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MAJOR ARTICLE

Hepatitis C Testing and Linkage to Care Among Adults on Probation in a Large US City

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Background. Despite constituting the largest segment of the correctional population, individuals on probation remain largely unstudied with respect to hepatitis C virus (HCV) testing and linkage to care. We implemented an HCV testing and patient navigation program at an adult probation department.

Methods. Adults were tested at a local probation department with a rapid point-of-care HCV antibody (Ab) assay followed by a laboratory-based HCV ribonucleic acid (RNA) assay if anti-HCV positive. All individuals received counseling rooted in harm reduction principles. Individuals testing positive for HCV Ab were immediately linked to a patient navigator in person or via telephone. The patient navigator assisted patients through cure unless the patient was lost to follow-up. Study participation involved an optional survey and optional point-of-care human immunodeficiency virus test.

Results. Of 417 individuals tested, 13% were HCV Ab positive and 65% of those tested for HCV RNA (34 of 52) had detectable HCV RNA. Of the 14 individuals who linked to an HCV treatment provider, 4 completed treatment, as measured by pharmacy fill documentation in the electronic medical record, and 1 obtained sustained virologic response. One hundred ninety-three individuals tested for HIV; none tested positive.

Conclusions. The study cohort had a higher HCV seroprevalence than the general population (13% vs 2%), but linkage to care, completion of HCV treatment, and successful test-of-cure rates were all low. This study indicates that HCV disproportionately impacts adults on probation and prioritizing support for testing and linkage to care could improve health in this population. Colocalization of HCV treatment within probation programs would reduce the barrier of attending a new institution and could be highly impactful.

Keywords. Criminal Justice Healthcare; hepatitis C; probation; public health.

Before the coronavirus disease 2019 pandemic, hepatitis C virus (HCV)-associated mortality had surpassed that of all other nationally notifiable infectious diseases combined in the United States [1]. Updated data show a trend toward decreased mortality in recent years, likely due to the introduction of direct-acting antivirals, although overall mortality rates remain high [2]. Incidence of acute HCV infection has increased in recent years, driven primarily by injection drug use [3]. It is estimated that 2.4 million individuals in the United States are currently living with HCV [4]. Less than 20% of individuals with HCV infection are estimated to have been prescribed treatment, and 9% are estimated to have been cured as defined by sustained virologic response [5].

Individuals in prisons or jails are known to bear a disproportionate burden of HCV infection. Hepatitis C virus prevalence among incarcerated adults varies geographically, and some studies estimate the range to be between 17% and 23%, although studies have found HCV seroprevalence to be as high as 44% in some correctional settings [6–8]. This is compared to an estimated 1.7% HCV seroprevalence among the general US population [4]. Furthermore, approximately one third of all persons with HCV are estimated to spend at least part of the year in correctional institutions [7, 9].

Individuals supervised by probation represent the largest single group of the US correctional population [10]. Probation allows an individual convicted of a crime to remain in the community under court-ordered supervision instead of being incarcerated. More than 3.6 million individuals were enrolled in probation programs in 2016, over 1.5 million more individuals than were incarcerated that year [10]. Despite this, HCV prevalence and engagement in care have not been extensively studied among individuals on probation [11]. To address this gap

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locally, we implemented an HCV testing and navigation program at an adult probation department in Denver, Colorado.

METHODS

We implemented an onsite HCV screening program utilizing point-of-care tests combined with linkage-to-care services at Denver Adult Probation located in Denver, Colorado between September 2018 and January 2020.

Setting

Denver Adult Probation supports the District Court of the 2nd Judicial District for the State of Colorado and provides supervision and related services to all adult-aged individuals sentenced to felony probation who reside within the judicial district. At any given time, Denver Adult Probation serves between 4500 and 5000 clients in several programs tailored to meet their specific needs.

Denver Public Health is a department within Denver Health and Hospital Authority (hereafter referred to as Denver Health), an integrated public safety net institution. The Denver Public Health Outreach team performed all HCV and human immunodeficiency virus (HIV) testing in a private office within the Denver Adult Probation building, located on the same floor in a separate area from where probation proceedings occur. To provide an additional setting outside of the probation building, individuals also had the option to test and enroll in the study at one of Denver Public Health's community-based testing locations.

