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Unmet Health Care Needs and Hepatitis C Infection Among Persons Who Inject Drugs in Denver and Seattle, 2009

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Abstract Persons who inject drugs (PWID) shoulder the greater part of the hepatitis C virus (HCV) epidemic in the USA. PWID are also disproportionately affected by limited access to health care and preventative services. We sought to compare current health care coverage, HCV, and HIV testing history, hepatitis A and B vaccination coverage, and co-occurring substance use among PWID in two US cities with similar estimated numbers of PWID. Using data from the 2009 National HIV Behavioral Surveillance system in Denver (n=428) and Seattle (n=507), we compared HCV seroprevalence and health care needs among PWID. Overall, 73 % of participants who tested for HCV antibody were positive. Among those who were HCV antibody-positive, vaccination coverage for hepatitis A and B was low (43 % in Denver and 34 % in Seattle) and did not differ significantly from those who were antibody-negative. Similarly, participation in alcohol or drug treatment programs during the preceding 12 months was not significantly higher among those who were HCV antibody-positive in either city. Significantly fewer participants in Denver had health care coverage compared to Seattle participants (45 vs. 67 %, p<0.001). However, more participants in Seattle reported being disabled for work and, thus, more likely to be receiving health care coverage through the federal Medicaid program. In both cities, the vast majority of those who were aware of their HCV infection reported not receiving treatment (90 % in Denver and 86 % in Seattle). Our findings underscore the need to expand health care coverage and preventative medical services for PWID. Furthermore, our findings point to the need to develop comprehensive and coordinated care programs for infected individuals.

Keywords Injection drug use · Hepatitis C · Access to health care · Prevention

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Introduction

Infection with hepatitis C virus (HCV) is an increasing global health problem. In 2005, 184 million persons worldwide were estimated to have been infected with HCV, an increase from the estimated 122 million persons in 1990 (Mohd Hanafiah et al. 2013). In the USA, HCV is the most prevalent chronic blood-borne infection. An estimated 4.1 million persons have been infected with HCV, of whom approximately 3.2 million are chronically infected (Armstrong et al. 2006). The vast majority of those chronically infected are unaware of their infection (Smith et al. 2012). Furthermore, HCV infection is an increasing cause of morbidity and mortality. Chronic HCV infection is a major cause of liver cirrhosis and liver cancer and claims the lives of approximately 15,000 Americans each year (Ly et al. 2012). The number of deaths attributed to HCV infection now surpasses the number of deaths attributed to HIV (Ly et al. 2012).

In the current absence of an effective vaccine, primary prevention against infection with HCV focuses on reducing risks through blood safety and safe injection practices. In developing countries, HCV infection is primarily transmitted through exposure to infected blood and blood products in

health care and community settings while injection drug use is the primary mode of transmission in developed countries (Maheshwari and Thuluvath 2010). In the USA, persons who inject drugs (PWID) are disproportionately infected with HCV (Aceijas and Rhodes 2007; Armstrong et al. 2006). Though the overall incidence of HCV has declined over the past 20 years, HCV incidence among young PWID in the range of 40 per 100 person-years has been reported (Klevens et al. 2012). In addition to the disproportionate number of new infections among PWID, the prevalence of HCV infection in studies among PWID ranges from 40 to 70 % (Amon et al. 2008; Hagan et al. 2011). PWID are also more likely to suffer from hepatitis-related health outcomes and comorbidities due to poor access to health care (Dore and Thomas 2005; Grebely et al. 2008).

On top of being disproportionately infected with HCV, PWID are at elevated risk for other viral infections including HIV. Among PWID, the prevalence of HIV and HCV coinfection ranges from 30 to 90 % (Miller et al. 2004; Vickerman et al. 2013). Among HIV-infected persons who receive antiretroviral therapy, chronic HCV infection is the leading cause of death after AIDS-related complications (Weber et al. 2006). Current prevention services recommended for PWID include testing for HCV infection, annual testing for HIV, receiving vaccinations for hepatitis A and B, treatment of substance use and mental disorders, and interventions for reduction of risk behavior (Centers for Disease Control and Prevention 2012a). However, PWID often lack access to preventative services and care due to myriad complex factors.

For the general population, health care coverage and access to preventative services varies widely across the USA. Nationwide, approximately 47 million Americans, or 15 % of the population, were uninsured in 2012 (Kaiser Commission on Medicaid and the Uninsured 2013). Federal programs, such as Medicaid, provide coverage for low-income individuals. A key goal of the Affordable Care Act legislation is to expand Medicaid coverage to millions of those currently uninsured. Estimates of health care coverage for PWID also vary and are mostly lower than the general population (Appel et al. 2004; Chitwood et al. 2002; Cronquist et al. 2001; Mehta et al. 2010). Across the USA, estimates of PWID range from 34 to 324 (median 91.5) per 10,000 persons (Tempalski et al. 2013). In an effort to help characterize current health care coverage and access to preventative services among PWID, we examined data from the National HIV Behavioral Surveillance System (NHBS) collected in Denver, Colorado and Seattle, Washington. Our objective was to compare health care coverage, HCV and HIV testing history, hepatitis A and B vaccination coverage, and co-occurring substance use among PWID in two cities with similar estimated numbers of PWID (136 per 10,000 population in Denver and 164 per 10,000 population in Seattle, Brady et al. 2008).

Methods

National HIV Behavioral Surveillance System

The NHBS system was established in 2003 by the Centers for Disease Control and Prevention (CDC) to monitor risk behaviors among three populations at the highest risk for HIV infection in the USA: men who have sex with men, injection drug users, and heterosexuals at increased risk for HIV. NHBS involves rotating 12-month cycles of surveillance activities in these three populations. Surveillance activities include ethnographic formative research, an in-depth behavioral survey, and HIV testing during each cycle. The analyses presented in the current paper are from the 2009 NHBS cycle among PWID in two of the participating NHBS sites, Denver, Colorado and Seattle, Washington (Centers for Disease Control and Prevention 2012b).

