exchange.

METHODS

SUBJECTS AND DATA

The RAVEN (Risk Activity Variables, Epidemiology, and Networks) Study is a longitudinal cohort study of health outcomes and risk behavior among IDUs. Recruitment for the study was carried out June 1994 to May 1997 in methadone treatment clinics, a drug detoxification center, a drug and alcohol assessment agency, and the county corrections facility and at a street outreach and social service agency operating in a downtown Seattle area with a highly visible drug-using population. A scheme based on random numbers was used to select the n th individual from agency census or client lists; in the street outreach site, the client entering the premises at the n th minute was selected. Needle-exchange programs were not used as recruitment locations. Once selected, individuals were screened for eligibility: They must have injected an illicit drug at least once in the previous year and have been English or Spanish speaking, age 14 or older, and not already enrolled in the study. Participants who consented to enrollment were paid \$10 to complete the enrollment study visit and \$25 to complete the follow-up visit. Study procedures involving human subjects were approved by two institutional review boards.

Address and phone information was obtained at enrollment so that study personnel could contact participants to schedule their follow-up visit 12 months after enrollment. We attempted to locate subjects for follow-up who did not respond to a reminder card sent to their address by mailing another card to the same or a second address. Census lists for the county jail and the recruitment sites for the drug treatment study were compared each week against lists of subjects due for a follow-up visit. Subjects were considered lost to follow-up

when they could not be reached by mail or phone after repeated attempts. Other subjects could not be followed because of death or imprisonment in state or federal prisons.

At each study visit, a standardized questionnaire was administered by a trained interviewer. Among other factors, the interviews asked about demographic characteristics, drug use frequency, enrollment in drug treatment programs, needle-exchange use, and injection risk behavior (i.e., the use of drug injection or drug preparation equipment already used by another injector and dividing up drugs between two or more injectors using a common syringe ["backloading"]). The referent periods for the enrollment interview were the recent 6- and 1-month periods; the follow-up questionnaire asked about behavior during the follow-up period and during the 1 month prior to the follow-up interview. The term *exchange user* is used throughout to refer to individuals who had ever used the exchange by the time of study enrollment; *nonexchangers* included IDUs who had never used the exchange by their study enrollment visit.

STATISTICAL METHODS

Subjects were subclassified on the propensity score (the probability of ever having used a needle-exchange program) using the method of Rosenbaum and Rubin,²¹ as follows. Propensity scores were calculated for each subject using a logistic regression model of exchange use (ever vs. never) that included factors identified in our previous analyses or in the published literature as predictors of exchange use. Factors considered included gender, age, race/ethnicity, years since first injection, primary injected drug, frequency of injection, injection risk behavior at study enrollment, and sexual orientation. Factors retained in the model included those that were associated statistically significantly with exchange use (characteristics are listed in Table I); the result was Model 1. Subjects were then divided into five subclasses with cut points defined by quintiles of the predicted likelihood of exchange use (the propensity score) obtained from the logistic regression model.

Balance within the subclasses was assessed by examination of the distribution of characteristics between exchange users and nonexchangers within each propensity score subclass and by two-way analyses of variance (ANOVAs; two exchange user groups by five subclasses; see Table II). The *F* statistics from the two-way ANOVAs were compared to the *F* statistics prior to subclassification (square of two-sample *t* statistics comparing the two exchange use groups). A series of models was constructed by adding variables with large *F* statistics prior to subclassification and quadratic and interaction terms. Figure 1 shows the resulting *F* statistics (minimum, maximum, lower and upper quartiles, and me-

TABLE 1 Distribution of Baseline Characteristics Within Propensity Score (PS) Subclass, Exchange Users Versus Nonexchangers