Population

Individuals at least 18 years of age engaged with any program located in the probation building were eligible for study inclusion. Individuals with known HCV who were currently engaged in HCV care were excluded. Most individuals were engaged with a program specific to Denver Adult Probation, although individuals engaged with other programs such as Pre-Trial Services and Drug Court were also eligible for participation.

Participants were recruited through flyer advertisement throughout the adult probation building, word of mouth by probation staff, and through verbal recruitment by testing staff when possible. Participants received a prepaid gift card of $25.00. All individuals presenting to the Denver Public Health team were able to decline participation in the research study and still receive free HIV and HCV testing and navigation services.

Point-of-Care Hepatitis C Antibody and HIV Antibody Testing

Hepatitis C virus antibody testing was performed with Rapid OraQuick HCV (OraSure Technologies, Bethlehem, PA). The sensitivity and specificity of the OraQuick HCV test is above 97% when used with blood/serum samples [12].

Human immunodeficiency virus testing was performed with either the Uni-Gold Recombigen HIV-1/2 (Trinity Biotech, Bray, Co., Wicklow, Ireland) or the INSTI HIV-1/HIV-2 Rapid Antibody Test (bioLyrtical Laboritories Inc., Richmond, British Colombia, Canada). The sensitivity and specificity of the Uni-Gold HIV test is 100% and 99.7%, respectively, when used with blood/serum samples [13]. The sensitivity and specificity of the INSTI HIV test is 99.8% and 99.5% , respectively, when used on fingerstick blood samples [14]. Individuals were able to opt out of the HIV test and still enroll in the study.

All testing was performed by trained test counseling staff of Denver Public Health's Outreach Testing program. Pretest counseling rooted in harm reduction principles was provided to all participants, and all testing was performed in compliance with the test manufacturers' protocols. For most participants, blood samples were collected through venipuncture and used for both rapid and confirmatory testing. If phlebotomy could not be performed on-site, either due to difficulty with venipuncture or client preference, blood from a fingerstick was used.

Hepatitis C Ribonucleic Acid Testing

Serum samples from individuals with positive point-of-care HCV antibody (anti-HCV) tests were submitted for quantitative HCV ribonucleic acid (RNA) testing at the Denver Health laboratory (Aptima HCV Quant Dx Assay; Hologic, Marlborough, MA). Those who were anti-HCV positive using fingerstick blood were referred to the Denver Sexual Health Clinic laboratory for free in-person HCV RNA testing via blood draw if venipuncture on-site at probation was unsuccessful. The Denver Sexual Health Clinic is on the Denver Health medical campus and located 1 mile away from the adult probation building.

Posttest Counseling, Linkage to Care, and Insurance Enrollment Support

All individuals testing anti-HCV positive were provided posttest counseling by the tester and then met either in-person or via telephone with a patient navigator specialized in engaging individuals with HCV care. Efforts were made to immediately connect clients with the navigator, but client time constraints or navigator schedules occasionally made an immediate connection impossible. In these cases, the patient navigator reached out to the client at a later date. The navigator provided in-depth education on the HCV treatment process, scheduled appointments with HCV treatment providers (primarily at Denver Health), and provided additional harm-reduction counseling. Navigators attempted to coordinate care throughout the entire HCV treatment process, from diagnosis to the point of cure as indicated by sustained virologic response 12 weeks after treatment completion (SVR12). Those with negative rapid test results were provided general harm reduction counseling and recommendations for retesting based on risk.

An insurance enrollment specialist from Denver Health was initially available on-site to assist with insurance enrollment for any client, especially those who tested positive for HCV and/or HIV and needing to engage in care. Due to low utilization and competing

staffing requirements, the insurance enrollment specialist was no longer present on-site after April 2019, but Denver Health insurance enrollment services remained accessible by phone.

Linkage to HIV Care

In the case of a positive HIV test, the Denver Public Health Linkage to Care team, a service specialized in engaging individuals living with HIV into medical care, were available by phone.

Longitudinal Follow-up

Individuals referred for HCV care were followed through the treatment process via chart review finalized in March 2021. Individuals were considered lost to follow-up if they were unable to be contacted after at least 3 attempts.