Study Design and Protocol

Between July and December 2009, participants were recruited using respondent-driven sampling (RDS), a peer-referral sampling methodology (Heckathorn 1997). In RDS, initial "seed" participants are identified through key stakeholders and are recruited for participation. Seeds are then asked to recruit persons from their networks using referral coupons, who in turn recruit persons from their networks, and so on. Participation rates are calculated by dividing the number of referred eligible participants by the number of distributed coupons and typically range from 30 to 50 %. Each eligible participant was allowed to refer up to five persons from their network. Participants were instructed to recruit someone they knew who injects drugs and who they had seen in the past 30 days. RDS employs a dual incentive structure; thus, participants were compensated for their participation in addition to being compensated a smaller amount for each eligible person they successfully recruited.

Persons were eligible to participate if they were at least 18 years or older, had injected drugs during the preceding 12 months, resided in the Denver or Seattle metropolitan statistical area, had not previously participated in the 2009 NHBS cycle, and were able to provide informed consent. Additional eligibility criteria included having physical evidence of recent injection (fresh track marks) or having current knowledge of drug packaging, pricing, and locations where drugs are sold.

Verbal informed consent was obtained from eligible participants. Participants completed a standardized interviewer-administered behavioral risk survey using handheld computers. Participants were also offered a rapid HIV test and a follow-up confirmatory Western blot was performed on all tests with an initial reactive result. In addition, participants were offered a standard HCV antibody test. In Denver,

participants were given US$25 for completing the survey, US$25 for providing specimens for testing, and US$10 for each eligible person they recruited. In Seattle, participants were given US$25 for completing the survey, US$15 for HIV testing, US$15 for HCV testing, and US$10 for each eligible referral. All NHBS activities were voluntary, and no names were collected. The study protocol was reviewed and approved by the Colorado Multiple and Washington State Institutional Review Boards.

HCV Testing

In Denver, a reference assay using the Ortho HCV Version 3.0 enzyme-linked immunosorbent assay was performed at the Colorado Department of Public Health and Environment's laboratory (Ortho Clinical Diagnostics). In Seattle, the reference assay, performed at the laboratory at Public Health - Seattle & King County, was the Abbott AxSYM anti-HCV microparticle immunoassay (Abbott Laboratories). The reference assays used to detect HCV antibodies have specificities in 99 % range (Alter et al. 2003). At both sites, a third-generation recombinant immunoblot assay (RIBA) (Chiron RIBA HCV 3.0 SIA; Novartis Vaccines and Diagnostics) was used to confirm antibody positivity for reactive specimens with a signal-to-cutoff ratio below the CDC-recommended threshold. Results of the reference assays for HCV infection are reported.

HIV Testing

In Denver, participants provided an oral specimen for a rapid HIV test using OraQuick *ADVANCE*® Rapid HIV-1/2 Antibody Test (OraSure Technologies Inc, Bethlehem, PA). In Seattle, participants provided a finger stick blood specimen for rapid testing using the OraQuick test or a blood specimen for standard EIA testing (Bio-Rad GS rLAV EIA, Human Immunodeficiency Virus Type 1) (Viral Lysate and E. coli Recombinant Antigen). At both sites, confirmatory testing was done by Western blot (Bio-Rad GS HIV-1 Western Blot Human Immunodeficiency Virus Type I).

Statistical Analysis

Descriptive frequencies are presented for each sample. Chi-square statistics were calculated to compare the two samples from Denver and Seattle. In addition, we used chi-square statistics to compare participants who were HCV antibody-positive to those who were antibody-negative within each site. Fisher's exact test was calculated when minimum expected frequency requirements were not met. All analyses were conducted using Stata Version 12.0 (StataCorp, College Station, TX).

Results

Demographics

A total of 3,356 RDS coupons were distributed, 2,044 in Denver and 1,312 in Seattle. To begin the RDS recruitment chains, 16 initial seed participants were identified, ten in Denver and six in Seattle. A sufficient number of recruitment waves was reached in both cities for the samples to reach equilibrium (i.e., the point at which sample characteristics no longer change and are not biased by seed participants). A total of 935 eligible persons were recruited via RDS, 428 (21 % of distributed coupons) from Denver and 507 (39 % of distributed coupons) from Seattle. Of the 428 persons recruited in Denver, 295 (68.9 %) were male, a little over half (51.6 %) identified as non-Hispanic white, and one-fifth (21.7 %) were 55 years or older (Table 1). In Seattle, 330 (65.1 %) of participants were male, 60 % identified as non-Hispanic white, and approximately 18 % were 55 or older. There were significant differences in the racial distribution of the Denver and Seattle populations. In particular, more participants in Denver identified as Hispanic compared to participants in Seattle (26.5 vs. 5.7 %, $p<0.001$). In both cities, approximately one quarter of participants reported having less than a high school education, 27.3 % in Denver and 25.6 % in Seattle. Participants differed by employment status between the two cities. More participants in Denver reported being unemployed (44.2 vs. 34.8 %, $p<0.001$), while significantly more participants in Seattle, 50 %, reported being disabled for work. In both cities, approximately 45 % of participants, 43.2 % in Denver and 44.5 % in Seattle, reported being currently homeless. While heroin was the drug most frequently injected in both cities (Denver 72.4 %; Seattle 81.7 %), higher proportions of Denver participants reported injecting methamphetamine, speedball, and cocaine as their primary drug compared to Seattle participants.

Health Care and Access to Testing

In Denver, a total of 196 (45.8 %) participants reported having current health insurance or coverage with the biggest proportion of coverage provided by Medicaid (20.6 %; Table 2). In Seattle, a total of 341 (67.4 %) participants reported current health care coverage with almost half reporting Medicaid coverage (46.1 %). In both cities, the majority of participants had seen a health care provider in the past 12 months though significantly more participants in Seattle had seen a provider compared to Denver (83.4 vs. 75.2 %, $p=0.002$). Among those who had seen a provider in the past 12 months, a slightly higher proportion of participants in Seattle (43 %) were

Table 1 Sociodemographic characteristics of a sample of injection drug users, National HIV Behavioral Surveillance (NHBS), Denver, Colorado and Seattle, Washington, 2009

