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Hepatitis C Among Clients of Health Care for the Homeless Primary Care Clinics

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Abstract

Objectives—To describe the prevalence, distribution and risk factors for hepatitis C virus (HCV) infection among homeless adults using eight Health Care for the Homeless (HCH) clinics nationally.

Methods—Data were collected for 387 participants through blood draws, structured interviews, chart reviews.

Results—Overall prevalence of HCV-antibody positivity was 31.0%, including 70.0% among injection drug users and 15.5% among reported non-injectors. Much HCV infection was “hidden” as the majority (53.3%) of HCV-antibody positive participants was unaware of their status. Independent risk factors for HCV among the total sample included injection drug use, prison and tattoos; among injectors, risk factors included prison and 3 years of injection drug use; and among reported non-injectors, risk factors included tattoos and prison.

Conclusion—These HCH clinics serve high concentrations of HCV-infected injectors, making these and similar clinics priority intervention sites for aggressive screening, education, testing, and treatment for HCV and other blood-borne diseases.

Keywords

homeless; hepatitis C; Health Care for the Homeless; tattoos; injection drug use; prison; risk factors; primary care clinics; blood borne disease; infectious disease; sexual risk

Hepatitis C in general populations

Hepatitis C is a contagious liver disease caused by the HCV virus (HCV) that is transmitted by direct exposure to infectious blood, and it constitutes a serious public health problem worldwide.¹ The US prevalence of hepatitis C is estimated to be 1.6% (or 4.1 million).² Most of these [an estimated 1.3% (or 2.7 to 3.9 million)] have *chronic* HCV.¹⁻² Although HCV-related diseases have a slow progression among persons with chronic HCV, chronic HCV infection is the leading cause of cirrhosis and liver cancer.^{1, 3-5} The prevalence of hepatitis C cirrhosis and its complications are expected to increase through 2020 in the US due to infections acquired between 1970 and 1990.⁶⁻⁷ A disproportionate burden of HCV in the US has been demonstrated for persons who have low family income or a prison history; who are non-Hispanic Black males, HIV-infected, or Vietnam veterans; or who were born between 1945 and 1964.^{2, 5}

Recent US prevalence estimates cited above are based on a national household survey, the National Health and Nutrition Examination Survey (NHANES) from 1999 through 2002.² The NHANES estimates are based on a national household sample that included non-institutionalized persons ages six and older.² The NHANES did not include understudied populations such as homeless persons or prison inmates, both of which have relatively higher rates of HCV^{5, 8-9} and lower access to medical services where HCV might be diagnosed and treated.^{1, 10} Higher rates of HCV have also been reported in US mental health treatment institutions.¹¹⁻¹² Rates of newly acquired HCV infections appear to be declining^{4, 13-14}, although interpretation of this trend is complicated by the failure to include many injection drug users and other high-risk groups in the current surveillance systems.¹

Hepatitis C in homeless persons

Earlier studies of HCV in US *homeless* adults report HCV rates that range widely between 26.5% and 69.1%,¹⁵⁻²⁰ depending on each study's demographic profile and sample source. Studies have been based on diverse sampling sites^{9, 16, 18, 21} and on very specific homeless sub-populations such as youth, veterans in domiciliary care, HIV-infected persons, injectors, and persons with serious mental illness or co-occurring substance use with major mental disorders.^{15-17, 20} One study reported retrospective test results (i.e., based on self-reported results of prior HCV tests) with questionable validity.¹⁷ Several studies found severity of homelessness to be an independent factor for HCV including Hall and colleagues who reported homelessness to be an independent risk factor for HCV among urban poor in San Francisco.^{9, 15}

In the past decade, the National Institutes of Health (NIH) and the Centers for Disease Control (CDC) have outlined a national agenda for HCV research that recommends continued epidemiological monitoring and studies on the specific modes of transmission among racial and ethnic minority persons, low socioeconomic groups, and injection and intranasal drug users.²²⁻²³ The NIH and the CDC have emphasized that early detection and treatment, along with educational efforts for high-risk and infected persons, are crucial elements of the national health agenda for preventing the spread and consequences of HCV. The Institute of Medicine's (IOM) 2010 report on a national strategy for prevention and control of hepatitis B and C reported that reducing the rates of illness and death associated

with hepatitis C will require improved identification of at-risk people and improved access to medical care.¹

The NIH, CDC, and IOM Reports are pertinent to healthcare providers who serve homeless clients due to the high prevalence of HCV among homeless persons who generally experience impaired health status and whose lives are already complicated by social demands.^{1, 22-23}

In contrast to previous studies, the present study investigated the seroprevalence, distribution, and risk factors for HCV in a broader cross section of the homeless population; that is, homeless adults that attended eight Health Care for the Homeless Program (HCH) primary care clinics. The HCH is funded by the Bureau of Primary Health Care of the US Health Resources and Services Administration. The federally funded HCH grantees serve about 700,000 persons yearly. This study analyzed the epidemiology, distribution, and risk factors for HCV among 387 homeless clients systematically sampled from eight of 185 HCH clinics nationally. The results of this multi-site study will inform policy makers and healthcare providers about the extent and risk factors for HCV among homeless adult clients of selected HCH clinics. In doing so, the paper will describe HCV prevalence and risk factors for exposure among a high-risk population. Findings will support the ongoing national agenda for preventing the spread and consequences of HCV to homeless persons and the broader community.

