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A Comparison of Modified Directly Observed Therapy to Standard Care for Chronic Hepatitis C

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Abstract

Hepatitis C virus (HCV) is the most common chronic blood-borne infection in the United States. Effective treatments are available, however adherence to treatment is challenging. Modified directly observed therapy (mDOT) with weekly administration of pegylated interferon might improve adherence and outcomes for patients infected with chronic HCV. To compare two treatment protocols and examine predictors of sustained virologic response (SVR). A retrospective review comparing chronic HCV treatment outcomes in two outpatient clinics at an urban academic medical center. Gastroenterology fellows provided standard treatment (SC) in one clinic; a nurse practitioner administered weekly pegylated interferon injections weekly in a primary care clinic. All patients received oral ribavirin. Data was extracted from the medical records of all treated patients over a 5-year period. 155 treatment-naïve, chronically infected HCV patients were treated. Ninety-seven patients received mDOT treatment and 58 received standard care. Mean age was 46 years. Genotype 1 represented 59 % of the sample. The mDOT patients were significantly more likely to be younger (44 vs. 50 years), have a history of injection drug use (93.1 vs. 50.0 %), and be HIV-infected (13.5 vs. 2 %) compared to SC patients. The overall SVR rate was 45.2 % and did not differ between the groups in unadjusted analyses ($p = 0.95$). Genotype was the only predictor of SVR. Patients treated by nurse practitioners trained in HCV care and seen weekly for interferon injections have comparable treatment outcomes to patients treated by specialists.

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Keywords

Primary care; Hepatitis; Urban health; Nursing; Disease management

Introduction

Hepatitis C virus (HCV) is the most common chronic blood-borne infection in the United States, affecting approximately four million persons, and is a significant public health problem [1]. When left untreated, chronic infection may progress to cirrhosis, hepatocellular carcinoma, liver failure, and death [2]. Chronic HCV infection is responsible for approximately 8,000–10,000 deaths annually and is the primary indication for liver transplantation in the US [1] Successful treatment of chronic hepatitis C can achieve viral clearance, reduce the burden of chronic liver disease, and improve morbidity and mortality in infected individuals [3].

Injection drug use (IDU) is the most common risk factor for hepatitis C infection and persons infected with HCV often have a history of substance use, comorbid psychiatric conditions, or incarceration. These patients face numerous barriers that make it difficult to obtain HCV care and treatment, including an inadequate number of trained providers to provide and monitor treatment [4, 5]. Many programs exclude substance users and those with psychiatric illness from treatment [6]. Depression and anxiety disorders are common among HCV-infected individuals and, because treatment with pegylated interferon (peg-IFN) and ribavirin (RBV) may cause or exacerbate these symptoms [7], this group of patients often does not receive treatment [8].

Prior to the approval of the direct-acting agents for HCV treatment, peg-IFN and RBV combination therapy was the most effective treatment for chronic HCV, achieving overall response rates of approximately 54–56 % across all genotypes [9–11]. However, achieving a sustained virologic response (SVR), defined as an undetectable HCV-RNA level 24 weeks after the completion of treatment, requires greater than 80 % adherence to both medications, and intermittent non-adherence or early discontinuation of therapy can substantially affect treatment outcomes and SVR rates [12]. Adherence to the treatment regimen is challenging because both components of treatment have numerous potential side effects, including precipitation or exacerbation of psychiatric symptoms.

In 2002, the National Institute of Health Consensus Statement on the treatment of chronic hepatitis C infection recommended that treatment decisions be individualized and cautioned against generalized treatment exclusion of patients with substance use or a history of psychiatric illness [13]. Directly observed therapy (DOT) models have been shown to be successful for many years in the treatment of chronic infections requiring complex therapy, such as tuberculosis and HIV infection [14–18]. Adopting this model of care delivery for the treatment of chronic hepatitis C may substantially increase the number of persons who successfully complete the course of treatment. Additionally, surveys of patients in methadone treatment programs documented that a majority of persons with HCV infection are interested in treatment [19].