	Denver, CO (n=428) n (%)	Seattle, WA (n=507) n (%)	p value
Gender			
Male	295 (68.9)	330 (65.1)	0.214
Female	133 (31.1)	177 (34.9)	
Race/ethnicity			
White, non-Hispanic	220 (51.6)	303 (60.0)	<0.001
Black, non-Hispanic	56 (13.1)	90 (17.8)	
Hispanic	113 (26.5)	29 (5.7)	
American Indian/Alaska Native	12 (2.8)	27 (5.4)	
Multiracial/other	25 (5.9)	56 (11.1)	
Age			
18–24	28 (6.5)	16 (3.2)	0.015
25–34	83 (19.4)	89 (17.6)	
35–44	105 (24.5)	133 (26.2)	
45–54	119 (27.8)	179 (35.3)	
55 or older	93 (21.7)	90 (17.8)	
Education			
Less than high school diploma	117 (27.3)	130 (25.6)	0.810
High school diploma	179 (41.8)	213 (42.0)	
More than high school diploma	132 (30.8)	164 (32.4)	
Annual Income			
0–US$9,999	257 (60.2)	336 (66.8)	0.109
US$10,000–US$19,999	99 (23.1)	89 (17.7)	
US$20,000–US$39,999	47 (11.0)	57 (11.3)	
US$40,000 or more	24 (5.6)	21 (4.2)	
Employment status			
Full time or part time	82 (19.2)	45 (8.9)	<0.001
Disabled for work	130 (30.4)	253 (50.0)	
Unemployed	189 (44.2)	176 (34.8)	
Other (homemaker, student, retired)	27 (6.3)	32 (6.3)	
Homeless in past 12 months			
No	164 (38.3)	169 (33.4)	0.203
Yes, currently homeless	185 (43.2)	225 (44.5)	
Yes, but not currently homeless	79 (18.5)	112 (22.1)	
Most frequently injected drug			
Heroin	310 (72.4)	414 (81.7)	0.015
Cocaine	21 (4.9)	12 (2.4)	
Speedball	35 (8.2)	35 (6.9)	
Methamphetamine	57 (13.3)	44 (8.7)	
Other	5 (1.1)	2 (0.4)	

Categories may not add up to total due to missing data for individual variables

offered an HIV test compared to Denver participants (41 %). We examined testing offered during stays in detention, jail, or prison and found that approximately 8 % of participants in Denver were offered both HIV and HCV tests while incarcerated during the past 12 months. In Seattle, 6.7 % of participants had been offered an HIV test and 3.6 % had been offered an HCV test during their last detention, jail, or prison stay.

HCV History

Participants were asked about their prior HCV testing experiences and HCV history. Overall, fewer participants in Denver had a prior blood test for HCV compared to Seattle participants (79.7 vs. 86.2 %, p=0.034, Table 3). Participants from both sites were similar in

Table 2 Health care and access to HIV and HCV testing variables in a sample of injection drug users, National HIV Behavioral Surveillance (NHBS), Denver, Colorado and Seattle, Washington, 2009

	Denver, CO (n=428) n (%)	Seattle, WA (n=507) n (%)	X^2 p value
Current health insurance or health care coverage			
Yes	196 (45.8)	341 (67.4)	<0.001
No	232 (54.2)	165 (32.6)	
Private health insurance			
Yes	19 (4.5)	9 (1.8)	0.017
No	408 (95.5)	497 (98.2)	
Medicaid (low income) coverage			
Yes	88 (20.6)	233 (46.1)	<0.001
No	339 (79.4)	273 (53.9)	
Medicare (elderly or disabled) coverage			
Yes	40 (9.4)	48 (9.5)	0.951
No	387 (90.6)	458 (90.5)	
Seen health care provider past 12 months			
Yes	322 (75.2)	421 (83.4)	0.002
No	106 (24.8)	84 (16.6)	
Offered HIV test by health care provider past 12 months			
Offered HIV test	133 (31.2)	181 (36.4)	0.009
Not offered HIV test	187 (43.9)	233 (46.8)	
No visit past 12 months	106 (24.9)	84 (16.9)	
Offered HIV test during last detention, jail, or prison stay during past 12 months			
Offered HIV test	35 (8.2)	34 (6.7)	0.331
Not offered HIV test	139 (32.6)	149 (29.5)	
Not incarcerated past 12 months	252 (59.2)	322 (63.8)	
Offered HCV test during last detention, jail, or prison stay during past 12 months			
Offered HCV test	35 (8.2)	18 (3.6)	0.008
Not offered HCV test	140 (32.8)	167 (32.9)	
Not incarcerated past 12 months	252 (59.1)	322 (63.5)	

Categories may not add up to total due to missing data for individual variables

terms of self-reported hepatitis C status, time since diagnosis, and ever having taken medication to treat their HCV infection.

HIV History

Participants were also asked about their prior HIV testing experiences and HIV history. Similar to prior HCV testing, fewer participants in Denver reported having a prior HIV test compared to Seattle participants (87.0 vs. 92.7 %, p=0.022, Table 3). However, more participants in Denver reported the result of their prior HIV test with 3.8 % reporting a positive result, 92.7 % reporting a negative result, and 3.5 % reporting they never obtained their result. This is compared to 10.0 % of Seattle participants reporting they never obtained their HIV result, 5.4 % reporting a positive result, and 84.6 % reporting a prior HIV-negative test result.

HCV and HIV Infection

There were no significant differences between Denver and Seattle in HCV prevalence, HIV prevalence, or HCV-HIV coinfection. This is true for the PWID population as a whole, among males who inject and report sexual activity with males, and among males who inject and report no male sexual activity (Table 3). A total of 395 participants in Denver and 260 participants in Seattle provided a blood specimen to test for HCV and HIV antibody. In Denver, 289 (73.2 %) were HCV antibody-positive while 189 (72.7 %) were antibody-positive in Seattle. In terms of HIV infection, 4.6 % of Denver participants and 5.8 % of Seattle participants tested positive. We also examined HCV and HIV coinfection among those who were screened for both infections. In Denver, 3.8 % of participants were coinfected, 69.4 % were mono-infected with HCV, and 0.8 % of participants were HIV mono-infected. In Seattle, 4.2 % of participants were coinfected, 68.5 % were HCV infected, and 1.5 % HIV infected.

