Gaps in the achievement of effectiveness of HCV treatment in national VA practice

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Background & Aims: Antiviral treatment for hepatitis C virus (HCV) has high efficacy rates for achieving sustained viral response (SVR) in randomized controlled trials (RCTs) (40–80%); however, it can be lower in community-based practice settings. We wanted to determine the effectiveness of HCV treatment in Veterans Administration (VA) hospitals nationwide.

Methods: Using the nationwide VA HCV Clinical Case Registry (CCR), we examined a cohort of veterans who had HCV viremia between 2000 and 2005 and identified patients who received pegylated-interferon (PEG-INF) and ribavirin. The duration of treatment and proportion of patients completing treatment was calculated. The effectiveness of treatment was measured as the proportion of patients who achieved SVR (negative viremia at least 12 weeks after the end of treatment) in the entire cohort, and among patients who initiated and completed treatment.

Results: We identified 99,166 patients with HCV viremia. Of those, 11.6% received PEG-INF with ribavirin and 6.4% completed treatment. Contraindications were present in 57.2% of the patients that did not receive treatment. SVR was documented in 39.9% and 58.3% of patients who completed treatment; 23.6% and 50.6% of patients who initiated treatment; and 3.9% and 11.2% of the entire HCV cohort for genotype 1 or 4 and 2 or 3, respectively. Overall, only 3.5% of the entire HCV viremic cohort had a documented SVR.

Conclusions: Treatment effectiveness for HCV is low. In addition to fixed factors, such as race and virus genotype, the drop in effectiveness is due to low rates of antiviral treatment initiation and treatment completion.

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Introduction

The major goal of treating patients with hepatitis C virus (HCV) is to achieve a sustained viral response (SVR). This has been associated with improvement in health-related quality of life; hepatic histological features; and even a reduction in long-term outcomes such as cirrhosis, hepatocellular carcinoma, and mortality [1–4]. Currently, the recommended antiviral treatment for HCV is a combination of pegylated-interferon (PEG-INF) and ribavirin. This combination has relatively high efficacy in achieving SVR, with rates in patients with genotype 1 from randomized controlled trials (RCTs) ranging from 41% to 52% [5–7].

Despite its high efficacy in clinical trials, the effectiveness of antiviral therapy in community-based practices is unclear. Clinical trials typically evaluate carefully selected participants with few or no contraindications; closely monitor patients; and have less ethnic and racial diversity than would be seen in most clinical practice settings [8]. A few studies in Europe, Canada, and Australia reported SVR rates among community-based patients that were comparable to those reported in clinical trials. However, these studies did not incorporate the uptake of treatment among all patients presenting to these setting. In addition, the treated patients had favorable features for achieving SVR (e.g., predominantly Caucasian with a high prevalence of HCV genotypes 2 or 3) [9–13]. On the other hand, studies of drug users and racial and ethnic minorities have shown substantially lower SVR rates in clinical practice settings [14,15]. No study has examined the overall effectiveness of care among all patients presenting with chronic HCV in a national healthcare system, while examining various steps in clinical care such as HCV genotype testing; contraindications to treatment; initiation of treatment; completion rates; and SVR.

It is important to understand the current state of treatment effectiveness so we can identify the gaps along the spectrum of care and the magnitude with which each of these gaps contributes to the drop in effectiveness. Such knowledge is essential for a rational and efficient approach to ensuring that more patients get access to treatment and ultimately, achieve SVR. In addition, with the anticipated release of newer, more efficacious therapies, addressing the gaps of effectiveness in clinical practice is very timely [16].

The Veterans Administration (VA) has the largest integrated healthcare system in the United States. It provides care for more

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than 190,000 chronically infected HCV patients [17], which is approximately 6% of the estimated 3.2 million HCV-infected individuals in the United States [18]. In this study, we sought to determine the overall effectiveness of HCV treatment in the VA, focusing on receipt of treatment and SVR rate in all patients with chronic HCV diagnosed from 2000 to 2005. We determined contraindications in patients with chronic HCV infection who did not receive treatment. We also examined SVR stratified by HCV genotype and race, among patients who received treatment.