Method

Design

For this community-based study, the HCV Task Force of the Health Care for the Homeless Clinicians' Network (HCHCN, a membership group of the National Health Care for the Homeless Council), which included HCH clinicians and researchers, worked collaboratively to design and oversee this study from its inception, including development of the fieldwork protocol and data collection instruments. Lead clinicians from the HCH Hepatitis C Task Force volunteered their clinics as study sites and agreed to lead their clinic's onsite data collection. Additional clinics were recruited to balance geographic distribution. A \$500 incentive was provided to each participating clinic to partially offset staff time used for data collection.

Eight clinics were chosen from geographically diverse urban settings. Although the clinics were not randomly selected, they were selected from diverse regions of the US including Los Angeles, CA; Phoenix, AZ; Denver, CO; Albuquerque, NM; Des Moines, IA; Milwaukee, WI; Birmingham, AL and Providence, RI.

Study protocols were piloted at three sites. Researchers and HCH project staff worked with clinical teams at each clinic to tailor the standard research protocol to each site. Then each clinical team, which would be collecting all data for the study at their respective sites, also piloted data collection and fieldwork protocols at their own sites. During the data collection period, the HCH Project Director and the researchers were available on-call throughout the data collection process to address emerging issues and concerns. Training in laboratory procedures was similarly carried out between the Project Director, individual site staffs, and the independent laboratory coordinator. The lab coordinator met with individual sites to discuss the lab protocol including blood testing, storage and mailing procedures. All blood was tested at a centralized laboratory.

Sampling, screening, and recruitment

The recruitment goal was fifty homeless adult clients randomly sampled from each of the eight study clinics for a total sample size of 400. Clients were sampled systematically with a random start. Lead clinicians continued recruitment over a number of days until a sample size of 50 clients was completed for each clinic.

At the beginning of the clinic day, an intake staff person systematically sampled potential subjects from the appointment list or intake roster, for example, by sampling every fifth client after a random start. In turn, each of these clients was screened for eligibility for the study based on two criteria: age (18 and older) and meeting the federal definition of literal homelessness. "Literal homelessness" was based on one question about the place where the client had spent the previous night. Eligible clients were invited to complete an interview and blood draw to test for HCV and hepatitis B (HBV) infections. The clinician then obtained written informed consent to participate in the study. A separate consent form authorized subsequent access to each client's medical records to determine whether they returned for their respective test results.

Each client completed a 20-minute face-to-face interview with the lead clinician followed by tailored pre-test counseling for HBV and HCV and a blood draw. Each client received an incentive of \$10 cash or a \$10-cash equivalent for completion of all three. Clients were then scheduled for an appointment in the same clinic about two weeks later to obtain the results of their blood tests.

Blood specimens were sent to and tested by an independent central laboratory. Only HCV antibody results were analyzed here. To assess for HCV, blood specimens were analyzed for the HCV antibody and alanine aminotransferase (ALT). Based on the CDC suggested protocol, confirmation of HCV antibody positivity was conducted using the recombinant immunoblot assay (RIBA) test for cases in which the signal-to-cutoff ratio was less than 3.8 on the initial anti-HCV antibody EIA test.²⁴

Individual lab results were faxed back to respective clinics and affixed to each client's medical chart by clinic staff. Depending on their HCV test results, returning clients received tailored post-test counseling and usual treatment according to local clinic protocols. The HCH Task Force provided written pre- and post-test counseling guidelines as a resource for the clinics.

Data Collection

The structured interview included questions about sociodemographic characteristics and background; homelessness history; detailed medical, psychiatric, and prison history; HCV-specific knowledge and prior testing; and recent alcohol use. Questions also included potential risk behaviors for HCV transmission including lifetime drug use [e.g., drugs used, modes of use (i.e., injection, intranasal, or smoked), and sharing of injection and other drug-use equipment]; tattoos; transfusions before 1990; and sexual risk behaviors (that included number of lifetime sex partners, trading sex for cash or drugs, and lifetime anal sex). The instrument was adapted from a prior study of homeless and other indigent adults. Additional items were developed by the HCHCN HCV Task Force to address specific concerns of clinical staff.

The completion rates varied by site from 92% to 100%. Overall, 396 clients completed interviews, and among these, 387 had blood draws for an overall completion rate of 97.7%. In six clinics, lead clinicians reviewed medical records for 300 participants to determine whether each one returned for results. Among these, records indicated that 186 (62%) participants returned to the clinic during their respective 30-day follow-up periods.

The University of California Los Angeles (UCLA) Institutional Review Board (IRB) served as the multiple project assurance agency that approved the study. The study was also approved by the Federal Office of Management and Budget and individual clinic IRBs. Prior to onset of data collection, all research and clinic personnel involved in the study completed an online UCLA IRB course in the protection of human subjects.

Data analysis

Data from the eight clinics were merged into an aggregated dataset. Data analysis was performed using SAS 9.0. Categorical variables were created for age (45 < and 45+), number of lifetime sexual partners (15< or 15+), chronic homelessness (one year or more accumulated since age 18 versus less than one year), tattoos, and years of injection drug use. Differences between sites were analyzed using *Chi* Square tests. At the bivariate level, associations between categorical variables and HCV infection were examined with odds ratios (OR) and 95% confidence intervals (CI).

