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Changes in Practice and Perception of Hepatitis C and Liver Transplantation: Results of a National Survey

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Abstract

With new practice guidelines, it is important to understand how liver transplant (LT) centers have incorporated direct-acting antivirals (DAAs) into the management of hepatitis C virus-infected (HCV+) candidates and recipients. To explore how DAAs have affected LT centers' willingness to treat HCV+ candidates and recipients and to use HCV+ donors, we surveyed high volume US LT centers (11/2014–12/2015) regarding practices for HCV+ candidates, recipients, and donors, before vs. after DAAs. We used the Scientific Registry of Transplant Recipients to compare centers' number of LTs, HCV+ recipients, and HCV+ donors in the years before (1/1/2012–12/31/2013) and after (1/1/2016–12/31/2017) survey administration. Of 80 centers contacted, 57 (71%) responded, representing 69% of the total volume of LTs in 2013. After DAAs, most centers increased treating candidates with low (<15) model for end-stage liver disease (MELD) (85.2%), intermediate/high (>15) MELD (92.6%), and hepatocellular carcinoma (79.6%). There was consensus to treat low MELD candidates (90.7% "most of the time/always"), but less certainty for intermediate/high MELD candidates (27.8% "sometimes"). Universal post-LT HCV treatment increased (7.4% vs. 57.4%). After DAAs, 42.6% were more willing to use HCV+ donors for HCV+ candidates, and 38.9% were willing to consider using HCV+ donors for HCV- candidates. Overall, with DAAs, centers were more willing to treat HCV+ candidates and recipients and to use HCV+ donors; recent recommendations may help to guide treatment decisions for intermediate/high MELD candidates.

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Keywords

Hepatitis C; liver transplantation; survey; transplant centers; DAA therapy; treatment guidelines

INTRODUCTION

Chronic hepatitis C virus (HCV) infection is the leading indication for liver transplantation (LT) in the United States (US) (1). In 2013, the advent of all-oral, interferon-free direct acting antivirals (DAAs) transformed treatment options for HCV-infected (HCV+) patients, and numerous studies have demonstrated the safety and efficacy of DAAs both pre- and post-LT (2–18). With the approval of DAAs, providers were faced with the challenge of deciding whether to initiate treatment of HCV+ transplant candidates pre-LT or post-LT. Weighing these options requires considering factors such as: a patient's disease severity and prognosis (as reflected in their model for end-stage liver disease [MELD] score), hepatocellular carcinoma (HCC) status, the availability of a living donor, the availability of HCV+ donor livers, and the center's use of HCV+ donor livers (19–22). Prior to 2015, few guidelines or recommendations were available to inform these choices.

In 2015, the Infectious Disease Society of America (IDSA) and American Association for the Study of Liver Diseases (AASLD) jointly published HCV treatment recommendations, detailing post-LT treatment guidelines (23). These recommendations did not, however, directly address how, when, or which candidates LT centers should treat prior to LT, leading to varied opinions in the field (8, 19, 20, 24–33). In 2017, the International Liver Transplantation Society (ILTS) expert consensus statements provided recommendations for the management of both HCV+ liver transplant candidates and recipients (34, 35). Despite this rapidly changing landscape, few studies have directly examined the impact of DAAs on center-level attitudes and treatment decisions for LT patients.

We hypothesized that the availability of DAAs would increase transplant centers' willingness to use HCV+ donor livers and to treat HCV overall, but centers might remain hesitant to treat certain groups of LT candidates without clear guidelines. The objective of this study was to survey US LT centers to describe changes in attitudes and practices related to HCV and LT before and after DAAs became available. To understand the impact of DAAs on LT, we surveyed the highest volume US LT centers from 11/2014–12/2015 to study whether treatment of HCV+ LT candidates and recipients and willingness to use HCV+ donors differed before and after DAA availability.

METHODS

Source Population

Transplant centers were identified using data from the Scientific Registry of Transplant Recipients (SRTR) external release made available in June 2014. The SRTR data system includes data on all donors, waitlist candidates, and transplant recipients in the US, submitted by members of the Organ Procurement and Transplantation Network (OPTN), and has been described elsewhere (36, 37). The Health Resources and Services Administration,

US Department of Health and Human Services, provides oversight to the activities of the OPTN and SRTR contractors. The top two-thirds of centers by volume of LTs performed on adult recipients from 1/1/2013–12/31/2013 were included (N=80). The SRTR external release made available in March 2018 was used to determine the number of LTs performed, calculate the number HCV+ recipients transplanted per year, and describe the use of HCV+ donor livers across surveyed centers in the years before (1/1/2012–12/31/2013) and after (1/1/2016–12/31/2017) survey administration.

