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Knowledge, Attitudes, and Planned Practice of HIV-positive to HIV-positive Transplantation in US Transplant Centers

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Abstract

Background: HIV+ donor organs can now be transplanted into HIV+ recipients (HIV D+/R+) following the HIV Organ Policy Equity (HOPE) Act. Implementation of the HOPE Act requires transplant center awareness and support of HIV D+/R+ transplants.

Methods: To assess center-level barriers to implementation, we surveyed 209 transplant centers on knowledge, attitudes, and planned HIV D+/R+ protocols.

Results: Responding centers (n=114; 56%) represented all UNOS regions. Fifty centers (93 organ programs) planned HIV D+/R+ protocols (kidney n=48, liver n=34, pancreas n=8, heart n=2, lung=1), primarily in the eastern US (28/50). Most (91.2%) were aware that HIV D+/R+ transplantation is legal; 21.4% were unaware of research restrictions. Respondents generally agreed with HOPE research criteria except the required experience with ≥ 5 HIV+ transplants by organ type. Centers planning HIV D+/R+ protocols had higher transplant volume, HIV+ recipient volume, increased infectious-risk donor utilization, and local HIV prevalence ($p < 0.01$). Centers not planning HIV D+/R+ protocols were more likely to believe their HIV+ candidates would not accept HIV+ donor organs ($p < 0.001$). Most centers (83.2%) supported HIV+ living donation.

Conclusions: Although many programs plan HIV D+/R+ transplantation, center-level barriers remain including geographic clustering of kidney/liver programs and concerns about HIV+ candidate willingness to accept HIV+ donor organs.

Keywords

HIV; HOPE Act; HIV-infected donors

INTRODUCTION

HIV-infected (HIV+) transplant candidates have increased risk of waitlist mortality and decreased access to transplantation, compared to HIV-uninfected (HIV-) candidates¹⁻⁵. Organs from HIV+ donors (HIV D+) can now be transplanted into HIV+ recipients (HIV R+) following the HIV Organ Policy Equity (HOPE) Act of 2013^{6,7}. Currently, HIV D+/R+ transplants must occur as research and in accordance with HOPE Safeguards and Research Criteria published by the Department of Health and Human Services (HHS) in November 2015 (Table 1)⁸.

Successful implementation of HIV D+/R+ transplantation requires that transplant centers are appropriately informed and prepared for this practice. This includes knowing: that HIV D+/R+ transplants are legal and limited to research protocols⁸, the estimated size of the annual HIV+ deceased donor organ pool⁹⁻¹¹, the number of HIV D+/R+ transplants performed worldwide¹²⁻¹⁵, reported outcomes for HIV D-/R+ transplants¹⁶⁻²¹, and awareness of the HHS Safeguards and Research Criteria⁸. The enactment of federally mandated criteria for research protocols is unprecedented in solid organ transplantation, and disagreement with criteria could limit implementation. Additionally, variability in transplant centers' knowledge about risks, management challenges, and outcomes of HIV+ transplants could affect HIV D+/R+ research protocols²².

We aimed to describe the scope of HIV D+/R+ transplantation planning among US transplant centers and to assess knowledge and attitudes about HIV+ transplantation, in order to determine potential transplant center barriers to implementation.

METHODS

Survey Distribution

We used Scientific Registry of Transplant Recipients (SRTR) data to identify 209 transplant centers that had performed ≥ 1 solid organ transplant from 1/1/2014–6/3/2014. Centers that only performed pediatric transplants were excluded (n=38). We compiled a convenience sample of one representative of the transplant team at 204 centers through center websites, personal connections, PubMed, and calls to administrators; contact information for 5 centers was unavailable. Survey invitations were sent to this representative contact who was asked to forward the survey to someone on their transplant team who could best represent the center's planned practice of HIV D+/R+ transplantation. The web-based survey was hosted by Qualtrics and distributed between 1/29/2016–6/8/2016. Non-respondents were sent three reminders. The Johns Hopkins Institutional Review Board acknowledged this study as exempt.

Survey Design

Respondents were asked to respond to the survey on behalf of their transplant center. The survey consisted of 26 items regarding participant specialty/role, number of HIV+ candidates on their waitlist, center opinions on the HHS safeguards and research criteria, perceptions of HIV+ waitlist candidates at their center, planned practice of HIV D+/R+ transplants, and perceived risk of HIV D+/R+ transplants. The survey also included five

multiple-choice and true/false-style questions assessing knowledge of HIV D+/R+ transplants (awareness that HIV D+/R+ transplants are legal, awareness that HIV D+/R+ transplants are limited to research, awareness of the HHS Safeguards and Research Criteria⁸, knowledge of the number of HIV D+/R+ transplants done worldwide^{12–15}, and knowledge of the estimated size of the annual HIV+ deceased donor organ pool^{9,10}), and six multiple-choice questions assessing knowledge of HIV-negative to HIV-positive (HIV D-/R+) transplants (impact of center experience, NIH study participation, and transplant era [2004–2007 and 2008–2011] on outcomes as published in the literature^{16–18}, and risk of acute rejection, graft survival, and patient survival in HIV D-/R+ transplants compared to HIV D-/R- transplants as published in the literature^{16–21,23}) (Appendix 1). The survey was pilot tested by two transplant surgeons, an infectious disease physician, and a statistician, and was revised based on feedback prior to distribution.

