Self-Reported Hepatitis C Virus Antibody Status and Risk Behavior in Young Injectors

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SYNOPSIS

Objective. This study was conducted to assess the accuracy of self-reported hepatitis C virus (HCV) antibody (anti-HCV) serostatus in injection drug users (IDUs), and examine whether self-reported anti-HCV serostatus was associated with recent injection risk behavior.

Methods. In five U.S. cities (Baltimore, Chicago, Los Angeles, New York, and Seattle), 3,004 IDUs from 15 to 30 years old were recruited for a baseline interview to determine eligibility for a randomized controlled trial of a behavioral intervention. HIV and HCV antibody testing were performed, and subject data (e.g., demographics, drug and sexual risk behavior, and history of HIV and HCV testing) were collected via audio computer-administered self-interview. Risk behavior during the previous three months was compared to self-reported anti-HCV serostatus.

Results. Anti-HCV prevalence in this sample of young IDUs was 34.1%. Seventy-two percent of anti-HCV-positive and 46% of anti-HCV-negative IDUs in this sample were not aware of their HCV serostatus. Drug treatment or needle exchange use was associated with increased awareness of HCV serostatus. Anti-HCV-negative IDUs who knew their serostatus were less likely than those unaware of their status to inject with a syringe used by another IDU or to share cottons to filter drug solutions. Knowledge of one's positive anti-HCV status was not associated with safer injection practices.

Conclusions. Few anti-HCV-positive IDUs in this study were aware of their serostatus. Expanded availability of HCV screening with high quality counseling is clearly needed for this population to promote the health of chronically HCV-infected IDUs and to decrease risk among injectors susceptible to acquiring or transmitting HCV.

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Hepatitis C virus (HCV) is the most frequently transmitted bloodborne virus in the United States, and is hyperendemic among injection drug users (IDUs), with research showing that 50%–80% have been infected.[1–3] HCV is a significant cause of morbidity and mortality in IDUs.[4,5] Empirical studies of the influence of public health interventions such as drug treatment and needle exchange on HCV transmission have reported mixed results.[6–12] Screening programs may be of public health benefit when the disease is common, the test is inexpensive, non-invasive, and accurate, and when early detection may lead to treatment or help reduce new infections.[13] HCV screening of high risk individuals such as IDUs may contribute to its control by reducing *exposure* risk behavior among uninfected IDUs, and by reducing *transmission* risk behavior among chronically HCV-infected injectors. While reductions in IDUs' risk practices rarely have been attributed to awareness of HIV serostatus alone, numerous studies have reported risk reduction after brief interventions that include HIV pre- and post-test counseling.[14–16]

Thus far, a relatively small number of studies have examined HCV counseling and testing as an approach to HCV prevention. It appears that many IDUs do not know their HCV antibody (anti-HCV) serostatus, and it is not clear whether HCV testing, education, and counseling can influence behaviors that may transmit HCV.[17–19] Particularly relevant behaviors include the shared use of equipment used to inject or prepare drugs for injection.[20–22] In this study of young IDUs in five U.S. cities, we examined the accuracy of self-reported anti-HCV serostatus and whether awareness of anti-HCV serostatus was associated with recent injection risk behavior.

METHODS

The Collaborative Injection Drug Users Study III/Drug User Intervention Trial (CIDUS III/DUIT) is a randomized controlled trial of a behavioral intervention to reduce HIV and HCV infection among young IDUs. Individuals aged 15 to 30 years old in Baltimore, Chicago, Los Angeles, New York, and Seattle who reported injection of any illicit drug in the previous six months were eligible for an initial screening visit. We recruited participants through street and agency outreach, targeted advertising, and respondent-driven recruitment. Enrollment was completed once a predetermined number of anti-HCV-negative subjects were recruited into the intervention trial. After giving informed consent, participants completed a risk behavior interview administered via audio computer-administered self-interview (ACASI). After completion of the interview, participants were counseled and tested for HIV and HCV antibody. HCV antibody testing was performed using an enzyme immunoassay (EIA) test (Abbott Laboratories EIA 2.0) or Ortho Diagnostic Systems EIA 3.0. Reactive specimens were retested in duplicate using EIA and interpreted as anti-HCV-positive if either or both specimens were reactive. Recombinant immunoblot assay (RIBA) was used to evaluate 22 samples without definitive results on the immunoassay;[23] 77% were confirmed positive. HIV antibody testing was performed using standard ELISA screening and Western blot confirmation.