Materials and methods

Data sources

This study was approved by Baylor College of Medicine's Institutional Review Board and all procedures conform to the ethical guidelines of the 1975 Declaration of Helsinki. We used data from the VA HCV Clinical Case Registry (CCR), which contains health information for all known HCV-infected patients from 128 VA facilities nationwide. The CCR automatically identifies patients with positive HCV antibody tests as well as HCV-related ICD-9 codes. Data elements in the CCR include demographics; laboratory test results; outpatient and inpatient VA pharmacy data; and inpatient and outpatient diagnoses codes. These data are extracted all the way back to the mid 1990s through December 31, 2006. Additional details of the CCR data are published elsewhere [17]. We examined datasets obtained from the VA HCV CCR database for patients diagnosed in the VA between January 1, 2000 and January 1, 2005. For patients with missing race/ethnicity, we linked the CCR to the VA Patient Treatment File and the Outpatient Care File to identify additional race/ethnicity information.

Study population

Patients had to have at least one positive HCV RNA test or HCV genotype test result; at least one visit at a VA facility; and an HCV index date between 2000 and 2005 to be included in the study cohort. The index date for HCV diagnosis reflected the date of the earliest positive HCV test or the first appearance of an ICD-9 code for HCV (070.51, 070.54, 070.41, 070.44, or V02.62). To be included in the treatment cohort, patients had to have at least two prescriptions for PEG-INF plus ribavirin with the first one occurring before September 30, 2005. This date was chosen based on the fact our CCR database ended on December 31, 2006 which ensured at least four months of follow-up time to determine SVR after a 48-week treatment course.

Definitions of study variables

We identified sociodemographic characteristics such age at HCV index; gender; and race/ethnicity (African American, white, Hispanic, other, or unknown) for all patients in the study cohort. We also defined variables based on ICD-9 codes (see Supplementary material for definitions) indicative of conditions that constitute absolute, or relative contraindications to treatment, based on the American Association for the Study of Liver Disease guidelines [19]. We used diagnoses in the two years before or after the HCV index date to define these conditions. Absolute contraindications included major depressive illness; renal, heart, or lung transplant; autoimmune hepatitis; severe hypertension; severe heart failure; significant coronary artery disease; poorly controlled diabetes; and severe chronic obstructive pulmonary disease (COPD). Relative contraindications included drug or alcohol use; HIV co-infection; chronic renal disease; decompensated cirrhosis; liver transplant; and uncontrolled psychiatric disease.

Treatment outcomes

All prescriptions for any interferon and/or ribavirin, including prescriptions dispensed as part of a clinical trial, were identified. Antiviral treatment initiation was defined by the date of the earliest prescription for PEG-INF released from any VA pharmacy. Duration of treatment was calculated from the earliest prescription date to the most recent prescription date plus days of supply. Prescriptions separated by time gaps of more than 45 days were not included as part of the treatment course. This definition has been used in previous studies [20]. Overlapping prescriptions were not considered. Treatment completion was defined as at least 48 weeks for genotypes 1 or 4 and at least 24 weeks for genotypes 2 or 3. Since patients in the clinical setting may have a shorter treatment course, we also considered patients who completed at least 80% of expected treatment duration to have completed therapy as done in a previous study (i.e. 38.4 weeks for genotypes 1 or 4 and 19.2 weeks for genotypes 2 or 3) [21]. The proportion of patients who discontinued treatment before 12 weeks was also examined. SVR was defined as all RNA tests being negative after treatment completion with one being recorded at least 12 weeks after treatment completion. Non-response to antiviral treatment was defined by all RNA tests during treatment being positive. Relapse was defined as any negative RNA test after treatment initiation, followed by a positive test at anytime. Undetermined response status was defined by the absence of an RNA test required to define SVR, non-response, or relapse.

Data analysis

We calculated the proportion of patients with SVR out of those who initiated treatment, those who completed treatment, and the entire cohort (all veterans with chronic HCV diagnosed in FY2000–2005). Among patients who did not receive treatment, we calculated the proportion with the contraindications defined above. Among treated patients, we calculated the treatment response outcomes (SVR, non-response, relapse, and undetermined) stratified by viral genotype (1 or 4 vs. 2 or 3) and further stratified by patient race (African American, white, and Hispanic). For all proportions of treatment response outcomes, we calculated 95% confidence intervals and used Chi-square tests and t-tests to determine statistical significance when appropriate.