Several studies support that higher SVR rates are achieved in current and former injection drug users [20] and patients on methadone maintenance therapy [21–23] when a DOT model for chronic HCV treatment is utilized. Grebely [20] and colleagues demonstrated that SVR rates of 55 % were obtained in IDUs receiving DOT for chronic HCV, comparable to SVR rates in randomized controlled trials.

This retrospective study examined whether persons treated for chronic HCV in a hospital-based clinic, with a high prevalence of drug use and mental health disorders, who were enrolled in an mDOT treatment program had a higher SVR rate when compared to those receiving SC treatment (self-administered peg-IFN) delivered in a specialty clinic.

Methods

Study Sample

The study sample included 155 participants treated for chronic HCV in two adjacent, outpatient, hospital-based clinics: a nurse practitioner-staffed Primary Care clinic, and a Gastroenterology (GI) fellow-staffed Hepatology specialty clinic. Staff physicians provided back up and consultation in both clinics. Patients were referred to either clinic for evaluation and potential treatment of chronic HCV from other hospital-based clinics, community physicians, community-based methadone clinics, and the state Department of Health. Participants were included in this analysis if they had evidence of chronic HCV infection by detectable HCV-RNA and received treatment in either clinic between 2003 and 2009.

Treatment Conditions

All patients received HCV treatment with peg-IFN administered at standard doses and ribavirin administered per weight-based guidelines. Mono-infected patients were treated for 24 or 48 weeks for genotypes 2 and 3, or 1 and 4, respectively. Patients co-infected with HIV were treated for 48 weeks. Growth factors were administered and dose reductions were implemented as clinically indicated. Adverse events, including depressive symptoms, anemia, relapse to drug and alcohol use, and emergency departments visits were monitored throughout the course of therapy.

Ninety-seven participants received mDOT treatment in the nurse practitioner-staffed primary care clinic. This clinic accepted patients by referral that were either mono-infected (with chronic Hepatitis C) or co-infected with chronic Hepatitis C and HIV. Patients were enrolled in the mDOT program in which the nurse practitioner (NP) administered peg-IFN injections weekly in the clinic. Ribavirin was prescribed for daily self-administration. Additionally, patients met each week with the NP for the evaluation of depressive symptoms, using a standardized scale. Weekly sessions also included counseling for side effect management and treatment-related symptoms. Following week twelve, participants were given the option of self-treatment with follow-up visits with the NP every 4 weeks.

Fifty-eight participants were treated in the Hepatology clinic by gastroenterology fellows. This hospital-based specialty clinic focused on the treatment of HCV mono-infection. This group of patients received SC that included one instructional session in side effect management and medication administration prior to the onset of treatment(led by a registered nurse). Patients in the SC treatment arm self-administered treatment at home, while reporting to the clinic every 1–3 months for clinical evaluations by a physician and standard laboratory evaluations.

Study Design

Institutional Review Board (IRB) approval was obtained for this retrospective cohort study at Rhode Island Hospital. Data was extracted from the clinical record using a standardized chart review instrument for all patients who received HCV treatment (received at least one dose of pegylated interferon) between January 1, 2003 and December 31, 2009. Patient demographics, HCV genotype and baseline viral load, medical and psychiatric history, history of injection drug use, treatment adherence, adverse events, and the frequency of HCV treatment visits were collected by chart review.

Measures

The primary endpoint for the study was a sustained virologic response to interferon-based therapy, defined as an undetectable HCV-RNA level (HCV-RNA <50 IU/ml, COBAS AMPLICOR HCV Test v2.0, Roche Diagnostic Systems) 24 weeks after the completion of treatment. All participants who received at least one peg-IFN injection were included in the analysis. Participants who did not complete the prescribed course of treatment were considered to be treatment failures. Relapse was defined as a lack of SVR in any participant who had been undetectable at the completion of therapy (i.e. achieved an end-of-treatment response).