Survey Administration

After center identification, survey participants were chosen using a two-stage process. First, initial contact information was derived through personal connections, PubMed, internet searches, and phone calls or emails to transplant directors at each center. Then, each contact was asked to suggest the most appropriate representative at their center and assist with connecting this individual to the study team. Links to the survey were sent between November 2014 and December 2015 to the identified study participants to complete as a representative on behalf of their transplant center. All surveys were conducted using Qualtrics Survey Software. Non-respondents were sent a minimum of 3 and a maximum of 6 follow-up reminder emails.

Survey Design

This study was reviewed and acknowledged to be exempt by the Johns Hopkins University Institutional Review Board. Survey instrument development was informed by a literature review and discussions with a clinical team composed of hepatologists, infectious disease physicians, and transplant surgeons, all with experience treating HCV+ LT patients. This clinical team, along with three transplant surgery research staff members, pilot tested the survey. The final survey consisted of 16 questions (see Supplemental Materials) regarding transplant center and respondent characteristics, practices and protocols for using HCV+ donors and treating HCV+ LT recipients, and treatment scenarios based on HCV+ LT candidate factors (MELD score 15 vs. >15, HCC status, and the availability of a living donor). Respondents were asked to select how often these candidates would be treated on the LT waitlist at their center, on a 5-point Likert scale from “never” to “always.” Respondents were also asked to identify barriers to treating HCV+ LT candidates and recipients at their center by selecting any/all that applied from a list provided or selecting “other” and providing a free response.

Statistical analysis

We used separate linear regression models to measure the association between center volume of HCV+ recipients and the Likert scale responses to survey questions about treating each candidate/recipient group by DAA era. We also dichotomized center HCV prevalence (> or median center HCV prevalence) and used logistic regression models to measure the association between high vs. low center HCV+ recipient volume and the Likert scale responses to survey questions about treating each candidate/recipient group by DAA era. Analyses were performed using Stata 15/MP for Linux (College Station, Texas). Figures were prepared using R 3.3.3 (the R Foundation for Statistical Computing, Vienna, Austria)

and Stata 15/MP for Linux (College Station, Texas). For surveys with partial responses, each question was treated as a complete case analysis.

RESULTS

Participating Center Characteristics, Practices, and Protocols

Of the 80 centers contacted, we received responses from 57 centers (71.3%). (Two centers submitted more than one response in error; for these centers, we kept the first survey that was completed in full.) Of responding centers, 53 surveys (93.0%) were completed in full, and 4 (7.0%) were submitted in part. Partial respondents answered between 4 (25.0%) and 14 (87.5%) of the total survey questions. Of the respondents, 47 (82.5%) were hepatologists, 9 (15.8%) were surgeons, and 1 (1.8%) was an infectious disease specialist (Table 1).

Twenty-nine (50.9%) centers reported having institutional protocols regarding the treatment of HCV+ LT candidates and recipients and 27 (47.4%) had no protocols (at one center, it was unknown whether any protocols existed). The physicians primarily responsible for treating HCV+ candidates and recipients were most often hepatologists affiliated with academic centers (n=50) and hepatologists in the community (n=8) (Table 1). Of the four centers selecting “other,” respondents identified providers (nurse practitioners and hepatologists) who were affiliated with non-academic transplant centers. We summarize the transplant volume of the respondents’ centers, including the proportion of HCV+ recipients and the use of HCV+ donors in a two-year pre-survey (1/1/2012–12/31/2013) and post-survey (1/1/2016–12/31/2017) period (Table 2 and Supplemental Materials). Overall, respondents’ centers performed an average of 145 LTs in the pre-survey period and 181 LTs in the post-survey period.

HCV Treatment of Candidates Based on Clinical Disease

Within each center, the degree to which treatment of HCV+ candidates changed after DAAs differed for candidates with low MELD (≤ 15), intermediate/high MELD (>15), and HCC (Figure 1). We did not find survey responses regarding treatment of the various HCV+ candidate groups to be associated with center HCV prevalence in any of the linear or logistic regression models (all were $p>0.05$) (see Supplemental Materials).