Results

Study cohort

There were 99,166 patients in the study cohort. Most were men (97%) with a mean age of 51.2 years (SD = 7.9). The racial/ethnicity composition of the cohort was 55.2% white, 29.9% African American, 3.5% Hispanic, 1.1% other, and 10.2% unknown. Almost half had HCV genotypes 1 or 4 (48.0; of which approximately 1% were genotype 4), 12.2% had genotypes 2 or 3, and 39.8% were not tested for genotype. Only 11.6% of patients had a liver biopsy in the VA during the two years before and two years after their HCV index date. Approximately 16.5% (n = 16,381) had *any* prescription for interferon *or* ribavirin before September 30, 2005, while 83.5% (n = 82,785) had no prescription for any antiviral treatment. Patients who were not tested for genotype were significantly less likely to receive any antiviral treatment (3.3% vs. 25.2%, p <0.0001). Untreated patients were significantly older (51.6 vs. 49.5 years old, p <0.001 and more likely to be African American (26.0% vs. 16.7%, p <0.001) than patients who received treatment. Approximately 43% of patients who did not receive antiviral treatment had none of the contraindications to treatment listed in Materials and methods and in Table 1. The remaining 57% had at least one contraindication, with 37.2% having at least one absolute contraindication and 38.3% having at least one relative contraindication. The most common contraindication was current use of drugs or alcohol (29.7%), followed by depressive illness (16.3%), COPD (11.5%), poorly controlled diabetes (8.1%), and significant coronary artery disease (7.5%) (Table 1). All contraindications were significantly different across racial/ethnic groups (p <0.05). African Americans were less likely to have a diagnosis of depression, severe coronary artery disease, severe COPD, and decompensated cirrhosis than whites. However, African Americans were more likely to be diagnosed with severe hypertension, severe heart failure, poorly controlled diabetes, HIV, chronic renal disease, and uncontrolled psychiatric disease than whites. African Americans and Hispanics had

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Table 1. Proportions of patients with contraindications to treatment in 82,785 patients with chronic hepatitis C virus not receiving antiviral therapy and stratified by racial/ethnic groups.[*]

Contraindication to Treatment	No. of Patients Overall (%)	African American (%)	White (%)	Hispanic (%)	Other (%)
Absolute contraindications					
Depression	13,494 (16.3)	3977 (15.0)	8116 (18.5)	582 (18.5)	149 (16.7)
Renal, heart, or lung transplant	1476 (1.8)	556 (2.1)	770 (1.8)	58 (2.0)	12 (1.3)
Autoimmune hepatitis	507 (0.6)	139 (0.5)	305 (0.7)	14 (0.5)	6 (0.7)
Severe hypertension	2028 (2.4)	1175 (4.4)	674 (1.5)	83 (2.9)	17 (1.9)
Severe heart failure	1710 (2.1)	743 (2.8)	823 (1.9)	56 (2.0)	11 (1.2)
Significant coronary artery disease	6195 (7.5)	1950 (7.4)	3682 (8.4)	210 (7.4)	58 (6.5)
Poorly controlled diabetes	6718 (8.1)	3049 (11.5)	2884 (6.6)	360 (12.6)	66 (7.4)
Severe COPD**	9559 (11.5)	2442 (9.2)	6286 (14.3)	242 (8.5)	97 (10.9)
Any absolute contraindication	30,828 (37.2)	10,037 (37.9)	17,536 (39.9)	1120 (39.2)	329 (36.8)
Relative contraindications					
Users of drug or alcohol	24,343 (29.7)	9434 (35.6)	12,699 (28.9)	927 (32.4)	225 (25.2)
HIV co-infection	5239 (6.3)	1393 (5.3)	625 (1.4)	145 (5.1)	9 (1.0)
Chronic renal disease	1920 (2.3)	1032 (3.9)	707 (1.6)	72 (2.5)	19 (2.1)
Decompensated cirrhosis	3913 (4.7)	672 (2.5)	2655 (6.0)	200 (7.0)	38 (4.3)
Liver transplant	315 (0.4)	18 (0.1)	249 (0.6)	17 (0.6)	3 (0.3)
Uncontrolled psychiatric disease	4344 (5.3)	1654 (6.3)	2428 (5.5)	167 (5.9)	37 (4.1)
Any relative contraindication	31,715 (38.3)	12,217 (46.2)	16,386 (37.3)	1236 (43.3)	292 (32.7)
Any absolute or relative contraindication	47,327 (57.2)	16,547 (62.5)	25,662 (58.4)	1767 (61.8)	496 (55.5)

[*]Patients with missing race are not included in numbers stratified by racial/ethnicity groups, which is why numbers do not add up to total.
All p values for contraindications stratified by racial/ethnicity groups were <0.05.
** Chronic obstructive pulmonary disease.

slightly fewer absolute contraindications overall compared to whites, but more relative contraindications.