Statistical Analysis

All statistical analyses were performed using Stata MP version 10.1 [24]. Descriptive statistics including means, proportions and standard deviations were calculated to summarize the characteristics of the sample. *T* tests for differences in means and Chi square tests for differences in proportions are reported to statistically compare clinic types. Participants who were lost to follow-up and for whom SVR test results were not obtained (n = 17) were defined as not achieving SVR (treatment failures).

A logistic regression model was estimated to examine the adjusted effect of clinic type on SVR and to evaluate potential predictors of achieving SVR. A small amount of item-specific missing data was observed on evaluated predictors. Complete data were available for 150 participants; four participants were missing data for one predictor and one participant was missing data for two predictors. We used multiple imputation by chained equations (MICE) to generate 20 complete imputed data sets [25]. Imputed data sets were generated using the program ice and the logistic regression model was estimated using the companion program mim [26].

Results

A total of 155 patients were included in the study. 97 (63 %) received mDOT and 58 (37 %) received standard care (Table 1). The mean age of the cohort was 46 years, and 73 % were male. Racial demographics of the sample included 59 % Caucasian, 11 % Black/African American, and 21 % Hispanic. A past history of IDU was reported by 78 % of participants. Regarding HCV genotype, type 1 was reported in 59 % of participants. Nearly one-half (45 %) of participants had a history of depression at baseline screening. Co-infection with HIV was reported in 9.4 % of participants. Among those who received at least one injection of peg-IFN, the overall sustained virologic response rate was 45 %.

Participants in the mDOT group were younger (43.7 vs. 50.1, $p < 0.001$), had a higher rate of co-infection with HIV (13.5 vs. 2.0 %, $p = 0.02$), were more likely to report a history of IDU (93.1 vs. 50.0 %, $p < 0.001$), and received fewer antidepressant prescriptions during HCV treatment (26.1 vs. 57.1 %, $p < 0.001$) when compared to participants in the SC arm. Drop out rates were lower in the mDOT group, although not statistically different (8.3 vs. 15.5 %, $p = 0.16$). The groups did not differ by gender, HCV genotype, or a history of depression. SVR rates for the two treatment groups were not significantly different (45.4 vs. 44.8 %, $p = 0.95$).

In multivariate analyses, genotype 1 emerged as a significant negative predictor of achieving SVR. Also, a having a history of depression, Black/African-American race, and history of injection drug use were associated with significantly lower odds of achieving an SVR (Table 2).

Discussion

This retrospective study compared the effectiveness of two treatment models for the delivery of HCV therapy. Our SVR rates were comparable to SVR rates reported in registration clinical trials [9–11] and real world treatment trials [21, 27–29]. We found that an mDOT approach, delivered by a nurse practitioner in a primary care clinic, produced comparable treatment outcomes to a standard academic gastroenterology clinic protocol. We suspect that the adherence benefits of mDOT were offset by the more complex comorbidities seen in the primary care patients.

Psychiatric comorbidity is common in patients chronically infected with Hepatitis C [22], and HCV treatment is associated with new onset or exacerbation of depressive symptoms [30, 31]. Patients in whom depressive symptoms occur or intensify may discontinue treatment prematurely, or have lower rates of adherence to the treatment regimen, ultimately affecting treatment outcomes and SVR rates [32]. Previous studies have demonstrated that DOT models can be effective in improving SVR rates in difficult to treat groups. Bonkovsky [21] showed that HCV-infected, methadone-maintained patients who were treated in a DOT program were three times more likely to achieve an SVR than those who self-administered treatment. Overall SVR in their study was similar to ours (46 %), despite our study having a higher proportion of Black and Hispanic participants—groups known to have lower SVR rates [33–35]. Although mDOT was not a predictor of SVR, it is notable that the patients in the mDOT arm required a significantly lower rate of antidepressant prescriptions during HCV therapy. Perhaps the increased frequency of supportive patient-provider visits in the mDOT arm was responsible for a decreased need for antidepressant medication, a clinical benefit since these medications have additional side effects and potential drug interactions.

