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Formal Hepatitis C Education Enhances HCV Care Coordination, Expedites HCV Treatment, and Improves Antiviral Response

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Abstract

Background and Aims—Formal HCV education improves HCV knowledge but the impact on treatment uptake and outcome is not well described. We aimed to evaluate the impact of formal HCV patient education on primary provider-specialist HCV comanagement and treatment.

Methods—Primary care providers within the San Francisco safety-net health care system were surveyed and the records of HCV-infected patients before and after institution of a formal HCV education class by liver specialty (2006–2011) were reviewed retrospectively.

Results—Characteristics of 118 patients who received anti-HCV therapy were: mean age 51, 73% males, and ~50% White and uninsured. The time to initiation of HCV treatment was shorter among those who received formal education (median 136 vs. 284 days, p<0.0001). When controlling for age, gender, race, and HCV viral load, non-1 genotype (OR 6.17, 95%CI 2.3–12.7, p=0.0003) and receipt of HCV education (OR 3.0, 95%CI 1.1–7.9, p=0.03) were associated with sustained virologic treatment response. Among 94 provider respondents (response rate=38%), mean age was 42, 62% were White, and 63% female. Most providers agreed that the HCV education class increased patients' HCV knowledge (70%), interest in HCV treatment (52%), and provider-patient communication (56%). A positive provider attitude (Coef 1.5, 95%CI 0.1–2.9 percent, p=0.039) was independently associated with referral rate to education class.

Conclusions—Formal HCV education expedites HCV therapy and improves virologic response rates. As primary care provider attitude play a significant role in referral to HCV education class, improving provider knowledge will likely enhance access to HCV specialty services in the vulnerable population.

Keywords

health disparity; hepatitis C knowledge; hepatitis C treatment; provider survey; hepatitis C education; vulnerable populations

Hepatitis C (HCV) is the most common chronic blood-borne disease and the leading cause of liver transplantation in the US, affecting an estimated 3.2 million Americans [1, 2]. Recent

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advancement in antiviral treatment options has significantly increased the response rates to anti-HCV therapy even among the difficult to treat populations [3, 4]. Despite this, it is estimated that only 34–48% of chronic carriers are referred for liver specialist assessment [5–7], and less than 37% of patients receive treatment for hepatitis C [6–8]. Therefore, instituting models of care that have the potential to overcome barriers and improve access to care represents a critical goal in addressing the HCV epidemic [9]. The Institute of Medicine recently released a report identifying “missed opportunities” in the prevention and control of HCV, and specifically recommended the development, coordination, and evaluation of education programs targeting at-risk populations, as well as improved coordination of hepatitis care delivery services in its national strategy to improve hepatitis care services [10]. In addition, the American Association for the Study of Liver Diseases (AASLD) and Centers for Disease Control and Prevention (CDC) joint conference proceedings on viral hepatitis emphasized the importance of a multidisciplinary approach to HCV care and HCV care coordination, including linkage of infected persons with care and treatment services to improve prevention of viral hepatitis and the effectiveness of treatment [8].

Patients within the safety-net healthcare systems that predominantly serve the uninsured and underinsured populations are especially at risk for experiencing health disparities, have limited access to care, and represent a growing vulnerable patient population [11]. HCV patient education is associated with positive outcomes in various models of HCV care, including increased disease-specific knowledge [12, 13], interest in treatment [14], willingness to accept treatment [5, 15], and increase liver specialty care clinic attendance [12, 13]. In a prior study within the San Francisco safety-net healthcare system, formal HCV education by liver specialists not only resulted in a significant improvement in HCV knowledge among patients, but appeared to create efficiencies in this healthcare system to allow better access to specialty care for these individuals [13]. Therefore, this patient-centered approach has the potential to impact HCV management, interest in receipt of HCV treatment, and treatment outcome. However, the impact of formal HCV education by specialists on facilitating HCV treatment initiation, adherence to treatment, and treatment outcome is not clearly understood. Furthermore, although primary care providers have a pivotal role in identifying patients with HCV, referring patients to specialty consultants for treatment, and collaborating with specialty care providers [16]; whether formal patient education by a specialist has a positive impact on HCV co-management between primary and specialty care providers has not been previously studied.

