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Disparities in Treatment with Direct-Acting Hepatitis C Virus Antivirals Persist Among Adults Coinfected with HIV and Hepatitis C Virus in US Clinics, 2010–2018

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Abstract

Human immunodeficiency virus (HIV) and hepatitis C virus (HCV) coinfection carries substantial risk for all-cause mortality and liver-related morbidity and mortality, yet many persons coinfected with HIV/HCV remain untreated for HCV. We explored demographic, clinical, and sociodemographic factors among participants in routine HIV care associated with prescription of direct-acting antivirals (DAAs). The HIV Outpatient Study (HOPS) is an ongoing longitudinal cohort study of persons with HIV in care at participating clinics since 1993. There are currently eight study sites in six US cities. We analyzed medical records data of HOPS participants diagnosed with HCV since June 2010. Sustained virological response (SVR) was documented with first undetectable HCV viral load (VL). We assessed factors associated with being prescribed DAAs by multi-variable logistic regression and described the cumulative rate of SVR. Among 306 eligible participants, 131 (43%) were prescribed DAA therapy. Factors associated with greater odds of being prescribed DAA were older age, private health insurance, higher CD4 cell count, being a person who injects drugs, and receiving care at publicly funded sites ($p < 0.05$). Of

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Author Disclosure Statement

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†HOPS study investigators are listed in the Appendix A1.

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127 (97%) participants with at least 1 follow-up HCV VL, 110 (87%) achieved SVR at 12 weeks. Of the total 131 participants, 123 (94%) eventually achieved SVR. Less than half of HIV/HCV coinfected patients in HOPS have been prescribed DAAs. Interventions are needed to address deficits in DAA prescription, including among patients with public or no health insurance, younger age, and lower CD4 cell count.

Keywords

HIV; HCV; DAA; hepatitis C treatment

Introduction

Owing to shared routes of transmission, coinfection with both hepatitis C virus (HCV) and human immunodeficiency virus (HIV) is common. There are >2.2 million HIV/HCV coinfections worldwide and the odds of HCV infection are six times as high in persons living with HIV (PWH) as among their HIV-negative counterparts.[1] In the United States, ~4.9% of PWH have chronic HCV.[2] One especially vulnerable population is persons who inject drugs (PWIDs), with coinfection prevalence exceeding 80%.[1] Over the past decade, sexual transmission of HCV, especially among gay, bisexual, and other men who have sex with men (collectively referred to as MSM), has increased with HIV identified as an independent factor in HCV transmission.[2,3]

High prevalence of HIV/HCV coinfection is clinically significant because HIV alters the natural history of HCV and is associated with considerable morbidity and mortality.[4] HIV/HCV coinfection accelerates disease progression and increases overall risk of developing severe liver disease.[5,6] In the early years of AIDS, reports noted unusually rapid progression to hepatic cirrhosis among coinfected persons, suggesting that HIV potentiates the liver injury of chronic HCV infection.[7] One meta-analysis found coinfected persons to be almost three times as likely to develop histological cirrhosis or decompensated liver disease compared with monoinfected persons with HCV.[4] In the modern era of antiretroviral therapy (ART), one-third of patients with HIV/HCV have hepatic steatosis, and chronic viral hepatitis (driven largely by HCV) is a leading non-AIDS cause of death for PWH, and chronic HCV viremia increases the overall mortality.[8–11]

Direct-acting antiviral (DAA) therapy has been shown to be curative in most persons treated for chronic HCV infection. This treatment success among diverse groups of patients, including those with significant comorbid conditions, argues for widespread implementation of DAA therapy.[11] The current goal of therapy in HCV infection is a sustained virological response (SVR). In a large multi-center study evaluating patients with HIV/HCV coinfection and psychosocial comorbid conditions such as mental health and substance use disorders, the only factor associated with lower SVR was early discontinuation of DAA.[12]

Nevertheless, a large proportion of patients with HIV/HCV coinfection remain untreated for HCV infection. Data from the early 2000s at a large urban HIV/HCV clinic showed that, among coinfected patients receiving HIV care, HCV treatment uptake was extremely low (<1%), but this was during a time when HCV treatment had significant side effects and

was often poorly tolerated.[13] More recently, a study using 2014–2018 data from 10 large US HIV clinics showed improved but suboptimal HCV treatment rates. The percentage of patients with chronic HCV who received treatment increased from 17% in 2014 to 23% in 2018. At the end of the observation period, only 46% were treated in this cohort of coinfected patients. The data also showed that women and patients <50 years of age had lower treatment rates.[14] In the United States, restrictions related to hepatic fibrosis staging, ongoing substance use, and DAA prescriber specialty remain and contribute to low HCV treatment rates.

