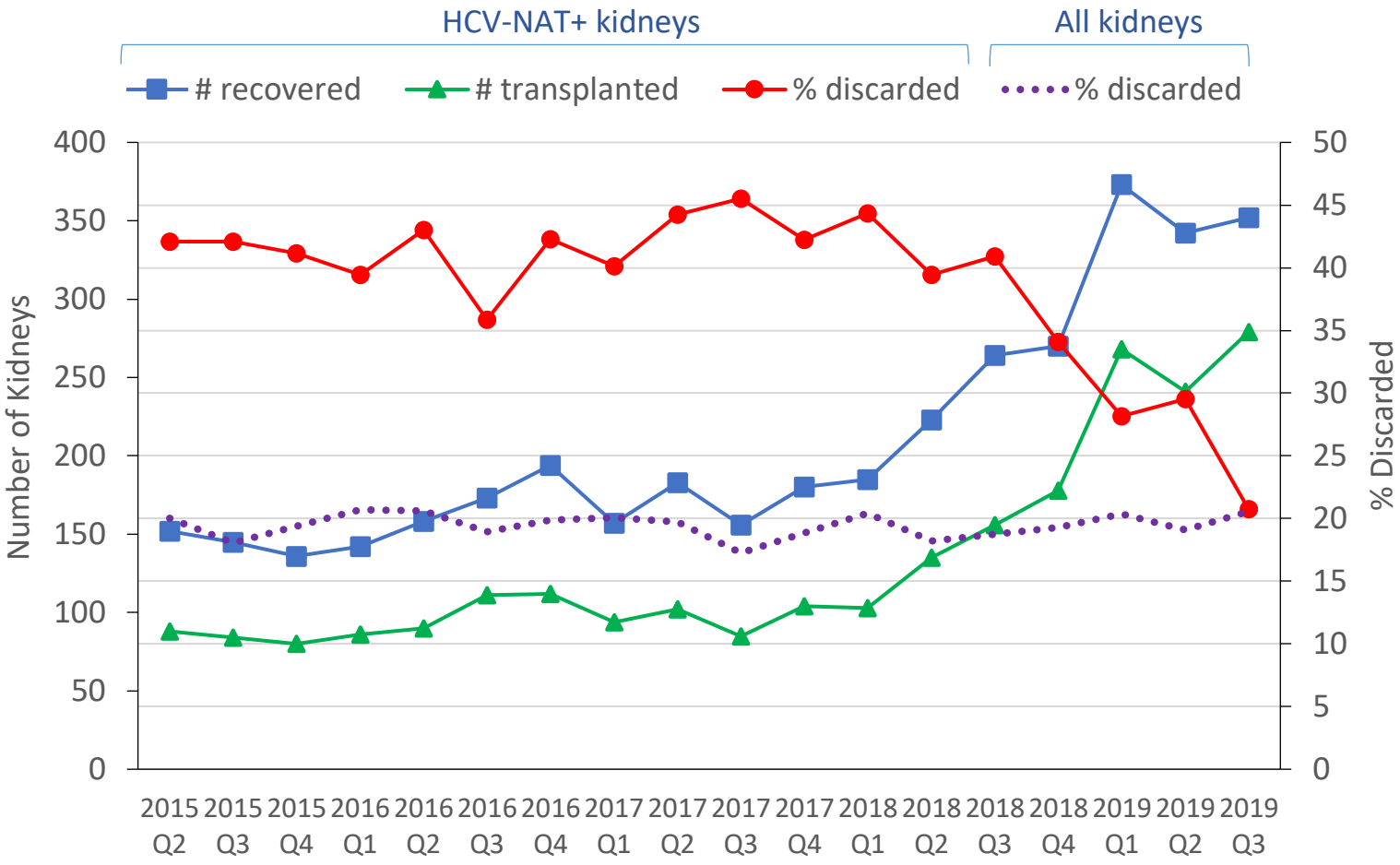
Figure S1. Quarterly recovery, transplantation, and discard of kidneys recovered for the purpose of transplantation from deceased donors with positive hepatitis C virus nucleic acid amplification testing (HCV-NAT+) with comparison to the discard rate among all deceased donor kidneys in the United States, 4/1/2015 - 9/30/2019.