Much literature supports that advanced practice nurses can successfully treat chronic illnesses with outcomes comparable to physicians. Nurses have managed the initiation and monitoring of antiretroviral therapy in HIV-infected individuals [36–39], hypertension [40], and diabetes management [41] with similar outcomes to their physician counterparts. Arora et al. [42] reported that patients treated for HCV by primary care clinicians (including nurse practitioners and physician assistants) had similar outcomes when compared to patients treated by an HCV specialty clinic. With the recent CDC recommendation of more widespread testing and treatment of HCV-infected individuals [1], the development of programs designed to treat large numbers of patients will be paramount. Increasing the number of nurse practitioners trained in the care of HCV has the potential to improve access to treatment. Even with the recent approval of the direct acting agents, peg-IFN remains central to the treatment regimen and continues to be a major cause of treatment discontinuation, especially among patients with comorbidities. The ability of advanced practice nurses to evaluate, administer, and closely monitor these complex regimens in challenging populations holds promise for improving the uptake of this difficult treatment. Furthermore, the literature suggests that less than 50 % of patients who are referred to GI specialists for evaluation and treatment of HCV follow-up with their referral appointments, a significant barrier to HCV treatment [43]. Incorporating HCV treatment by advanced practice nurses into primary care settings will broaden the accessibility of treatment and minimize this barrier to care.

Our study has some limitations. The data were collected retrospectively in a single site. In this cohort study, selection effects might have influenced treatment outcomes. In addition, the sample size was modest, limiting statistical power to detect meaningful associations with treatment outcome. Finally, we did not incorporate a cost analysis into this study. Assuming similar efficacy, the implications of greater number of visits yet lower antidepressant medication costs should be evaluated in future work.

Despite its limitations, our study suggests that the mDOT model of HCV treatment might benefit difficult-to-treat patients, such as those with a history of injection drug use or HIV co-infection, allowing them to achieve comparable cure rates as those with less comorbidity treated in usual settings. Furthermore, shifting HCV treatment to appropriately trained nurse practitioners is feasible, potentially improving access to treatment for those with chronic Hepatitis C infection.

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References

1. Center For Disease Control And Prevention. Centers for Disease Control and Prevention; 2012. Retrieved May 18, 2012, from http://www.cdc.gov/hepatitis
2. El-Serag HB. Hepatocellular carcinoma. New England Journal of Medicine. 2011; 365:1118–1127. [PubMed: 21992124]
3. Backus LI, Boothroyd DB, Phillips BR, Belperio P, Halloran J, Mole LA. A sustained virologic response reduces risk of all-cause mortality in patients infected with hepatitis C. Clinical Gastroenterology & Hepatology. 2011; 9:509–516.10.1016/j.cgh.2011.03.004 [PubMed: 21397729]
4. McGowan CE, Monis A, Bacon BR, et al. A global view of hepatitis C: Physician knowledge, opinions, and perceived barriers to care. Hepatology. 2013 (Epub ahead of print). 10.1002/hep.26246
5. McGowan CE, Fried MW. Barriers to hepatitis C treatment. Liver International. 2012; 32(suppl 1): 51–56.10.1111/j.1478-3231.2011.02706.x [PubMed: 22212572]
6. Stephenson J. Former addicts face barriers to treatment for HCV. JAMA. 2001; 285:1003–1005. [PubMed: 11209154]
7. Trask PC, Esper P, Riba M, Redman B. Psychiatric side effects of interferon therapy: Prevalence, proposed mechanisms, and future directions. Journal of Clinical Oncology. 2000; 18(11):2316–2326. [PubMed: 10829053]
8. Feuerstadt P, Bunim AL, Garcia H, et al. Effectiveness of hepatitis C treatment with pegylated interferon and ribavirin in urban minority patients. Hepatology. 2010; 51:1137–1143.10.1002/hep.23429 [PubMed: 20049907]
9. Fried MW, Shiffman ML, Reddy KR, et al. Peginterferon alfa-2a plus ribavirin for chronic hepatitis C virus infection. New England Journal of Medicine. 2002; 347:975–982. [PubMed: 12324553]
10. Manns MP, McHutchison JG, Gordon SC, et al. Peginterferon alfa-2b plus ribavirin compared with interferon alfa-2b plus ribavirin for initial treatment of chronic hepatitis C: A randomised trial. Lancet. 2001; 358:958–965. [PubMed: 11583749]
11. Hadziyannis SJ, Sette H, Morgan TR, et al. Peginterferon alfa-2a and ribavirin combination therapy in chronic hepatitis C: A randomized study of treatment duration and ribavirin dose. Annals of Internal Medicine. 2004; 140:346–355. [PubMed: 14996676]
12. Lo Re V III, Teal V, Localio R, Amorosa V, Kaplan DE, Gross R. Relationship between adherence to hepatitis C virus therapy and virologic outcomes. Annals of Internal Medicine. 2011; 155:353–360. [PubMed: 21930852]
13. National Institutes Of Health. National Institutes of Health Consensus Development Conference Statement: Management of hepatitis C: 2002. Final statement. 2002. Retrieved from http://consensus.nih.gov/cons/116/091202116cdc_statement.htm
14. Batki SL, Gruber V, Moon Bradley J, Bradley M, Delucchi K. A controlled trial of methadone treatment combined with daily observed isoniazid for tuberculosis prevention in injection drug users. Drug and Alcohol Dependence. 2002; 6:283–293. [PubMed: 12062463]

