Published in final edited form as:

J Viral Hepat. 2015 May ; 22(5): 489–495. doi:10.1111/jvh.12344.

Uptake and Utilization of Directly-Acting Antiviral Medications for Hepatitis C Infection in U.S. Veterans

Risha Gidwani^{1,2,3}, Paul G. Barnett^{1,4}, Jeremy D. Goldhaber-Fiebert^{3,5}, Steven M. Asch^{2,3}, Jeanie Lo¹, Sharon K. Dally¹, and Douglas K. Owens^{2,3,5}

Risha Gidwani: Risha.Gidwani@va.gov; Paul G. Barnett: Paul.Barnett@va.gov; Jeremy D. Goldhaber-Fiebert: jeremygf@stanford.edu; Steven M. Asch: Steven.Asch@va.gov; Jeanie Lo: Jeanie.Lo@va.gov; Sharon K. Dally: Sharon.Dally@va.gov; Douglas K. Owens: Owens@stanford.edu

¹VA Health Economics Resource Center

²VA Center for Innovation to Implementation

³Stanford University Department of Medicine

⁴Stanford University Department of Health Research and Policy

⁵Stanford University Center for Health Policy/Center for Primary Care and Outcomes Research

Abstract

New drugs therapies have revolutionized the treatment of hepatitis C virus (HCV) infection. The objectives of this study were to evaluate uptake and utilization of boceprevir and telaprevir in the Department of Veterans Affairs (VA). We evaluated whether therapies confirmed to response-guided protocols, whether they replaced standard interferon plus ribavirin therapy treatment, and whether IL-28B was used to guide therapy. This work can inform our understanding of how other new effective HCV therapies will be used, their diffusion, and the timing of their diffusion in actual clinical practice. We performed an administrative-data based analysis of all patients receiving pharmacologic treatment for HCV in VA from October 2009 to July 2013.

Results—There were 12,737 new HCV prescriptions in VA during this time, with 5,564 boceprevir or telaprevir prescriptions (44%) and 7,173 prescriptions (56%) written for standard dual therapy (interferon plus ribavirin treatment). Prescriptions for the new treatments heavily favored boceprevir versus telaprevir (83% versus 17%). Sixty two percent (62%) of boceprevir-treated patients completed their minimum-specified protocol, while 69.2% of telaprevir-patients completed their minimum-specified protocol. From October 2010 to July 2012, 4,090 patients had an IL-28B test; less than 16% of these tests guided subsequent HCV prescriptions. Uptake of boceprevir and telaprevir was rapid and the number of patients initiating treatment approximately doubled in the period after their introduction. While new prescriptions favor boceprevir or telaprevir over standard dual therapy, there appears to still be a strong role of interferon and ribavirin in treating HCV patients.

Correspondence: Risha Gidwani, DrPH, Health Economist - VA Health Economics Resource Center, Investigator - VA Center for Innovation to Implementation, 795 Willow Road, 152 MPD, Menlo Park, CA 94025, (650) 493-5000 x22937, Fax: 650-617-2639, Risha.Gidwani@va.gov.

Conflict Of Interest: The authors declare that there are no conflicts of interest.

Keywords

boceprevir; IL-28B; interferon; ribavirin; telaprevir

In the United States, 2.7 million individuals have chronic Hepatitis C (HCV) infection, making HCV the most prevalent chronic blood-borne infection in the U.S. (1). The recent introduction of new drug treatment options has revolutionized the treatment of HCV. The first two directly-acting antiretroviral agents (DAAs), boceprevir and telaprevir, were approved by the Food and Drug Administration in May 2011. Subsequently, additional agents have become available, including sofosbuvir and simeprevir, and many new agents are undergoing trials (2-6).

Prior to the introduction of directly-acting antivirals, standard treatment for chronic HCV had been a two-drug therapy of daily oral ribavirin and weekly subcutaneous injections of pegylated alpha interferon (called hereafter interferon/ribavirin). However, this therapy is associated with low rates of uptake, high rates of side-effects and treatment discontinuation, and low cure rates. HCV patients are considered cured if they achieve sustained virologic response (SVR), denoted by the absence of disease 24-48 weeks after treatment end. Randomized controlled trials of interferon/ribavirin treatment indicate SVR rates of 33-46% in treatment-naïve chronic HCV genotype 1 patients (7-9).