Item S1. Supplemental Methods

Center Bypass Filters

Transplant centers indicate in advance their desire to receive offers or be bypassed during allocation for certain types of deceased donors whose organs are being placed regionally or nationally by the United Network for Organ Sharing (UNOS) Organ Center. Centers select responses to a set of filters for over 48 donor characteristics including demographics (e.g. maximum age), medical and social history (diabetes, IV drug use, etc.), as well as details surrounding the donor's hospitalization and death (e.g. maximum doses of inotropic medications), organ recovery process, and organ characteristics (maximum warm ischemic time, presence of plaque in the renal artery, etc.). *All* waitlisted patients at that center will be bypassed during allocation based on the center's selected criteria. These filters help prevent regional and national offers from going to centers that already know they would not be willing to accept them and can save time during allocation.

Hepatitis C virus (HCV) status is currently captured in two bypass filters. One filter screens out donors based on HCV antibody (anti-HCV) seropositivity, and this filter has been used since 2007. An additional filter to screen out viremic donors with a positive Nucleic Acid Test (NAT) was introduced in August 2015.

Data Sources

We used the national UNOS Standard Transplant Analysis and Research (STAR) files based on the Organ Procurement and Transplantation Network (OPTN) database as of 12/6/2019 for information on all deceased donors and kidney transplants in the United States. We used additional data provided by UNOS on transplant centers' current bypass criteria filter settings for offers from the UNOS Organ Center as of 7/31/2019, as well as an audit trail of centers' past filter settings and changes made to their settings since 1/31/2007. Data used to map the DSA boundaries was obtained from HRSA's public data portal at data.HRSA.gov, using the Organ Procurement Organizations – Service Areas data published by HRSA, Healthcare Systems Bureau (HSB), Division of Transplantation and UNOS.

This study was approved by the institutional review board at Columbia University Medical Center. Individual-level informed consent was not obtained in this large, retrospective database study.

Hepatitis C Definitions

Data on donor Hepatitis C nucleic acid testing (HCV-NAT) were first systematically recorded for all donors and made available in the STAR files beginning on 3/31/2015. A donor with a documented positive NAT result was considered HCV-NAT+.

We used a documented negative Anti-HCV test result to define HCV-seronegative recipients for HCV positive-to-negative transplants in our study. Data on recipient HCV-NAT testing has only been collected since 2018 and was therefore not considered in this analysis.

Study Period

Overall center bypass filter data were available beginning 1/31/2007 through 7/31/2019, but the earliest date with uniformly reported HCV-NAT data for donors (3/31/2015) was selected as the beginning date for our study. For analyses of centers' bypass filter settings and transplantation of HCV-NAT+ kidneys into HCV-seronegative recipients, 7/31/2019 was selected as the end date to correspond with the latest known filter settings. Data on all deceased donors and transplants were available through 9/30/2019. For analyses of national deceased donor kidney recovery, utilization, and discard trends, donations and transplants through 9/30/2019 (the end of 2019 Q3) were included.

"Key Study" Selection

Two authors who are practicing transplant nephrologists (SAH and SM) performed a search in Medline (PubMed) using the search term "kidney transplant AND hepatitis C." Search results were reviewed independently to identify key studies on the topics of safety and efficacy of kidney transplantation using HCV NAT+ organs, based on expert opinion. The two lists were compared, and differences were resolved by review and consensus of all authors.

Exposure

Transplant center: 245 transplant centers that performed at least one deceased donor kidney transplant between 3/31/2015 and 7/31/2019 were included in the study.

Primary Outcomes

Centers' filter setting for HCV-NAT+ donors could be documented as either:

A) opting in to receive these offers
B) opting out to not receive the offers
C) no response.

Centers with no response to the HCV-NAT filter continue to receive offers for these donors by default. At each time point that a center changed their HCV-NAT filter setting between 8/10/2015 and 7/31/2019, we calculated the proportion of centers in each filter setting category out of the 245 transplant centers included in the study and graphed the changes over time (Figure 1).