Table 3 HCV history, HCV and HIV serology results, and reported male-male sexual behavior in a sample of injection drug users who were tested for HCV, National HIV Behavioral Surveillance (NHBS), Denver, Colorado and Seattle, Washington, 2009

	Denver, CO (n=395) n (%)	Seattle, WA (n=260) n (%)	X^2 p value
Ever had blood test for HCV			
Yes	310 (79.7)	219 (86.2)	0.034
Never tested	79 (20.3)	35 (13.8)	
Ever told had hepatitis C			
Yes	197 (49.9)	139 (53.5)	0.369
No	198 (50.1)	121 (46.5)	
Time since told had hepatitis C			
6 months or less	11 (5.6)	4 (2.9)	0.470
>6 months and <1 year	5 (2.5)	5 (3.6)	
1 year or more	181 (91.9)	130 (93.5)	
Taken medicine to treat hepatitis C			
Yes	20 (10.2)	20 (14.4)	0.238
No	177 (89.8)	119 (85.6)	
Ever tested for HIV			
Yes	341 (87.0)	240 (92.7)	0.022
No	51 (13.0)	19 (7.3)	
Most recent HIV result			
Self-reported positive	13 (3.8)	13 (5.4)	0.009
Self-reported negative	315 (92.7)	203 (84.6)	
Never obtained result	12 (3.5)	24 (10.0)	
HCV serology			
Antibody-positive	289 (73.2)	189 (72.7)	0.894
Antibody-negative	106 (26.8)	71 (27.3)	
HIV serology			
Positive	18 (4.6)	15 (5.8)	0.492
Negative	376 (95.4)	245 (94.2)	
HIV and HCV coinfection			
HCV and HIV	15 (3.8)	11 (4.2)	0.804
HCV only	274 (69.4)	178 (68.5)	
HIV only	3 (0.8)	4 (1.5)	
No infection	103 (26.1)	67 (25.8)	
Males: reported oral or anal sex with a man past 12 months			
Yes	13 (4.8)	33 (19.9)	<0.001
No	257 (95.2)	133 (80.1)	
HIV and HCV coinfection among those reporting MSM activity			
HCV and HIV	3 (23.1)	6 (18.2)	0.967
HCV only	5 (38.4)	13 (39.4)	
HIV only	2 (15.4)	4 (12.1)	
No infection	3 (23.1)	10 (30.3)	
HIV and HCV coinfection among those reporting no MSM activity			
HCV and HIV	9 (3.5)	3 (2.3)	0.734
HCV only	174 (67.7)	97 (72.9)	
HIV only	1 (0.4)	0 (0)	
No infection	73 (28.4)	33 (24.8)	

Categories may not add up to total due to missing data for individual variables

Given the higher prevalence of HIV among men who have sex with men (MSM), we examined HIV and HCV coinfection by report of MSM activity (Table 3). Significantly, more male participants in Seattle reported oral or anal sex with a man in the past 12 months compared to Denver participants (19.9 vs. 4.8 %, p<0.001). Among males who reported MSM

activity in Denver, 23.1 % were HCV and HIV coinfected, 38.4 % were mono-infected with HCV, and 15.4 % were HIV mono-infected. In Seattle, 18.2 % of males reporting MSM activity were HCV and HIV coinfected, 39.4 % were mono-infected with HCV, and 12.1 % were HIV mono-infected.

Injection History, Vaccination Status, and Other Substance Use by HCV Antibody Status

Within each site, we compared participants who were HCV antibody-positive (anti+) to those who were antibody-negative (anti−) by injection history, vaccination status, and non-injection substance use. In both sites, the median age at first injection was significantly lower among participants who were HCV anti+ compared to those who were HCV anti− (19.9 vs. 24.8 in Denver and 21.6 vs. 27.2 in Seattle, Table 4). Similarly, there were significant differences in HCV infection status by the number of years since first injection in both sites. In Denver, slightly more participants who were HCV anti+ had hepatitis A and/or B vaccinations compared to those who were HCV anti− (43.2 vs. 28.3 %, p=0.052). In Seattle, HCV anti+ participants actually had lower hepatitis A and/or B vaccination coverage compared to HCV anti− participants (34.3 vs. 47.9 %, p=0.181), though the difference was not significant.

Alcohol and marijuana use can exacerbate the effects of HCV, so we examined the use of these substances. There did not appear to be substantial differences in behavior based on HCV infection status in either site. In Denver, slightly more participants who were HCV anti+ reported not binge drinking in the past 12 months compared to HCV anti− participants (48.3 vs. 41.5 %, p=0.038). In Seattle, the pattern was similar with slightly more HCV anti+ participants reporting that they had not engaged in binge drinking during the past 12 months (50.5 vs. 43.7 %, p=0.495). Frequency of marijuana use did not differ by HCV infection status in either site. In Denver, fewer participants who were HCV anti+ reported never having participated in an alcohol or drug treatment program compared to HCV anti− participants (17.3 vs. 29.3 %, p=0.101).

Discussion

This study characterizes current health care coverage, HCV and HIV seroprevalence, HCV testing history, hepatitis A and B vaccination coverage, and co-occurring substance use among PWID in two urban areas in the USA. Our results provide evidence that persons who inject drugs in both Denver and Seattle have substantial unmet needs for health care coverage and access to medical preventative services. The vast majority of participants were at or below the federal poverty threshold in 2009 (US$10,830 for a family of one and US$14,570 for a family of two), either unemployed or disabled for work, and in unstable housing situations. Despite this, most participants (75 % in Denver and 83 % in Seattle) reported seeing a health care provider in the past 12 months. However, the visit with a health care provider was most likely to address an acute medical need and not to receive preventative medical care, such as screening for HCV and HIV infection or vaccinations for hepatitis A and B.

In our samples of PWID, substantially, more participants reported being uninsured in Denver (54 %) compared to Seattle (33 %). However, when we examined the number of uninsured persons in the general population during the same time frame, the difference was not as substantial with 18 % uninsured in Denver and 12 % in Seattle (US Census Bureau 2014). In both cities, the majority of participants report Medicaid as their source of health care coverage. The difference in coverage observed between the two samples of PWID may be due, in part, to the substantial difference in the number of persons reporting being disabled for work (30 % in Denver vs. 50 % in Seattle) given that Medicaid is also the federal government's mechanism for providing health care to persons with disabilities.

Though Seattle has higher Medicaid coverage compared to Denver (46 vs. 21 %), there is still ample room for expanded coverage to those currently eligible but uncovered. While not all 50 states opted to participate in Medicaid expansion as part of the Affordable Care Act, Colorado and Washington are two states moving forward with Medicaid expansion. As such, identifying those most in need of health care coverage and better access to preventative services is essential. Our findings are similar to other studies that have documented the high prevalence of health care needs among PWID. In San Francisco, 82 % of homeless PWID reported needing health care during the preceding 6 months while 75 % of the sample reported having no health insurance (Robbins et al. 2010). Restricting our samples to those PWID who reported being currently homeless, 66 % of those in Denver and 44 % of those in Seattle reported being uninsured. In Miami, the prevalence of unmet health care need among PWID was similarly high at 76 % (Chitwood et al. 1999).