15. Berg KM, Litwin AH, Li X, Heo M, Arnsten JH. Lack of sustained improvement in adherence or viral load following a directly observed antiretroviral therapy intervention. Clinical Infectious Diseases. 2011; 53(9):936–943. [PubMed: 21890753]
16. Flanigan TP, Taylor LE, Mitty JA. Use of community-based, directly observed therapy for HIV infection: Lessons learned for treatment of hepatitis C virus infection. Clinical Infectious Diseases. 2005; 40:S346–S348. [PubMed: 15768346]
17. Gourevitch MN, Wasserman W, Panero MS, Selwyn PA. Successful adherence to observed prophylaxis and treatment of tuberculosis among drug users in a methadone program. Journal of Addictive Diseases. 1996; 15:93–104. [PubMed: 8729149]
18. McCance-Katz EF, Gourevitch MN, Arnsten J, Sarlo J, Rainey P, Jatlow P. Modified directly observed therapy (MDOT) for injection drug users with HIV disease. American Journal of Addiction. 2002; 11:271–278.
19. Stein MD, Maksad J, Clarke J. Hepatitis C disease among injection drug users: knowledge, perceived risk and willingness to receive treatment. Drug and Alcohol Dependence. 2001; 61:211–215. [PubMed: 11164684]
20. Grebely J, Raffa JD, Meagher C, et al. Directly observed therapy for the treatment of hepatitis C virus infection in current and former injection drug users. Journal of Gastroenterology and Hepatology. 2007; 22:1519–1525.10.1111/j.1440-1746.2007.05032.x [PubMed: 17645460]
21. Bonkovsky HL, Tice AD, Yapp MD, et al. Efficacy and safety of pegInterferon alfa-2a/ribavirin in methadone maintenance patients: Randomized comparison of direct observed therapy and self-administration. American Journal of Gastroenterology. 2008; 103:2757–2765.10.1111/j.1572-0241.2008.02065.x [PubMed: 18684176]
22. Litwin AH, Soloway I, Gourevitch MN. Integrating services for injection drug users infected with hepatitis C virus with methadone maintenance treatment: Challenges and opportunities. Clinical Infectious Diseases. 2005; 40:S339–S345. [PubMed: 15768345]
23. Litwin AH, Harris KA, Nahvi S, et al. Successful treatment of chronic hepatitis C with pegylated interferon in combination with ribavirin in a methadone maintenance treatment program. Journal of Substance Abuse Treatment. 2009; 37:32–40.10.1016/j.jsat.2008.09.009 [PubMed: 19038524]
24. StataCorp. Stata statistical software: Release 10.1. College Station, TX: StataCorp LP; 2010.
25. White IR, Royston P, Wood AM. Multiple imputation using chained equations: Issues and guidance for practice. Statistics in Medicine. 2011; 30(4):377–399. [PubMed: 21225900]
26. Royston P. Multiple imputation of missing values: Further update of ice, with an emphasis on interval censoring. Stata Journal. 2007; 7(4):445–464.
27. Idress M, Riazuddin S. A study of best positive predictors for sustained virologic response to interferon alpha plus ribavirin therapy in naive chronic hepatitis C patients. BMC Gastroenterology. 2009; 9(5)10.1186/1471-230X-9-5
28. Neukam K, Mira JA, Claro E, et al. Efficacy of chronic hepatitis C therapy with pegylated interferon and ribavirin in patients on methadone maintenance treatment. European Journal of Clinical Microbiology and Infectious Diseases. 2011; 31(6):1225–1232.10.1007/s10096-011-1433-5
29. Sylvestre DL, Clements BJ. Adherence to hepatitis C treatment in recovering heroin users maintained on methadone. European Journal of Gastroenterology and Hepatology. 2007; 19(9):741–747. [PubMed: 17700258]
30. Ebner N, Wanner C, Winklbaur B, et al. Retention rate and side effects in a prospective trial on hepatitis C treatment with pegylated interferon alpha-2a and ribavirin in opioid-dependent patients. Addiction Biology. 2009; 14:227–237.10.1111/j.1369-1600.2009.00148.x [PubMed: 19291011]
31. Schaefer M, Engelbrecht M, Gut O, et al. Interferon alpha (IFNalpha) and psychiatric syndromes: A review. Progress in Neuro-Psychopharmacology and Biological Psychiatry. 2002; 26:731–746. [PubMed: 12188106]
32. Leutscher P, Lagging M, Buhl M, et al. Evaluation of depression as a risk factor for treatment failure in chronic hepatitis C. Hepatology. 2010; 52:430–435.10.1002/hep.23699 [PubMed: 20683942]