Given the significant public health burden of HCV, the World Health Organization set targets to eliminate viral hepatitis by 2030.[15] Australia implemented universal access to DAA in 2016. A prospective cohort study enrolled Australian adults with HIV/HCV coinfection and found that annual HCV treatment uptake increased from 7% in 2014 to 91% in 2018 after unrestricted DAA access. HCV viremia also decreased from 82% to 8% over this time period, indicating the treatment is effective.[16] These data suggest that unrestricted access to DAA has the potential to dramatically reduce HCV infection among adults living with HIV and that chronic HCV infection elimination is a feasible goal. Another study using data from the Canadian HIV/HCV coinfection cohort from 2010 to 2018 reported that after the removal of fibrosis stage restrictions on HCV treatment, DAA initiation nearly doubled immediately.[17] The annual treatment rates peaked at 25% by 2016. However, this rate was nonsustained and fell to 17% by 2018, noting that the remaining population needing treatment was marginalized (persons of Indigenous ethnicity, those reporting homelessness, and PWID) and largely disengaged from care. Thus, although removing structural barriers, such as medication access, is an important step in HCV elimination, this alone may not be sufficient to maintain high treatment rates and HCV eradication.[16,18]

Unless barriers to HCV treatment are addressed, further advances in HCV therapy will have limited effect on reducing HCV-related disease at the population level. A better understanding of HIV/HCV coinfected patient characteristics that are associated with HCV treatment access is needed to address these barriers. We explore sociodemographic and clinical variables among coinfected participants in routine HIV care that predict access to DAA therapy.

Methods

The HIV Outpatient Study

The HIV Outpatient Study (HOPS) is an ongoing longitudinal observational cohort study that prospectively follows PWH who receive care at participating HIV clinics (university based, public, and private) since 1993. There are currently eight study sites in six US cities (Chicago, IL; Denver, CO; Stony Brook, NY; Philadelphia, PA; Tampa, FL; and Washington, DC). The HOPS is an open cohort study: patients may enter the study at any point after HIV diagnosis regardless of treatment history, after providing informed consent, and may leave the study at any point for reasons such as patient request or loss to follow-up. Each year, the HOPS is approved by institutional review boards at the Centers for Disease Control and Prevention (Atlanta, GA), Cerner Corporation (Kansas City, MO), and each local site. Patient data, including sociodemographic characteristics, diagnoses, ART use, and other

treatments, and laboratory values (including CD4 cell count and HIV viral load; VL) are abstracted from medical charts and entered into an electronic database by trained research coordinators. The present analysis is based on HOPS data current through December 31, 2018.

Variable definitions

We characterized patients as having chronic HCV infection if they (1) had at least one elevated HCV RNA VL (confirmatory VL) or (2) had a genotype test since June 30, 2010, to account for patients who were waiting for approval of DAAs, or (3) were prescribed DAA on or after January 1, 2014, but their HCV RNA VL or genotype tests were results not available. DAA therapy start date was ascertained by prescription records from the HOPS database and assumed to represent the date of DAA treatment initiation. DAA agents include sofosbuvir, daclatasvir, simprevir, ledipasvir, velpatasvir, voxilaprevir, grazoprevir, elbasavir, glecaprevir, pibrentasvir, paritaprevir, ombitasvir, and dasabuvir. Patients treated with interferon/ribavirin along with DAA were excluded. SVR was defined as an undetectable level of serum HCV RNA 12 weeks after therapy completion. History of substance use was ascertained by documentation of injection drugs, cocaine, heroin, marijuana, crystal meth (methamphetamine), ecstasy, and lysergic acid diethylamide (LSD) use in the medical record, and prior mental health diagnoses including diagnosis codes for anxiety, depression, biochemical, psychological, or bipolar disorder. Demographic (e.g., age) and clinical covariates (e.g., insurance type and CD4 cell count) were measured at baseline, defined as the time of confirmatory HCV diagnosis with positive HCV RNA test or genotype test or the documented start date of DAA prescription if no HCV RNA test or genotype test for those prescribed DAA medication were available for this analysis.

Statistical analyses

Bivariate analyses with Pearson's chi-squared test or Fisher's exact test for categorical and *t*-test or nonparametric Wilcoxon rank-sum test for continuous variables were used to compare differences in sociodemographic and clinical factors of patients prescribed DAA therapy versus those who were not (Table 1). Univariate logistic regression analyses were used to determine unadjusted effect by each sociodemographic and clinical factor on the probability of being prescribed DAA therapy (Table 2). Considering the limited number of persons who were prescribed DAA therapy ($n = 131$), only factors with a p value <0.1 in univariate logistic regression analyses were included in the final multi-variable regression model, and only factors with significant associations ($p < 0.05$) were retained in the final multi-variable model (Table 2). For persons prescribed DAA therapy, patient-level post-treatment longitudinal HCV VL test results were analyzed to evaluate time to SVR and overall SVR rates. We examined patients prescribed DAA therapy who were HCV VL suppressed over time. Cumulative count/percentage of patients with SVR after DAA initiation was calculated as an indicator of DAA therapy effectiveness (Fig. 1); univariate general linear models addressing time from positive HCV VL testing to DAA therapy initiation were used to evaluate for sociodemographic factors that influenced promptness of HCV treatment. Analyses were performed using SAS 9.4 (SAS Institute, Inc., Cary, NC).