Boceprevir and telaprevir can be used in combination with standard interferon/ribavirin treatment. This three-drug combination therapy significantly increases SVR while requiring a shorter treatment course, though it requires monitoring to ensure the response is underway (so-called response-guided therapy). Randomized trial data indicate much higher SVR rates for boceprevir and telaprevir combination therapy compared to ribavirin plus interferon alone: 63-66% for boceprevir-treated patients (10) and 69-75% for telaprevir-treated patients (11). However, boceprevir and telaprevir can have a higher probabilities of adverse events, including gastrointestinal disorders, anemia and rash (10, 11), and are substantially more expensive than dual therapy.

Some providers have used Interleukin (IL)-28B genotype testing to identify patients who stand to benefit the most from combination therapy with boceprevir and telaprevir. Patients with the CC IL-28B genotype are most responsive to any HCV therapy: up to 70% achieve SVR with ribavirin/interferon therapy and up to 90% achieve SVR with boceprevir or telaprevir combination therapy. In contrast, SVR for CC or TT genotype patients are 30% for ribavirin/interferon and up to 70% for combination therapy with boceprevir or telaprevir (12-14).

The aims of the present study were to assess uptake rates of new DAAs in the Department of Veterans Affairs (VA), assess whether DAA prescriptions dispensed were aligned with response-guided protocols, assess whether DAAs replaced existing dual therapies, and whether IL-28B tests were used to guide HCV treatment. The VA provides care for more than 180,000 chronically infected HCV patients (15), one of the largest populations of HCV-infected patients in the U.S.

Materials and Methods

We performed a retrospective observational analysis to assess use of boceprevir and telaprevir therapy amongst a national population. Patients were identified as being treated for HCV if they had a prescription for boceprevir or telaprevir, or a prescription for ribavirin or interferon alpha accompanied by a VA inpatient or outpatient encounter with an International Classification of Disease-9 (ICD-9) code for Hepatitis C (070.41, 070.44, 070.51, 070.54, 070.70, or 070.71).

The date of new HCV prescription was determined by searching VA Decision Support System (DSS) National Pharmacy Extracts for dispensed medications. The time frame of this study was October 1, 2009 to July 31, 2013. Patients who received interferon or ribavirin in the 90 days prior to October 1, 2009 were excluded from the analysis, as these were considered existing dual therapy prescriptions. Patients treated with ribavirin or interferon could be treatment-naïve or treatment-experienced. A patient was considered to have treatment with ribavirin and interferon alone if he was dispensed both interferon and ribavirin and did not have a prescription for telaprevir or boceprevir; or had a prescription for telaprevir or boceprevir that started more than 60 days after the interferon or ribavirin prescription (which was considered a separate episode of care).

As the Food and Drug Administration (FDA) approved telaprevir and boceprevir in mid-May 2011, we included telaprevir and boceprevir prescriptions dispensed between June 1, 2011 and July 31, 2013 in the analysis. The length of the boceprevir and telaprevir medication treatment episodes were calculated using all available pharmacy data from June 2011 to July 2013. Boceprevir and telaprevir therapies follow a response-guided protocol and can last as long as 12 months (13, 14). Boceprevir-based and telaprevir-based treatment also includes use of pegylated interferon and ribavirin; for the purposes of evaluating length of treatment episodes, we analyzed boceprevir and telaprevir only. Using data from June 2011 to July 2012, we defined 4-week periods beginning at treatment initiation, and calculated the number of 4-week treatment intervals available for each patient. A patient was right-censored if he or she did not have sufficient time for follow-up, or if the patient was lost to follow-up. For example, a patient who did not have a prescription dispensed at week 37 would also be ineligible for evaluation of treatment adherence in the 37-40 week time interval. For each interval, we evaluated, amongst those who were not censored, the percentage of patients with medication dispensed for that entire interval. If a patient had a gap in refill of greater than 60 days, we considered the prescription after the 60 days to be a separate, second episode of treatment, and evaluated the length of treatment for the first episode only. This affected few records; only 24 boceprevir-treated patients and one telaprevir-treated patient had more than one episode of treatment. We also separately calculated the medication possession ratio for boceprevir and telaprevir as the total days' supply divided by the length of time covered by the filled script(s). The medication possession ratio therefore serves to proxy medication adherence.