33. Conjeevarum HS, Fried MW, Jeffers LJ, et al. Peginterferon and ribavirin treatment in African American and Caucasian American patients with hepatitis C genotype 1. Gastroenterology. 2006; 131:470–477.10.1053/j.gastro.2006.06.008 [PubMed: 16890601]
34. Muir AJ, Bornstein JD, Killenberg PG. Peginterferon alpha-2b and ribavirin for the treatment of chronic hepatitis C in Blacks and non-Hispanic whites. New England Journal of Medicine. 2004; 350:2265–2271. [PubMed: 15163776]
35. Rodriguez-Torres M, Jeffers LJ, Sheikh MY, et al. Peginterferon alpha-2a and ribavirin in latino and non-latino whites with hepatitis C. New England Journal of Medicine. 2009; 360:257–267. [PubMed: 19144941]
36. Fairall L, Bachmann M, Lombard C, et al. Task shifting of antiretroviral treatment from doctors to primary-care nurses in South Africa (STRETCH): A pragmatic, parallel, cluster-randomised trial. Lancet. 2012; 380:889–898.10.1016/S0140-6736(12)60730-2 [PubMed: 22901955]
37. Sanne I, Orrell C, Fox MP, et al. Nurse versus doctor management of HIV-infected patients receiving antiretroviral therapy (CIPRA-SA): A randomised non-inferiority trial. Lancet. 2010; 376:33–40.10.1016/S0140-6736(10)60894-X [PubMed: 20557927]
38. Shumbusho F, Van Griensven J, Lowrance D, et al. Task shifting for scale-up of HIV care: Evaluation of nurse-centered antiretroviral treatment at rural health centers in Rwanda. PloS Medicine. 2009; 6(10):1–12.10.1371/journal.pmed.1000163
39. Bedelu M, Ford N, Hilderbrand K, et al. Implementing antiretroviral therapy in rural communities: The Lusikisiki model of decentralized HIV/AIDS care. Journal of Infectious Diseases. 2007; 196:S464–S468. [PubMed: 18181695]
40. Logan AG, Milne BJ, Achber C, Campbell WP, Haynes RB. Work-site treatment of hypertension by specially trained nurses. A controlled trial. Lancet. 1979; 314:1175–1178. [PubMed: 91901]
41. Condosta D. Comparison between nurse practitioner and MD providers in diabetes care. The Journal for Nurse Practitioners. 2012; 8:792–796.
42. Arora S, Thornton K, Murata G, et al. Outcomes of treatment for hepatitis C virus infection by primary care providers. New England Journal of Medicine. 2011; 364(23):2199–2207.10.1056/NEJMoa1009370 [PubMed: 21631316]
43. Fishbein DA, Lo Y, Reinus JF, Gourevitch MN, Klein RS. Factors associated with successful referral for clinical care of drug users with chronic hepatitis C who have or are at risk for HIV infection. Journal of Acquired Immune Deficiency Syndromes. 2004; 37(3):1367–1375. [PubMed: 15483466]