Results

Study population characteristics

Of 9246 patients in the HOPS data set, 343 patients were diagnosed with HCV based on the presence of at least one confirmatory HCV VL test, 10 patients were identified with HCV genotype test since June 30, 2010, and 4 patients were prescribed DAA after January 1, 2014, but without confirmatory HCV VL test or genotype test results available. Of the 357 patients diagnosed with HCV, 51 were excluded due to medication prescription of interferon or ribavirin for a study population of $N = 306$ patients. Of the 306 HIV/HCV coinfected patients, the median age at time of HCV diagnosis was 52 years, 209 (68%) were male, 139 (45%) were non-Hispanic Black, 92 (30%) were MSM, 102 (33%) were PWID, 207 (68%) had public insurance, and 179 (59%) received HIV care at a publicly funded clinic site (Table 1).

Factors associated with being prescribed DAA therapy

Among 306 participants in the study cohort, 131 (42.8%) were prescribed DAA therapy since June 2014 (Table 1). Compared with persons who were prescribed DAAs, those not prescribed DAAs were younger (50.0 ± 9.4 vs. 52.4 ± 8.4, mean ± standard deviation), injected drugs (26.9% vs. 42.0%), were less likely ($p < 0.05$) to have private insurance (21.7% vs. 32.8%), were more likely to be seen in private HOPS clinics (33.6% vs. 47.3%), and had lower CD4 cell count (median: 457–622). In unadjusted analysis, lower likelihood of being prescribed DAA therapy occurred among patients with younger age, MSM or heterosexual risk groups (vs. PWID), private insurance, and lower CD4 cell count group (all $p > 0.10$). Factors independently associated with greater odds of being prescribed DAA therapy were older age [odds ratio (OR) 1.16, 95% confidence interval (CI) 1.01–1.34], having private health insurance (OR 2.70, 95% CI 1.35–5.38), receiving care at publicly funded HOPS sites (OR 2.30, 95% CI 1.17–4.50), and higher CD4 cell count group (OR 1.64, 95% CI 1.29–2.07).

Time from start of DAA therapy to HCV suppression

Among 131 active HIV/HCV coinfected patients who initiated DAA therapy, 127 (96.9%) had at least 1 HCV VL during follow-up (a median of 4 VLs, maximum of 13 VLs). Out of 127 patients with follow-up information, 110 (86.7%) achieved SVR at 12 weeks; overall, 123 of 131 (93.6%) patients eventually achieved SVR up to 4 years after DAA initiation, assuming that the 4 patients missing HCV VL did not achieve SVR (Fig. 1). No patients had evidence of retreatment with DAAs in the medical record.

Time from confirmatory HCV test to start of DAA therapy

Among 131 patients prescribed DAA therapy, 4 were prescribed therapy in the absence of a confirmatory HCV laboratory test. We presume that the patients underwent additional testing through care that occurred outside of HOPS clinics. One patient did not start DAA therapy until 5 years (256 weeks) after a positive confirmatory HCV RNA test. Of the remaining 126 patients, the median time between HCV RNA confirmatory test and the start of DAA therapy was 7 weeks with a minimum of 1 and a maximum of 50 weeks (Fig.

2). In univariate linear regression analyses, factors including age, gender, race/ethnicity, and insurance were not associated with longer gap between confirmatory HCV test and DAA therapy prescription (data not shown).

Discussion

Among 306 HOPS participants coinfected with HIV/HCV, only 42.8% were prescribed DAA therapy, and those patients had an overall eventual SVR rate of 93.6%. Relatively low rates of DAA prescription have been reported in other contemporary cohorts of persons with HIV/HCV coinfection. For example, in the US-based TRIO Network, only 46% (1804/3986) of patients coinfected with HIV/HCV were treated with DAAs during 2014–2018.[19] Men and individuals aged 50–64 years were more likely to be prescribed DAA therapy than women and persons younger than 50 years. Earlier research from the same group found that nonsuppressed HIV VL and active alcohol or drug use were associated with lack of prescribed DAA therapy.[19] In a European study, only 25.8% of PWH who had HCV infection were prescribed HCV DAA therapy during 2014–2016; women and PWH not receiving ART or with a detectable HIV VL were less likely to receive DAA therapy.[20] In our HOPS cohort, prescription of DAAs was less among persons with public or no health insurance, younger persons, and those with lower CD4 cell counts. Notably, persons with injection drug use as a risk factor for HIV infection were more likely to be prescribed DAAs than persons with MSM or heterosexual risk for HIV, even after adjusting for age, CD4 count, type of insurance, and public versus private HIV site of care. We did not detect any DAA treatment differences by gender, or history of substance use or mental health disorders.