Probation Data

Individuals who are on probation risk being incarcerated in brick-and-mortar institutions if they fail to meet the requirements of their probation program, which would significantly hinder linkage to HCV care. To characterize the probation disposition status of participating clients, the Evaluation Unit of the Division of Probation Service matched study participants against probation data and provided case status for all participants with cases under the Division's jurisdiction. It was possible for participants to have multiple probation cases. In the event of multiple cases, if any case was still active at the time of review, the participant's probation disposition was classified as active. For those participants with multiple terminated probation cases, the disposition status of the most recently terminated case was used. A disposition of prerelease recidivism or failure is defined as (1) an adjudication or conviction for a felony or misdemeanor or (2) a technical violation relating to a criminal offense while under supervision in a criminal justice program [15]. Individuals who are unsuccessful on probation are most commonly sentenced to jail, but they can also be sentenced to community corrections programs or the department of corrections.

Data Protection

Study data were collected and managed using the secure, web-based software REDCap [16] hosted on secure, password-protected Denver Health servers accessible only by authorized members of the study team.

Statistical Analysis

Because this study was pilot in nature, no formal sample size calculations were performed. Basic descriptive characteristics and bivariate analyses were performed to characterize the study cohort. Statistical analyses were performed in the SAS/STAT software, version 7.1 (SAS Institute Inc., Cary, NC).

Institutional Review Board

This study was approved by the Colorado Multiple Institutional Review Board. Signed informed consent was obtained for all study enrollees. Among the elements related to participation in the study, the consent emphasized that participation in the study would not affect their legal proceedings and that the results of their HCV and HIV test would not be shared with anyone associated with their probation proceedings.

RESULTS

Approximately 70% (288 of 417) of the participants identified as cisgender male; median age was 39 years (interquartile range, 30–49); 32% (132 of 417) were Hispanic/Latinx of all races; 28% (116 of 417) were black; and 30% (125 of 417) were non-Hispanic white (Table 1). Approximately 54% of survey respondents (207 of 384) indicated that their highest level of education was some high school or completion of high school. The majority of participants (82%) were engaged with Denver Adult Probation with the remaining engaged with either Denver County Probation (4%) or other programs (13%).

Hepatitis C Testing

A total of 417 individuals enrolled in the study and completed HCV testing. Six clients opted to be tested offsite at the community-based testing location, all others were tested on-site at the probation office. Among the study cohort, 13% (56 of 417) were HCV antibody-positive (Figure 1). Of those tested for HCV RNA, 65% (34 of 52) had detectable HCV RNA levels. Four of the 56 individuals who were anti-HCV positive did not have HCV RNA performed (blood samples for RNA testing were not obtained on-site, and participants were lost to follow-up after referral to the Denver Health laboratory). Factors associated with testing positive for anti-HCV antibodies included older age, being non-Hispanic white, lack of insurance, and self-reported drug used in the past 12 months (Table 1).

Approximately 41% (14 of 34) of participants with detectable HCV RNA levels were linked to care with an HCV treatment provider. Treatment was prescribed to 79% (11 of 14) of those linked to care, and 29% (4 of 14) completed treatment. Only 1 individual had documented SVR12 at the time of the final chart review in March 2021. Two of the individuals who completed treatment were lost to follow-up before SVR12 laboratory tests could be obtained. One individual completed treatment but was not yet due for SVR12 laboratory tests at the time of the final chart review.

Human Immunodeficiency Virus Testing

Of the 417 study enrollees who completed point-of-care HCV antibody testing, 193 (46%) opted in to point-of-care HIV testing and all were negative for HIV.

Probation Data

Probation disposition could be determined for 68% (285 of 417) of study participants. Matching adult probation records could not be found for the remaining individuals, most likely because they were engaged with programs other than adult probation

Table 1. Characteristics of Adults on Probation Testing Both Anti-hepatitis C Virus Positive and Negative Between September 2018 and January 2020