The interview asked about injection and sexual risk behaviors in the three-month period prior to study enrollment; these included whether the participant had injected with a syringe previously used by another IDU (receptive syringe sharing), passed on their own used syringe to another IDU (distributive sharing), and the shared use of drug preparation equipment including cookers, filtration cotton, or water to dilute the drug or rinse injection equipment. Since IDUs commonly re-use drug preparation equipment, "shared use" included sharing their own used equipment with other IDUs or using materials previously used by another injector. The use of a previously used syringe to divide drugs with other IDUs was also assessed. In addition, the interview asked about history of HIV and HCV screening, and whether the participant had received HIV and HCV antibody test results prior to study enrollment. General knowledge of hepatitis and HIV natural history was assessed using eight true/false questions; the number of correct answers were summed to create a general knowledge score (Cronbach's alpha=0.7). Knowledge of hepatitis and HIV transmission risk was assessed using thirteen true/false questions, and the number of correct answers were summed to create a risk knowledge score (Cronbach's alpha=0.7). To understand underlying psychological factors influencing risk behavior in participants, the Rosenberg Self Esteem Scale was included in the assessment (Cronbach's alpha=0.9),[24] as was a self-efficacy scale to measure whether participants believed they could avoid injection risk behavior (e.g., subjects were asked to rate statements such as, "I can avoid sharing a needle even if I am dope sick or in withdrawal") (Cronbach's alpha=0.9). Depression was measured using the Brief Symptom Inventory (Cronbach's alpha=0.9).[25] The questionnaire also asked about peer norms related to injection risk behavior (proportion of their friends who inject with syringes previously used by other IDUs). The study was reviewed and approved by the institutional review boards of the U.S. Centers for Disease Control and Prevention (CDC) and the individual study sites.

The analysis addressed whether self-reported HCV serostatus was related to behavior that could transmit HCV (including receptive and distributive syringe sharing, the shared use of cookers, cotton, or rinse water, and the use of a used syringe to divide drugs). Separate analyses were carried out among anti-HCV seropositive and seronegative subjects because risk behavior was expected to differ in relation to true HCV serostatus. Although HCV counseling and testing sessions are an opportunity to discuss sexual risk behavior to reduce transmission of HIV and other sexually transmitted diseases, sexual risk behavior was not examined in this analysis because of the low likelihood of sexual HCV transmission.[26] Participants aware of their anti-HIV positive serostatus or who refused to answer this question were excluded from this analysis, since they comprised a relatively small proportion of screened and otherwise eligible individuals (1.7%) and may have introduced different motivations to avoid injection risk behavior.

We examined the association between recent injection risk behavior (past three months) and self-reported HCV antibody serostatus (positive, negative, or don't know), restricting the analysis to those who had injected within the previous three months. Univariate analyses using chi-square tests compared participants classified according to self-reported HCV serostatus with respect to sociodemographic characteristics, history of incarceration, drug treatment, or needle exchange use, alcohol use, and factors that may potentially modify or explain any association between awareness of serostatus and risk behavior (such as depression, self-esteem, self-efficacy, and peer norms). We used logistic regression analyses to estimate the association between risk behavior and self-reported HCV status, calculating the odds ratio (OR) and its 95% confidence interval (CI). The multivariate models included adjustment variables (age, race, sex, and site) that changed the coefficient for the independent variable by 10% or more.[27] Because risk behavior may be affected by prior screening for both HIV and HCV, the multivariate analysis was repeated including self-reported HIV serostatus as an adjustment term. However, the inclusion of this variable and other potential confounding variables (such as duration of injection) did not change the adjusted odds ratios to a meaningful degree, and therefore these were not included in the final models.

RESULTS

From May 2002 to January 2004, 3,285 participants enrolled in the CIDUSIII/DUIT study; 3,004 (91%) provided a blood specimen for anti-HCV and anti-HIV testing, were anti-HIV-negative and answered questions about prior HCV and HIV testing. Mean age of the sample was 23.8 years (median=24); mean duration of drug injection was 5.0 years (median=4). Sixty-six percent were white, non-Hispanic, 16% Hispanic, 7% black, and 11% other race/ethnicity; 70% of the subjects were male.

HCV seroprevalence and awareness of one's serostatus

Thirty-four percent (1,033) were anti-HCV-positive, and the remainder (1,971) were anti-HCV-negative. Of those who tested anti-HCV-positive, 72% (745) were unaware of their serostatus; more than half of these subjects believed they were anti-HCV-negative based on previous testing (Table 1). The sensitivity of self-reported HCV serostatus to detect true anti-HCV positivity was low (only 28% of truly anti-HCV-positive participants were aware of their serostatus). Specificity of self-report was somewhat higher (54% of all true anti-HCV-negatives correctly reported their serostatus). The predictive value of self-report was high, particularly for those who reported that they were anti-HCV-positive (very few, only 6%, were actually anti-HCV-negative). Those who reported that they were anti-HCV-negative were correct 72% of the time. A large proportion of anti-HCV-negative IDUs did not know their status or had never been tested (45%), and more than two-thirds of anti-HCV-positive subjects (72%) did not know their HCV serostatus or believed they were anti-HCV-negative.