The Infectious Disease Society of America and American Association for Advancement of Liver Disease joint HCV treatment recommendations consider persons with HIV/HCV coinfection a priority population, noting that complications from chronic HCV infection result in excess mortality and morbidity among PWH.[21] Yet when DAAs were first approved by the Food and Drug Administration in 2014, the financial cost of HCV treatment was enormous. United States payers struggled to contain costs through prior authorization processes that prioritized patients with hepatic fibrosis, took note of prescriber specialty and patient history of substance use. In our cohort, HCV treatment gaps remained most prominent among persons with public insurance or no health insurance: patients with private insurance were two times as likely to be treated with DAA therapies as patients with public insurance. A study from a Ryan White-funded HIV clinic demonstrated that persons with HIV/HCV coinfection who were privately insured or covered by Medicare were more likely to initiate HCV DAA therapy than the uninsured and recipients of Medicaid coverage.[22] Removing insurance barriers is crucial to increasing DAA therapy among persons with HIV/HCV coinfection.

It has been demonstrated repeatedly that younger persons with HIV/HCV coinfection receive DAA therapy less often than older persons.[14,19,20,23] Many potential reasons may explain this finding, including less severe liver fibrosis and potentially more active substance abuse, which are frequent insurance barriers to DAA access. However, there may also be provider preference. In a study of the HCV care cascade among persons with HIV/HCV coinfection in St. Louis, patients 20–40 years old were less likely to be offered DAA

therapy by their provider than older persons.[23] They also had less well-controlled HIV, more active substance use, higher rates of being uninsured, and were less likely to have hepatic cirrhosis.[23] Similar to the interferon era for HCV treatment, providers may choose to prioritize optimization of HIV control and interventions for substance use before considering initiation of HCV treatment.[24,25] However, the highest rates of ongoing HCV transmission are among younger individuals, generally those who are engaged in active substance use or condomless anal intercourse (CAI). For these reasons, prompt availability of DAA HCV treatment and achievement of SVR among younger individuals is important to controlling the HCV incidence.[26] Data indicate that DAA therapy is successful among persons who use illicit drugs; these include studies involving persons with prior and current drug use, those on opiate substitution therapy or not, with similar rates of SVR achieved despite these comorbidities.[26–28] Hepatitis C reinfection rates are also low among persons who use drugs, with an incidence of reinfection 1.22 per 100 person-years.[29] Therefore, it is paramount not only to ease insurance restrictions, but also to study and change provider perceptions regarding the success of HCV DAA among young persons with HIV/HCV coinfection, to close the HCV treatment gap.

Barriers to HCV treatment in the United States still exist at all levels.[18] At the systems level, health insurers continue to deny coverage despite the availability of newer effective well-tolerated DAAs. Absolute denials of payer coverage of DAAs have increased over time, regardless of insurance type.[30] At the practitioner level, physicians have cited inadequate training and negative attitudes toward treating PWID as barriers to initiating HCV care in this patient group.[31,32] The patient ultimately makes the decision to engage in care and patient-level barriers must also be explored; poor knowledge combined with stability of comorbid conditions, life circumstances, and the patient–provider relationship have all been cited as factors influencing patients' decision to initiate treatment.[25,28]

In our study, having a lower CD4 count was associated with lower uptake of DAA therapy. Suboptimal HIV control, as evidenced either by viral nonsuppression or by low CD4 cell counts, has been associated with less DAA uptake in other patient cohorts of persons with HIV/HCV coinfection.[19,20,22–24] Many persons with HIV/HCV coinfection who are poorly engaged in HIV care are also poorly engaged with HCV care. In a study that examined predictors of missed HCV intake appointments among persons with HIV/HCV coinfection, having nonsuppressed HIV viremia was independently associated with missed HCV intake appointments.[24] Targeted strategies to improve HIV care engagement, such as stigma minimization, intensive out-reach, and colocation of services (which have been successful in disease states other than infection with HIV and HCV), assistance with other social determinants of health including housing, food, and transportation assistance as well as substance use and mental health treatment, may help retain HIV/HCV coinfected individuals in care and thereby increase HCV treatment and response to treatment rates.[20,29]