Candidates with Low MELD—Before DAAs, 20 centers (37.0%) indicated that candidates with low MELD would be treated “most of the time” or “always” while on the waitlist (Figure 2). After DAAs, 52 centers (90.7%) said low MELD candidates would be treated “most of the time” or “always.” For 8 centers (14.8%), there was no change in how often low MELD candidates were treated before and after DAAs, while 46 (85.2%) increased treatment after DAAs (Table 3).

Candidates with Intermediate/High MELD—Before DAAs, 6 centers (11.3%) indicated that candidates with intermediate/high MELD would be treated “most of the time” or “always” while on the waitlist, and 24 (45.3%) selected “sometimes” (Figure 3). After DAAs, 36 centers (66.7%) said that intermediate/high MELD candidates would be treated “most of the time” or “always,” with 15 (27.8%) selecting “sometimes.” For 4 centers

(7.4%), there was no change how often intermediate/high MELD candidates were treated before and after DAAs, while 50 (92.6%) increased treatment after DAAs.

Candidates with HCC—Before DAAs, 20 centers (37.0%) indicated that candidates with HCC would be treated “most of the time” or “always” while on the waitlist (Figure 4). After DAAs, 52 centers (96.3%) said that candidates with HCC would be treated “most of the time” or “always.” For 9 centers (16.7%), there was no change how often candidates with HCC were treated before and after DAAs, while 43 (79.6%) increased treatment after DAAs.

Candidates with Living Donors—Before DAAs, 6 centers (11.3%) indicated that candidates with living donors would be treated “most of the time” or “always” while on the waitlist (Figure 5). After DAAs, 36 centers (66.7%) said that candidates with living donors would be treated “most of the time” or “always.” For 2 centers (3.7%), there was no change how often candidates with living donors were treated before and after DAAs, while 26 (48.1%) increased treatment after DAAs.

HCV Treatment of Recipients

The proportion of HCV+ recipients among surveyed centers decreased from an average of 40.8% pre-survey to 26.8% post-survey (Table 2). Before DAAs, 20 centers (37.0%) indicated that HCV+ recipients would be treated “most of the time” or “always” post-LT. After DAAs, 52 centers (96.3%) (including the 8 centers where local providers were primarily responsible for treating HCV+ transplant patients), said that HCV+ recipients would be treated “most of the time” or “always” post-LT. For 8 centers (14.8%), there was no change how often HCV+ recipients were treated post-LT before and after DAAs, while 45 (83.3%) increased treatment after DAAs (Table 4). We did not find survey responses regarding treatment of HCV+ recipients to be associated with center HCV prevalence in either the linear or logistic regression models (both were $p>0.05$).

Willingness to Transplant & Retransplant HCV+ Recipients

After DAAs, 14 centers (25.9%) reported increased willingness to perform LTs for HCV+ recipients, with 40 centers (74.1%) experiencing no change in willingness to transplant these patients. Before DAAs, 6 centers (11.3%) indicated that recipients with recurrent HCV and liver failure would be retransplanted “most of the time” or “always.” After DAAs, 36 centers (66.7%) said they would retransplant these patients “most of the time” or “always.” For 11 centers (20.8%), there was no change how often recipients with recurrent HCV and liver failure would be retransplanted before and after DAAs, while 41 (77.4%) increased willingness to retransplant these patients after DAAs (Table 4). We did not find willingness to re-transplant HCV+ recipients to be associated with center HCV prevalence in either the linear or logistic regression models (both were $p>0.05$).

Selection Criteria and Use of HCV+ Donor Organs

On average, the use of HCV+ donors among surveyed centers doubled from the pre-survey to post-survey period (3.9% to 8.0%) (Table 2). Of the 52 centers (98.1%) that reported using HCV+ donor livers for HCV+ LT candidates, 34 centers (63.0%) also reported using specific criteria for selecting HCV+ donors. When asked to describe these criteria, 28

centers (82.1%) referred to screening potential HCV+ donors based on the age of the donor. Additionally, 29 centers (85.3%) reported having modified these HCV+ donor-specific criteria since DAAs have become available. When asked to describe these modifications, 20 centers (69.6%) indicated that they have relaxed or removed their age-based restrictions on HCV+ donors.