Three logistic regression models were developed to identify variables independently associated with HCV infection for the total sample and for two mutually exclusive groups: i.e., those who reported injection of any illicit drugs in their lifetimes, and those who reported none. Each model initially included all variables that were at least marginally associated with HCV status in the bivariate analysis ($p < 0.10$). Each model also controlled for age as a continuous variable, biological sex and race. Variables were entered into stepwise backward logistic regression models to create a core model, and then they were confirmed using stepwise forward analysis. Variables in each core model were examined and corrected for multicollinearity, defined as correlations greater than 0.5 and a variance inflation factor greater than or equal to four. Model fit was judged by the comparison of the -2 log-likelihood of model improvement and Wald statistics of the beta coefficients.

Results

Sample Overview

The majority of the sample was male, non-white, and high school graduates with a median age of 44 (Table 1.) Few self-identified as gay or bisexual (5.9%). Most experienced chronic homelessness (i.e., one year or longer cumulatively as an adult), and half (51.7%) were homeless for two years or longer. Sixteen per cent of the sample (21% of men, not shown) were US military veterans. During the 30 days prior to the interview, about half the sample had used alcohol at least once, and about one-third of the sample reported hazardous drinking (i.e., they drank four or more drinks on at least one of those days).

Regarding potential risk factors for HCV, more than one-third of the sample had ever been in prison. Two-fifths of the sample had at least one tattoo. Fourteen percent reported a transfusion of blood or blood products before 1990. Regarding sexual history, about half reported more than 15 sexual partners, and about one fifth had ever been paid for sex or been given drugs for sex. More than one-third (38.5%) of women and 3.3% of men reported lifetime anal sex.

Lifetime drug use was highly prevalent, with three-quarters reporting illicit drug use at least once. More than half (54.8%) of the sample had ever snorted cocaine. Many (28.4%) had ever injected illicit drugs, including heroin, cocaine and speed, and half of these had injected drugs during the previous 12 months.

HCV seroprevalence and distribution

Overall, 31% of the sample was HCV-antibody positive. The majority of clients who tested HCV antibody positive (53.3%) were unaware of their status. In all sites, HCV was significantly associated with rates of IDU (i.e., HCV ranged from 55.6% to 81.8% among injectors in eight study sites). Injectors accounted for the great majority (nearly two-thirds) of all HCV-positive clients in all clinics studied. HCV prevalence varied only marginally by site ($p < .086$) (Table 1), largely a function of the proportion of injection drug users.

Bivariate associations with HCV for the total sample—In bivariate analysis of the total sample, HCV rates were significantly higher among men, older persons, and adults with more education (Table 1). HCV was also higher among adults with time in prison, tattoos, recent hazardous drinking, 15 or more lifetime sexual partners, and a history of trading drugs for sex. HCV rates were significantly lower in African Americans. High risk lifetime sexual practices such as anal sex or having been paid cash for sex were not significantly associated with HCV. Drug use history was associated with HCV antibody positivity including lifetime illicit drug use, intranasal use of cocaine, and injection drug use. We conducted a subgroup analysis by injection history.

Bivariate associations with HCV for injectors—HCV prevalence among lifetime injection drug users was 70.0%. The injector subgroup was mostly male, white, and high school graduates, with a median age of 44 (Table 3). The majority had been in prison and had tattoos. The median time using injection drugs was 3.5 years, and HCV rates rose rapidly as a function of time injecting (i.e., HCV was 45.5% at less than one year, 60.0% at 1 to <3 years, and 81.4% at ≥ 3 years). More than 70% had been chronically homeless (> 1 year). Among injectors, HCV-antibody positivity was significantly higher among participants who were age 45 or older, were former prison inmates, had injected drugs for three years or longer, or had ever injected cocaine or injected heroin. Hepatitis C rates were only marginally higher for males compared to females, for Hispanics compared to non-Hispanic Whites, and for participants reporting fifteen or more lifetime sexual partners.

Bivariate associations with HCV for non-injectors—In the subgroup that reported *no* history of injection drug use, 15.5% were HCV-antibody positive. The non-injector subgroup was predominantly male, non-white, and high school graduates with a median age of 45 (Table 3). One-third had ever been in prison or had tattoos. Two-thirds of the non-injector subset had used illicit drugs. Two-fifths had more than 15 lifetime sexual partners. In the non-injector subgroup, HCV positivity was significantly higher among men, Native Americans compared to non-Hispanic Whites, participants with tattoos, former prison inmates and those who had ever been paid for sex. HCV rates were only marginally higher among more educated participants and those never given drugs for sex.

Multivariate associations with HCV for the total sample—Logistic regression analysis was used to identify significant risk factors for HCV antibody positivity in the total sample and then for the injector and non-injector subgroups, controlling for age (as a continuous variable), biological sex and white vs. non-white race (Table 4.) In the *total sample*, lifetime injection drug use, prison history, and having tattoos were significant independent predictors for HCV-antibody positivity. That is, injectors had 12.2 times greater odds of testing positive for HCV compared with the rest of the total sample. Participants with a prison history or tattoos had respectively 2.9 and 2.7 times greater odds of testing positive for HCV compared with the rest of the total sample.