Considering the increasing emphasis on systemic improvements to our healthcare delivery system and enhanced coordination of health services, this study was conducted to evaluate the impact of the institution of a mandatory formal HCV education class by liver specialty providers on HCV treatment initiation and outcomes and to evaluate provider attitudes towards the impact of formal patient education on HCV management.

Materials and Methods

This study consists of 1) a retrospective review of electronic medical records of HCV-infected patients before and after the institution of a mandatory HCV education class prior to initiation of treatment, and 2) a cross-sectional survey of primary care providers within the San Francisco safety-net healthcare system. This healthcare system provides services to over 150,000 patients annually including most of the county’s uninsured and underinsured population [17]. This system consists of the San Francisco Community Clinic Consortium, which has ten nonprofit primary care community health centers, and the San Francisco Department of Public Health’s Community Health Network, which includes eleven community-based primary care clinics and one acute care hospital with primary care and

specialty clinics on-site [17]. This study was approved by the Committee on Human Research of the University of California San Francisco.

Patient Population

Electronic medical records of HCV-infected viremic patients with elevated HCV viral loads, who underwent pegylated interferon (PEG-IFN) and ribavirin combination antiviral therapy in the liver specialty clinic at San Francisco General Hospital (SFGH) from January 2006 to June 2011 were reviewed. This study period includes the period before and after initiation of a mandatory formal HCV education class (November 2007) by the liver specialty clinic. There were no changes in the liver specialty clinic scheduling procedures or the number of providers within the liver clinics during the entire study period. Data included patient demographics, medical and psychiatric co-morbidities, time to initiation of HCV therapy from first liver specialty clinic visit, adherence to HCV treatment (which included measurement of adherence to clinic visits, medications, and recommended laboratory testing and procedures), and viral response to anti-HCV therapy. Adherence to anti-HCV medications was defined as use of ≥80% of pegylated interferon and ≥80% of ribavirin for more than 80% of the expected treatment duration [18]. Response to anti-HCV therapy was defined as: early virologic response, EVR (>2-$\log_{10}$ decline in HCV RNA viral load by week 12), end of therapy response, ETR (undetectable HCV RNA viral load at end of therapy), and sustained virologic response, SVR (undetectable HCV RNA viral load at 24 weeks following discontinuation of treatment).

Provider survey design and methods

The provider survey instrument was developed by the study investigators with input from hepatologists, survey design experts, and previously published surveys. Content domains included provider and practice characteristics, HCV management practices, provider attitudes regarding HCV education, and provider perception of the impact of HCV education on improvement of HCV management, patient-provider communication, patient HCV knowledge, interest in receipt of therapy, patient adherence to HCV management plan, and access to specialty care. The survey was pilot-tested with 20 physicians and revised based on their feedback. The survey was sent to the 248 primary care providers of the San Francisco safety net healthcare system by mail or electronic mail between electronic email between October 15 and December 15, 2011. A second and third mailing to non-respondents was conducted at four-week intervals.

HCV education class

In November 2007, the liver specialty clinic at San Francisco General Hospital instituted a mandatory formal HCV education class accessible to all HCV-infected patients within San Francisco's safety net healthcare system. Providers who wish to refer patients to liver specialty clinic initially schedule patients in the formal HCV education class offered by this specialty service prior to being evaluated in the liver specialty clinic. The patients are directly scheduled for the formal education class by the primary providers (direct access) based on patient's availability and the classes are offered every two weeks. The HCV education class consists of a 2-hour standardized in-person PowerPoint presentation delivered by a liver clinic nurse practitioner. Each class has approximately 25–30 participants and is offered in English and any other languages by using certified interpreters as needed. The class provides information on HCV transmission, diagnosis, symptoms, natural history, severity of liver disease, appropriate candidacy for treatment, response rates of antiviral therapy, and side effects of treatment.