Table 1. Sensitivity, specificity, and predictive value of self-reported anti-HCV serostatus, 15–30-year-old IDUs in five U.S. cities

	True anti-HCV serostatus (by EIA test)	
Self-reported anti-HCV serostatus	*Positive*	*Negative*
Positive	288	17
Negative	414	1,062
Unsure/don't know	331	892
Total	1,033	1,971
Sensitivity	288/1,033=28%	
Specificity	1,062/1,971=54%	
Predictive value of self-reported anti-HCV positivity	288/305=94%	
Predictive value of self-reported anti-HCV negativity	1,062/1,476=72%	

Factors associated with being aware of one's HCV serostatus for IDUs

Awareness of anti-HCV-positive status. Among the anti-HCV-positives, those who knew their status were more likely to be Hispanic and to report that they were homeless (Table 2). Gender and age were not related to awareness of HCV status in this group. A higher proportion of anti-HCV-positive participants in New York (48%) and Seattle (43%) knew their status, as compared with Los Angeles (24%), Baltimore (19%), and Chicago (14%) ($p<0.01$). Self-reported anti-HCV seropositivity was associated with a history of ever having been in drug treatment or use of a needle exchange program in the past three months. However, knowing one's HCV serostatus was not associated with reporting a primary source of new syringes in the previous three months that was likely to be "safe" (i.e., needle exchange, hospitals, or pharmacies), or lifetime history of being in jail. In addition, knowledge of one's anti-HCV-positive status was not associated with number of injection partners. Self-reported anti-HCV positivity was not associated with recent frequency of injection or type of drug usually injected, but anti-HCV seropositive IDUs who had been injecting for four or more years were more likely to know their HCV serostatus. Participants who knew they were anti-HCV-positive were also no more likely to avoid alcohol—a recommendation routinely made to minimize disease progression—compared with those anti-HCV-positive IDUs who did not know their status.

Anti-HCV-positive IDUs who accurately reported their serostatus also reported more frequent symptoms of depression and scored higher on tests of general HCV knowledge and HIV/HCV risk behavior. However, knowing one's HCV serostatus was not related to self-efficacy for safe injection, self-esteem, or peer norms related to safe injection. Anti-HCV-positive IDUs who correctly reported their serostatus were less likely to report refusing to share a syringe with an anti-HCV-positive injector; those who believed they were anti-HCV-negative or did not know their serostatus were more likely to report that they had never been in that situation. Anti-HCV-positive IDUs who did not know their HCV serostatus were far more likely to believe they were HIV-positive (28% vs. 1% of others).

In terms of transmission risk behaviors, anti-HCV-positive IDUs who knew their serostatus were no less likely to report receptive or distributive syringe sharing (Table 3). Indeed, approximately half of all anti-HCV-positive IDUs reported passing on their used syringe to another injector. The shared use of cookers and cottons and dividing drugs with a used syringe did not vary in relation to self-reported HCV serostatus. After adjustment for age, race, and site, those who believed they were anti-HCV-negative were less likely to share rinse water (adjusted odds ratio [AOR]=0.6; 95% confidence interval [CI] 0.4, 0.9). Adjustment for other potentially confounding factors (age, race, and site) did not result in a statistically significant association with other injection behavior that could transmit HCV.

Awareness of anti-HCV-negative status. Anti-HCV-negative IDUs who knew their serostatus were somewhat more likely to be female (35% vs. 29% of others) (Table 2). Anti-HCV-negative participants in New York and Seattle were more likely to correctly report their serostatus (61%) than those in other study sites (50%; $p<0.01$). Similar to anti-HCV-positive IDUs, anti-HCV-negative IDUs who correctly reported their HCV serostatus were more likely to have been in drug treatment, to have used a needle exchange program, and to have injected for four or more years. Anti-HCV-negative IDUs who knew their serostatus were also more likely to report getting most of their syringes from a "safe" source (72% vs. 63% of those who believed they were seropositive, or did not know their serostatus). Among anti-HCV-negatives, knowing one's serostatus was associated with higher scores on HIV/HCV knowledge tests and higher self-efficacy for safe drug injection. There was no association between awareness of serostatus and depression, self-esteem, or peer norms related to injection. Similar to anti-HCV-positive IDUs, anti-HCV-negative subjects who reported they did not know their serostatus were more likely to believe they were anti-HIV positive (33% vs. 2% of others).