Multivariate associations with HCV for the injector sub-sample—Among the *injector* subsample, prison history and three or more years of injection drug use were

significant independent predictors of HCV-antibody positivity. That is, among injectors, those with prison history or at least three years of injection drug use had respectively 3.7 and 3.3 times greater odds of testing positive for HCV compared to other injectors.

Multivariate associations with HCV for the non-injector subsample—Among the *non-injector* subsample, having tattoos and prison history were significant independent predictors of HCV-antibody positivity. That is, among non-injectors, those with one or more tattoos or time in prison had respectively 4.4 and 2.2 times greater odds of testing positive for HCV compared to other non-injectors.

HCV testing history, knowledge, and hidden infection

About 41.7% of the sample reported prior HCV testing. However, more than half (53.4%) of participants who actually tested HCV positive did not know they were currently HCV positive. While a great majority of the sample knew they could get infected with HCV from using a “dirty” or contaminated needle or syringe (90.2%), only about one-third knew that they could not get infected with HCV from contaminated food (35.2%) or that there was no vaccination against HCV (30.3%) (not shown).

Discussion

This study reports the prevalence, distribution, and risk factors for HCV infection among homeless clients from eight Health Care for the Homeless Program primary care clinics nationally. The prevalence of HCV infection overall (31.0%), was in the lower range of estimates and similar to the rates found in two previous studies of homeless adults.^{9, 17} HCV prevalence rates varied only marginally by site and were largely a function of the percentage of injection drug users.

Overall, and in each of the clinics (ranging from 18.0%–47.9%), HCV rates were high relative to the estimated HCV rate for the US general population (1.6%). Unfortunately, the US estimate is based on the general population ages six and older, which deflates the nation; 144(10):705-14nal HCV rate and which exaggerates the difference between rates of HCV between homeless adults and the general population.

Total sample

Generally, the burden of HCV fell more heavily on males, older clients, and clients with time in prison, tattoos, recent hazardous drinking, 15 or more sexual partners, and a history of trading drugs for sex. In contrast to the general population, HCV prevalence was significantly lower for non-Hispanic Blacks and clients with lower education.² In bivariate analysis, important drug-use correlates of HCV-antibody positivity were lifetime injection drug use (heroin, crack, and speed), lifetime illicit drug use, and intranasal use of cocaine. As reported here for the majority of HCV-positive homeless clients (53%), many high-risk populations in the US similarly lack knowledge about HCV including chronic HCV infection.¹

Consistent with the broader literature on HCV, the primary independent risk factor for HCV in this sample was injection of illicit drugs. More than one-quarter of the sample (28%) reported lifetime injection drug use compared to an estimated 2% in the US general adult population.² Among homeless injectors, 70.0% tested HCV-antibody positive compared to 57.5% among injectors in the general adult population, ages 20 to 59.² Rates for the eight clinics ranged from 55.6% to 81.8%. While injectors represented about one-quarter of the entire sample (28.4%), they accounted for nearly two-thirds (64.2%) of HCV-positive cases. Injectors were twelve times more likely than other clients to be HCV-positive. Overall,

about one in five homeless adults in the sample (19.9%) was an injector who tested positive for HCV. Strikingly, HCV rates rose rapidly as a function of duration of injection drug use: HCV rates were 45.5% at less than one year, 60.0% from one up to three years, and 81.4% for three years or longer.

Homeless injectors

The HCV rates for homeless and general population adults are more similar with comparisons by similar ages and risk factor. *Homeless* adult injectors (ages 18 and older) had a higher rate of HCV (70.0% reported here) compared to adult injectors in the *general population* (ages 20-59), which is estimated at 57.5% based on the NHANES data.² Nearly two-thirds of homeless adults who were HCV-positive reported histories of injection drug use, while by comparison, only about half of HCV-positive adults in the general population reported injection histories.² The rate of HCV among injectors in our sample (70%) was higher than the rates among housed young injectors in Los Angeles (27%), but similar to the range of HCV rates found among longer-term injectors in other samples (65-90%).¹

Homeless non-injectors

Reported *non-injectors* had significantly lower yet still noteworthy rates of HCV positivity (15.5%) compared to non-injectors in the general US population, which ranged from 0.7%-3.5%.² Non-injectors accounted for more than one-third of the HCV-positive clients (35.8%). Homeless non-injectors had high HCV infection rates (15.5%) In multivariate analysis, ever getting a tattoo or having a prison history were independent risk factors for HCV-positivity. Among non-injectors, clients with any histories of prison or tattoos were respectively two and four times more likely to test HCV-positive.