Treatment cohort

The treatment cohort consisted of a total of 11,479 (11.6%) patients with at least two released prescriptions for PEG-INF and ribavirin. The mean age was 49.4 years (SD = 6). Race/ethnicity distribution was 68.0% white, 18.2% African American, 4.1% Hispanic, and 1.3% other racial groups. Race was unknown in 8.4% of patients. There were 7792 (67.9%) patients with genotype 1 or 4, 2670 (23.3%) with genotype 2 or 3, and 1017 (8.8%) with unknown genotype.

Overall, 16.3% of patients discontinued treatment after less than 12 weeks. This was very similar across genotypes. Approximately 47.7% (n = 3719) and 27.2% (n = 2121) of patients with genotype 1 or 4 completed at least 38.2 and 48 weeks of treatment, respectively. On the other hand, 75.2% (n = 2007) and 50.1% (n = 1338) of patients with genotypes 2 or 3 completed 19.2 and 24 weeks of treatment, respectively. Table 2 displays the treatment outcomes by HCV genotype. Of those patients with genotype 1 or 4, 23.6% achieved SVR, 30.7% had no response, 15.4% had a relapse, and 30.2% were undetermined. Of the patients with undetermined treatment response, 36.6% discontinued treatment before 12 weeks, while nearly half discontinued treatment before 24 weeks. For patients with genotype 2 or 3,

50.6% achieved SVR and only 6.1% had no response; 13.6% had a relapse, and 29.7% were undetermined. Of the patients with undetermined treatment response, 32.0% discontinued treatment before 12 weeks, while 43% discontinued treatment before 19.2 weeks.

Table 3 shows the treatment outcomes stratified by race and HCV genotype. For genotype 1 or 4, whites had the highest SVR at 27.0% *vs.* 15.8% in African Americans and 17.5% in Hispanics. Whites were also more likely to have a relapse and African Americans were more likely to have non-response. For genotype 2 or 3, there were no statistically significant differences in SVR rates across races/ethnicities.

Overall effectiveness

We examined SVR among VA patients who initiated treatment (n = 11,479), patients who completed treatment (n = 5723), and the entire cohort of veterans with chronic HCV (n = 99,166) diagnosed in FY2000–2005. For genotype 1 or 4, 23.6% of patients who initiated treatment achieved SVR; 39.9% of patients who completed at least 38.4 weeks of treatment achieved SVR; and 3.9% of the entire cohort achieved SVR. For genotype 2 or 3, 50.6% of patients who initiated treatment achieved SVR; 58.3% of patients who completed at least 19.2 weeks of treatment achieved SVR; and 11.2% of the entire cohort achieved SVR. Fig. 1 displays the gaps in care that are partly responsible for

Table 2. Treatment outcomes for 11,479 patients with chronic hepatitis C virus who received at least one prescription of pegylated-interferon and ribavirin during 2000–2005.

Treatment outcomes	HCV* Genotype 1 or 4 (n = 7792)		HCV Genotype 2 or 3 (n = 2670)		Unknown HCV Genotype (n = 1017)	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
SVR†	1843	23.6 (22.5-24.9)	1352	50.6 (48.7-52.3)	297	29.2 (26.0-32.6)
No response	2393	30.7 (29.5-31.9)	162	6.1 (4.1-8.1)	245	24.1 (20.9-27.5)
Relapse	1196	15.4 (14.2-16.6)	362	13.6 (11.6-15.6)	166	16.3 (13.1-19.7)
Undetermined	2360	30.3 (29.1-31.5)	794	29.7 (27.8-31.8)	309	30.4 (27.1-33.8)

*Hepatitis C virus.
†Sustained viral response.

Table 3. Treatment outcomes for 9399 patients with chronic hepatitis C virus who received at least one prescription of pegylated-interferon and ribavirin during 2000–2005, stratified by race and genotype.

| Treatment outcomes	HCV* Genotype 1 or 4						HCV Genotype 2 or 3					
	Caucasian (N = 4911)		African American (N = 1800)		Hispanic (N = 331)		Caucasian (N = 2105)		African American (N = 140)		Hispanic (N = 112)	
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
SVR†	1326	27.0 (25.5-28.5)	284	15.8 (13.3-18.3)	58	17.5 (12.1-23.5)	1060	50.3 (48.1-52.6)	67	47.9 (40.0-57.1)	53	47.3 (38.4-57.6)
No response	1273	25.9 (24.4-27.5)	785	43.6 (41.2-46.1)	110	33.3 (27.8-39.2)	134	6.4 (4.1-8.7)	11	7.8 (0.0-17.1)	4	3.6 (0-13.9)
Relapse	777	15.8 (14.3-17.4)	236	13.1 (10.7-15.6)	49	14.8 (9.4-20.8)	274	13.0 (10.8-15.3)	20	14.3 (6.4-23.5)	19	17.0 (8.0-27.3)
Undetermined	1535	31.3 (29.8-32.8)	495	27.5 (25.1-30.0)	114	34.4 (29.0-40.4)	637	30.3 (28.0-32.5)	42	30.0 (22.1-39.2)	36	32.1 (23.2-42.5)