Characteristics	All Participants	HCV Ab$^-$	HCV Ab$^+$	
	N (%)	N (%)	N (%)	*P* Value
Total	417 (100)	361 (100)	56 (100)	
Gender				.52[a]
Cis male	288 (69)	252 (70)	36 (64)	
Cis female	119 (29)	101 (28)	18 (32)	
Other[b]	10 (2)	8 (2)	2 (4)	
Age				<.01[c]
Median (IQR)	39 (30–49)	37 (29–49)	48 (41–55)	
Race/Ethnicity[d]				.02[a]
Hispanic/Latinx, all races	132 (32)	119 (33)	13 (24)	
Black, NH	116 (28)	105 (29)	11 (20)	
White, NH	125 (30)	98 (27)	27 (49)	
Asian	4 (1)	3 (1)	1 (2)	
Other[e]	13 (3)	11 (3)	2 (4)	
Multirace	26 (6)	25 (7)	1 (2)	
Sexual Orientation[f]				.24[a]
Heterosexual	328 (85)	291 (86)	37 (79)	
Gay or lesbian	21 (5)	19 (6)	2 (4)	
Bisexual	35 (9)	27 (8)	8 (17)	
Other	2 (0.5)	2 (0.6)	0 (0)	
Health Coverage				.04[a]
Public[g]	344 (82)	301 (83)	43 (77)	
Private	16 (4)	16 (4)	0 (0)	
Uninsured	57 (14)	44 (12)	13 (23)	
Education[h]				.07[a]
Less than high school	54 (14)	48 (14)	6 (13)	
High school diploma/GED	153 (40)	130 (39)	23 (48)	
Some college	120 (31)	104 (31)	16 (33)	
College degree	35 (9)	35 (10)	0 (0)	
Some graduate study	7 (2)	5 (1)	2 (4)	
Graduate degree	15 (4)	14 (4)	1 (2)	
Probation Program				.21[i]
Denver Adult Probation	344 (82)	300 (83)	44 (79)	
Denver County Probation	18 (4)	17 (5)	1 (2)	
Other[j]	55 (13)	44 (12)	11 (20)	
Self-Reported History of Drug Use in Past 12 Months[k]				<.01[i]
Yes	167 (44)	128 (38)	39 (81)	
No	216 (56)	207 (62)	9 (19)	
Self-Reported Condomless Intercourse in Past 12 Months[l]				.86[a]
Yes	223 (57)	194 (57)	29 (60)	
No	164 (42)	145 (42)	19 (40)	
Don't know/not sure	4 (1)	4 (1)	0 (0)	

Abbreviations: Ab, antibody; GED, General Educational Diploma; HCV, hepatitis C virus; IQR, interquartile range; NH, non-Hispanic.

[a]Fisher's exact test.

[b]Includes transgender female, transgender male, genderqueer/nonbinary.

[c]Mann-Whitney *U* test.

[d]Missing for 1 individual.

[e]Includes American Indian, Alaskan Native, Native Hawaiian, and Other Pacific Islander.

[f]Missing for 31 individuals.

[g]Includes Medicaid, Medicare, CHAMPUS, Tricare, VA, or any other military-sponsored coverage.

[h]Missing for 33 individuals.

[i]χ^2 test.

[j]Includes drug court, electronic home monitoring, home detention/monitoring, and pretrial services.

[k]Includes heroin, crack, cocaine, and methamphetamine; missing for 34 individuals.

[l]Missing for 26 individuals.