We extracted data from VA Corporate Data Warehouse (CDW) to determine use of IL-28B genotyping and IL-28B results from October 1, 2010 to July 31, 2012. In order to determine what percentage of HCV therapy was IL-28B-guided, we combined VA Decision Support

System (DSS) person-level prescription data with these VA Corporate Data Warehouse-based laboratory data. The Institutional Review Board of Stanford University approved the study (Protocol Number 26030) and a waiver of informed consent was obtained.

Results

In the period following the introduction of boceprevir and telaprevir combination therapy, VA nearly doubled the monthly volume of chronic HCV patients treated, with the largest increase occurring in use of boceprevir-based triple therapy. Between June 1, 2011 and July 31, 2013, 5,564 patients initiated DAA treatment (on average, 199 patients per month). Boceprevir was dispensed approximately five times more frequently than telaprevir (N= 4,628 for boceprevir and N= 936 for telaprevir); 83% of new DAA prescriptions were for boceprevir. In VA, boceprevir was included on formulary, while telaprevir was available but required pharmacy approval. Between October 1, 2009 and July 31, 2013, 7,173 patients initiated interferon/ribavirin therapy. From October 1, 2009 until May 31, 2011, there were, on average, 225 new ribavirin/interferon prescriptions written per month. After the introduction of boceprevir and telaprevir combination therapy, this number fell to 96 new interferon/ribavirin prescriptions written on average per month. New prescriptions for boceprevir or telaprevir were infrequent from June to September of 2011, the first four months of their approval; a large increase in prescriptions occurred in November 2011 (Table 1). They peaked in the spring of 2012 and then declined in subsequent months (Figure 1). The introduction of boceprevir and telaprevir was accompanied by a decline in the number of new interferon/ribavirin prescriptions.

We assessed the percentage of patients whose boceprevir and telaprevir prescriptions were aligned with time frames specified by response-guided protocols using data from June 2011 to July 2012. For patients who do not respond to treatment, boceprevir may be stopped at 8 weeks and telaprevir stopped at 4 weeks (16). Our data show a higher treatment rate for telaprevir at 4 weeks (95.1%) versus boceprevir at 8 weeks (88.0%), likely that most patients had a response to therapy (Table 2). In patients who respond to therapy, the minimum-specified protocol for boceprevir is 24 weeks; 62.1% of boceprevir-treated patients completed 24 weeks of therapy. The minimum-specified protocol for telaprevir is 12 weeks; 69.2% of telaprevir-patients completed this protocol. The maximum-specified protocol for boceprevir is 44 weeks; 15.1% of boceprevir-treated patients completed the maximum-specified protocol. (There is no maximum-specified protocol for telaprevir.) The median length of treatment was between 24 and 28 weeks for boceprevir, and for telaprevir, was between 12 and 16 weeks. Length of time on therapy for each drug is denoted in Table 2.

We also assessed adherence to treatment, as measured by medication possession ratios for these same patients. A medication possession ratio of 1.0 indicates perfect adherence in filling prescriptions, a medication possession ratio less than 1.0 indicates some degree of under-filling, and a medication possession ratio of greater than 1.0 indicates some degree of over-filling. We found that 57.1% of boceprevir or telaprevir-treated patients had a medication possession ratio of 1.0 and 92.0% of these patients had a medication possession ratio between 0.8 and 1.2.

IL-28B testing was used infrequently in patients receiving HCV pharmacotherapy (Table 3). Between October 1, 2010 and July 31, 2012, there were 4,090 IL-28B tests conducted in VA, yet only 23.8 % of people receiving this testing also had a dual or DAA prescription (16.3% received a DAA prescription and 7.5% receive a dual therapy prescription). Of the 6,170 patients who had a HCV prescription, only 974, or 15.8% had an IL-28B test. Of these 974 patients, 88.0% had an IL-28B test prior to their prescription; the remainder had their IL-28B tests conducted after being prescribed a HCV medication (Table 3).