Anti-HCV-negative IDUs who knew their HCV serostatus were only 80% as likely to report receptive syringe sharing or sharing of filtration cotton as those who did not know their status (Table 3). No association between self-reported HCV serostatus and distributive syringe sharing, cooker sharing, rinse water sharing, or dividing drugs with a used syringe was noted among anti-HCV-negative injectors.

DISCUSSION

In this large multi-site study of young IDUs, self-report detected only 28% of all anti-HCV-positive injectors. Self-reported anti-HCV negativity correctly identified a little more than half of all anti-HCV-negative participants. These findings were nearly identical to a Denver, Colorado, study reporting that only 29% of anti-HCV-positive IDUs believed they were positive.[15] Clearly, such a low level of detection of an endemic disease in a population suggests that improved access to HCV testing and education is needed, particularly as medical monitoring and treatment of HCV infection may have

Table 2. Characteristics associated with self-reported anti-HCV serostatus, 15–30-year-old injection drug users in five U.S. cities.

	Anti-HCV-positive Self-reported anti-HCV serostatus				*Anti-HCV-negative Self-reported anti-HCV serostatus*			
	Positive (n=288) n *(percent)*	*Negative (n=414)* n *(percent)*	*Don't know (n=331)* n *(percent)*	p	*Negative (n=1,062)* n *(percent)*	*Positive (n=17)* n *(percent)*	*Don't know (n=892)* n *(percent)*	p
Age (years)				NS				NS
15–19	21 (7.3)	25 (6.0)	21 (6.3)		154 (14.5)	4 (23.5)	163 (18.3)	
20–24	100 (34.7)	165 (39.9)	148 (44.7)		513 (48.3)	8 (47.1)	404 (45.3)	
25–30	167 (58.0)	224 (54.1)	162 (48.9)		395 (37.2)	5 (29.4)	325 (36.4)	
Race				<0.01				NS
Hispanic	76 (26.7)	70 (17.1)	45 (13.7)		144 (13.7)	4 (23.5)	143 (16.1)	
Black	11 (3.9)	16 (3.9)	17 (5.2)		87 (8.3)	2 (11.8)	75 (8.5)	
White	174 (61.1)	278 (67.8)	224 (68.1)		691 (65.6)	8 (47.1)	579 (65.4)	
Other	24 (8.4)	46 (11.2)	43 (13.1)		131 (12.4)	3 (17.6)	89 (10.0)	
Sex				NS				0.03
Male	213 (74.0)	290 (70.0)	253 (76.4)		692 (65.2)	12 (70.6)	631 (70.7)	
Female	75 (26.0)	124 (30.0)	78 (23.6)		370 (34.8)	5 (29.4)	261 (29.3)	
Homeless (6 months)				<0.01				NS
No	132 (45.8)	244 (59.1)	205 (62.1)		660 (62.3)	6 (35.3)	545 (61.4)	
Yes	156 (54.2)	169 (40.9)	125 (37.9)		400 (37.7)	11 (64.7)	343 (38.6)	
Ever incarcerated				NS				NS
No	42 (14.6)	76 (18.4)	60 (18.1)		326 (30.7)	3 (17.6)	291 (32.6)	
Yes	246 (85.4)	338 (81.6)	271 (81.9)		736 (69.3)	14 (82.4)	601 (67.4)	
Ever in drug treatment				<0.01				<0.01
No	75 (26.0)	159 (38.5)	148 (44.8)		437 (41.2)	9 (52.9)	473 (53.2)	
Yes	213 (74.0)	254 (61.5)	182 (55.2)		625 (58.8)	8 (47.1)	416 (46.8)	
Used needle exchange in past three months				<0.01				<0.01
No	77 (26.8)	181 (44.0)	159 (49.8)		375 (35.7)	6 (35.3)	448 (51.2)	
Yes	210 (73.2)	230 (56.0)	160 (50.2)		676 (64.3)	11 (64.7)	427 (48.8)	
Primary syringe source "safe"[a]				NS				<0.01
No	96 (33.8)	149 (36.7)	135 (42.7)		288 (27.7)	6 (35.3)	319 (37.3)	
Yes	188 (66.2)	257 (63.3)	181 (57.3)		753 (72.3)	11 (64.7)	536 (62.7)	
Years since first injection				<0.01				<0.01
0–3	56 (19.5)	109 (26.5)	95 (28.9)		469 (44.4)	6 (35.3)	503 (56.8)	
4+	231 (80.5)	302 (73.5)	234 (71.1)		587 (55.6)	11 (64.7)	382 (43.2)	
Primary drug injected				NS				NS
Heroin	182 (63.4)	282 (69.1)	211 (65.5)		786 (76.2)	10 (58.8)	663 (77.2)	
Speedball	74 (25.8)	82 (20.1)	81 (25.2)		72 (7.0)	4 (23.5)	49 (5.7)	
Amphetamines	10 (3.5)	24 (5.9)	17 (5.3)		121 (11.7)	1 (5.9)	105 (12.2)	
Cocaine	15 (5.2)	10 (2.4)	11 (3.4)		28 (2.7)	1 (5.9)	22 (2.6)	
Other	6 (2.1)	10 (2.4)	2 (0.6)		25 (2.4)	1 (5.9)	20 (2.3)	
Injection frequency				NS				NS
Less than daily	93 (32.3)	124 (30.0)	120 (36.2)		529 (49.8)	8 (47.1)	463 (51.9)	
Daily	195 (67.7)	290 (70.0)	211 (63.8)		533 (50.2)	9 (52.9)	429 (48.1)	