Statistical analysis

Patient data analysis—Patient characteristics were summarized using mean ± SD, median (range), and frequencies. To evaluate patient factors associated with the outcomes SVR and time to initiation of HCV therapy, univariate analysis was performed using Chi-square test (Fisher's exact test when appropriate) for categorical variables and Mann-Whitney test for continuous variable. Multivariable regression modeling evaluating factors associated with SVR and time to initiation of therapy included predictors from an a priori compiled list as well as those with a p value <0.05 as determined by the univariate analysis.

Provider survey data definition and analysis—Provider and practice characteristics were summarized using mean ± SD, median (range), and frequencies. The provider attitude score towards impact of formal HCV education class on HCV management was determined by summing the numerical codes assigned to responses to eleven questions assessing provider attitudes as follows: 4 to an "strongly agree" response, 3 to an "agree" response, 2 as "neither agree or disagree", 1 as "disagree", and 0 as "strongly disagree." Univariate regression analysis was performed to evaluate provider and practice characteristics associated with formal HCV education class. Multivariable regression modeling evaluating factors associated referral to HCV education class included predictors from an a priori compiled list as well as those with a p value <0.05 as determined by the univariate analysis.

For all analysis, statistical significance was assessed at the p value of <0.05 level (2-sided) in all models. All analysis was performed using SAS version 9.2 (SAS Institute, Inc., 2007, Cary, NC, USA).

Results

Patient Characteristics

During the study period, of the 551 HCV-infected patients who attended the liver specialty clinic, 118 treatment eligible patients underwent antiviral therapy. The overall treatment rates (24% vs 19%, p=0.1) were similar before and after HCV education class initiation. Patient characteristics of treated and untreated groups were similar with respect to age (50 vs 50, p=0.43), male sex (62% vs 65%, p=0.52), and White race (48% vs 39%, p=0.058). Mode of HCV transmission was predominantly injection drug use in both groups (59% vs 69%, p=0.25).

Table 1 summarizes the overall patient characteristics of those who underwent antiviral therapy and characteristics by receipt of formal HCV education class. Overall, the majority of patients were middle-aged and approximately half of patients were minorities. Injection drug use (IDU) was the most common HCV risk factor in both groups (59%), and nearly all patients were treatment naïve (94%). Although there was a lower proportion of men among those who received HCV education (50% vs 74%, p = 0.008), other patient and viral characteristics were similar amongst those who did and did not receive formal HCV education.

With respect to HCV antiviral therapy, although overall adherence to HCV therapy and clinic visits was high (>85%) in those who underwent therapy, there were higher rates of SVR among those who received formal HCV education (68% vs 50%), lower rates of discontinuation of HCV antiviral therapy due to side effects (3% vs 12%), and lower virologic relapse rates following discontinuation of therapy (16% vs 28%), but these did not reach statistical significance. The overall higher rates of SVR observed in this safetynet system is related to the lower proportion of genotype 1 patients (56%) than that reported for the general US population.

Host and Viral Factors Associated with Treatment Initiation and Treatment Outcomes

On univariable analysis, the time to initiation of HCV treatment from initial liver clinic visit date was significantly shorter among those who received formal HCV education compared to those who did not (median 136 vs 284 days, p<0.0001) (Table 1). On multivariable analysis time to initiation of therapy was negatively associated with receipt of formal HCV education, when controlling for patient age, sex, race, and HCV genotype (coef −182, 95%CI −272 to −92 days, p<0.0001), and also when accounting for severity of liver disease (fibrosis stage >2) on liver biopsy (coef −123, 95%CI −233 to −14 days, p=0.028).