The average number of HCV+ to HCV+ LTs among surveyed centers also doubled (pre-survey: 5.6; post-survey: 11.9) (Table 2). Since the advent of DAAs, 23 centers (42.6%) reported increased willingness to use HCV+ donors for HCV+ LT candidates, 27 (50.0%) had no change, and 4 (7.4%) were less willing to use these organs. Before DAAs, 3 centers (5.6%) reported using HCV+ donors for HCV- candidates; after DAAs, 21 (38.9%) were willing to consider using HCV+ donors for HCV- candidates. Among surveyed centers, 6 had any record of HCV+ to HCV- LTs (ranging from 1 to 4 by center) for a total of 12 HCV+ to HCV- LTs in the pre-survey period. In the post-survey period, this increased to 26 centers with a record of HCV+ to HCV- LTs (ranging from 1 to 41 by center) for a total of 129 HCV+ to HCV- LTs (Table 2).

Barriers to Treatment

Third party payers were the most commonly selected obstacle, (n=43) followed by concerns for co-morbidities in this patient population (n=16). Free responses included: cost of the drug, case load of limited staff, clinical instability of LT candidates on the waitlist, patient refusal of treatment, and concern for lowering patients' MELD scores and thereby decreasing their chances of receiving an organ offer (Table 5).

DISCUSSION

This national survey collected data from 57 of the highest volume US LT centers (71.3% response rate), predominantly provided by hepatologists (82.5%) identified as representatives for their center. Only half of these centers (50.9%) reported having standardized institutional protocols for treating HCV+ patients on the waitlist or post-LT. Hepatologists affiliated with academic centers (n=50) or hepatologists in the community (n=8) were primarily responsible for treating HCV+ transplant patients. Nearly all centers (98.1%) used HCV+ deceased donor organs for HCV+ recipients, with 63.0% using pre-specified, mostly age-based, criteria for selecting HCV+ donors. Of these, 85.3% have modified HCV+ donor selection criteria since the approval of DAAs, primarily by relaxing age-based restrictions. Though very few centers (5.6%) had used HCV+ donors for HCV-recipients in the past, there was increased willingness to consider this practice, given the approval of DAAs (38.9%). DAA availability increased the willingness of centers to treat LT candidates with low MELD (85.2%), intermediate/high MELD (92.6%), HCC (79.6%), and with living donors (48.1%), to transplant for HCV+ recipients (25.9%), to treat LT recipients with post-LT HCV treatment (83.3%), to use HCV+ donors for HCV+ LT recipients (42.6%), and to retransplant recipients with recurrent HCV post-LT (77.4%). The most commonly identified barrier to treating HCV+ patients cited by transplant centers was third party payers.

In our study, hepatologists affiliated with academic transplant centers were largely responsible for managing the care of HCV+ LT patients. This is consistent with the 2015 IDSA/AASLD guidelines to refer HCV+ patients with decompensated cirrhosis to a medical practitioner with experience treating HCV and managing advanced liver disease, ideally in a transplant center. The 2017 ILTS consensus statement emphasizes the importance of considering the expected time to LT (based on MELD), HCC diagnosis, and the availability of HCV+ donors and/or living donors when making treatment decisions for waitlist candidates, as does our survey (35). Unpredictable organ offers complicate timing the initiation of DAA therapy for LT candidates, particularly those with higher MELD scores who are less clinically stable and more likely to be transplanted (21, 38). In the DAA era we found that centers were much more likely to universally treat candidates with MELD ≤ 15 (57.4%) than those with MELD >15 (1.9%), in keeping with subsequently published practice recommendations advising selective treatment for candidates with MELD scores between 20 and 30. Similarly, consensus guidelines advocate treating stable HCV+ candidates with HCC, and we found 96.3% of centers would treat HCV+ candidates with HCC “most of the time” or “always” in the DAA era.

The availability of HCV+ donor livers also plays a role in HCV treatment decisions for LT candidates. We found that 98.1% of the transplant centers we surveyed reported using organs from HCV+ deceased donors for consenting HCV+ recipients to expand the pool of available donors for candidates on their waitlist. After DAAs, we also found that centers reported both an increased willingness to use HCV+ donors and to accept HCV+ donors with fewer restrictions. This was reflected in the higher proportion of HCV+ donor livers utilized in the post- vs. pre-survey period (8.0% vs. 3.9%) and is consistent with a study showing increased utilization of HCV+ donor livers in the era of DAAs (22). Of note, we also found that 21 centers (38.9%) were willing to consider using HCV+ donor livers for HCV- recipients after DAAs became available. After these centers were surveyed, this practice grew from 6 centers with 12 HCV+ to HCV- LTs (2012–2014) to 26 centers with 129 HCV+ to HCV- LTs (2016–2018). As clinical trials of HCV+ to HCV- kidney transplantation demonstrate the potential of this approach in the DAA era and new guidelines emerge for LT candidates (39–41), institutional protocols to expand the use of HCV+ donor livers for HCV- LT candidates may also merit further review and consideration (42–45).