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Table 2. (continued) Characteristics associated with self-reported anti-HCV serostatus, 15–30-year-old injection drug users in five U.S. cities.

	Anti-HCV-positive Self-reported anti-HCV serostatus				*Anti-HCV-negative Self-reported anti-HCV serostatus*			
	Positive (n=288) n *(percent)*	*Negative (n=414)* n *(percent)*	*Don't know (n=331)* n *(percent)*	p	*Negative (n=1,062)* n *(percent)*	*Positive (n=17)* n *(percent)*	*Don't know (n=892)* n *(percent)*	p
Number of injection partners				NS				NS
0	35 (12.5)	53 (13.0)	42 (13.0)		167 (16.0)	2 (11.8)	130 (15.0)	
1	33 (11.8)	53 (13.0)	40 (12.4)		162 (15.5)	4 (23.5)	144 (16.6)	
2–4	91 (32.5)	151 (37.2)	115 (35.6)		368 (35.2)	1 (5.9)	328 (37.9)	
≥5	121 (43.2)	149 (36.7)	126 (39.0)		349 (33.4)	10 (58.8)	263 (30.4)	
Alcohol use				NS				<0.01
4–7 days/week	51 (17.7)	74 (17.9)	64 (19.3)		205 (19.3)	10 (58.8)	179 (20.1)	
1–3 days/week	72 (25.0)	99 (23.9)	90 (27.2		299 (28.2)	1 (5.9)	258 (29.0)	
0–3 days/month	99 (34.4)	121 (29.2)	93 (28.1)		355 (33.5)	4 (23.5)	297 (33.4)	
Never	66 (22.9)	120 (29.0)	84 (25.4)		201 (19.0)	2 (11.7)	155 (17.4)	
General HIV/HCV knowledge				<0.01				<0.01
<75% correct	38 (13.2)	94 (22.7)	87 (26.3)		242 (22.8)	5 (29.4)	311 (34.9)	
≥75% correct	250 (86.8)	320 (77.3)	244 (73.7)		820 (77.2)	12 (70.6)	581 (65.1)	
HIV/HCV risk knowledge				<0.01				<0.01
<75% correct	136 (47.2)	264 (63.8)	210 (63.4)		616 (58.0)	11 (64.7)	585 (65.6)	
≥75% correct	152 (52.8)	150 (36.2)	121 (36.6)		446 (42.0)	6 (35.3)	307 (34.4)	
Depression–bothered by symptoms				0.03				NS
Not at all	51 (18.0)	103 (25.3)	70 (22.1)		245 (23.5)	3 (18.8)	195 (22.5)	
A little bit	91 (32.0)	161 (39.5)	121 (38.2)		391 (37.4)	5 (31.3)	322 (37.1)	
Moderately	79 (27.8)	89 (21.8)	78 (24.6)		252 (24.1)	4 (25.0)	219 (25.3)	
Quite a bit	50 (17.6)	43 (10.5)	38 (12.0)		131 (12.6)	4 (25.0)	99 (11.4)	
Extremely	13 (4.6)	12 (2.9)	10 (3.2)		25 (2.4)	0 (0.0)	32 (3.7)	
Self-efficacy for safer drug injection				NS				0.02
1 Lower self-efficacy	14 (5.0)	32 (7.9)	21 (6.7)		41 (4.0)	1 (6.2)	32 (3.7)	
2	64 (22.7)	86 (21.2)	61 (19.4)		125 (12.1)	4 (25.0)	134 (15.6)	
3	123 (43.6)	173 (42.6)	140 (44.6)		387 (37.5)	8 (50.0)	348 (40.6)	
4 Higher self-efficacy	81 (28.7)	115 (28.3)	92 (29.3)		479 (46.4)	3 (18.8)	342 (40.0)	
Self-esteem				NS				NS
1 Lower self-esteem	2 (0.7)	4 (1.0)	1 (0.3)		4 (0.4)	0 (0.0)	5 (0.6)	
2	98 (34.6)	111 (27.5)	97 (30.7)		284 (27.7)	4 (25.0)	221 (26.0)	
3	170 (60.1)	252 (62.5)	199 (63.0)		615 (60.0)	10 (62.5)	537 (63.1)	
4 Higher self-esteem	13 (4.6)	36 (8.9)	19 (6.0)		122 (11.9)	2 (12.5)	88 (10.3)	
Friends inject w/ used needles				NS				NS
None of them, or none inject	72 (25.6)	105 (26.5)	86 (27.6)		338 (32.8)	4 (26.7)	290 (34.5)	
Fewer than half	88 (31.3)	133 (33.6)	93 (29.9)		362 (35.2)	7 (46.7)	284 (33.8)	
About half	56 (19.9)	69 (17.4)	49 (15.8)		143 (13.9)	1 (6.7)	119 (14.2)	
More than half	46 (16.4)	51 (12.9)	53 (17.0)		133 (12.9)	1 (6.7)	99 (11.8)	
All of them	19 (6.8)	38 (9.6)	30 (9.6)		53 (5.2)	2 (13.3)	49 (5.8)	