Similar to other studies among PWID, we also found high prevalence of HCV antibody in our two samples (Amon et al. 2008; Fisher et al. 2006; Havens et al. 2013; Mehta et al. 2011). Though a large proportion of participants were aware of their HCV status, approximately 30 % were unaware of their infection. Our estimate of those unaware of their HCV infection is lower than some estimates of other at-risk populations. For example, in a study among homeless adults in Los Angles, nearly half of those who were HCV infected were unaware of their infection (Gelberg et al. 2012). Among young PWID in five US cities, 72 % of those who were HCV antibody-positive were unaware of their infection (Hagan et al. 2006).

Table 4 Drug use-related variables in a sample of injection drug users who were tested for hepatitis C virus (HCV), National HIV Behavioral Surveillance (NHBS), Denver, Colorado and Seattle, Washington, 2009

	Denver, CO			Seattle, WA		
	HCV anti+ (n=289) n (%)	HCV anti− (n=106) n (%)	p value	HCV anti+ (n=189) n (%)	HCV anti− (n=71) n (%)	p value
Mean age at first injection (SE)	19.9 (0.39)	24.8 (0.93)	<0.001	21.6 (0.54)	27.2 (1.16)	<0.001
Number of years since first injection						
0–5 years	18 (6.2)	47 (44.3)	<0.001	11 (5.8)	29 (40.9)	<0.001
6–15 years	54 (18.7)	28 (26.4)		40 (21.2)	36 (50.7)	
16–25 years	66 (22.8)	17 (16.0)		62 (32.8)	4 (5.6)	
>=26 years	151 (52.3)	14 (13.2)		76 (40.2)	2 (2.8)	
Hepatitis vaccinations						
Hepatitis A vaccine	11 (3.8)	2 (1.9)	0.052	8 (4.2)	3 (4.2)	0.181
Hepatitis B vaccine	20 (6.9)	3 (2.8)		10 (5.3)	7 (9.9)	
Hepatitis A and B vaccines	94 (32.5)	25 (23.6)		47 (24.8)	24 (33.8)	
Never vaccinated or do not know	164 (56.8)	76 (71.7)		124 (65.6)	37 (52.1)	
Frequency of "binge" drinking past 12 months[a]						
Never	139 (48.3)	44 (41.5)	0.038	95 (50.5)	31 (43.7)	0.495
At least once a day	13 (4.5)	11 (10.4)		12 (6.4)	4 (5.6)	
At least once a week	48 (16.7)	27 (25.5)		32 (17.0)	13 (18.3)	
At least once a month	36 (12.5)	11 (10.4)		21 (11.2)	6 (8.5)	
Less than once a month	52 (18.1)	13 (12.3)		28 (14.9)	17 (23.9)	
Frequency of marijuana use past 12 months						
Never	117 (40.5)	36 (34.0)	0.581	73 (38.8)	22 (31.0)	0.427
At least once a day	44 (15.2)	20 (18.9)		19 (10.1)	12 (16.9)	
At least once a week	42 (14.5)	14 (13.2)		30 (16.0)	9 (12.7)	
At least once a month	41 (14.2)	14 (13.2)		35 (18.6)	13 (18.3)	
Less than once a month	45 (15.6)	22 (20.7)		31 (16.5)	15 (21.1)	
Participated in alcohol or drug treatment program in past 12 months						
Yes	118 (40.8)	45 (42.6)	0.010	62 (33.0)	22 (31.0)	0.354
Not in past 12 months	121 (41.9)	30 (28.3)		100 (53.2)	34 (47.9)	
Never	50 (17.3)	31 (29.3)		26 (13.8)	15 (21.1)	

Categories may not add up to total due to missing data for individual variables

[a] "Binge" drinking defined as five or more drinks in one sitting for males and four or more drinks in one sitting for females

Among persons who were HCV antibody-positive, approximately 40 % reported being vaccinated for hepatitis A and/or B. Surprisingly, our vaccination coverage rates are slightly higher than those reported in a cohort study of HCV-infected patients enrolled in private health insurance plans and population-based estimates (Centers for Disease Control and Prevention 2006; Kanwal et al. 2010; Wong et al. 1996). One study of PWID aged 15 to 30 found that only 10 % had been vaccinated for hepatitis B (Kuo et al. 2004a, b). In an earlier study conducted between 1999 and 2002, the same investigators demonstrated that the validity of self-reported hepatitis B vaccination was poor with 52 % of those claiming to be vaccinated actually being susceptible to HBV as measured by serological markers (Kuo et al. 2004a, b). Our vaccination coverage rates should be interpreted with caution given that they are based on participant self-report and were not confirmed by examination of medical record, or serological verification of immunity status, for those who most likely received the vaccines as adults. Furthermore, our data does not capture the number of doses an individual received. A study evaluating the uptake of free hepatitis B vaccinations among PWID in the Netherlands suggests that perceived behavioral control related to vaccination was predictive of vaccine uptake (Baars et al. 2008). While hepatitis B vaccination does not provide biological protection against HCV, it may help create stronger pro-health attitudes among PWID (Quaglio et al. 2003). Most importantly, because infection with hepatitis A and/or B creates serious complications for those with chronic liver disease, ensuring that persons with HCV infection are

vaccinated for both hepatitis A and B is a critical prevention issue.

Given that excessive alcohol consumption is also an important factor affecting the progression of liver disease among those infected with HCV, we compared the frequency of "binge" drinking between those who were HCV infected and those who were not. There was no evidence that HCV-positive participants reported less binge drinking than HCV-negative participants. In both sites, roughly half of those who were HCV infected reported abstaining from alcohol during the preceding 12 months. Still, we found that approximately 20 % of participants reported binge drinking at least weekly during the past 12 months. A recent analysis of the National Health and Nutrition Examination Survey (NHANES III) examined the long-term outcomes among those with chronic hepatitis C. The authors found that chronically infected patients with excessive alcohol use had a dramatically increased risk of all-cause mortality with a hazard ratio of 5.12 (95 % CI 1.97–13.28), in addition to increased liver-related mortality (Younossi et al. 2013). In a cohort study of HIV-infected patients, reporting being told that they were HCV infected was associated with greater abstinence from alcohol with an adjusted odds ratio of 1.60 (95 % CI 1.13–2.27). The authors suggest that it is being told of one's hepatitis C diagnosis, rather than actually having infection, that is linked to the effect on drinking (Tsui et al. 2007).