We also evaluated IL-28B results to examine the percentage of HCV therapy that was IL-28B concordant. Of the 528 patients who had an IL-28B result of CT or TT, 75.8% were subsequently prescribed a boceprevir or telaprevir combination therapy, compared with the 64.5% of CC-genotype patients who had boceprevir or telaprevir therapy (Relative Risk, or $RR = 1.17$, 95% CI 1.06-1.30). Of the 251 patients who had an IL-28B result of CC, 35.5% were subsequently prescribed dual therapy, while 64.5% were subsequently prescribed a DAA-based triple therapy. Persons with CT/TT genotype were slightly less likely to get any treatment compared with persons with CC genotypes ($RR = 0.77$, 95% CI 0.69-0.87). Amongst patients who received any prescription, those who had an IL-28B test (regardless of test result) were more likely than patients who did not have an IL-28B test to receive boceprevir or telaprevir; 68.6% of patients with IL-28B testing received telaprevir, while 43.8% of patients without IL-28B received boceprevir or telaprevir, ($RR, = 1.42$, 95% CI 1.35 -1.50).

Discussion

Our analysis of one of the largest cohort of HCV-infected patients in the U.S indicates that initiation of treatment for HCV approximately doubled during the year after introduction of boceprevir and telaprevir. Boceprevir was dispensed almost five times more than telaprevir, which is unsurprising given that boceprevir is on-formulary at VA, while telaprevir requires special approval at many VA centers.

During the first year of their availability, boceprevir and telaprevir served in largely as a complement to, rather than a substitute for, interferon/ribavirin therapy. However, approximately one year after the introduction of boceprevir and telaprevir, new prescriptions for interferon/ribavirin therapy began a further decline. Although boceprevir and telaprevir began to play a larger relative role in the new treatment of patients with HCV, during that same time period (Spring 2013 on), there was a decline in all new HCV prescriptions. This may be an indication that providers were waiting for even newer, more effective, HCV therapies to become available before starting their patients on pharmacologic treatment. Of note, the continue role of dual therapy in VA be in part due to the fact that VA has only approved boceprevir and telaprevir patients with genotype 1 HCV infections. Therefore, patients infected by other genotypes would continue to be candidates for ribavirin/interferon. However, only 10 to 15% of the total sample would likely be non-genotype 1 patients; these patients likely do not account for the majority of the new ribavirin/interferon prescriptions.

The total number of HCV patients treated during the study was small relative to the estimated number of Veterans with chronic HCV; there were 5,564 DAA prescriptions and

7,173 new interferon/ribavirin therapy prescriptions versus an estimated 180,000 chronically infected HCV patients (15). This implies that less than 8% of infected persons received treatment for HCV. While this percentage is low, it may be due to comorbidities and/or contraindications for treatment, and concerns regarding side-effects of HCV treatment regimens. In addition, both clinicians and patients may have chosen to delay therapy to wait for treatment options with even higher efficacy and fewer side effects. Of note, the patients who were dispensed boceprevir or telaprevir largely had perfect or near-perfect medication possession ratios. This indicates that highly-adherent patients were being selected for boceprevir and telaprevir treatment.

Patterns of DAA use in VA are largely consistent with response-guided protocols and provide evidence of low rates of early discontinuation. The median length of treatment was almost 28 weeks for boceprevir and between 12 and 16 weeks for telaprevir; roughly two-thirds of DAA-treated patients completed their minimum-specified protocol. The difference in median time on DAA therapy is heavily driven by the shorter treatment course for telaprevir. Boceprevir-treated patients have a longer minimum-specified DAA protocol of 24 weeks of therapy, compared with a minimum-specified DAA protocol of 12 weeks for telaprevir. Median time on therapy for each drug should therefore be interpreted in the context of these treatment length and discontinuation guidelines. Belperio et al.'s analysis of 859 HCV-infected veterans also found higher rates of discontinuation of telaprevir versus boceprevir at week 12 (17).