In our cohort, persons with HIV/HCV coinfection who acquired HIV through injection drug use were more likely to be prescribed DAA treatment than those who acquired HIV through sexual contact. This finding is concerning given elevated rates of sexually acquired HCV in MSM, especially among those who practice CAI, and who use pre-exposure prophylaxis for HIV prevention.[33,34] In a previously published HOPS analysis from 2000 to 2013, the

overall annual HCV incidence was 1.0% among MSM.[34] However, HCV seroprevalence increased from 8.7% to 12.3% among MSM living with HIV in San Francisco from 2004 to 2011.[35,36] MSM are also less likely than PWID to undergo HCV screening.[37] Even more concerning is the lack of annual HCV screening among MSM, given the high rates of sexually acquired HCV.[38–40] A recent HOPS analysis demonstrated that 63.7% of HIV-positive MSM had been tested for HCV, but the annual HCV testing rate was only 30.3% between 2011 and 2018.[35,41]

There is evidence that successful treatment of HCV among MSM living with HIV can have marked effects upon the overall HCV incidence. In the Netherlands, a 50% reduction in acute HCV incidence was seen within 1 year of expanded HCV DAA therapy among MSM living with HIV/HCV coinfection, during 2014–2016.[42] Consequently, achievement of HCV SVR among MSM with HIV/HCV coinfection through ready availability of DAA is key to HCV elimination. However, vigilance in annual HCV screening for sexually active MSM PWH must be maintained and screening for reinfection among persons in this group cannot be neglected.

Limitations

Our findings from this observational cohort of patients in routine HIV care are subject to some limitations. The HOPS providers obtain information on medical records from specialty and outside care, whenever possible. However, the HOPS database may have not captured all out-of-network prescriptions or care received at external sites, which could underestimate DAA utilization. Patients may also have undergone outside HCV RNA tests that went uncaptured, underestimating HCV diagnosis or SVR. Further, despite guidelines indicating that persons with HCV should undergo regular monitoring of HCV RNA levels while receiving DAA therapy, patients with HIV/HCV coinfection in the HOPS generally had less frequent and irregular follow-up HCV tests than recommended, which could be due to noncompliance with appointments, or other reasons.[20] This could translate into under-reporting of the overall effectiveness and promptness of response to DAA therapy, in terms of both overall SVR rate and time to SVR after treatment initiation. It is also compelling to comment on the changing state Medicaid and payor restrictions of HCV DAAs. Some payors require sobriety, advanced liver fibrosis, and/or specialist referral before approval of medication. The HOPS cohort does not track these variables, so we could not stratify treatment based on changing restrictions. These criteria have evolved rapidly over the time period of this study, but despite these restrictions, guidelines consistently prioritized treatment of HIV/HCV individuals.[20] In addition, limited social and structural determinants of health information are collected in HOPS, and we cannot rule out residual confounding in the presented associations by some unmeasured factors.[21] Finally, HOPS participants represent a convenience sample of patients seen at select HIV urban specialty clinics and, therefore, correlates and levels of DAA therapy may not reflect those in other settings.

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Appendix

Appendix A1.: HIV Outpatient Study Investigators

The HIV Outpatient Study (HOPS) investigators include the following persons and sites: Kate Buchacz, Marcus D. Durham, Jun Li, Division of HIV/AIDS Prevention, National Center for HIV, Viral Hepatitis, STD, and TB Prevention (NCHHSTP), Centers for Disease Control and Prevention (CDC), Atlanta, GA; Cheryl Akridge, Stacey Purinton, Selom Agbobil-Nuwoaty, Kalliope Chagaris, Kimberly Carlson, Qingjiang Hou, Carl Armon, Linda Battalora, Jonathan Mahnken Cerner Corporation, Kansas City, MO; Frank J. Palella, Saira Jahangir, Conor Daniel Flaherty, Feinberg School of Medicine, Northwestern University, Chicago, IL; Kenneth S. Greenberg, Barbara Widick, Rosa Franklin, Rocky Mountain Cares, Denver, CO; Douglas J. Ward, Linda Kirkman, Dupont Circle Physicians Group, Washington, DC; Jack Fuhrer, Linda Ording-Bauer, Rita Kelly, Jane Esteves, State University of New York (SUNY), Stony Brook, NY; Ellen M. Tedaldi, Ramona A. Christian, Faye Ruley, Dania Beadle, Princess Davenport, Gina Simoncini Lewis Katz School of Medicine at Temple University, Philadelphia, PA; Richard M. Novak, Andrea Wendrow, Stockton Mayer. University of Illinois at Chicago, Chicago, IL; Mia Scott, Billie Thomas, APEX Family Medicine, Denver, CO; Cynthia Mayer, Victoria Franco, Karen Maroney, Carrie Humberger, SJH Comprehensive Research Institute, Tampa, FL.