Table 1

Background characteristics (N = 155)

	Cohort	Clinic		t (*p*=) or χ^2 (*p*=)
	Mean (±SD) or n (%)	SC (n = 58) Mean (±SD) or n (%)	mDOT (n = 97) Mean (±SD) or n (%)	
Age, years	46.0 (±8.8)	50.1 (±7.9)	43.7 (±8.5)	4.35 (0.000)
Male, gender	100 (72.5 %)	34 (69.4 %)	66 (74.2 %)	0.36 (0.548)
Race/ethnicity				
Caucasian	82 (59.4 %)	22 (44.9 %)	60 (67.4 %)	24.88 (0.000)
African-American	15 (10.8 %)	6 (12.2 %)	9 (10.1 %)	
Hispanic	29 (21.0 %)	9 (18.4 %)	20 (22.5 %)	
Other	12 (8.7 %)	12 (24.5 %)	0 (0.0 %)	
Genotype 1	81 (58.7 %)	30 (61.2 %)	51 (57.3 %)	0.20 (0.654)
HIV co-infection	13 (9.4 %)	1 (2.0 %)	12 (13.5 %)	4.85 (0.028)
Current smoker	91 (66.9 %)	21 (44.7 %)	70 (78.7 %)	16.03 (0.000)
Depression history	61 (44.5 %)	24 (49.0 %)	37 (42.1 %)	0.61 (0.434)
History of IDU	105 (77.8 %)	24 (50.0 %)	81 (93.1 %)	33.25 (0.000)
SVR	70 (45.2 %)	26 (44.8 %)	44 (45.4 %)	0.00 (0.949)
Antidepressant treatment	51 (37.2 %)	28 (57.1 %)	23 (26.1 %)	12.95 (0.000)
Lost to follow-up	17 (11.0 %)	9 (15.5 %)	8 (8.3 %)	1.96 (0.161)

Table 2

Logistic regression model predicting SVR (n = 155)

Predictor	OR (95 % CI)
Age, years	0.98 (0.94–1.02)
Male, gender	1.02 (0.46–2.27)
Race\ethnicity	
African-American	0.28 (0.07–1.08)
Hispanic	0.85 (0.35–2.03)
Other	0.08 (0.21–3.00)
Caucasian [REF]	1.00
Genotype 1	0.28 ** (0.14–0.58)
HIV co-infection	1.50 (0.38–5.82)
Depression history	0.78 (0.37–1.67)
IDU history	0.49 (0.17–1.39)
Antidepressant receipt	1.04 (0.46–2.37)
Clinic type (mDOT)	0.95 (0.35–2.58)

* $p < 0.05$;

** $p < 0.01$