We also calculated the cumulative sum of unique centers performing transplants from a HCV-NAT+ donor to a HCV serostatus-negative recipient since 3/31/2015, when donor HCV-NAT status was first recorded, through 7/31/2019.

Secondary Outcomes

We examined nationwide recovery and utilization of kidneys from deceased HCV-NAT+ donors between 3/31/2015 and 9/30/2019. We calculated the number of HCV-NAT+ kidneys recovered for transplantation, the number actually transplanted, and the proportion discarded by quarter (Figure S1).

We also calculated the discard rate for all deceased donor kidneys recovered for transplantation during the same study period for additional context.

We next compared the centers that were receiving HCV-NAT+ offers from the UNOS Organ Center as of 7/31/2019, including those actively opting in or receiving offers by default (no filter response), to those not receiving offers. Centers' waitlist size and transplant volume were characterized by calculating the total number of unique kidney transplant candidate registrations, prevalent or incident, appearing on a center's waitlist between 3/31/2015 and 7/31/2019 and the number of deceased donor kidney transplants performed at a center during the same time period. The total number of transplants was divided by 4.33 to annualize transplant volume. Centers' responses to the anti-HCV filter as of 7/31/2015 were also compared.

To examine the geographic distribution of centers' intentions and utilization of HCV-NAT+ kidneys, we calculated and mapped the proportion of transplant centers within each Donation Service Area (DSA) receiving HCV-NAT+ offers from the UNOS Organ Center as of 7/31/2019. We also mapped the number of HCV-NAT+ transplants to HCV-seronegative recipients performed between 3/31/2015 and 7/31/2019 within each DSA. We additionally examined the distribution of HCV-NAT+ filter responses across OPTN regions.

Statistical Analyses

Anti-HCV filter usage, HCV-NAT+ to seronegative transplant history, and regional distribution were compared between centers that opted out of HCV-NAT+ kidney offers versus those who were receiving the offers as of 7/31/2019 using the chi-squared test. Median waitlist size and transplant volume were compared using the Wilcoxon rank sum test. Statistical significance was determined at alpha of 0.05. Analyses were conducted in Stata MP 15.1 (StataCorp, College Station, TX), and ArcGIS ArcMap 10.6 was used to create the maps.

Table S1. Major publications regarding the safety and efficacy of transplantation of kidneys from donors with positive hepatitis C virus nucleic acid testing.

Study	Earliest Publication Date	First Author	Citation
A	6/1/2015	Scalea, JR	Transplantation. 2015 Jun;99(6):1192-6. doi: 10.1097/TP.0000000000000479. Shorter waitlist times and improved graft survivals are observed in patients who accept hepatitis C virus+ renal allografts.
B	11/20/2015	Kamar, N	Am J Transplant. 2016 May;16(5):1474-9. doi: 10.1111/ajt.13518. Efficacy and Safety of Sofosbuvir-Based Antiviral Therapy to Treat Hepatitis C Virus Infection After Kidney Transplantation.
C	11/25/2015	Sawinski, D	Am J Transplant. 2016 May;16(5):1588-95. doi: 10.1111/ajt.13620. Successful Treatment of Hepatitis C in Renal Transplant Recipients With Direct-Acting Antiviral Agents.
D	11/15/2016	Colombo, M	Ann Intern Med. 2017 Jan 17;166(2):109-117. doi: 10.7326/M16-1205. Treatment With Ledipasvir-Sofosbuvir for 12 or 24 Weeks in Kidney Transplant Recipients With Chronic Hepatitis C Virus Genotype 1 or 4 Infection: A Randomized Trial.
E	4/30/2017	Goldberg, DS	N Engl J Med. 2017 Jun 15;376(24):2394-2395. doi: 10.1056/NEJMc1705221. Trial of Transplantation of HCV-Infected Kidneys into Uninfected Recipients.
F	5/1/2017	Sawinski, D	Transplantation. 2017 May;101(5):968-973. doi: 10.1097/TP.0000000000001410. Use of HCV+ Donors Does Not Affect HCV Clearance With Directly Acting Antiviral Therapy But Shortens the Wait Time to Kidney Transplantation.
G	5/2/2017	Bhamidimarri, KR	Transpl Int. 2017 Sep;30(9):865-873. doi: 10.1111/tri.12954. Transplantation of kidneys from hepatitis C-positive donors into hepatitis C virus-infected recipients followed by early initiation of direct acting antiviral therapy: a single-center retrospective study.
H	7/1/2017	Levitsky, J	Am J Transplant. 2017 Nov;17(11):2790-2802. doi: 10.1111/ajt.14381. The American Society of Transplantation Consensus Conference on the Use of Hepatitis C Viremic Donors in Solid Organ Transplantation.
I	3/6/2018	Durand, CM	Ann Intern Med. 2018 Apr 17;168(8):533-540. doi: 10.7326/M17-2871. Direct-Acting Antiviral Prophylaxis in Kidney Transplantation From Hepatitis C Virus-Infected Donors to Noninfected Recipients: An Open-Label Nonrandomized Trial.
J	8/7/2018	Reese, PP	Ann Intern Med. 2018 Sep 4;169(5):273-281. doi: 10.7326/M18-0749. Twelve-Month Outcomes After Transplant of Hepatitis C-Infected Kidneys Into Uninfected Recipients: A Single-Group Trial.