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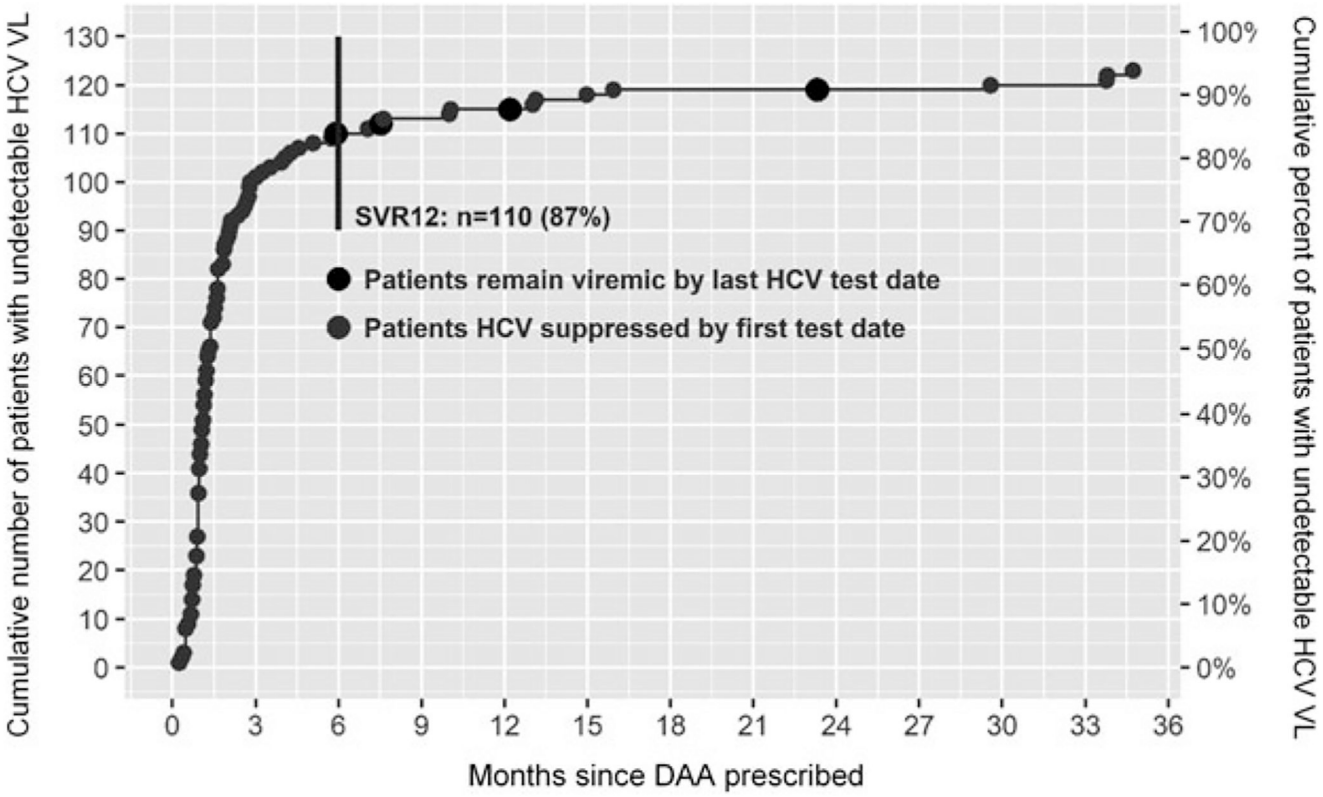

FIG. 1.

Cumulative longitudinal HCV suppression in patients prescribed DAA, the HIV Outpatient Study, 2010–2018 (*N* = 131). DAA, direct-acting antiviral; HCV, hepatitis C virus; HIV, human immunodeficiency virus; SVR12, sustained virological response at 12 weeks.