IL-28B tests do not appear to be frequently used to guide treatment decisions. The vast majority of patients (76.2%) with IL-28B testing received no drug treatment at all. However, low use of IL-28B to guide HCV therapy is not incongruent with treatment practice guidelines. VA Hepatitis C Resource Center Program and National Hepatitis C Program Office acknowledge the potential utility of IL-28B testing in making treatment decisions but do not specifically recommend its use (16). Of the IL-28B genotype testing that did occur, between 9.8% to 15.9% of tests were followed by HCV prescriptions that can be considered to be guided by test results. IL-28B testing is, however, associated with greater use of DAAs; patients who had IL-28B testing were 1.42 times more likely to receive a DAA compared to patients who did not have an IL-28B test. This may be due to some unmeasured confounder, such as physician preference; it is possible some physicians are more likely to update new technologies, and those who uptake new diagnostic technologies are more likely to update new pharmaceutical interventions as well.

New treatment options may reduce the clinical utility of IL-28B genotype testing. Recent clinical trials demonstrate that sofosbuvir-based interferon-sparing HCV treatment regimens achieve high SVR rates across multiple HCV genotypes (2, 3). Compared with telaprevir or boceprevir, sofosbuvir-treated patients experience higher SVR regardless of their IL-28B genotype; in patients treated with sofosbuvir and daclatasvir, SVR was 93% in CC genotype patients and 98% in non-CC genotype patients (6).

The retrospective nature of our study poses some limitations. We evaluated the percentage of patients beginning boceprevir or telaprevir therapy who remained on therapy at various follow-up times. From the data available, it was not possible to determine the reason for

treatment discontinuation, which could be attributed to patient noncompliance, or to a physician decision to stop therapy due to lack of response. We were not able to ascertain whether patients were treatment-naïve or being retreated; this may affect length of time on treatment.

The treatment landscape for HCV has changed dramatically in the recent past, with FDA approval of telaprevir and boceprevir in June 2011, the November 2013 approval of simeprevir, and the December 2013 approval of sofosbuvir. Given the extremely high expense of sofosbuvir and simeprevir and the large expense of telaprevir and boceprevir compared with dual therapies, it will become important to evaluate the effectiveness of these therapies in real-world clinical practice. Recent evidence on HCV-infected genotype 1 veterans indicates, for telaprevir and boceprevir, lower rates of SVR in clinical practice than was seen in randomized controlled trials (17, 18). Therefore, it is important to evaluate both the effectiveness and the cost-effectiveness of these new therapies as they are used in practice

Our analysis of national data from VA indicate that boceprevir and telaprevir will be adopted quickly after approval and that the number of new patients being treated for HCV approximately doubled during this time. However, we also found that approximately half of new prescriptions written after the approval of boceprevir and telaprevir did not include these new medications and were for interferon/ribavirin alone. This indicates DAA have served largely as a complement to, rather than a substitute for, interferon/ribavirin therapy. As new treatment regimens become available with higher efficacy and better tolerability, treatment rates may increase further. The new treatment options hold the promise of better outcomes for patients, but may also create challenges due to the substantial cost of treating the large number of treatment-eligible HCV patients in the U.S.

Acknowledgments

The authors wish to thank Paul Shekelle, MD MPH PhD and Matthew Goetz, MD for their valuable feedback on this study and manuscript. This research was partially supported by VA Health Services Research and Development Service project IIR 12-059-2. Jeremy Goldhaber-Fiebert was partially funded by the NIH NIA K01 AG037593.

References

1. Alter MJ, Kruszen-Moran D, Naian O, et al. The prevalence of hepatitis C virus infection in the United States, 1988 through 1994. *N Engl J Med.* 1999; 341(8):556–562. [PubMed: 10451460]
2. Gane EJ, Stedman CA, Hyland RH, et al. Nucleotide polymerase inhibitor sofosbuvir plus ribavirin for hepatitis C. *N Engl J Med.* 2013; 368(1):34–44. [PubMed: 23281974]
3. Jacobson IM, Gordon SC, Kowdley KV, et al. Sofosbuvir for Hepatitis C Genotype 2 or 3 in Patients without Treatment Options. *N Engl J Med.* 2013; 368(20):1867–1877. [PubMed: 23607593]
4. Lawitz E, Mangia A, Wyles D, et al. Sofosbuvir for previously untreated chronic hepatitis C infection. *N Engl J Med.* 2013; 368(20):1878–1887. [PubMed: 23607594]
5. Marcellin P, Cooper C, Balart L, et al. Randomized controlled trial of danoprevir plus peginterferon alfa-2a and ribavirin in treatment-naïve patients with hepatitis C virus genotype 1 infection. *Gastroenterology.* 2013; 145(4):790–800. [PubMed: 23811112]
6. Sulkowski MS, Gardiner DF, Rodriguez-Torres M, et al. Daclatasvir plus Sofosbuvir for Previously Treated or Untreated Chronic HCV Infection. *N Engl J Med.* 2014; 370(3):211–21. [PubMed: 24428467]