	Propensity Score Subclass by Exchange Use										F Statistic Before Stratification	F Statistic After Stratification
	I (n = 329)		II (n = 329)		III (n = 329)		IV (n = 331)		V (n = 330)			
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No		
Number in each PS subclass	200	129	239	90	263	66	273	58	304	26		
Mean age (years)	36.7	36.8	36.4	35.3	36.8	38.4	37.7	37.1	37.4	37.0	2.65	<0.001
(SD)	(7.8)	(7.4)	(8.0)	(8.1)	(8.7)	(8.0)	(8.9)	(6.5)	(8.9)	(9.7)		
Nonwhite (n)	39	21	56	16	81	18	108	18	173	17	6.86	<0.001
(%)	(19.5)	(16.3)	(23.4)	(17.8)	(30.8)	(27.3)	(39.6)	(31.0)	(56.9)	(65.4)		
Homeless (n)	25	13	21	5	21	8	62	12	121	11	8.32	0.01
(%)	(12.5)	(10.1)	(8.8)	(5.6)	(8.0)	(12.1)	(22.7)	(20.7)	(39.8)	(42.3)		
Primarily injects heroin (n)	124	69	201	76	249	60	261	57	297	26	79.22	1.34
(%)	(62.0)	(53.5)	(84.1)	(84.4)	(94.7)	(90.9)	(95.6)	(98.3)	(97.7)	(100.0)		
Mean years since first injection	10.0	9.7	14.5	12.8	16.7	18.0	18.2	18.3	20.2	19.4	27.19	0.15
(SD)	(8.5)	(8.6)	(9.2)	(9.8)	(9.6)	(10.0)	(9.4)	(7.5)	(9.8)	(10.5)		
Mean number injections/month	56.4	51.0	68.6	65.5	80.5	93.8	105.7	104.8	218.5	177.6	55.44	0.97
(SD)	(56.1)	(55.6)	(75.1)	(74.7)	(62.9)	(94.2)	(87.3)	(106.2)	(164.0)	(139.2)		
Any syringe sharing (n)	114	62	95	35	91	25	108	30	97	9	1.84	<0.001
(%)	(57.0)	(48.1)	(39.7)	(38.9)	(34.6)	(37.9)	(39.6)	(51.7)	(31.9)	(34.6)		
Any backloading (n)	44	18	76	35	115	30	190	40	261	20	29.78	0.15
(%)	(22.0)	(14.0)	(31.8)	(38.9)	(43.7)	(45.5)	(69.6)	(69.0)	(85.9)	(76.9)		
Heterosexual (n)	189	120	224	82	241	61	241	52	248	23	1.57	<0.001
(%)	(94.5)	(93.0)	(93.7)	(91.1)	(91.6)	(92.4)	(88.3)	(89.7)	(81.6)	(88.5)		

TABLE II Subject Characteristics in Relation to Risk Behavior at Follow-up, Seattle, Washington, Injection Drug Users

	Any Syringe Sharing					Cooker or Cotton Sharing					Backloading				
	No		Yes		P	No		Yes		P	No		Yes		P
	n	%	n	%		n	%	n	%		n	%	n	%	
Risk behavior at follow-up															
Gender															
Male	516	54	448	46	<.01	383	54	323	46	.03	479	51	460	49	.05
Female	282	46	336	54		206	48	220	52		267	46	318	54	
Age group (years)															
<25	51	37	88	63	<.01	46	48	50	52	ns	54	40	81	60	.01
25-34	211	47	239	53		175	54	148	46		197	45	242	55	
35-44	383	52	356	48		265	49	272	51		363	51	349	49	
>44	153	60	101	40		103	59	73	41		132	55	106	45	
Race/ethnicity															
White	499	47	556	53	<.01	372	48	397	52	<.01	494	49	521	51	ns
African-American	205	60	136	40		134	58	96	42		167	50	165	50	
Other	94	51	92	49		83	62	50	38		85	48	92	52	
Homeless															
Yes	148	50	147	50	ns	116	56	92	44	ns	124	42	172	58	<.01
No	650	51	637	49		473	51	451	49		622	51	606	49	
Heterosexual															
Yes	727	51	696	49	ns	531	52	495	48	ns	689	50	682	50	<.01
No	71	45	88	55		58	55	48	45		57	37	96	63	
Primarily inject heroin															
Yes	704	52	659	48	.02	494	50	490	50	<.01	649	50	652	50	ns
No	94	43	125	57		95	64	53	36		97	43	126	57	
Years since first drug injection															
≤1	49	45	61	55	<.01	39	52	36	48	ns	46	43	62	57	.05
2-5	101	44	127	56		84	52	79	48		101	46	120	54	
6-10	101	47	112	53		78	53	69	47		97	47	110	53	
≥11	547	53	484	47		388	52	359	48		502	51	486	49	
Exchange user															
Ever	653	53	583	47	<.01	475	53	423	47	ns	580	49	615	51	ns
Never	145	42	201	58		114	49	120	51		166	50	163	50	
Behavior during the 1 month prior to the enrollment visit															
Injected more than once every day															
Yes	569	50	580	50	ns	427	51	408	49	ns	524	47	588	53	.02
No	229	53	204	47		162	55	135	45		222	54	190	46	
Syringe sharing															
Yes	207	32	439	68	<.01	176	39	274	61	<.01	234	37	401	63	<.01
No	591	63	345	37		413	61	269	39		512	58	377	42	