*Hepatitis C virus.
†Sustained viral response.

low overall effectiveness of HCV antiviral therapy in the VA. Based on the entire cohort, for every 100 patients with chronic HCV, 60 had a genotype test; 12 received PEG-INF and ribavirin; six completed treatment; and only three achieved SVR.

Discussion

This is one of the largest studies examining HCV treatment effectiveness in a community practice setting. We showed that, compared to efficacy estimates obtained in RCTs, PEG-INF and ribavirin treatment effectiveness was low in a national sample of veterans with chronic HCV. Overall effectiveness for HCV treatment in achieving SVR was only 3.6% for the entire study population. Thus, nearly 96,000 of the 99,166 veterans with HCV diagnosed between FY2000 and FY2005 have either not been treated or have not cleared the virus. Since the benefits of treatment are limited to patients with SVR, our data show that antiviral treatment has been minimally effective in reducing the burden of HCV-related chronic liver disease. Most of the drop in effectiveness resulted from low treatment rates (12.7%); high treatment discontinuation rates (16.3%); and low response to therapy (23.6% and 50.6%).
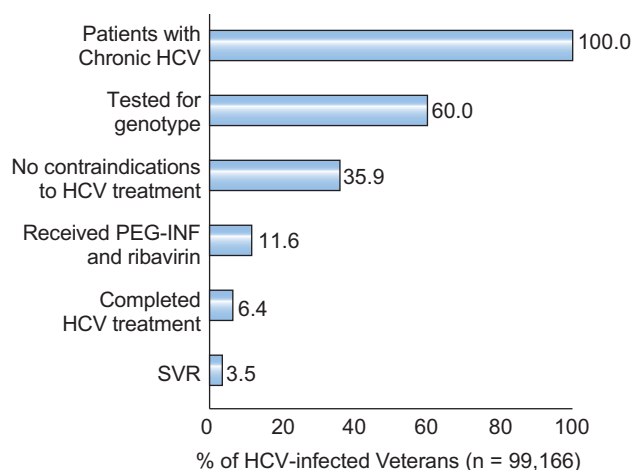
Fig. 1. Gaps in care resulting in low overall effectiveness of HCV treatment in veterans with chronic HCV.

There is a chasm between efficacy and effectiveness of antiviral treatment in the VA. Among patients who received at least one PEG-IFN treatment, we found SVRs of 23.6% for genotype 1 or 4

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and 50.6% for genotype 2 or 3, whereas RCTs with combination therapy have published SVR rates as high as 52% in genotype 1 and 80% for genotype 2 or 3 [5–7]. However, the patients in our study were older (49 *vs.* 43 years old); disproportionately African Americans and Hispanics; and adhered less to treatment (as suggested by lower treatment completion rates) than patients enrolled in clinical trials.

Previous effectiveness studies in other populations have also demonstrated that HCV antiviral therapy in clinical practice is substantially less effective than was previously published. A recent single-center study by Feuerstadt *et al.* conducted in urban minority patients that were predominantly Hispanic, reported SVR rates of 14% in genotype 1 patients, 37% in genotype 2 or 3 patients, and an overall effectiveness rate of 3.3% in HIV-antibody negative patients [14]. Our results are similar to those from a study conducted with the same data source by Backus *et al.*, who found an SVR rate of 20% in genotype 1, 52% in genotype 2, and 43% in genotype 3 [20]. Our study also extended previous findings by examining more recently available data and other treatment outcomes, such as non-response and relapse, as well as overall effectiveness of antiviral treatment in the VA.

Race/ethnicity has been shown to be an important predictor of SVR in clinical trials, where only 19–28% of African Americans with genotype 1 and 57% of those with genotype 2 or 3 had SVR [22–24]. In our study, African Americans had SVR rates lower than those of Caucasians, and lower than those of African Americans in previous studies (15.8% for genotype 1 or 4 and 47.9% for genotype 2 or 3). For Hispanics, published SVR rates are 34–47% for patients with genotype 1 and 66% for patients with genotype 2 or 3 [25,26]. In our study, Hispanics had SVR rates lower than those of Caucasians, and lower than those of Hispanics in previous publications (17.5% for genotype 1 or 4 and 47.3% for genotype 2 or 3).