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Table 2. (continued) Characteristics associated with self-reported anti-HCV serostatus, 15–30-year-old injection drug users in five U.S. cities

	Anti-HCV-positive Self-reported anti-HCV serostatus				*Anti-HCV-negative Self-reported anti-HCV serostatus*			
	Positive (n=288) n *(percent)*	*Negative (n=414)* n *(percent)*	*Don't know (n=331)* n *(percent)*	p	*Negative (n=1,062)* n *(percent)*	*Positive (n=17)* n *(percent)*	*Don't know (n=892)* n *(percent)*	p
Refused to share syringe with HCV+ IDU				<0.01				0.02
No	132 (46.0)	104 (25.4)	97 (30.3)		196 (18.6)	4 (25.0)	188 (21.6)	
Yes	67 (23.3)	120 (29.3)	76 (23.8)		252 (23.9)	4 (25.0)	155 (17.8)	
Not in that situation	88 (30.7)	185 (45.2)	147 (45.9)		605 (57.4)	8 (50.0)	528 (60.6)	
Perceived HIV status				<0.01				<0.01
Positive	4 (1.4)	2 (0.5)	88 (28.3)		25 (2.4)	1 (6.2)	273 (33.2)	
Negative	281 (98.6)	409 (99.5)	223 (71.7)		1,025 (97.6)	15 (93.8)	548 (66.8)	

NOTE: All injection and alcohol use risk behaviors are within the past three months unless otherwise noted; *p*-values refer to chi-square test for differences between subjects who reported they were anti-HCV-positive, negative, or didn't know their serostatus.

[a]Safe sources of syringes included needle exchanges, pharmacies and hospitals.

substantial health benefits.[28] In another large study of IDUs, a much higher proportion of HIV-positive participants (44%) correctly reported their HIV-status.[29] We also found substantial geographic differences in awareness of HCV serostatus, with higher proportions of both anti-HCV-negative and positive participants in New York and Seattle knowing their HCV serostatus. It is conceivable that there are regional differences in access to HCV screening and in the proportion of patients returning for test results; there may also be geographic differences in the quality of pre- and post-test counseling available.

In our study, previous enrollment in drug treatment or the use of needle exchange were both associated with awareness of HCV serostatus; this suggests that these programs may contribute to case-finding and HCV prevention education. A small study of IDUs in methadone treatment in London (n=90) found that 77% of anti-HCV-positive IDUs were aware of their serostatus.[30] A survey of U.S. drug treatment programs reported that 76% of methadone programs do provide onsite HCV antibody testing to their clients,[31] and a national survey of needle exchange programs in the U.S. found that 43% of programs do offer HCV antibody testing. (Personal communication, D.C. Des Jarlais, 2005). We found no association between HCV awareness and history of incarceration. A recent study reported an increase in universal or targeted HCV screening programs in U.S. state prisons,[32] which may contribute to a net increase in access to testing for drug injectors. The quality and content of HCV counseling and education in screening programs in these settings may vary substantially; efforts to standardize and improve HCV-screening protocols may be warranted.