(continued)

TABLE II Continued

	Any Syringe Sharing					Cooker or Cotton Sharing					Backloading				
	No		Yes		P	No		Yes		P	No		Yes		P
	n	%	n	%		n	%	n	%		n	%	n	%	
Cooker or cotton sharing															
Yes	411	42	578	58	<.01	275	40	409	60	<.01	405	42	566	58	<.01
No	382	66	197	34		310	70	131	30		334	62	207	38	
Backloading															
Yes	348	43	459	57	<.01	239	42	334	58	<.01	305	38	495	62	<.01
No	450	58	325	42		350	63	209	37		441	61	283	39	

dian *F* statistics) from four different models. The model selected for this analysis was Model 1, which achieved balance in the distribution of covariates between exchange users and nonexchangers within each propensity score subclass, balance in the ratio of exchange users to nonexchangers in each subclass, and small *F* statistics (none of which were significant statistically). Model 3 (which included the square root of total injections per month at study enrollment and interaction between total injections and other covariates) had the lowest *F*-statistic values, but did not achieve balance in the numbers of subjects in each needle-exchange group within the subclasses.

Estimates of the exchange use effect on risk behavior at follow-up (syringe sharing, cooker or cotton sharing, and backloading) were estimated within each

FIGURE 1 The *F* statistics for the association between exchange use and subject characteristics before and after subclassification by the propensity score.

propensity score subclass using the odds ratio (OR). The summary odds ratio of the association between exchange use and reporting of injection risk behavior during the 1-month period prior to the follow-up interview, adjusted for background differences, was calculated using the method of Mantel and Haenszel.²⁴ To evaluate the propensity score as a method of adjustment for confounding, we also performed multivariate logistic regression analysis of injection risk behavior at follow-up, with needle-exchange use as the independent variable. The same background characteristics considered in the development of the propensity score analysis were entered into the logistic regression model as adjustment terms, and those retained had to meet empirical criteria for confounding (i.e., caused a 10% or greater change in the coefficient for the needle-exchange term).

RESULTS

There were 3,261 subjects screened and asked to participate in the RAVEN Study between June 1994 and May 1997; of these, 8% (266) refused. Of the 2,995 who were enrolled, 116 (4%) were excluded from further analyses because they had never injected drugs (discovered during subsequent interviews), had enrolled in the study more than once (either inadvertently or on purpose), or data they provided were judged by the interviewer to be unreliable (based on inconsistent responses to questionnaire items). Among 2,879 eligible subjects, 65 (2%) died between baseline and follow-up. Of 2,814 believed to be alive, 2,208 (78%) completed a follow-up interview. For this analysis, we included 1,582 (72%) who injected at least once during the 1-month period prior to the follow-up visit so that we could look at changes in injection risk behavior among those who were still injecting.

UNIVARIATE ANALYSIS OF RISK BEHAVIOR AT FOLLOW-UP

Table II shows the distribution of subject characteristics in relation to risk behavior at the follow-up visit. In univariate analysis, syringe sharing at follow-up was significantly more common among females, IDUs younger than 25, whites, those who primarily injected drugs other than heroin, and those who reported fewer years since first injection. Exchange users were less likely to report syringe sharing at the follow-up visit (47% vs. 58% of nonexchangers). Syringe sharing was also more common among those who had reported sharing syringes, cookers, or cottons or backloading during the 1 month prior to the enrollment visit. Sharing of drug cookers or filtration cotton at follow-up was more common among females and whites; heroin injectors were more likely than other IDUs to report cooker/cotton sharing. Female, young, homeless, and nonheterosexual IDUs and those who injected more than once each day were more likely to report backload-

ing at the follow-up visit. Injection risk behavior at the baseline was associated with both cooker/cotton sharing and backloading at follow-up. There were no differences between exchange users and nonexchangers in cooker/cotton sharing or backloading at follow-up.