Specific risk factors for HCV

Prison History—As reported in previous studies, prison exposure was a significant independent risk factor for HCV infection for the total sample and the injector and non-injector subgroups, even after controlling for sex, race and age. Strikingly, 38% of the sample reported time spent in prison, and about half these were HCV antibody positive (50.7%), a rate that is higher than the range found in incarcerated populations in the US (12-35%).¹⁻²

As prison is a potential site of HCV transmission due to injection drug use or tattoos with contaminated paraphernalia, improved prison-specific HCV screening and prevention strategies are needed.^{10, 25-26} In one report, while 94% of all inmates are incarcerated in state facilities which have HCV testing policies, 69% of these facilities direct testing to 'high risk' groups or per patient request.²⁷ While testing populations with high rates of injection drug use is efficient for identifying HCV-positive persons, factors contributing to acceptance of testing and completion of treatment also need to be identified.¹⁰

Tattoos—Tattoos were a significant independent risk factor for HCV in the total sample and among non-injectors, even after controlling for prison exposure. This finding contributes to the larger body of evidence suggesting tattoos as a potential mode of HCV transmission.¹⁹ There is also evidence that tattoos, particularly those received in prison, may be a risk factor given reported sharing of tattoo-making equipment in a population with high HCV infection rates and other risk behaviors for HCV.²⁸⁻²⁹

No evidence of sexual risk for HCV—Consistent with previous studies of homeless adults, we found no evidence of HCV risk associated independently with risky sexual behaviors.⁹ Although HCV was significantly higher in bivariate analysis among clients with two sexual risk behaviors (i.e., more than 15 sexual partners and giving sex for drugs),

neither had an independent relationship to HCV infection once other variables were controlled for.

No evidence of intranasal drug use as a risk for HCV—Although HCV was significantly higher in bivariate analysis among clients with a history of intranasal cocaine use, no intranasal drug use variables had an independent relationship to HCV infection after other variables were accounted for.

Severity of Homelessness—As reported elsewhere,¹⁹ we reported marginally higher HCV prevalence among persons who experienced chronic homelessness (i.e., one year or longer cumulatively).

Strengths

Significantly, this study demonstrated the successful collaboration between a community-based interdisciplinary team of HCH clinicians and clinician-researchers with academic researchers. As a function of the project's organization, clinicians rather than research staff conducted interviews at each site. Other strengths of this study include its multisite design, random patient selection within each site, and extensive information collected from structured interviews, blood tests and medical chart reviews.

Limitations

Most data (other than HCV-antibody status and medical record data) were self-reported and subject to bias (e.g., injection drug use may be underreported due to stigma). Although all eight clinics were in urban settings, and clients were randomly selected within each site, the clinic sites themselves were not randomly selected, limiting generalizability of findings to these specific clinics. However, the demographic characteristics closely parallel figures for a nationally representative sample of homeless adults by Burt on gender, race/ethnicity, and education.³⁰ Finally, interviews were conducted by clinic staff, which may have influenced response rates and the reliability of self-reported data.

Conclusion

There were high concentrations of HCV-antibody positivity among homeless clients overall and in each of the eight HCH primary care clinics studied. Injection drug use was the strongest predictor of HCV-antibody positivity and continues to be the presumptive primary mode of HCV transmission. However, findings suggest that tattoos may also be a significant mode of transmission given that tattoos demonstrated a relationship with HCV that was independent of injection drug use, prison, and other risk factors. Tattoos may particularly help explain HCV among non-injectors. However, given the cross-sectional nature of the study, we were unable to draw causal inferences about the association between HCV and tattoos in this sample.

The high concentrations of HCV-infected adults along with adults engaged in high-risk behaviors make these and similar clinics opportune intervention sites for aggressive and comprehensive services that would include screening, testing, education, and treatment for HCV and other blood-borne diseases, as recommended by the NIH, IOM, CDC and others.^{1, 5, 23}

Our findings support the explicit inclusion of homeless persons in the national agenda on preventing and controlling HCV. The agenda emphasizes that early detection and treatment of infected persons, along with educational efforts for those with high-risk behaviors, are crucial elements for preventing the spread and consequences of HCV. Our study also supports the inclusion of homeless adults in continued epidemiological monitoring and

studies of specific modes of transmission.²³ Effective HCV prevention, education and treatment programs for homeless persons could decrease transmission, improve morbidity and mortality rates, and potentially decrease health care costs from end stage liver disease.

Nearly one-third of homeless adults who presented at the eight HCH clinics during the study were already infected with HCV. The majority of these did not know that they had been infected. Many of the rest, although not infected, reported risk behaviors for HCV exposure including injection drug use, non-injection drug use, and having tattoos.

As HCV prevalence was relatively high in all eight homeless clinics sampled, our findings lend weight to earlier studies that identified homeless persons as a high-risk group for HCV infection, primarily due to injection drug use, but also potentially due to non-injection drug use and tattoos. Reducing new cases of HCV in homeless adults requires aggressive risk-behavior screening, testing, and educational interventions to help them protect themselves and others from exposure to HCV. For those already infected with HCV, medical management of the condition is indicated to help mitigate the complications of chronic HCV.⁵

Increased age and chronic HCV—The median age of homeless adults in the US is increasing over time.³² Chronic health conditions such as hepatitis-related liver cancer and cirrhosis increase with age, and they will present challenges to traditional care giving in an aging homeless population. Researchers warn that public systems of care should expect increasing costs related to HCV infection as homeless and other indigent individuals develop the serious medical sequelae of chronic HCV infection.^{6, 16}

Findings here support the explicit inclusion of homeless persons in the NIH National HCV Agenda which emphasizes early detection and treatment, along with educational efforts, for high-risk and infected persons.²³ Similarly, findings support including homeless adults in voluntary testing to identify new cases of HCV among high-risk persons as recommended by Alter.²²