The association between self-reported HCV serostatus and risk behavior in this population varied in relation to whether participants were anti-HCV-positive or negative. Among anti-HCV-positive IDUs, those who knew their serostatus were no less likely than other anti-HCV-positive IDUs to report injection practices that may transmit infection. Similar results have been found in other studies. In the Denver study, there was no association between knowledge of anti-HCV-positive serostatus and distributive syringe sharing, although fewer who were aware of their serostatus reported sharing drug preparation equipment.[17] A longitudinal study of young IDUs reported that those who received an anti-HCV-positive test result were no more likely to change risk behavior than those who believed they were anti-HCV-negative; overall, 20% of participants reduced their risk behavior after learning the results of their HCV antibody test.[19] A relatively high proportion of anti-HCV-positive participants in that study also reported heavy alcohol use (48%), and no change in frequency of use was noted. However, the sample size was relatively small, and follow-up retention was relatively low (<50%); thus, it remains unclear whether awareness of serostatus may be sufficient to change behavior that may transmit HCV or worsen progression of disease among anti-HCV-positive injectors.

Awareness of anti-HCV negativity appeared to benefit young IDUs in this study in reducing exposure risk, as they were significantly less likely than those who did not know their anti-HCV serostatus to inject with a syringe previously used by another injector or share filtration cotton. An association between awareness of anti-HCV negativity and risk behavior has not been reported previously; these findings would support expansion of HCV testing for the purpose of identifying and counseling anti-HCV-negative injectors.

Limitations should be considered before drawing conclusions from this study. Awareness of HCV serostatus was associated with a history of drug treatment and longer duration of drug injection—characteristics that may indicate more problematic drug use. This difference could have led to confounding in the association between awareness of one's status and other characteristics. However, adjustment for duration of injection in estimating the association between knowledge of anti-HCV serostatus and risk behavior did not change the odds ratio to a meaningful degree. This study did not collect information on known or perceived HCV serostatus of the IDUs' injection partners, and we were unable to discern whether anti-HCV-positive IDUs injected in a different manner when they were with anti-HCV-negative IDUs. This limitation applied to previous studies that found little benefit from counseling and education on reducing risk among anti-HCV-positive IDUs.[17,19] However, this study and previous studies do suggest that HCV counseling and education protocols could be improved with increased emphasis on the importance of reducing transmission risk behavior. In

Table 3. Association between injection risk behavior and self-reported anti-HCV serostatus, 15–30-year-old injection drug users in five U.S. cities

	Anti-HCV-positive				*Anti-HCV-negative*			
Self-reported anti-HCV serostatus	*Yes* n *(percent)*	*No* n *(percent)*	*OR (95% CI)*	*AOR (95% CI)*	*Yes* n *(percent)*	*No* n *(percent)*	*OR (95% CI)*	*AOR (95% CI)*
Receptive syringe sharing								
Positive	143 (50)	141 (50)	1.0 (0.7, 1.4)	1.0 (0.7, 1.4)	361 (34)	686 (66)	0.8 (0.6, 0.9)	0.8 (0.6, 0.9)
Negative	185 (46)	216 (54)	0.8 (0.6, 1.1)	0.8 (0.6, 1.2)	7 (41)	10 (59)	1.0 (0.4, 2.7)	1.1 (0.4, 3.1)
Don't know	164 (50)	162 (50)	1.0	1.0	357 (41)	518 (59)	1.0	1.0
Distributive syringe sharing								
Positive	141 (49)	144 (51)	0.9 (0.7, 1.3)	0.9 (0.6, 1.3)	432 (41)	613 (59)	0.9 (0.8, 1.1)	1.0 (0.8, 1.2)
Negative	218 (54)	184 (46)	1.1 (0.8, 1.5)	1.1 (0.8, 1.5)	8 (50)	8 (50)	1.4 (0.5, 3.6)	1.2 (0.4, 3.3)
Don't know	168 (52)	157 (48)	1.0	1.0	374 (43)	506 (57)	1.0	1.0
Cooker sharing								
Positive	229 (80)	57 (20)	1.0 (0.7, 1.6)	0.9 (0.6, 1.5)	723 (68)	336 (32)	0.9 (0.8, 1.1)	0.9 (0.7, 1.1)
Negative	313 (76)	99 (24)	0.8 (0.6, 1.2)	0.7 (0.5, 1.04)	15 (88)	2 (12)	3.2 (0.7, 13.9)	2.7 (0.6, 12.3)
Don't know	259 (79)	68 (21)	1.0	1.0	619 (70)	262 (30)	1.0	1.0
Cotton sharing								
Positive	215 (75)	71 (25)	1.1 (0.8, 1.6)	1.0 (0.7, 1.5)	583 (55)	475 (45)	0.8 (0.6, 0.9)	0.8 (0.6, 0.9)
Negative	282 (69)	128 (31)	0.8 (0.6, 1.1)	0.7 (0.5, 1.03)	15 (88)	2 (12)	4.7 (1.1, 20.7)	3.8 (0.9, 17.4)
Don't know	239 (74)	86 (26)	1.0	1.0	542 (61)	341 (39)	1.0	1.0
Rinse water sharing								
Positive	217 (76)	68 (24)	1.1 (0.7, 1.6)	1.0 (0.7, 1.6)	607 (57)	449 (43)	0.8 (0.7, 0.99)	0.8 (0.7, 1.03)
Negative	278 (68)	130 (32)	0.7 (0.5, 0.9)	0.6 (0.4, 0.9)	14 (82)	3 (18)	2.8 (0.8, 9.9)	4.4 (1.0, 19.8)
Don't know	244 (75)	82 (25)	1.0	1.0	550 (62)	334 (38)	1.0	1.0
Dividing drugs with a used syringe								
Positive	141 (54)	118 (46)	1.3 (0.9, 1.8)	1.3 (0.9, 1.9)	332 (34)	649 (66)	0.9 (0.7, 1.1)	0.9 (0.7, 1.2)
Negative	192 (52)	175 (48)	1.2 (0.9, 1.6)	1.0 (0.8, 1.5)	7 (47)	8 (53)	1.6 (0.6, 4.3)	1.1 (0.4, 3.4)
Don't know	139 (48)	149 (52)	1.0	1.0	291 (36)	519 (64)	1.0	1.0