Table S2. Comparing kidney transplant centers receiving HCV-NAT+ offers from the UNOS Organ Center versus opting out as of 7/31/2019

		Receiving HCV-NAT+ offers		Not receiving HCV-NAT+ offers	p-value[a]
	All Centers	Opting In	No Response	Opting Out	
Count	245 (100%)	93 (38%)	73 (30%)	79 (32%)	
Response to additional Anti-HCV filter[b]					< 0.001
Receiving Offers	178 (73%)	92 (99%)	50 (68%)	36 (46%)	
Opting Out of Offers	67 (27%)	1 (1%)	23 (32%)	43 (54%)	
HCV-NAT+ to seronegative transplant history[c]					< 0.001
≥ 1 transplant	70 (29%)	35 (38%)	26 (36%)	9 (11%)	
0 transplants	175 (71%)	58 (62%)	47 (64%)	70 (89%)	
Waitlist size[c]	754 (348 - 1534)	1009 (610 - 1791)	762 (161 - 2250)	478 (157 - 946)	0.0001
DDK Transplant Volume, annualized[c]	44 (16 - 86)	61 (33 - 93)	47 (12 - 117)	30 (12 - 62)	0.0006
OPTN Region					0.526
1	14 (6%)	5 (5%)	4 (5%)	5 (6%)	
2	35 (14%)	13 (14%)	11 (15%)	11 (14%)	
3	27 (11%)	9 (10%)	13 (18%)	5 (6%)	
4	31 (13%)	10 (11%)	6 (8%)	15 (19%)	
5	31 (13%)	11 (12%)	10 (14%)	10 (13%)	
6	9 (4%)	4 (4%)	1 (1%)	4 (5%)	
7	23 (9%)	10 (11%)	8 (11%)	5 (6%)	
8	18 (7%)	3 (3%)	8 (11%)	7 (9%)	
9	16 (7%)	9 (10%)	3 (4%)	4 (5%)	
10	19 (8%)	9 (10%)	3 (4%)	7 (9%)	
11	22 (9%)	10 (11%)	6 (8%)	6 (8%)	

Abbreviations: HCV-NAT+, Hepatitis C Nucleic Acid positive donor; UNOS, United Network for Organ Sharing; Anti-HCV, Anti-Hepatitis C Virus Antibody; DDK, deceased donor kidney; OPTN, Organ Procurement and Transplantation Network

[a] p-value compares centers receiving HCV-NAT+ offers (combined opting in/no response) to centers not receiving HCV-NAT+ offers (opting out)

[b] The Anti-HCV filter is an additional filter that screens out donors based on HCV antibody seropositivity. This filter has been available for use longer than the HCV-NAT filter, and centers select separate responses to each filter.

[c] Transplant History, Waitlist Size, and DDK Transplant Volume were all calculated from 3/31/2015 through 7/31/2019, with total DDK transplant volume annualized by dividing by 4.33 years.