In its 2010 report on the prevention and control of hepatitis B and C, the IOM recommended that federal and state governments reduce the risk of hepatitis C virus infection due to injection drug use by providing comprehensive HCV prevention programs for injectors in community health facilities. Such programs would include education on safer injection practices, access to sterile needle syringes and drug-preparation equipment, and expansion of prevention and care services in settings that injectors and non-injection drug users are likely to use.^{1, 31}

However, the IOM Report concluded that funding for preventive and other viral hepatitis services at community health centers, including homeless programs, had been inadequate.¹ IOM authors recommended that public agencies provide adequate resources to federally funded treatment facilities, including primary care sites, to provide comprehensive viral hepatitis services for homeless and other at-risk indigent clients.

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Table 1

Distribution of hepatitis C antibody for the total sample and by site stratified by Injection Drug Use History (N=387).

Study Site	Sample size	HCV Prevalence % N	Injection Drug Users			HCV Prevalence among non- injectors % N
			Injectors as % of sample % N	HCV Prevalence among injectors % N	Injectors as % of all HCV+ %	
Total HCH Sites Ages 18+	387	31.0% (120)	28.4% (110)	70.0% (77)	64.2%	15.5% (43)
Providence, RI	48	47.9% (23)	45.8% (22)	81.8 (18)	78.3	19.2(5)
Phoenix, AZ	50	34.0% (17)	28.0 (14)%	78.6 (11)	64.7	21.4 (3)
Birmingham, AL	46	28.3% (13)	19.6% (9)	77.8 (7)	53.8	16.2 (6)
Milwaukee, WI	50	18.0% (9)	16.0% (8)	75.0 (6)	66.7	7.1 (3)
Albuquerque, NM	49	36.7% (18)	34.7% (17)	70.6(12)	66.7	18.8 (12)
Los Angeles, CA	46	28.3% (13)	17.4% (8)	62.5 (5)	38.5	21.1 (8)
Des Moines, IA	48	25.0% (12)	29.2% (14)	57.1 (8)	66.7	11.8 (4)
Denver, CO	50	30.0% (15)	36.0% (18)	55.6 (10)	66.7	15.6 (5)

Note: Prevalence of HCV varied only marginally by site ($p < .10$). Prevalence of injection drug use and prevalence of HCV among injectors varied significantly by site ($p < .05$).

Table 2

Prevalence of Antibody to Hepatitis C (HCV+) among homeless adult clients of eight HCH clinics by demographic characteristics and potential risk behaviors (N=387).

Characteristic		Sample	% HCV+	Unadjusted OR (95% CI)
		% (n)	%	
Total Sample		100.0% (387)	31.0	...
<i>Demographics/Background</i>				
Biological Sex	Male Female	72.9% (282) 27.1% (105)	34.4* 21.9	1.9 (1.1-3.2)
Race/ethnicity	White Non-White	43.9% (170) 56.1% (217)	34.7 28.1	1.4 (0.9-2.1)
Race/ethnicity (compared to White)	White, Non Hispanic Black, Non-Hispanic Latino/Hispanic Asian/Pacific Islander Native American Mixed Race	.. 38.8% (150) 9.6% (37) 0.3% (1) 3.1% (12) 4.4% (17)	.. 22.7** 40.5 0.0 58.3 [†] 9.1	.. 0.55(0.3-0.9) 1.3 (0.6-2.7) 0.6(0.0-15.5) 2.6(0.8-8.7) 0.8(0.3-2.3)
Age	<45 45	52.9% (205) 48.3% (182)	24.4 38.5***	1.9 (1.3-3.0)
Age (compared to total sample)	18-29 30-44 45-59 60	10.6% (41) 42.4% (164) 43.4% (168) 3.6% (14)	14.6* 26.8 39.9*** 21.4	0.3(0.1-0.8) 0.7(0.5-1.1) 2.1 (1.3-3.2) 0.6 (0.2-2.2)
Education completed	Less than 12 years 12 years or more	31.5% (122) 68.5%(265)	23.8* 34.3	1.7 (1.03-2.7)
Sexual Preference	Heterosexual Gay/Bisexual	94.1% (364) 5.9% (23)	30.8 34.8	0.8 (0.3-2.0)
Veteran	Yes No	16.3%(63) 83.7%(323)	34.9 30.3	1.2(0.7-2.2)
<i>Potential Risk Factors</i>				
Chronic homelessness ^a	1 year < 1 year	67.2% (260) 32.8% (127)	33.9 [†] 25.2	1.5(0.9-2.4)
Ever in Prison	Yes No	37.9% (146) 62.1% (239)	50.7*** 18.8	4.4 (2.8-7.0)
Current drinker ^b	Yes No	46.2% (179) 53.8% (208)	37.4 25.5	1.7 (1.1-2.7)
Hazardous drinker ^c	Yes No	30.0% (116) 70.0% (270)	38.8* 27.8	1.7 (1.04-2.6)
<i>Drug Use</i>				
Illicit Drug Use, ever	Yes No	77.3% (297) 22.7% (87)	36.0*** 14.9	3.2 (1.7-6.1)
Injection Drug Use, ever	Yes No	28.4% (110) 71.6%(277)	70.0*** 15.5	12.7 (7.5-21.4)
Cocaine, crack, ever	Yes No	73.1% (283) 26.9% (104)	37.1*** 14.4	3.5 (1.9-6.4)
Injected cocaine, crack ever	Yes No	21.2% (82) 78.8% (305)	78.1*** 18.4	15.8(8.7-28.7)