With respect to treatment outcome, factors associated with achieving SVR on univariate analysis included non-1 genotype HCV (OR 5.4, 95%CI 2.1–15.0 p=0.0002) and higher grades of inflammation on histology among patients who had a liver biopsy (OR 4.5, 95%CI, 1.3–16.2, p=0.022). On multivariable analysis (Table 2), when controlling for age, gender, race, and baseline HCV viral load, non-1 genotype HCV and receipt of formal HCV education were independently associated with SVR. In addition, accounting for adherence to antiviral therapy did not significantly alter these odds ratios. In the subset of patients who had undergone a liver biopsy prior to HCV therapy, higher grade of liver inflammation (OR 5.9 95%CI 1.3–26.6 p=0.02) and lower stage of fibrosis (OR 0.23, 95%CI 0.05–0.95, p=0.043) in addition to non-1 HCV genotype (OR 6.0, 95%CI, 1.6–22.6 p=0.008) were significantly associated with achieving SVR when controlling for age, gender, race, and baseline HCV viral load. Once again, adherence to antiviral therapy did not significantly alter these odds ratios.

Provider and Practice Characteristics

Out of 248 providers, 94 (38%) responded to the survey. Provider characteristics are summarized in Table 3. The mean age of providers was 42, and the majority was White and female. Most providers held an MD degree and ~40% were in practice for more than 10 years. The median proportion of White patients in practices was 25%, the median proportion of patients with limited English proficiency was 50%, and the median proportion of uninsured patients in practices was reported at 50%.

HCV Management Practices

Provider HCV management practices are summarized in Table 4. Nearly one quarter of providers reported that HCV patients comprised more than 25% of their practice population. Among HCV patients, the reported mode of transmission for HCV was IDU in more than 80% of patients and ~20% of providers reported current alcohol or illicit drug abuse in over half of their HCV patients. A rate of greater than 10% co-infection with HIV or HBV among HCV patients was reported by 30% and 17% of providers, respectively. Over 75% of providers reported that at least half of their HCV patients have been vaccinated against hepatitis A and hepatitis B, and only 17% reported that more than 25% of the HCV patients had received HCV antiviral therapy.

Provider Attitudes towards Formal HCV Education Class

Nearly all providers (90%) reported being aware of the presence of a formal HCV education class by the liver specialty clinic, and 40% of providers had referred at least half of their HCV patients to the HCV education class. The most common reasons for patient referral to class were to receive general education about HCV disease (62%) and to receive HCV therapy (57%). The most common reasons for not referring patients to the education class were patients' lack of interest in HCV therapy (54%), followed by coexisting psychiatric contraindication to HCV therapy (47%), and ongoing alcohol and/or drug abuse (46%).

Provider attitudes towards the impact of the formal HCV education class on HCV management within their practices are summarized in Table 5. On average, a majority of primary care providers agreed that the formal HCV education class increased their patients' HCV knowledge and interest in receipt of HCV treatment. Over half of providers also agreed that the class improved patient communication regarding HCV disease and patient understanding of HCV-related resources. In addition, over half of providers reported that formal HCV education resulted in overall improved management of HCV patients and has helped them address patient concerns about their disease. Moreover, more than 40% of providers agreed that formal HCV education has improved primary care-specialist HCV co-management and increased access to liver specialty care.

Provider and Practice Factors Associated with referral rates to Formal HCV Education Class

On univariable analysis, the proportion of patients with HCV in practice (coef −21.2, 95%CI −37.5 to −4.9 percent, p=0.012), the proportion of uninsured patients in practice (coef 0.65, 95%CI 0.15–1.2 percent, p=0.012), a positive provider attitude towards the impact of HCV class in practice (coef 1.2, 95%CI −0.13 to 2.6 percent, p=0.075), and not possessing an MD degree (coef −6.2, 95%CI −12.3 to −0.19 percent, p=0.044), were associated with referral of patients to the formal HCV education class. On multivariable analysis (Table 6), when controlling for provider age, gender, and degree, only a positive provider attitude towards the impact of the HCV class was independently associated with higher rates of referral to formal HCV education class.