Several studies have documented the association between moderate to severe fibrosis and daily cannabis use among HCV-infected individuals (Dore and Thomas 2005; Hezode et al. 2008; Ishida et al. 2008). In both cities, we did not see significant differences in marijuana use between those who were HCV infected and those who were not, with approximately 15 % of participants reporting daily cannabis use in both cities. Cannabis use may also be related to syringe sharing among PWID which has obvious implications for HCV and HIV transmission. In a study of PWID of which 236 (36.6 %) were regular cannabis users and 227 (35.2 %) were non-regular cannabis users, cannabis use was associated with a fivefold increased risk of sharing syringes in non-regular users compared to regular users (Jutras-Aswad et al. 2010).

Despite the recommendation that PWID be tested annually for HIV, less than half of participants who had seen a health care provider in the past 12 months were offered an HIV test. Our findings are similar to those from a study of PWID in two Mexico-US border cities which showed that 65 % of those who had never been tested for HIV experienced at least one missed opportunity for testing (Moyer et al. 2008). Detention, whether in jail or prison, often offers an opportunity to screen for HIV and HCV for detention facilities where medical services are available. In our study, we found that approximately 20 % of those who had been incarcerated during the past 12 months had been offered an HIV and/or HCV test. However, we did not ask if vaccinations for hepatitis A and B were offered during the last detention stay.

While we observed differences between the two cities related to medical coverage and potential access to preventative medical services, it is also important to note a key difference between the two cities related to harm reduction services for PWID. Since 1989, Seattle has had legally operating syringe programs that offer HIV/HCV testing and counseling, hepatitis A and B vaccinations, and abscess treatment and care in addition to the provision of sterile syringes. In contrast, Denver did not legalize syringe programs until 2012. Prior to that, harm reduction services for PWID were limited to the provision of clean cookers, cottons, and water and HIV/HCV testing and counseling. We compared several indicators related to harm reduction between the two cities. Significantly, more PWID in Seattle (33 %) reported always using a sterile syringe compared to Denver participants (20 %, $p<0.001$). Similarly, fewer participants in Seattle reported sharing syringes with others compared to Denver (31.5 vs. 40.7 %, $p<0.01$). Despite this, the overall prevalence of HIV and HCV in our samples is comparable between the two cities.

Our findings are subject to several limitations. First, because the survey was administered by an interviewer, some participants might not have reported their behaviors accurately. Second, we did not run HCV RNA tests on samples from participants who were HCV antibody-positive so our HCV+ results may include some individuals who have cleared the infection Third, because of logistics related to the premarket evaluation of the rapid HCV antibody assays, there was a delay in initiating HCV testing resulting in not all NHBS participants being offered an HCV test. Fourth, though participants were recruited using RDS, we do not present RDS-weighted estimates. Finally, our results are limited to respondents in two urban cities in the Western part of the USA and may not be generalizable to PWID in other parts of country or to other countries.

Not only are PWID disproportionately affected by HIV and HCV infection, they are also disproportionately affected by limited access to health care and other social and preventative services they so desperately need. An analysis of population-based data demonstrated that HCV infection was an independent predictor of being uninsured (Stepanova et al. 2011). Our findings underscore the need to improve access to preventative services and care, such as hepatitis A and B vaccination, for PWID. Previous studies have shown that providing on-site vaccination at locations where PWID access other services can increase adherence to vaccination (Burr et al. 2014; Campbell et al. 2007; Des Jarlais et al. 2001). While access to preventative services is essential, ensuring that PWID utilize services once they are accessed is also critical. As recently demonstrated in a randomized control trial of methadone maintenance patients, the provision of coordinated care which includes on-site screenings, motivational-enhanced education

and counseling, on-site vaccination, and case management services is efficacious in increasing hepatitis A and B vaccinations and HCV evaluation (Masson et al. 2013). Given how marginalized PWID can often be, providing comprehensive preventative services at locations where they may feel more comfortable accessing other services, such as syringe exchange programs or community-based organizations, is essential.

Whereas PWID account for a substantial proportion of the HIV epidemic, their burden of the HCV epidemic is enormous. With a new generation of highly effective interferon-free direct-active antivirals for the treatment of HCV on the horizon, coupled with the expansion of health coverage in the USA, a real opportunity to achieve substantial reductions in prevalent HCV now exists. However, juxtaposed against the promise of making a significant public health impact, we are confronted by the challenge of a "re-emerging HCV epidemic" among adolescent and young PWID. In both cities, the mean age of first injection was significantly lower among those who were HCV infected indicating an increased risk for younger PWID. As recently summarized by recommendations from the US Office of HIV/AIDS and Infectious Disease Policy, "embracing a perspective that recognizes the syndemic nature of emergent HCV infection among adolescent and young IDUs requires a commitment to simultaneously address substance use and its social antecedents as well as to confront the ongoing and powerful stigma associated with substance use disorders and persons who inject drugs (Valdiserri et al. 2014)." Prevention science has a critical role to play in addressing this syndemic as developmentally appropriate interventions to prevent substance use upstream could have a tremendous impact on mitigating the downstream effects.

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References

Aceijas, C., & Rhodes, T. (2007). Global estimates of prevalence of HCV infection among injecting drug users. *The International Journal on Drug Policy, 18*, 352–358.

Alter, M. J., Kuhnert, W. L., & Finelli, L. (2003). Guidelines for laboratory testing and result reporting of antibody to hepatitis C virus. Centers for Disease Control and Prevention. *MMWR Recommendations and Reports, 52*, 1–13.

Amon, J. J., Garfein, R. S., Ahdieh-Grant, L., Armstrong, G. L., Ouellet, L. J., Latka, M. H., et al. (2008). Prevalence of hepatitis C virus infection among injection drug users in the United States, 1994–2004. *Clinical Infectious Diseases, 46*, 1852–1858.