7. Manns M, 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 randomized trial. *Lancet*. 2001; 358(9286):958–965. [PubMed: 11583749]
8. Fried MW, Shiffman ML, Reddy KR, et al. Peginterferon alfa-2a plus ribavirin for chronic hepatitis C virus infection. *N Engl J Med*. 2002; 347(13):975–982. [PubMed: 12324553]
9. McHutchison JG, Lawitz EJ, Shiffman ML, et al. Peginterferon alfa-2b or alfa-2a with ribavirin for treatment of hepatitis C infection. *N Engl J Med*. 2009; 361(6):580–593. Erratum, *N Engl J Med* 2009; 361:1027. [PubMed: 19625712]
10. Poordad F, McCone J Jr, Bacon BR, et al. Boceprevir for untreated chronic HCV genotype 1 infection. *N Engl J Med*. 2011; 364(13):1195–1206. [PubMed: 21449783]
11. Jacobson IM, McHutchison JG, Dusheiko G, et al. Telaprevir for previously untreated chronic hepatitis C virus infection. *N Engl J Med*. 2011; 364(25):2405–2416. [PubMed: 21696307]
12. Thompson AJ, Muir AJ, Sulkowski MS, et al. Interleukin-28B polymorphism improves viral kinetics and is the strongest pretreatment predictor of sustained virologic response in genotype 1 hepatitis C virus. *Gastroenterology*. 2010; 139(1):120–129.e18. [PubMed: 20399780]
13. Merck & Co. FDA Antiviral Drugs Advisory Committee Meeting. Boceprevir Capsules (NDA 202-258). Briefing Document. Silver Spring, MD. U. S. Food and Drug Administration; Mar 29. 2011 Available: www.fda.gov/downloads/AdvisoryCommittees/CommitteesMeetingMaterials/Drugs/AntiviralDrugsAdvisoryCommittee/UCM252343.pdf [2011, November 3]
14. Vertex Pharmaceuticals. Silver Spring, MD: U.S. Food and Drug Administration; Apr 28. 2011 Telaprevir 375-mg Film-Coated Tablet for the Treatment of Genotype 1 Chronic Hepatitis C. Antiviral Drugs Advisory Committee. Briefing Document (NDA 201-917). Available: www.fda.gov/downloads/AdvisoryCommittees/CommitteesMeetingMaterials/Drugs/AntiviralDrugsAdvisoryCommittee/UCM252562.pdf [2011, November 3]
15. Department of Veterans Affairs Veterans Health Administration Public Health Strategic Health Care Group. State of Care for Veterans with Chronic Hepatitis C. Nov. 2010 Available: <http://www.hepatitis.va.gov/provider/policy/HCV-state-of-care-2010.asp>
16. Yee HS, Chang MF, Pocha C, et al. Update on the Management and Treatment of Hepatitis C Virus Infection: Recommendations from the Department of Veterans Affairs Hepatitis C Resource Center Program and the National Hepatitis C Program Office. *Am J Gastroenterol*. 2012; 107(5): 669–689. [PubMed: 22525303]
17. Belperio PS, Hwang EW, Thomas IC, Mole LA, Cheung RC, Backus LI. Early Virologic Responses and Hematologic Safety of Direct-Acting Antiviral Therapies in Veterans with Chronic Hepatitis C. *Clin Gastroenterol Hepatol*. 2013; 11(8):1021–1027. [PubMed: 23524130]
18. Ioannou GN, Beste LA, Green PK. Comparison of Boceprevir to Telaprevir Regimens for Hepatitis C Virus Infection in a Nationwide Study of 4,455 Patients. *Clin Gastroenterol Hepatol*. 2013