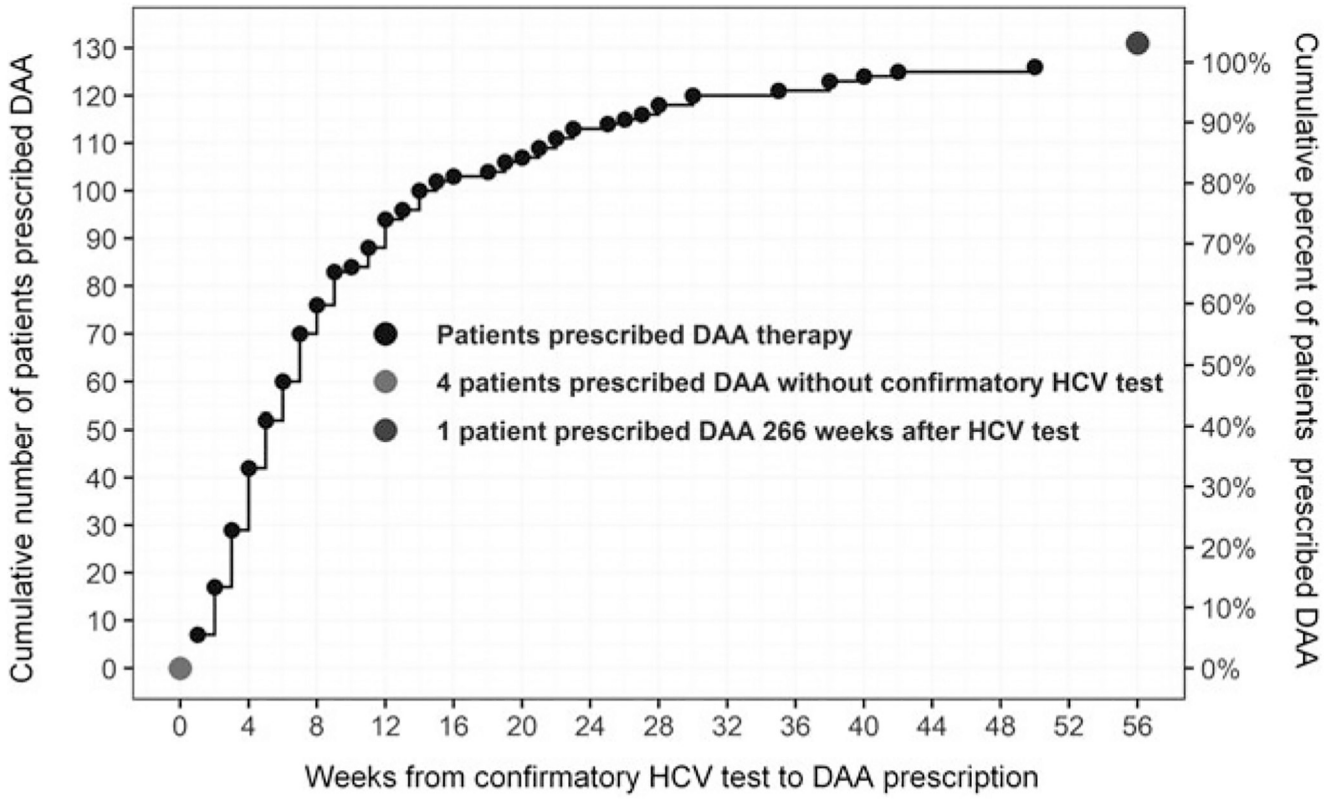

FIG. 2.

Distribution of time delay between HCV confirmatory test and DAA initiation for patients prescribed DAA, the HIV Outpatient Study, 2010–2018 (*N* = 131). DAA, direct-acting antiviral; HCV, hepatitis C virus; HIV, human immunodeficiency virus.

Table 1.

Demographic and Clinical Characteristics of Patients Coinfected with HIV/Hepatitis C Virus, by Receipt of Direct-Acting Antiviral Therapy, HIV Outpatient Study, 2010–2018 ($N = 306$)

	N (%)	Prescribed DAA therapy *n* (%)	Not prescribed DAA therapy *N* (%)	*p*
Total	306 (100)	131 (42.8)	175 (57.2)	
Age at baseline (years)				
18–39	37 (12.1)	11 (8.4)	26 (14.9)	0.24
40–49	87 (28.4)	39 (29.8)	48 (27.4)	
50+	182 (59.5)	81 (61.8)	101 (57.7)	
Age, mean ± SD	52 ± 9.0	52.4 ± 8.4	50.0 ± 9.4	0.02
Gender				
Female	97 (31.7)	48 (36.6)	49 (28.0)	0.15
Male	209 (68.3)	83 (62.5)	126 (72.0)	
Race/ethnicity				
White, non-Hispanic	104 (34.0)	47 (35.9)	57 (32.6)	0.17
Black, non-Hispanic	139 (45.4)	52 (39.7)	87 (49.7)	
Other/unknown	7 (2.3)	2 (1.5)	5 (2.9)	
Hispanic/Latino	56 (18.3)	30 (22.9)	26 (14.9)	
HIV transmission risk group				
MSM	92 (30.1)	33 (25.2)	59 (33.7)	0.05
Heterosexual	95 (31.1)	37 (28.2)	58 (33.1)	
PWID	102 (33.3)	55 (42.0)	47 (26.9)	
Other/unknown	17 (5. 6)	6 (4.58)	11 (6.3)	
Insurance type at baseline				
Private	81 (26.5)	43 (32.8)	38 (21.7)	0.01
Public	207 (67.7)	85 (64.9)	122 (69.7)	
Self-pay/other/unknown	18 (5.9)	3 (2.3)	15 (8.6)	
Type of HOPS site				
Private	127 (41.5)	44 (33.6)	83 (47.4)	0.02
Public	179 (58.5)	87 (66.4)	92 (52.6)	
Primary care available				