Appel, P. W., Ellison, A. A., Jansky, H. K., & Oldak, R. (2004). Barriers to enrollment in drug abuse treatment and suggestions for reducing them: Opinions of drug injecting street outreach clients and other system stakeholders. *The American Journal of Drug and Alcohol Abuse, 30*, 129–153.

Armstrong, G. L., Wasley, A., Simard, E. P., McQuillan, G. M., Kuhnert, W. L., & Alter, M. J. (2006). The prevalence of hepatitis C virus infection in the United States, 1999 through 2002. *Annals of Internal Medicine, 144*, 705–714.

Baars, J., Boon, B., De Wit, J. B., Schutten, M., Van Steenbergen, J. E., Garretsen, H. F., et al. (2008). Drug users' participation in a free hepatitis B vaccination program: Demographic, behavioral, and social-cognitive determinants. *Substance Use & Misuse, 43*, 2145–2162.

Brady, J. E., Friedman, S. R., Cooper, H. L., Flom, P. L., Tempalski, B., & Gostnell, K. (2008). Estimating the prevalence of injection drug users in the U.S. and in large U.S. metropolitan areas from 1992 to 2002. *Journal of Urban Health, 85*, 323–351.

Burr, C. K., Storm, D. S., Hoyt, M. J., Dutton, L., Allread, V., et al. (2014). Integrating health and prevention services in syringe access programs: A strategy to address unmet needs in a high-risk population. *Public Health Reports, 129*, 26–32.

Campbell, J. V., Garfein, R. S., Thiede, J., Hagan, H., Ouellet, L. J., Golub, E. T., et al. (2007). Convenience is the key to hepatitis A and B vaccination uptake among young adult injection drug users. *Drug and Alcohol Dependence, 91*, S64–S72.

Centers for Disease Control and Prevention. (2006). Hepatitis B vaccination coverage among adults–United States, 2004. *MMWR Weekly Report, 55*, 509–511.

Centers for Disease Control and Prevention. (2012a). Integrated prevention services for HIV infection, viral hepatitis, sexually transmitted diseases, and tuberculosis for persons who use drugs illicitly: Summary guidance from CDC and the U.S. Department of Health and Human Services. *MMWR Recommendations and Reports, 61*, 1–40.

Centers for Disease Control and Prevention. (2012b). HIV infection and HIV-associated behaviors among injecting drug users—20 cities, United States, 2009. *MMWR Weekly Report, 61*, 133–138.

Chitwood, D. D., Comerford, M., & McCoy, H. V. (2002). Satisfaction with access to health care among injection drug users, other drug users, and nonusers. *The Journal of Behavioral Health Services & Research, 29*, 189–197.

Chitwood, D. D., McBride, D. C., French, M. T., & Comerford, M. (1999). Health care need and utilization: A preliminary comparison of injection drug users, other illicit drug users, and nonusers. *Substance Use and Misuse, 34*, 727–746.

Cronquist, A., Edwards, V., Galea, S., Latka, M., & Vlahov, D. (2001). Health care utilization among young adult injection drug users in Harlem, New York. *Journal of Substance Abuse, 13*, 17–27.

Des Jarlais, D. C., Fisher, D. G., Newman, J. C., Trubatch, B. N., Yancovitz, M., Paone, D., et al. (2001). Providing hepatitis B vaccination to injection drug users: Referral to health clinics vs on-site vaccination at a syringe exchange program. *American Journal of Public Health, 91*, 1791–1792.

Dore, G. J., & Thomas, D. L. (2005). Management and treatment of injection drug users with hepatitis C virus (HCV) infection and HCV/human immunodeficiency virus coinfection. *Seminars in Liver Disease, 25*, 18–32.

Fisher, D. G., Reynolds, G. L., Jaffe, A., & Perez, M. J. (2006). Hepatitis and human immunodeficiency virus co-infection among injection

drug users in Los Angeles County, California. *Journal of Addictive Diseases, 25*, 25–32.

Gelberg, L., Robertson, M. J., Arangua, L., Leake, B. D., Sumner, G., Moe, et al. (2012). Prevalence, distribution, and correlates of hepatitis C virus infection among homeless adults in Los Angeles. *Public Health Reports, 127*, 407–421.

Grebely, J., deVlaming, S., Duncan, F., Viljoen, M., & Conway, B. (2008). Current approaches to HCV infection in current and former injection drug users. *Journal of Addictive Diseases, 27*, 25–35.

Hagan, H., Campbell, J., Thiede, H., Strathdee, S., Ouellet, L., Kapadia, F., et al. (2006). Self-reported hepatitis C virus antibody status and risk behavior in young injectors. *Public Health Reports, 121*, 710–719.

Hagan, H., Pouget, E. R., & Des Jarlais, D. C. (2011). A systematic review and meta-analysis of interventions to prevent hepatitis C virus infection in people who inject drugs. *Journal of Infectious Diseases, 204*, 74–83.

Havens, J. R., Lofwall, M. R., Frost, S. D., Oser, C. B., Leukefeld, C. G., & Crosby, R. A. (2013). Individual and network factors associated with prevalent hepatitis C infection among rural Appalachian injection drug users. *American Journal of Public Health, 103*, e44–e52.

Heckathorn, D. D. (1997). Respondent-driven sampling: A new approach to the study of hidden populations. *Social Problems, 44*, 174–199.

Hezode, C., Zafrani, E. S., Roudot-Thoraval, F., Costentin, C., Hessami, A., Bouvier-Alias, M., et al. (2008). Daily cannabis use: A novel risk factor of steatosis severity in patients with chronic hepatitis C. *Gastroenterology, 134*, 432–439.

Ishida, J. H., Peters, M. G., Jin, C., Louie, K., Tan, V., Bacchetti, P., et al. (2008). Influence of cannabis use on severity of hepatitis C disease. *Clinical Gastroenterology and Hepatology, 6*, 69–75.

Jutras-Aswad, D., Zang, G., & Bruneau, J. (2010). Cannabis use correlates of syringe sharing among injection drug users. *The American Journal on Addictions, 19*, 231–237.

Kaiser Commission on Medicaid and the Uninsured (2013) Key Facts about the Uninsured Population Retrieved Feb 12, 2014, from http://kff.org/uninsured/fact-sheet/key-facts-about-the-uninsured-population/

Kanwal, F., Schnitzler, M. S., Bacon, B. R., Hoang, T., Buchanan, P. M., & Asch, S. M. (2010). Quality of care in patients with chronic hepatitis C virus infection: A cohort study. *Annals of Internal Medicine, 153*, 231–239.