Discussion

This is the first study to evaluate the impact of formal HCV patient education on receipt of HCV therapy, treatment outcomes, and primary provider HCV management practices in a safety-net healthcare system. We have shown that formal HCV education expedites receipt of HCV antiviral therapy and is associated with higher rates of virologic response to HCV treatment. In addition, a majority of providers reported that the formal HCV education class improved their patient's knowledge, communication, interest in therapy, understanding of resources for HCV management, and improved the overall management of the HCV-infected patients in their practice. Furthermore, a positive provider attitude towards the impact of formal HCV education was associated with higher rates of patient referral to the HCV education class.

The vulnerable patient population within the safety-net healthcare system is disproportionally affected by HCV and adverse disease outcomes [11]. A prior study in this healthcare setting has shown that formal HCV education class results in improvement of patient's HCV knowledge across all ages, racial groups, education backgrounds, and socioeconomic status [13]. Prior studies have also shown that HCV patients consider HCV education an important healthcare need that results in a marked increase in willingness to accept treatment [15, 19]. In this study, the majority of primary providers also perceived that their patients' HCV knowledge had increased as a result of participation in the class. In addition, over half of providers reported that HCV education class increased their patient's interest in HCV treatment. Moreover, the HCV class appeared to improve patient's understanding of available resources for HCV care within the healthcare system, improved patient-provider communication, assisted providers in addressing patients' concerns regarding HCV disease, and improved overall HCV management within the primary care practice by provider report. These findings are important in that while primary care providers often feel confident in their ability to screen for HCV and provide initial HCV disease evaluation, and believe they should be involved in HCV co-management with specialists, they feel less confident about HCV monitoring and treatment [20–22]. Therefore, in

addition to their patient's direct benefit in receipt of education, they too may benefit from additional resources and support in these areas [20, 21]. Indeed, approximately 40% of providers also reported that HCV education class facilitated HCV co-management within their practices and increased access to liver specialty care services.

Interestingly, in this study primary providers did not report a significant increase in patient adherence to HCV management plans or interest in substance abuse therapy within their practices. In the practices surveyed in this study approximately 25% of providers indicated that over 25% of patients within their practice were infected with HCV. By contrast, in a national survey of primary providers, 73% of respondents had reported caring for 5 or less HCV-infected patient within the past year [23]. Given the high prevalence of HCV infection within practices in the San Francisco safety-net healthcare setting, it is possible that our providers had previously implemented their own mechanisms within practices to effectively address substance abuse therapy and adherence to HCV monitoring.

Whether the observed improvement in patient's knowledge and the positive impact on provider practices following formal HCV education actually influences HCV treatment initiation and treatment outcomes has not been previously studied. We have found that the time to initiation of HCV therapy was reduced by half in those patients who underwent formal HCV education compared to those who did not receive disease-specific education. This patient-centered approach to HCV education may have resulted in faster uptake of treatment by helping motivated patients to self-identify, more actively participate in their medical decision-making [24, 25], and overcome treatment-related fears that impede or delay antiviral therapy [26]. This also suggests that the education class has resulted in efficiencies within this resource-limited healthcare system that allow better utilization of specialty care services in this population.

HCV education appears to improve adherence to HCV therapy [27, 28]. However, there are only limited studies evaluating the role of patient education on HCV treatment outcome. In a study by Cacoub et al, there was a 7% increase in the rate of SVR and 6% decrease in rates of virologic relapse among those received support documents and educational material during individual sessions compared to those who did not receive disease specific education, but these findings did not reach statistical significance [27]. Larrey et al. assessed the impact of ongoing patient education during HCV therapy. In that study, the odds of achieving SVR were 2.5 times higher among patients who received systematic consultation by a nurse regarding patient adherence and the efficacy of therapy compared to those who did not receive the education [29]. Similarly, we have shown that a formal HCV education class prior to HCV treatment resulted in an 18% increase in rates of SVR, and patients who received education were 3 times more likely to achieve SVR, independent of medication adherence and patient or viral factors. It is known that adherence to anti-HCV medications impacts rates of response to therapy. We did not observe a significant difference in patient adherence to medications in those who did and did not receive patient education. The overall rates of adherence to medication by self-report was high at 88% in this study, similar to that reported in other HCV populations ranging from 76–89% [30]. However, our study did show that patients who attended formal HCV education were less likely to discontinue treatment due to side effects (3% vs 12%), one of the most common reasons for early discontinuation of treatment in several prior studies [9, 31, 32]. Higher rates of early discontinuation of therapy and delay in initiation of treatment in those who did not undergo HCV education, can potentially contribute to lower rates of SVR observed in this population.