SUBCLASSIFICATION BY THE PROPENSITY SCORE

In general, exchange users had a higher predicted likelihood of exchange use, and there were a number of exchange user subjects whose propensity score was higher than for any nonexchanger (Fig. 2). There were also nonexchangers with propensity scores lower than any exchange user. Overall, however, there was a fairly narrow range of propensity score values, in the range 65–88%, indicating that, in this sample of Seattle area IDUs, there was a relatively high likelihood of prior exchange use.

In Table I, the distribution of subjects and their baseline characteristics is shown in relation to propensity score subclass and treatment group (exchange user vs. never exchanger). There were between 329 and 331 subjects in each subclass, with a higher proportion of exchange users in Subclass V (92%) than in those classes with a lower probability of exchange use. Prior to subclassification, many of these characteristics were associated significantly with exchange use.

FIGURE 2 Box plot of predicted likelihood of exchange use (propensity score) by observed exchange use (ever vs. never).

After subclassification, there was relatively good balance in each subclass in the proportion of exchange users and nonexchangers who were non-white, primarily injected heroin, reported syringe sharing or backloading at baseline, or were heterosexual. Mean age of study subjects, mean number of years since first drug injection, and mean number of injections per month were also similar between exchange users and nonexchangers across propensity score subclasses. The *F* statistics after subclassification were small, and none were significant statistically.

MULTIVARIATE ANALYSES OF RISK BEHAVIOR AT FOLLOW-UP

Table III shows the results of the analysis of the association between exchange use and injection risk behavior at the follow-up interview, adjusted for confounding factors using both the propensity score method and logistic regression. The odds ratios for syringe sharing were consistent across the subclasses, in the range 0.4–0.8; there was a statistically significant association between needle-exchange use and syringe sharing at follow-up as estimated by the summary odds ratio of 0.7 (95% confidence limit [CL] 0.5, 0.9). The same estimate was obtained (OR = 0.7, 95% CL 0.5, 0.9) from the logistic regression analysis using a model that adjusted for homelessness, sexual orientation, heroin use, years since first injection, frequency of injection, and sharing and backloading at the baseline interview. Sharing of drug cooker or filtration cotton at follow-up was not associ-

TABLE III Association Between Exchange Use and Injection Risk Behavior at Follow-up

		Treatment Group	Any Syringe Sharing				Cooker or Cotton Sharing				Backloading			
			n	Yes	5	OR	n	Yes	5	OR	n	Yes	5	OR
Propensity score														
Subclass I	Exchange user	191	95	49.7	0.7	134	57	42.5	0.9	185	83	44.9	1.0	
	Nonexchanger	119	70	58.8		84	37	44.0		117	52	44.4		
Subclass II	Exchange user	232	113	48.7	0.7	163	68	41.7	0.7	226	97	42.9	0.7	
	Nonexchanger	85	50	58.8		52	27	51.9		76	39	51.3		
Subclass III	Exchange user	251	119	47.4	0.9	189	96	50.8	0.9	234	117	50.0	0.9	
	Nonexchanger	62	31	50.0		43	23	53.5		58	31	53.4		
Subclass IV	Exchange user	263	119	45.2	0.4	191	105	55.0	0.8	256	148	57.8	1.1	
	Nonexchanger	55	37	67.3		36	22	61.1		52	29	55.8		
Subclass V	Exchange user	299	137	45.8	0.8	221	97	43.9	0.6	294	170	57.8	1.6	
	Nonexchanger	25	13	52.0		19	11	57.9		26	12	46.2		
Adjustment across subclass:														
OR (95% CL)		0.67 (0.51, 0.86)				0.79 (0.58, 1.08)				0.96 (0.74, 1.25)				
Logistic regression: OR (95% CL)		0.67 (0.51, 0.86)				0.76 (0.55, 1.04)				0.94 (0.73, 1.21)				

ated significantly with exchange use, either by the propensity score analysis (OR = 0.8, 95% CL 0.6, 1.1) or by the logistic regression analysis (OR = 0.8, 95% CL 0.6, 1.04). Adjustment terms included in that logistic regression model were heroin injection, frequency of injection, and syringe or cooker/cotton sharing or backloading at baseline. Backloading at follow-up also was not associated significantly with exchange use; the summary odds ratio obtained from the propensity score analysis was 1.0 (95% CL 0.7, 1.2). In a logistic regression model of backloading that adjusted for whether backloading occurred at baseline, the odds ratio for exchange use was 0.9 (95% CL 0.7, 1.2).