Klevens, R. M., Hu, D. J., Jiles, R., & Holmberg, S. D. (2012). Evolving epidemiology of hepatitis C virus in the United States. *Clinical Infectious Disease, 55*, S3–S9.

Kuo, I., Mudrick, D. W., Strathdee, S. A., Thomas, D. L., & Sherman, S. G. (2004a). Poor validity of self-reported hepatitis B virus infection and vaccination status among young drug users. *Clinical Infectious Diseases, 38*, 587–590.

Kuo, I., Sherman, S. G., Thomas, D. L., & Strathdee, S. A. (2004b). Hepatitis B virus infection and vaccination among young injection and non-injection drug users: Missed opportunities to prevent infection. *Drug and Alcohol Dependence, 73*, 69–78.

Ly, K. N., Xing, J., Klevens, R. M., Jiles, R. B., Ward, J. W., & Holmberg, S. D. (2012). The increasing burden of mortality from viral hepatitis in the United States between 1999 and 2007. *Annals of Internal Medicine, 156*, 271–278.

Maheshwari, A., & Thuluvath, P. J. (2010). Management of acute hepatitis C. *Clinics in Liver Disease, 14*, 169–176.

Masson, C. L., Delucchi, K. L., McKnight, C., Hettema, J., Khalili, M., Min, A., et al. (2013). A randomized trial of a hepatitis care coordination model in methadone maintenance treatment. *American Journal of Public Health, 103*, e81–e88.

Mehta, S. H., Astemborski, J., Kirk, G. D., Strathdee, S. A., Nelson, K. E., Vlahov, D., et al. (2011). Changes in blood-borne infection risk among injection drug users. *Journal of Infectious Diseases, 203*, 587–594.

Mehta, S. H., Kirk, G. D., Astemborski, J., Galai, N., & Celentano, D. D. (2010). Temporal trends in highly active antiretroviral therapy initiation among injection drug users in Baltimore, Maryland, 1996-2008. *Clinical Infectious Diseases, 50*, 1664–1671.

Miller, C. L., Wood, E., Spittal, P. M., Li, K., Frankish, J. C., Braitstein, P., et al. (2004). The future face of coinfection: Prevalence and incidence of HIV and hepatitis C virus coinfection among young injection drug users. *Journal of Acquired Immune Deficiency Syndromes, 36*, 743–749.

Mohd Hanafiah, K., Groeger, J., Flaxman, A. D., & Wiersma, S. T. (2013). Global epidemiology of hepatitis C virus infection: New estimates of age-specific antibody to HCV seroprevalence. *Hepatology, 57*, 1333–1342.

Moyer, L. B., Brouwer, K. C., Brodine, S. K., Ramos, R., Lozada, R., Cruz, M. F., et al. (2008). Barriers and missed opportunities to HIV testing among injection drug users in two Mexico–US border cities. *Drug and Alcohol Review, 27*, 39–45.

Quaglio, G. L., Lugoboni, F., Pajusco, B., Sarti, M., Talamini, G., Mezzelani, P., et al. (2003). Hepatitis C virus infection: Prevalence, predictor variables and prevention opportunities among drug users in Italy. *Journal of Viral Hepatitis, 10*, 394–400.

Robbins, J. L., Wenger, L., Lorvick, J., Shiboski, C., & Kral, A. H. (2010). Health and oral health care needs and health care-seeking behavior among homeless injection drug users in San Francisco. *Journal of Urban Health, 87*, 920–930.

Smith, B. D., Morgan, R. L., Beckett, G. A., Falck-Ytter, Y., Holtzman, D., Teo, C. G., et al. (2012). Recommendations for the identification of chronic hepatitis C virus infection among persons born during 1945–1965. *MMWR Recommendations and Reports, 61*, 1–32.

Stepanova, M., Kanwal, F., El-Serag, H. B., & Younossi, Z. M. (2011). Insurance status and treatment candidacy of hepatitis C patients: Analysis of population-based data from the United States. *Hepatology, 53*, 737–745.

Tempalski, B., Pouget, E. R., Cleland, C. M., Brady, J. E., Cooper, H. L., Hall, H. I., et al. (2013). Trends in the population prevalence of people who inject drugs in US metropolitan areas 1992-2007. *PLoS One, 8*, e64789.

Tsui, J. I., Saitz, R., Cheng, D. M., Nunes, D., Libman, H., Alperen, J. K., et al. (2007). Awareness of hepatitis C diagnosis is associated with less alcohol use among persons co-infected with HIV. *Journal of General Internal Medicine, 22*, 822–825.

United States Census Bureau (2014) Health Insurance Coverage Status, 2009-201 American Community Survey 3-Year Estimates. Retrieved March 3, 2014, from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_11_3YR_S2701&prodType=table

Valdiserri, R., Khalsa, J., Dan, C., Holmberg, S., Zibbell, J., Holtzman, D., et al. (2014). Confronting the emerging epidemic of HCV infection among young injection drug users. *American Journal of Public Health, 104*, 816–821.

Vickerman, P., Martin, N. K., Roy, A., Beattie, T., Jarlais, D. D., Strathdee, S., et al. (2013). Is the HCV-HIV co-infection prevalence amongst injecting drug users a marker for the level of sexual and injection related HIV transmission? *Drug and Alcohol Dependence, 132*, 172–181.

Weber, R., Sabin, C. A., Friis-Moller, N., Reiss, P., El-Sadr, W. M., Kirk, O., et al. (2006). Liver-related deaths in persons infected with the human immunodeficiency virus: The D:A:D study. *Archives of Internal Medicine, 166*, 1632–1641.

Wong, V., Wreghitt, T. G., & Alexander, G. J. (1996). Prospective study of hepatitis B vaccination in patients with chronic hepatitis C. *British Medical Journal, 312*, 1336–1337.

Younossi, Z. M., Zheng, L., Stepanova, M., Venkatesan, C., & Mir, H. M. (2013). Moderate, excessive or heavy alcohol consumption: Each is significantly associated with increased mortality in patients with chronic hepatitis C. *Alimentary Pharmacology & Therapeutics, 37*, 703–709.