OR = odds ratio

AOR = adjusted odds ratio

fairness to the providers of HCV counseling and testing evaluated in these studies, standardized protocols have only recently been developed in the U.S.,[23] and scientific knowledge regarding specific transmission risk behavior was relatively uncertain for many years after HCV was identified. A recent qualitative study of IDUs in London—one third of whom were anti-HCV-positive—noted that many reported confusion and uncertainty regarding HCV risk, and that, in addition, HCV was perceived as an almost inevitable consequence of drug injection.[33]

As mentioned, we were not able to discern whether HCV seroconcordance among injection partners mitigated the potential for HCV transmission suggested by risk behavior among anti-HCV-positive IDUs. It was also not possible to identify specific weaknesses in any previous HCV counseling and education our participants received. Another limitation was the cross-sectional design of this study, which limits the attribution of risk behavior to prior awareness of HCV serostatus, since we cannot be certain that testing occurred more than three months prior to study enrollment. It is also conceivable that there was measurement error such that self-reported risk behavior did not conform precisely to the three-month period of interest. However, the short span of the referent period would tend to increase the accuracy of self-report, and would also make it less likely that a meaningful proportion of HCV tests were performed and results given during that time period. A further limitation is that we cannot determine whether motivation to be tested is associated with risk avoidance; all observational studies of screening programs suffer from this limitation and a randomized controlled trial of HCV screening is unlikely.

Several implications can be drawn from this analysis. Clearly, there is a great need to expand access to screening and counseling in this high prevalence population, as 72% of anti-HCV-positive and 46% of anti-HCV-negative IDUs did not know their antibody status. HCV testing and education may provide knowledge and motivation for anti-HCV-negative IDUs to continue safe injection practices or reduce their injection frequency. HCV education and counseling for anti-HCV-positive IDUs should stress the importance of their role in reducing HCV transmission and encourage the avoidance of alcohol to maintain their health. We could not examine the most important potential benefit of case-finding for anti-HCV-positive IDUs, which is to facilitate access to medical monitoring and treatment of HCV infection. However, a cost-effectiveness study of HCV screening in the general population showed that the cost per case detected was substantially lower ($1,246 per case) than the cost of other accepted public health screening programs such as fecal occult blood ($4,000) and pap smears ($5,000).[13] Using a pre-screening protocol that selects only individuals at risk of HCV, the estimated cost per case was reduced to $487. However, whether increased HCV case-finding in IDUs will lead to an increase in medical management and treatment of HCV remains an open question.

The U.S. Preventive Services Task Force recently issued a set of recommendations related to HCV screening; their review of published research led them to conclude that no studies had shown that "looking for HCV infection in adults who had no symptoms but were at high risk . . . leads to benefits."[34] The current study suggests that an important benefit of HCV screening in this high risk population may be to support maintenance of safe injection among anti-HCV-negative drug injectors. It also suggests the need for improvements in counseling for anti-HCV-positive IDUs to decrease their risk for transmitting HCV to other IDUs and for avoiding alcohol use. Thus, our findings would support HCV screening recommendations by the CDC and the National Institutes of Health Consensus Panel on Medical Management of HCV to screen users of injection drugs.[35–37] One outstanding research question arising from this analysis is how to improve risk-reduction counseling for anti-HCV-positive individuals to make further gains toward reducing the HCV disease burden in this population.

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