Characteristic		Sample	% HCV+	Unadjusted OR (95% CI)
		% (n)	%	
Snorted Cocaine, ever	Yes	54.8% (212)	39.2 ^{***}	2.4(1.5-3.8)
	No	45.2% (175)	21.1	
Heroin, ever	Yes	28.4% (109)	59.6 ^{***}	5.9 (3.6-9.5)
	No	71.6% (274)	20.0	
Injected Heroin, ever	Yes	19.9% (76)	76.3 ^{***}	12.7 (7.0-23.1)
	No	80.1% (306)	20.3	
Speed, ever	Yes	45.6% (175)	42.3 ^{***}	2.6 (1.7-4.1)
	No	54.4% (209)	22.0	
Injected Speed, ever	Yes	13.8% (53)	69.8 ^{***}	6.9 (3.7-13.1)
	No	86.2% (331)	25.1	
Received transfusion before 1990	Yes	14.2% (55)	40.0	1.6 (0.9-2.9)
	No	85.8% (331)	29.6	
Tattoo, ever	Yes	38.0% (147)	46.3 ^{***}	3.1 (2.0-4.9)
	No	62.0% (240)	21.7	
<i>Sexual Practices</i>				
Anal sex, ever	Yes	12.1%(44)	22.7	0.6(0.3-1.2)
	No	87.9%(320)	33.1	
> 15 sex partners, lifetime	Yes	47.5% (184)	39.1 ^{***}	2.1 (1.4-3.2)
	No	52.5% (203)	23.7	
Been paid for sex, ever	Yes	21.1% (81)	37.0%	1.4 (0.8-2.3)
	No	78.9% (302)	29.8	
Been given drugs for sex, ever	Yes	18.0% (69)	42.0 [*]	1.8 (1.04-3.1)
	No	82.0% (314)	28.9	

[†]
p 0.10;

^{*}
p 0.05;

^{**}
;p 0.01;

^{***}
p 0.001

^aCumulative time homeless as adult.

^bAny alcohol use in previous 30 days

^cFour or more drinks on at least one day during the past 30 days

Table 3

Prevalence of hepatitis C antibody (HCV+) among homeless adult clients of eight HCH clinics by background characteristics and potential risk behaviors, stratified by history of injection drug use (N=387).

Background Characteristics	Categories	Injection Drug Use in Lifetime (Reported)					
		Injection Drug Use (n=110)			No Injection Drug Use (n=277)		
		% (n)	HCV+	OR (95% CI)	% (n)	HCV+	OR (95% CI)
Biological Sex	Male	72.7% (80)	75.0% †	0.4 (0.2-1.1)	72.9% (202)	18.3% *	0.4 (0.2-0.96)
	Female	27.3% (30)	56.7%		27.1% (75)	8.0%	
Race/ethnicity	White, non-Hispanic	61.8% (68)	64.7%	0.5 (0.2-1.2)	36.8% (102)	14.7%	0.9 (.5-1.8)
	Non-White	38.2% (42)	78.6%		63.2% (175)	16.0%	
Race/ethnicity	White/ Non - Hispanic
	Black/ African American	20% (22)	72.7%	1.4(0.5-4.2)	46.2% (128)	14.0%	0.9(0.4-2.0)
	Latino/Hispanic	10.9% (12)	91.7% †	6.0(0.7-49.3)	9.0% (25)	16%	1.1(0.3-3.7)
	Asian/ Pacific Islander	0	0	...	0.4% (1)	0	1.9(0.1-48.3)
	Native American	2.7% (3)	100%	3.9(0.2-77.7)	3.3% (9)	44.4% *	4.6(1.1-19.2)
	Mixed Race	4.6% (5)	60%	0.8(0.1-5.2)	4.3% (12)	16.7%	1.2(0.2-5.8)
Age	<45	47% (52)	57.7	3.1 (1.3-7.4)	55.2% (153)	13.1%	1.5 (0.8-2.9)
	45	53% (58)	81.0 **		44.8% (124)	18.6%	
Age	18-29	9.1% (10)	40.0 *	0.2 (0.1-0.9)	11.2% (31)	6.5%	0.3(0.1-1.5)
	30-44	38.2% (42)	61.9	0.5 (0.2-1.2)	44.0% (122)	14.8%	0.9(0.5-1.7)
	45-59	51.8% (57)	80.7 *	3.0 (1.3-6.9)	40.1% (111)	18.9%	1.5(0.8-2.9)
	60	0.9% (1)	100.0	1.3 (0.1-33.1)	4.7% (13)	15.4%	1.0(0.2-4.6)
Education completed	< 12 years	26.4% (29)	69.0	1.1 (0.4-2.7)	34% (93)	10%	2.1 (0.97-4.6)
	12 years	73.6% (81)	70.4		66% (184)	18.5% †	
Sexual Preference	Heterosexual	90.0% (99)	69.7%	0.9 (0.2-3.5)	95.7% (265)	16.2%	4.9 (0.2-84.1)
	Gay/Bisexual	10.0% (11)	72.7%		4.3% (12)	0.0%	
Total time homeless as adult	< 1 year	22.7% (25)	60.0	1.8 (0.7-4.6)	36.8% (102)	16.7%	0.9(0.4-1.7)
	1 year	77.3% (85)	72.9		63.2% (175)	14.9%	
Prison, ever	Yes	57.8% (63)	82.5 ***	4.3 (1.8-10.3)	30% (83)	26.5% **	2.95 (1.5-5.7)
	No	42.2% (46)	52.2		70% (193)	11%	
Hazardous Drinker	Yes	36.4% (40)	75.0%	1.5 (0.6-3.5)	27.5% (76)	19.7%	1.5 (0.8-3.0)
	No	63.6% (70)	67.1%		72.5% (200)	14.0%	
<i>Drug Use</i>							
Illicit Drug Use, ever	Yes	100.0%(110)			68% (187)	16%	1.1 (0.5-2.2)
	No	0.0%			32% (87)	15%	
Injection Drug Use, ever	Yes	100.0% (110)			None		
	No	0.0%					
Injection Drug Use (duration)	<1 year	10.0% (11)	45.5%	None		
	1 < 3 years	36.4% (40)	60.0%	1.8 (0.5-6.9)			
	3 years	53.6% (59)	81.4% *	5.2 (1.3-20.3)			
Cocaine, crack ever	Yes	98.2% (108)	71.3%	12.3 (0.5-263.5)	63.2% (175)	16.0%	1.1(0.6-2.2)
	No	1.8% (2)	0.0%		36.8% (102)	14.7%	
Injected cocaine, crack ever	Yes	74.6% (82)	78.1% **	4.1 (1.7-10.2)	None		
	No	25.4% (28)	46.4%				