Abbreviations

HCV	Hepatitis C
DAA	Directly-acting antiviral
VA	Veterans Health Administration
SVR	Sustained Virologic Response
IL	Interleukin

Figure 1. Uptake of Boceprevir, Telaprevir, and Interferon plus Ribavirin

Table 1
Uptake of Hepatitis C Treatment

Date	Number of New Boceprevir Prescriptions (% of total new monthly DAAs)	Number of New Telaprevir Prescriptions (% of total new monthly DAAs)	Number of Interferon/Ribavirin starts
Jun-11	1 (100%)	0 (0%)	115
Jul-11	15 (38%)	24 (62%)	127
Aug-11	11 (31%)	25 (69%)	112
Sep-11	28 (51%)	27 (49%)	119
Oct-11	94 (71%)	38 (29%)	125
Nov-11	266 (88%)	37 (12%)	110
Dec-11	204 (85%)	35 (15%)	90
Jan-12	183 (79%)	49 (21%)	141
Feb-12	306 (91%)	31 (9%)	98
Mar-12	309 (86%)	50 (14%)	139
Apr-12	264 (85%)	45 (15%)	120
May-12	268 (85%)	49 (15%)	110
Jun-12	217 (86%)	36 (14%)	94
Jul-12	229 (87%)	33 (13%)	75
Aug-12	202 (77%)	62 (23%)	118
Sep-12	184 (80%)	45 (20%)	92
Oct-12	185 (78%)	53 (22%)	111
Nov-12	220 (85%)	38 (15%)	71
Dec-12	137 (83%)	28 (17%)	40
Jan-13	134 (81%)	32 (19%)	104
Feb-13	211 (84%)	40 (16%)	63
Mar-13	173 (83%)	36 (17%)	74
Apr-13	181 (83%)	37 (17%)	81
May-13	146 (87%)	21 (13%)	83
Jun-13	124 (84%)	24 (16%)	51
Jul-13	123 (92%)	10 (8%)	49
Total	4,628 (83%)	936 (17%)	2,675

Table 2
DAA treatment length

	Boceprevir N= 2,403		Telaprevir N = 485	
Weeks of treatment	Number (Percentage) of patients not right-censored	Percentage of patients remaining in treatment	Number (Percentage) of patients not right-censored	Percentage of patients remaining in treatment
4	2,403 (100%)	96.1%	485 (100%)	95.1%
8	2,403 (100%)	88.0%	485 (100%)	85.6%
12	2,235 (93.0%)	79.1%	464 (95.7%)	69.2%
16	2,049 (85.2%)	73.0%	430 (88.7%)	4.4%
20	1,826 (76.0%)	69.9%	392 (80.8%)	0.3%
24	1,555 (64.7%)	62.1%	349 (72.0%)	0.0%
28	1,324 (55.1%)	44.5%	308 (63.5%)	0.0%
32	1,007 (41.9%)	38.6%	262 (54.0%)	0.0%
36	766 (31.9%)	24.7%	228 (47.0%)	0.0%
40	583 (24.3%)	20.9%	190 (39.2%)	0.0%
44	378 (15.7%)	15.1%	148 (30.5%)	0.0%
48	143 (6.0%)	3.5%	115 (2%)	0.0%
52	55 (2.3%)	0.0%	76 (15.7%)	0.0%
56	30 (1.2%)	0.0%	50 (10.3%)	0.0%

Table 3

IL-28B testing and HCV prescriptions

		IL-28B Result = CC	IL-28B Result = CT or TT	Total	Percent of Total IL-28B tests
IL-28B test before HCV Rx	Dual	89	128	217	
	DAA	162	400	562	
	Total	251	528	779	19.0%
IL-28B test after HCV Rx	Dual	28	61	89	
	DAA	39	67	106	
	Total	67	128	195	4.8%
	No Tx	802	2314	3116	76.2%
	Total	1120 (27.4%)	2970 (72.6%)	4090 (100%)	100%