This study has several limitations that merit consideration. First, we relied on our contacts at each LT center to identify an individual to represent the views of their center as a whole. Since there may be different attitudes and practices within a single LT center, it may not be possible to capture these in each response. We cannot rule out the potential that survey responses more closely reflected a respondent’s perception than their center’s practices, particularly for centers with no specific protocols to report. We were also only able to sample a portion of all US transplant centers. However, we believe that the high response rate, together with our focus on high volume centers, likely yields results with little responder bias that represent the most relevant data. Finally, this survey did not collect more specific, granular information on how many HCV+ patients were treated at each center on the waitlist or post-LT, which particular DAAs were used, or how care of HCV+ transplant patients might transition from transplant centers to local providers. Instead, we sought to

describe the national landscape of centers' attitudes and general treatment practices of HCV + LT patients in the US before and after DAA availability.

In conclusion, we surveyed 57 of the highest volume US LT centers (71.3% response rate) to learn how DAAs have impacted attitudes and practices towards treating HCV+ LT candidates and recipients and using HCV+ donors. Overall, DAAs increased LT centers' willingness to use HCV+ donors more broadly and to treat, transplant, and retransplant HCV + candidates and recipients, but the management of particular candidate groups still varies across centers.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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ABBREVIATIONS

AASLD	American Association for the Study of Liver Diseases
DAAs	Direct-acting antivirals
HCC	Hepatocellular carcinoma
HCV	Hepatitis C virus
IDSA	Infectious Disease Society of America
ILTS	International Liver Transplantation Society
LT	Liver transplantation
MELD	Model for end-stage liver disease
OPTN	Organ Procurement and Transplantation Network
SRTR	Scientific Registry of Transplant Recipients
US	United States of America

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Figure 1.

Magnitude of relative changes (before vs. after direct-acting antiviral [DAA] medication availability) in treatment practices of hepatitis C virus-infected (HCV+) candidates on the liver transplant waitlist. Each horizontal line is a single center's response, shown for each candidate-type (indicated by columns), based on model for end-stage liver disease (MELD) score (low MELD ≤ 15 ; intermediate/high MELD >15) and hepatocellular carcinoma (HCC) status. Line segments in darker green indicate large increases in Likert score treatment frequency for a given center (before vs. after DAAs), lighter green show minor increases, yellow means no change, and orange shows reduced treatment.

Figure 2.

Likert scale responses indicating how often centers would treat hepatitis C virus-infected (HCV+) candidates on the liver transplant waitlist with a low (≤ 15) model for end-stage liver disease (MELD) score, based on the availability of direct-acting antivirals (DAAs).

Frequency of HCV Treatment for Waitlist Candidates with High MELD

Figure 3.

Likert scale responses indicating how often centers would treat hepatitis C virus-infected (HCV+) candidates on the liver transplant waitlist with an intermediate/high (>15) model for end-stage liver disease (MELD) score, based on the availability of direct-acting antivirals (DAAs).

Figure 4.

Likert scale responses indicating how often centers would treat hepatitis C virus-infected (HCV+) candidates on the liver transplant waitlist with hepatocellular carcinoma (HCC), based on the availability of direct-acting antivirals (DAAs).

Frequency of HCV Treatment for Waitlist Candidates with Living Donors

Figure 5.

Likert scale responses indicating how often centers would treat hepatitis C virus-infected (HCV+) candidates on the liver transplant waitlist with living donors, based on the availability of direct-acting antivirals (DAAs).

Table 1.

Respondent medical specialties and transplant program role; affiliations and specialties of physicians primarily responsible for treating hepatitis C virus-infected (HCV+) candidates and recipients.