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	N (%)	Prescribed DAA therapy *n* (%)	Not prescribed DAA therapy *N* (%)	*p*
On site	230 (75.2)	93 (71.0)	137 (78.3)	0.15
Off site	57 (18.6)	31 (23.7)	26 (14.9)	
Other/unknown	19 (6.2)	7 (5.34)	12 (6.9)	
CD4 cell count at baseline (cells/mm^3)				
<100	14 (4.6)	2 (1.5)	12 (6.9)	0.003
100–199	27 (8.8)	5 (3.8)	22 (12.6)	
200–349	49 (16.0)	19 (14.5)	30 (17.1)	
350–499	51 (16.1)	22 (16.8)	29 (16.6)	
500+	165 (53.9)	83 (63.4)	82 (46.9)	
Median CD4 count (IQR)	534 (307–755)	622 (400–786)	457 (229–684)	
HIV viral load at baseline (copies/mL)				
<200	229 (74.8)	109 (83.2)	120 (68.6)	0.01
200–999	11 (3.59)	6 (4.58)	5 (2.9)	
1000–99,999	42 (13.73)	10 (7.63)	32 (18.3)	
≥100,000	15 (4.90)	4 (3.05)	11 (6.3)	
Missing	9 (2.94)	2 (1.53)	7 (4.0)	
Substance use at entry into care				
Current	120 (39.2)	46 (35.1)	74 (42.3)	0.54
Previous	47 (15.4)	20 (15.3)	27 (15.4)	
Never	116 (37.91)	53 (40.5)	63 (36.0)	
Unknown	23 (7.5)	12 (9.2)	11 (6.3)	
Prior diagnosis of mental disorder at entry into care				
Yes	108 (35.3)	43 (32.8)	64 (36.6)	0.47
No	198 (64.7)	88 (67.2)	111 (63.4)	

Baseline refers to the date of confirmatory HCV-RNA test; *p* values for categorical variables by Fisher's exact chi-square test; quantitative variable by *t*-test. All factors measured as of baseline unless otherwise specified.

DAA, direct-acting antiviral; HCV, hepatitis C virus; HIV, human immunodeficiency virus; HOPS, HIV Outpatient Study; IQR, interquartile range; MSM, men who have sex with men; PWIDs, person who injects drugs; SD, standard deviation.

Table 2.

Unadjusted and Adjusted Associations of Factors Associated with Receipt of Direct-Acting Antiviral Therapy Among HIV/Hepatitis C Virus Coinfected Patients, HIV Outpatient Study, 2010 – 2018 (N = 306)

	Univariable logistic regression		Multi-variable logistic regression	
Covariates	**Odds ratio (95% CI)**	***p***	**Odds ratio (95% CI)**	***p***
Gender		0.11		
Female	0.50 (0.05–0.40)			
Male	Reference			
Age at baseline[a]		0.24		
18–39	0.53 (0.25–1.13)			
40–49	1.10 (0.61–1.69)			
50+	Reference			
5-year interval[b]	1.16 (1.02–1.32)	0.02	1.16 (1.01–1.34)	0.04
Insurance type		0.02		
Private	1.46 (0.87–2.46)		2.70 (1.35–5.38)	0.01
Self-pay/other/unknown	0.29 (0.08–1.02)		0.48 (0.12–1.89)	0.29
Public	Reference			
Type of HOPS site		0.02		
Private	0.56 (0.35–0.90)		0.44 (0.22–0.85)	0.01
Public	Reference			
HIV transmission risk		0.05		
MSM	0.48 (0.27–0.85)		0.50 (0.23–1.01)	0.07
Heterosexual	0.55 (0.31–0.96)		0.51 (0.27–0.95)	0.03
Other/unknown	0.47 (0.16–1.36)		1.00 (0.27–3.59)	0.97
PWID	Reference		Reference	
CD4 count at baseline (cells/mm^3)		0.01		
<100	0.17 (0.04–0.76)			
100–199	0.23 (0.08–0.62)			
200–349	0.63 (0.33–1.20)			
350–499	0.75 (0.40–1.41)			
500+	Reference			

	Univariable logistic regression		Multi-variable logistic regression	
Covariates	**Odds ratio (95% CI)**	***p***	**Odds ratio (95% CI)**	***p***
Ordinal	1.48 (1.20–1.83)	<0.001	1.64 (1.29–2.07)	<0.001
HIV viral load at baseline (copies/mL)		0.02		
200–999	1.32 (0.39–4.45)			
1000–99,999	0.34 (0.16–0.73)			
≥100,000	0.40 (0.12–1.29)			
<200 copies/mL	Reference			

[a]Baseline refer to date with confirmatory HCV-RNA test.

[b]Every 5-year interval.

CI, confidence interval; HCV, hepatitis C virus; HIV, human immunodeficiency virus; HOPS, HIV Outpatient Study; MSM, men who have sex with men; PWID, person who injects drugs.