DISCUSSION

In this study, we found that IDUs who were exchange users by the time of study enrollment were 30% less likely than nonexchangers 1 year later to report injections with a syringe used by another IDU. This result was obtained using two different analytic approaches to the question of the influence of exchange use on risk behavior. Both sets of analyses adjusted for injection risk behavior at the enrollment study visit, an analytic approach that might have tended to diminish differences in behavior 1 year later substantially. The design of this study was such that needle-exchange use clearly preceded self-reported syringe sharing and thus would not be subject to the same concerns about temporal relationships as cross-sectional analyses of current exchange use versus current risk behavior. Therefore, we would conclude that participation in the Seattle needle-exchange program very likely led to a reduction in drug injections with a previously used syringe. However, there were no significant differences at follow-up between exchange users and nonexchangers in other injection risk practices, such as sharing of drug cookers or filtration cotton or backloading.

Several methodological limitations to this study must be considered. Both needle-exchange use and risk behavior information were obtained by self-report; differential error in the collection of these data could lead to bias in the estimate of any associations. Since we asked about exchange use at both baseline and follow-up, there might be a tendency for exchange users not to report risk behavior at follow-up in an effort to impress the interviewer. This is not likely to have biased our results seriously since the amount of risk behavior reported by our subjects is higher than in most studies,²⁵⁻²⁷ and needle exchange use was associated only with less reporting of syringe sharing and not with all types of injection risk behavior. (The logic of this second argument is expanded below.) As in any longitudinal study, losses to follow-up might introduce bias, but only

when the follow-up rate is low or when study retention is associated with both exposure (exchange use) and outcome (risk behavior). Neither case applies in our study.

These study findings—of lower syringe sharing, but no influence of needle exchange on other injection risk behavior—may aid in the interpretation of our previous report that showed no effect of needle-exchange use on risk of hepatitis B and C seroconversion in the RAVEN cohort.¹⁷ It would appear logical that risk reduction measures we observed in exchange users were insufficient to prevent infection with hepatitis B and C. We have also showed recently that, among IDUs who did not share syringes, hepatitis C seroconversion was nearly four-fold higher in those who shared cookers or cotton.²⁸

Thus, it may be the case that hepatitis C transmission may continue among users of a needle exchange unless sharing of injection and drug preparation equipment is reduced substantially or eliminated. The results of this study may also explain why HIV transmission among Seattle IDUs is, in contrast to HCV and HBV incidence, extremely low, at a rate of 2 infections per year per 1,000 IDUs.¹⁷ Since HIV is transmitted less efficiently than HBV or HCV via needlestick exposure, it is possible that HIV transmission via cookers and cottons is relatively rare.²⁹ Thus, the reductions in syringe sharing we report here may have contributed to this low rate of HIV infection in IDUs while having an effect on HCV or HBV transmission that is perhaps too small to be detected reliably.

Two other studies have reported similar patterns of risk behavior among exchange users. A study by Bluthenthal and others⁷ analyzed the relationship between use of an illegal needle exchange in San Francisco, California, and sharing of different types of equipment. In that study, exchange users were only 60% as likely as nonusers to share syringes, but there were no differences in the sharing of drug cookers, filtration cotton, or rinse water. A Harlem, New York City, study also found lower rates of syringe sharing among exchange users, but no difference in sharing of other injection equipment.³⁰ Bluthenthal and colleagues suggested that the lack of an effect on sharing drug preparation equipment may be because awareness of the risk associated with this practice is relatively recent.⁷ There is also the problem of uncertainty in the degree of risk inherent in equipment sharing. Another of our Seattle studies indicates that cooker/cotton sharing may be a relatively efficient means of transmitting HCV, with HCV incidence of 16%/year among cooker/cotton sharers who did not share syringes, compared to only 4% in those who did not share equipment.²⁸ Dissemination of this type of risk information to IDUs, backed up by data from other studies, may help them to reduce or eliminate entirely these types of injection risk behavior. More-

over, there may be as yet unanticipated benefits to adopting such a standard for drug users in that newly introduced blood-borne viruses may be prevented from becoming endemic disease in the population.

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