The recent single topic conference cosponsored by the AASLD and CDC has emphasized the value of "systemic changes in our healthcare delivery system and enhanced coordination of prevention and care services through education of the public and health care providers,

and linkage of infected persons with care and treatment services to successfully prevent viral hepatitis and increase treatment efficacy" [8]. Primary care providers play a significant role in linkage of HCV-infected persons to available HCV care and treatment services. Limited data, predominantly in the HIV-HCV co-infection setting, suggest that provider attitudes affect rates of both provider HCV treatment recommendation and patient uptake of HCV treatment [33, 34]. A national survey of family physicians has also shown that having a positive attitude regarding HCV care in the primary care setting was associated with more provision of HCV care services [21]. Moreover, patients interpret a lack of referral to HCV specialty care or discussion of treatment by primary care providers as an indicator that pursuit of HCV treatment should not be considered a priority [35]. We have shown that a positive provider attitude towards the impact of HCV education is independently associated with higher rates of referral to formal HCV education class. Therefore, increasing provider understanding of the impact of patient education on HCV care and treatment outcomes will be essential to improving patient access to HCV care services and success of antiviral therapy.

The main limitation of this study is the retrospective patient data collection, while the primary strengths include long-term patient follow-up and prospective assessment of provider attitudes and practices. Because the formal HCV education class was instituted as a mandatory component of referral of HCV patients to the liver specialty clinic, the study was limited by a lack of randomization of patients to education versus no education class when evaluating treatment outcomes. However, we were able to utilize a historical control of HCV patients prior to the initiation of education class to compare HCV treatment outcomes. Both the formal HCV education patient cohort and the historical controls likely represent individuals who are motivated to receive HCV therapy and management. Therefore, selection bias is unlikely to play a role in our finding that HCV education significantly impacts time to initiation of HCV therapy and HCV antiviral response. In addition, since the anti-viral therapy regimen (pegylated interferon in combination with ribavirin), the treating providers, and the liver specialty clinic scheduling procedures did not change before and after institution of formal HCV education, it is unlikely that differences in antiviral therapy management practices or scheduling practices overtime would impact the findings. Generalization to other non-safety-net practice settings may also be limited; nevertheless our results present a potentially effective intervention to improve linkages to HCV specialty care, HCV treatment uptake, and treatment outcome.

In summary, formal HCV education by liver specialists creates efficiencies in resource-limited healthcare systems, which not only allows better access to specialty care and treatment services but also improves HCV antiviral effectiveness. Provider attitudes towards the impact of HCV patient education play a significant role in referral to these services. Along with improvements in the healthcare delivery system, interventions directed at increasing provider knowledge of HCV disease and the important role of patient education in improving HCV management will likely enhance HCV care coordination and ultimately amplify the success of antiviral therapy, particularly in vulnerable populations.

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Abbreviations

HAV	Hepatitis A Virus
HBV	Hepatitis B Virus

HCV	Hepatitis C virus
HIV	Human Immunodeficiency Virus
IDU	Injection drug use
PEG-IFN	pegylated interferon
RNA	Ribonucleic Acid
EVR	Early Virologic Response
ETR	End of Therapy Response
SVR	Sustained Virologic Response