Respondent Characteristics		n (%)
Medical Specialty	Hepatology	47 (82.5)
	Infectious Diseases	1 (1.8)
	Surgery	9 (15.8)
	Other	1 (1.8)
Specific role in the transplant program	Medical Director or Transplant Hepatologist	44 (77.2)
	Surgery Chief or Surgeon	8 (14.0)
	Other	5 (8.8)
Providers treating HCV+ transplant patients	Hepatologists at an academic center	50
	Hepatologists in the community	8
	Infectious Disease Specialists at an academic center	3
	Infectious Disease Specialists in the community	0
	Other	4

Table 2.

Summary of surveyed liver transplant including the transplant volume, proportion of hepatitis C virus-infected (HCV+) recipients, number and proportion of HCV+ donors, and the use of HCV+ donors among HCV+ and HCV- recipients centers in a two-year pre-survey (1/1/2012–12/31/2013) and post-survey (1/1/2016–12/31/2017) period.

Responding Transplant Center Characteristics (n=57)	
Average liver transplant volume	
Pre-survey	145
Post-survey	181
Average proportion of HCV+ recipients	
Pre-survey	40.8%
Post-survey	26.8%
Average number of HCV+ donors	
Pre-survey	5.8
Post-survey	14.1
Average proportion of HCV+ donors	
Pre-survey	3.9%
Post-survey	8.0%
Average number of HCV+ to HCV+ liver transplants	
Pre-survey	5.6
Post-survey	11.9
Average number of HCV+ to HCV- liver transplants	
Pre-survey	0.2
Post-survey	2.2

Table 3.

How often centers would treat various hepatitis C virus-infected (HCV+) candidates (those with low model for end-stage liver disease [MELD] (score ≤ 15), moderate/high MELD (score >15), hepatocellular carcinoma [HCC], or living donors) while on the liver transplant waitlist, based on the availability of direct-acting antiviral (DAA) therapy to treat HCV.

	Candidates with Low MELD		Candidates with Moderate/High MELD	
	Before DAA availability N (%)	After DAA availability N (%)	Before DAA availability N (%)	After DAA availability N (%)
Never	0 (0)	0 (0)	3 (5.7)	1 (1.9)
Rarely	4 (7.4)	1 (1.9)	20 (37.7)	2 (3.7)
Sometimes	30 (55.6)	1 (1.9)	24 (45.3)	15 (27.8)
Most of the Time	16 (29.6)	21 (38.9)	5 (9.4)	33 (61.1)
Always	4 (7.4)	31 (57.4)	1 (1.9)	3 (5.6)
	Candidates with HCC		Candidates with Living Donors	
	Before DAA availability N (%)	After DAA availability N (%)	Before DAA availability N (%)	After DAA availability N (%)
Never	0 (0)	0 (0)	3 (5.7)	1 (1.9)
Rarely	4 (7.4)	1 (1.9)	20 (37.7)	2 (3.7)
Sometimes	30 (55.6)	1 (1.9)	24 (45.3)	15 (27.8)
Most of the Time	16 (29.6)	21 (38.9)	5 (9.4)	33 (61.1)
Always	4 (7.4)	31 (57.4)	1 (1.9)	3 (5.6)
N/A			23 (42.6)	25 (46.3)

Table 4.

How often centers would treat hepatitis C virus-infected (HCV+) recipients post-liver transplant and how often centers would retransplant patients with recurrent HCV, based on the availability of direct-acting antiviral (DAA) therapy to treat HCV.

	Treatment of Post-Transplant Recurrent HCV		Retransplantation of HCV+ Recipients with Recurrent HCV	
	Before DAA availability N (%)	After DAA availability N (%)	Before DAA availability N (%)	After DAA availability N (%)
Never	0 (0)	0 (0)	3 (5.7)	1 (1.9)
Rarely	4 (7.4)	1 (1.9)	20 (37.7)	2 (3.7)
Sometimes	30 (55.6)	1 (1.9)	24 (45.3)	15 (27.8)
Most of the Time	16 (29.6)	21 (38.9)	5 (9.4)	33 (61.1)
Always	4 (7.4)	31 (57.4)	1 (1.9)	3 (5.6)

Table 5.

Factors identified by centers as barriers to treating hepatitis C virus-infected (HCV+) liver transplant candidates and recipients.

Barriers to Treatment	Number of Centers
Third party payers	43
Co-morbidities	16
Drug-drug interactions	8
Lack of guidelines for treating this patient population	8
Lack of experience treating this patient population	4
In-patient pharmacy protocols	4
Other	10