Background Characteristics	Categories	Injection Drug Use in Lifetime (Reported)					
		Injection Drug Use (n=110)			No Injection Drug Use (n=277)		
		% (n)	HCV+	OR (95% CI)	% (n)	HCV+	OR (95% CI)
Intranasal cocaine ever	Yes	86.4% (95)	68.4%	0.5 (0.1-2.1)	42.2% (117)	15.4%	1.0(0.5-1.9)
	No	13.6% (15)	80.0%		57.8% (160)	15.6%	
Heroin ever	Yes	75.5% (83)	75.9% *	2.9 (1.2-7.2)	9.5% (26)	7.7%	0.4 (0.1-1.8)
	No	24.5% (27)	51.9%		90.5% (247)	16.6%	
Injected heroin ever	Yes	69% (76)	76% *	2.5 (1.1-6.0)	None		
	No	31% (34)	56%				
Speed ever	Yes	74% (81)	70%	1.1 (0.4-2.7)	34% (94)	18%	1.3 (0.7-2.6)
	No	26% (29)	69%		66% (180)	14%	
Injected speed ever	Yes	48% (53)	70%	0.98 (0.4-2.2)	None		
	No	52% (57)	70%				
<i>Potential behavioral risk factors</i>							
Tattoo ever	Yes	55% (61)	70%	1.1 (0.5-2.4)	31.1% (86)	29.1% ***	3.9 (2.0-7.7)
	No	45% (49)	69%		68.9% (191)	9.4%	
> 15 sex partners lifetime	Yes	63.6% (70)	75.7% †	2.1 (0.9-4.8)	41.2% (114)	16.7%	1.2 (0.6-2.2)
	No	36.4% (40)	60.0%		58.8% (163)	14.7%	
Been paid for sex, ever	Yes	31.8 (35)	71.4%	1.1 (0.5-2.7)	16.9% (46)	10.9%	0.2 (0.02-1.1)
	No	68.2% (75)	69.3%		83.1% (227)	16.7% *	
Been given drugs for sex, ever	Yes	32.7% (36)	77.8%	1.8(0.7-4.5)	12.1% (33)	3.0%!	0.1 (0.02-1.1)
	No	67.3% (74)	66.2%		87.9% (240)	17.5%	

† p-value 0.10;

* p-value 0.05;

** p-value 0.01;

*** p-value 0.001

Note: OR= Odds ratio; CI= 95% Confidence interval

Table 4

Factors independently associated with hepatitis C antibody positivity (HCV+) among homeless adult clients of eight HCH Clinics for the total sample and stratified by injection history.

Risk Factors	Total Sample (N=387)		Reported Injection History (lifetime)			
			Injectors (n=110)		Never Injectors (n=277)	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Injection drug use	12.2	6.6 to 22.6	--	--	--	--
3+ years of IDU	--	--	3.3	1.3 to 9.8	--	--
Prison ever	2.9	1.7 to 5.2	3.7	1.3 to 9.7	2.2	1.1 to 4.6
Tattoo ever	2.7	1.5 to 4.8	--	--	4.4	2.1 to 9.6

Note. Multivariate logistic regression analysis controlling for age as a continuous variable, biological sex and white/non-white race or ethnicity. AOR= adjusted odds ratio; CI=confidence interval.