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Table 1

Characteristics of patients who did or did not undergo formal HCV education

Patient Characteristic	Overall (N=118)	Patients who did not receive HCV education (n = 58)	Patients who received HCV education (n= 60)	p-value*
Age (years), median (quartiles)	51 (42–58)	50 (41–57)	51 (44–58)	0.69
Males (%)	73 (62)	43 (74)	30 (50)	0.008
Race/ethnicity (%)				0.90
White	57 (48)	26 (45)	31 (52)	
African American	11 (9)	6 (10)	5 (8)	
Latino	22 (19)	11 (19)	11 (18)	
Asian/Pacific Islander	28 (24)	15 (26)	13 (22)	
English as primary language (%)	84 (71)	39 (67)	45 (75)	0.42
Uninsured (%)	57 (48)	25 (43)	32 (53)	0.28
Income < $15,000 per year (%)	83 (75)	38 (68)	45 (82)	0.13
Concurrent substance abuse treatment (methadone, buprenorphine) (%)	8 (7)	5 (9)	3 (5)	0.49
Duration of HCV infection (years), median (range)	20 (2–52)	21 (2–47)	19 (2–52)	0.75
Prior history of IDU (%)	56 (59)	27 (54)	29 (64)	0.40
HIV coinfection (%)	15 (13)	10 (17)	5 (8)	0.17
HBV coinfection (%)	5 (4)	4 (7)	1 (2)	0.20
Psychiatric comorbidities	47 (40)	24 (41)	23 (38)	0.85
Serum ALT (Units mL-1), median (range)	68 (18–586)	72.5 (18–257)	63.5 (18–586)	0.34
Log_{10} HCV Viral Load (IU mL-1), median (range)	5.9 (3.9–7.1)	5.9 (3.9–6.7)	6.0 (4.3–7.1)	0.43
HCV genotype (%)				0.51
1	66 (56)	34 (59)	32 (53)	
2	22 (19)	12 (21)	10 (17)	
3	25 (21)	9 (16)	16 (27)	
Other	5 (4)	3 (5)	2 (3)	
Inflammation Grade on histology** (%)				0.77
< 2	15 (19)	8 (17)	7 (22)	
≥2	63 (81)	38 (83)	25 (78)	
Fibrosis Stage on histology** (%)				0.45
< 2	21 (27)	14 (30)	7 (22)	
≥ 2	57 (73)	32 (70)	25 (78)	

Patient Characteristic	Overall (N=118)	Patients who did not receive HCV education (n = 58)	Patients who received HCV education (n= 60)	p-value*
Steatosis on histology** (%)	32 (41)	17 (37)	15 (47)	0.48
Treatment naïve (%)	111 (94)	53 (91)	58 (97)	0.27
Early virologic response (%)	93 (88)	42 (82)	51 (93)	0.14
End of treatment response (%)	90 (83)	43 (80)	47 (87)	0.44
Sustained virologic response (%)	61 (59)	27 (50)	34 (68)	0.07
Early discontinuation of therapy due to side effects† (%)	9 (8)	7 (12)	2 (3)	0.09
Adherence to clinic visit (%)	100 (87)	51 (88)	49 (86)	0.79
Adherence to medications (%)	102 (88)	51 (88)	51 (86)	1.0
Adherence to procedures (%)	103 (90)	52 (90)	51 (90)	1.0
Time to initiation of therapy (days), median (quartiles)	184 (102–316)	284 (147–431)	136 (88–212)	<0.0001

* p-value refers to the comparison of patients who did and did not receive formal HCV education; statistical significant was designated at p <0.05 (2-sided)

** Liver biopsy was performed in 78 patients

† A total of 30 patients discontinued therapy early

Table 2

Multivariate analysis of factors associated with sustained virologic response to HCV antiviral therapy

Variables	Odds Ratio	95% CI*	p value**
Age per decade	0.7	0.4–1.1	0.12
Female gender	0.6	0.2–1.8	0.36
Race (vs White)			
African-American	0.8	0.2–4.2	0.80
Latino	0.4	0.1–1.4	0.14
Asian/Pacific Islander	1.5	0.5–4.7	0.51
HCV non-1 genotype (vs genotype 1)	6.2	2.3–16.7	0.0003
Log_{10} HCV viral load (IU mL-1)	0.8	0.3–2.1	0.72
Receipt of formal HCV education	3.0	1.1–7.9	0.031