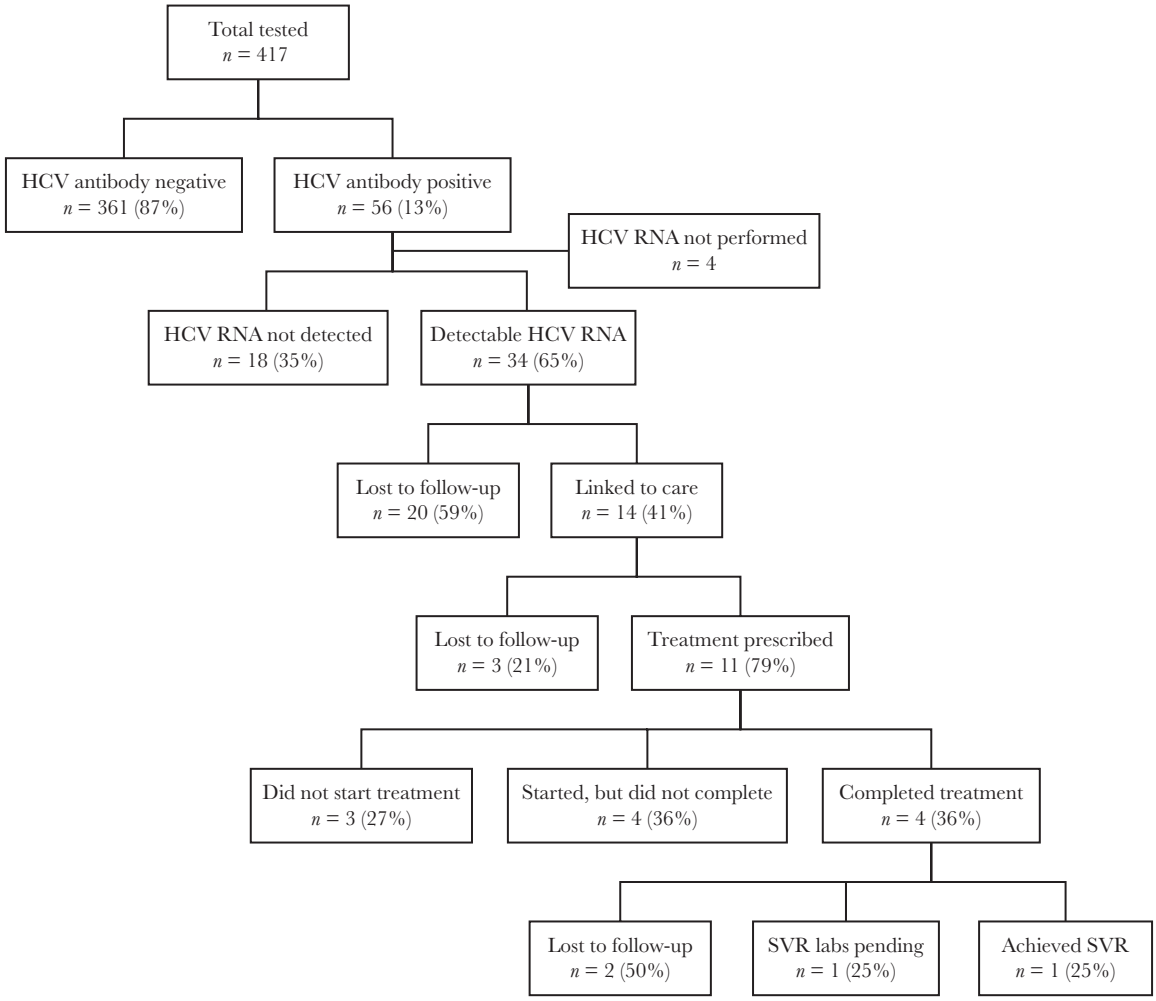

Figure 1. Hepatitis C care continuum among adults on probation. HCV, hepatitis C virus; RNA, ribonucleic acid; SVR, sustained virologic response.

(such as pretrial supervision or drug court) that also operate out of the probation building. Among those in whom probation data were available, 37% (106 of 285) had active cases at the time of data review. Sixty-six individuals (23%) had cases that were terminated for failure and 78 (27%) successfully completed probation. The remaining 35 (12%) had neutral terminations (disposition to community corrections or supervised for another jurisdiction for a period of time before being transferred back to the other jurisdiction).

Three of the 14 individuals (21%) who were linked to HCV care had a probation disposition classified as failure, compared to 7 of the 20 individuals (35%) with detectable HCV RNA who were not linked to care. Differences in probation disposition between those who were and were not linked to care were not statistically significant ($P = .70$).

DISCUSSION

We conducted a large prospective HCV program colocated at an urban probation department. Hepatitis C virus seroprevalence was much higher in the study population compared to the general public (13% vs 1.7% [4]) but lower than estimates of HCV seroprevalence in incarcerated populations. Self-reported drug use in the past 12 months was associated with HCV antibody positivity in the study cohort, consistent with both national and statewide data demonstrating that injection drug use is driving the current HCV epidemic in the United States [17, 13]. In Colorado, 2018 was the first year that chronic HCV diagnoses and rate of chronic HCV diagnoses among individuals 20–39 years old surpassed those of the "Baby Boomer" generation (those born between 1945 and 1965) [17]. In this study cohort, older age was associated with HCV antibody positivity, suggesting that HCV testing in the probation setting may reach a slightly older population.