Starting patients on antiviral treatment remains the most important obstacle in improving the effectiveness of HCV antiviral treatment in the VA. The underutilization of therapy shown in this study can be reasonably explained in just over half of the patients, who had contraindications to treatment. However, even among these patients, some contraindications are potentially reversible or manageable. Efforts toward management of drug and alcohol use and psychiatric disorders, such as depression, could increase treatment rates. The lack of treatment in the remaining patients is potentially concerning. While inappropriate underutilization of treatment is likely occurring in a considerable proportion of these patients, some may have unrecorded contraindications, while others may be refusing treatment or not adhering to recommended prescriptions. Further study of this group is required. In addition, a majority of patients never received a biopsy as part of their evaluation process, and therefore their fibrosis stage remains unknown—thus lack of significant fibrosis does not seem to explain the low treatment rates in this population of HCV patients.

The low effectiveness of HCV therapy in achieving SVR among patients in our cohort could be due to several factors, including low treatment completion rates; large proportion of African Americans; and lack of appropriate documentation of viral load following initiation and completion of treatment. The study highlights the sporadic testing for viral counts among patients started on antiviral treatment, which does not allow for classifying patients to the conventional randomized trial definition. The lack of viral count testing at conventional times not only hampers the ability to examine the true outcomes of therapy, but also makes prognostic estimates and hence decision making about re-treatment difficult (i.e. patients who are true non-responders have a lower response rate to re-treatment than patients who relapse).

In addition, HCV genotype was unknown in 8.8% of the patients who received treatment. We cannot exclude the fact that some of these patients may have been tested for genotype at a non-VA institution and not retested at the VA. Since genotype 1 is the most common HCV genotype in the United States, it is likely that the majority of these patients have genotype 1, resulting in a slight underestimation of SVR rates for patients with genotype 1 or 4.

There are several limitations to this study. First of all, patient–physician interactions and some of the decisions that result from them (e.g., patient declining treatment, physician discouraging treatment, or physician prescribing treatment but patient not filling the prescription) was not captured by this study. In addition, there could be variability in the knowledge and care of patients with HCV by facility and we did not examine rates by facility. These factors could explain some of the apparently inappropriate underutilization of treatment. In addition, dosage/adherence information for PEG-INF/ribavirin therapy were not known. We used prescription release date rather than fill date to improve the capture of actual receipt of the drug, but we could not determine whether a patient actually took the medication. We were also unable to determine the reason for treatment discontinuation for the patients in the undetermined group. This could include inability to tolerate it, refusal to take it, improper RNA monitoring, or simple loss to follow-up. The reasons behind low completion of treatment rates were not examined in this study; it is important to examine this issue further in order to intervene accordingly.

An additional limitation of this study is that contraindications were defined by ICD-9 codes, which may not be valid and may result in over- or under-ascertainment of the condition. However, these definitions have been used in previously published work [27,28]. If underestimation of contraindications occurred, this may explain the high proportion of untreated patients that appeared treatment eligible; however, we do not believe this underestimation would affect everyone and feel many patients are eligible who are not receiving treatment. Also, there was information missing from the dataset for some of the study variables, such as genotype and race. Finally, our study population was overrepresented with African American men who are generally more difficult to cure compared to the general population, thus, generalizability to other medical systems may be limited. However, the study population of close to 100,000 patients represents more than 3% of the *estimated* number of patients with chronic HCV infection in the United States and close to 10% of patients with *known* infection since only one-third to one-half of patients with HCV infection have been identified. The VA also represents the largest integrated healthcare system in the United States and with the availability of the comprehensive HCV registry data it is an ideal population for this "real world" descriptive study.

In conclusion, overall effectiveness of HCV therapy is low in a national sample of veterans with chronic HCV. When studying only patients who completed treatment, it improves, but remains lower than that seen in RCTs. Potential explanations for this include racial diversity and low treatment receipt and completion rates. We can use this knowledge to target interventions such as,

improving depression management to increase treatment rates, or introducing a clinical reminder to conduct genotype testing with the hope that these efforts will improve the effectiveness of HCV treatment and, ultimately, reduce the burden of liver disease in the VA.

Conflict of interest

The authors who have taken part in this study declared that they do not have anything to disclose regarding funding or conflict of interest with respect to this manuscript.

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Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jhep.2011.05.032.

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