Table 3

Provider and practice characteristics in the San Francisco safety net healthcare system (n = 94)

Provider and Practice Characteristic	
Age ± SD (years)	42 ±11
Male (%)	25 (27)
Race/ethnicity (%)	
White	58 (62)
African American	3 (3)
Latino	5 (5)
Asian American/Pacific Islander	24 (26)
Other	3 (3)
Post-graduate degree (%)	
MD	68 (72)
Nurse Practitioner	24 (26)
Physician's Assistant	2 (2)
Specialty (%)	
Internal Medicine	48 (51)
Family Practice	31 (33)
Infectious Disease	1 (1)
HIV	8 (9)
Other	6 (6)
Years in Practice	
0–10	55 (58.5)
11–20	24 (25.5)
>20	15 (16)
Number of patients seen per week (%)	
0–20	35 (37)
21–40	28 (30)
>40	31 (33)
Median Proportion of patients by Race	
White	25
African-American	20
Latino	25
Asian/Pacific Islander	20
Other	2
Median proportion of patients with limited English proficiency	50
Median proportion of patients in practice with	

Provider and Practice Characteristic	
Private or Public Insurance	50
Uninsured	50

Table 4

HCV management practices among the San Francisco safety net providers

Practice with more than 25% HCV patients	24
Proportion of HCV patients with history of IDU in practice	85
Proportion of HCV patients in practice that have been vaccinated against HAV	
≤25%	13
26–50%	12
51–74%	10
≥75%	65
Proportion of HCV patients in practice that have been vaccinated against HBV	
≤25%	9
26–50%	10
51–74%	13
≥75%	68
Proportion of HCV patients in practice that are coinfected with HIV	
≤25%	79
26–50%	7
51–74%	1
≥75%	13
Proportion of HCV patients in practice coinfected with HBV	
≤25%	98
>25%	2
Proportion of HCV patients in practice currently abusing alcohol or illicit drugs	
≤25%	45
26–50%	32
51–74%	9
≥75%	14
Proportion of HCV patients in practice currently undergoing outpatient substance abuse therapy	
≤25%	80
26–50%	15
51–74%	0
≥75%	5
Proportion of HCV patients in practice that have received HCV antiviral therapy	
≤25%	83
26–50%	9
51–74%	1
≥75%	7

Table 5

Impact of formal HCV education class on provider practices

Impact of Education Class	% agree	%neutral	%disagree
Improved my patients' knowledge of HCV disease	70	26	4
Increased patients' interest in being treated for HCV	52	39	9
Increased adherence to HCV-related medical testing such as blood tests, imaging, liver biopsy, clinic visits	30	64	6
Improved patients' understanding of available resources for HCV care within the San Francisco safety net system	55	35	10
Increased my patients' level of interest in substance abuse (illicit drugs, alcohol) therapy	21	65	14
Improved my patient's adherence to my management plan recommendations for other medical conditions (such as hypertension, diabetes, etc.)	23	62	15
Resulted in improved patient communication with me regarding HCV	56	35	8
Helped me better address patient's concerns regarding HCV disease and its management	53	41	6
Overall improved the management of my patients with HCV in my practice	54	39	7
Made it easier for me to co-manage my patients with liver specialty care providers	44	45	11
Increased the access to liver specialty care in our safety net system	41	46	13

Table 6

Multivariate analysis of provider and practice factors associated with referral to formal HCV education class

Variables	Coefficient	95% CI	p value
Provider age	0.5	−0.4–1.3	0.29
Provider female gender	11.9	−9.0–32.8	0.26
Provider degree Non-MD (vs MD)	4.3	−3.4–12.0	0.27
Proportion of HCV patients in practice	−15.9	−36.1–4.2	0.12
Proportion of uninsured patients in practice	0.6	−0.1–1.3	0.071
Provider attitude toward impact of formal HCV education class	1.5	0.1–2.9	0.039