Four individuals who were positive of HCV antibody using blood obtained via fingerstick did not have blood drawn onsite at the probation building for follow-up HCV RNA testing due to difficult vein access. None of these participants presented to the laboratory for their follow-up blood draw for HCV RNA testing. This emphasizes the need for on-site venipuncture

capability and the opportunity for point-of-care HCV RNA or antigen testing in the future. Referring individuals to offsite laboratory locations may introduce barriers such as transportation, time commitment, inconvenience, and lack of familiarity with a new medical setting.

Individuals in this study had the option to be tested for HIV. However, a larger number of individuals declined HIV testing. Assessment of factors contributing to decreased acceptance of HIV testing (eg, low risk perception and potential for more stigma around testing for HIV compared with HCV in this setting) merits further research, and additional strategies specialized for HIV testing may be needed.

Linkage-to-care rates among individuals who tested positive for HCV in this study were low (14 of 34, 41%). More than half of the individuals with detectable HCV RNA were lost to follow-up after their testing session at probation, and of the 14 individuals who linked to care with an HCV treatment provider, only 1 individual had documentation of cure as measured by SVR12. Hepatitis C virus screening studies in similar settings, including among adults on probation and individuals in jail settings, have also found low linkage rates [11, 18–20], demonstrating that establishing care at a different location or institution from where testing occurs poses numerous barriers. Although not all studies utilized a patient navigator, the low rate of care linkage in our study suggests that the utilization of a patient navigator alone is not sufficient to engage all individuals with HCV into care through cure.

Qualitative research findings among individuals incarcerated in jail settings emphasize barriers to testing and linking to HCV care such as varying levels of HCV knowledge, stigma, concern for treatment interruption or reinfection, and competing priorities such as housing insecurity and unemployment [21, 22]. Facilitators include peer-to-peer education, social support, and paring HCV referrals with other referrals such as for opioid use disorder treatment [21, 22].

Future efforts that address barriers faced by adults on probation are needed to optimize models for testing and linkage to HCV care in the probation population. One study found a modest but significant benefit of an on-site health navigator at a probation office for linkage to a primary care provider [23], and shifting HCV treatment to community-based nonspecialist providers has been shown to be safe and effective [24, 25]. Increased availability of HCV treatment in nonspecialist settings for adults on probation, ideally coupled with patient navigation efforts, could therefore be impactful for this population. Offering on-site HCV treatment at probation departments is also a promising next step and is being explored in other community venues such as syringe services programs [26–28]. On-site-facilitated telehealth visits is another model that merits further research. Importantly, engagement of individuals with lived experience in the justice system has been highlighted as being paramount for the development of new strategies [21].

The goal of colocating screening on-site at probation facilities is to (1) reduce barriers to access to tests and (2) provide opportunities for education around various topics important to public health. Denver Adult Probation strives to promote long-term prosocial behavioral change in the clients with whom they work and providing in-person HCV and HIV screening aligns with this goal. Nonetheless, individuals supervised by probation are navigating a complex system. A substantial number of the study cohort (16%, 66 of 417) were known to have their most recent probation case terminated due to recidivism. This is important to consider from a public health perspective, given that an individual started on treatment who is subsequently incarcerated may face disruption of their HCV treatment course if treatment is not continued during incarceration.

This study has some limitations. We were not able to assess whether those who tested positive for HCV accessed care at a different healthcare institution. We did not capture the distribution of fingerstick versus venipuncture for the initial blood sample, although the on-site testers report that the vast majority were tested solely using blood obtained by venipuncture. Our analysis does not include a multivariable analysis, and the number of individuals following up with an HCV treatment provider was too small to examine factors associated with linkage to care. This study may also have limited generalizability in nonresearch settings, especially in terms of willingness to test, as well as in nonurban settings.

CONCLUSIONS

Our study supports other limited data endorsing the feasibility and utility of performing on-site HCV testing at probation departments. Hepatitis C virus screening, patient navigation, targeted education campaigns, and support to people in probation programs could be highly impactful for HCV elimination efforts. Additional work is needed to develop interventions that would promote improved linkage to care and treatment completion rates.

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