Data Sources

SRTR data was used to identify transplant centers and to supplement analyses of the primary survey data. The SRTR data system includes data on all donor, wait-listed candidates, and transplant recipients in the US, submitted by the members of the Organ Procurement and Transplantation Network (OPTN). The Health Resources and Services Administration (HRSA), U.S. Department of Health and Human Services provides oversight to the activities of the OPTN and SRTR contractors. County-level HIV prevalence was obtained from AIDSvu (2013) (Center for AIDS Research, Emory University Rollins School of Public Health in partnership with Gilead Sciences, Inc²⁴).

Center Factors and Survey Responses

Using SRTR data, we calculated the number of kidney, liver, pancreas, heart, and lung transplants performed annually at participating centers from 1/1/2010–5/31/2016. To characterize center experience with HIV R+ transplantation, we calculated the total number of HIV+ recipients transplanted each year. As a measure of center willingness to use higher-risk allografts, we calculated the percentage of transplants that involved increased-infectious risk donors (IRD). Using AIDSvu 2013 All County Prevalence Data, we determined HIV prevalence in the county in which each center was located²⁴. Based on plans for HIV D+/R+ protocols (planning vs. not planning, as reported in the survey), we compared centers in terms of transplant volume, HIV R+ volume, IRD use, knowledge of HIV D+/R+ transplants, and knowledge of HIV D-/R+ transplants using Wilcoxon-Mann-Whitney tests. All statistical analyses were performed using Stata 14.2 SE (College Station, TX).

RESULTS

Study Population

A total of 114 centers responded, including at least one center from each UNOS region (response rate=56%). The most common respondent role/specialty was surgery (49%), followed by infectious disease (15%) (Table 2). Among responding centers, median annual transplant volume was 93 (range 2–190), median annual volume of HIV+ recipients was 0 (range 0–7), median proportion of IRD donor organs used was 14% (range 2%–44%), and median county HIV prevalence was 419 per 100,000 (range 0–2,286) (Table 2). Number of

HIV+ candidates on an organ transplant waitlist was not captured in SRTR at the time of this survey; as reported by survey respondents, the median number of HIV+ candidates was 3 (range 0–52). The total number of HIV+ transplant candidates of all organ types reported by all centers was 803.

Planned Practice of HIV D+/R+ Transplants

Fifty respondents (43.8%) reported that their centers are planning to perform HIV D+/R+ transplants. Specific programs planning HIV D+/R+ transplants included kidney (n=48, 98.0%), liver (n=34, 68.0%), pancreas (n=8, 16.0%), heart (n=2, 4.0%) and lung (n=1, 2.0%). At least one center in each UNOS region reported planning to perform HIV D+/R+ transplants. However, most centers planning HIV D+/R+ protocols were located in the eastern U.S. (n=28, UNOS regions 1, 2, 3, 9, 11), with 4 centers on the west coast (Regions 5, 6) and 18 in central U.S. (Regions 4, 7, 8 10).

Transplant centers planning to implement HIV D+/R+ transplantation had 2.9-fold higher median transplant volume (159 vs. 54, $p<0.01$), higher median volume of HIV+ transplant recipients (1 vs. 0, $p<0.01$), higher proportion of transplants using IRD organs (15% vs. 12%, $p<0.01$), and a higher county prevalence of HIV (541 vs. 321 per 100,000, $p<0.01$) compared to centers not planning to implement HIV D+/R+ transplantation (Table 3).

Preparedness to transplant HIV+ organs: knowledge of the HOPE Act and HIV+ transplantation

Of respondents, 104 (91.2%) were aware that HIV D+/R+ is legal. Twenty-four (21.4%) were unaware that HIV D+/R+ transplants must occur under research protocols in accordance with HHS criteria; of those unaware, 5 reported planning HIV D+/R+ protocols. Of respondents, 40.2% had reviewed the HOPE Safeguards and Research Criteria.

Among centers planning HOPE protocols, overall knowledge of HIV D+/R+ transplants reported in the peer-reviewed literature was high (Table 4). Of respondents planning HOPE protocols, 54.5% correctly identified the number of HIV D+/R+ transplants that had been reported worldwide at the time of survey distribution (15–45 HIV D+/R+ transplants were reported by June 8 2016^{12–15}) and 58.0% correctly identified the estimated size of the HIV+ deceased organ donor pool each year (200–600 potential HIV+ organ donors per year^{9,10}).

Most respondents planning HOPE protocols correctly responded that published studies demonstrate equivalent patient survival (89.1%) and graft survival (78.3%) but higher rates of rejection (84.8%) for HIV D–/R+ recipients. Of respondents planning HOPE protocols, 82.6% were also aware that later transplant era has been reported as a predictor of improved outcomes for HIV+ transplant recipients. However, 36.9% of respondents planning HOPE protocols believed that there is a difference in recipient outcomes among centers that have performed <5 HIV D–/R+ transplants compared to centers that have performed >5 HIV D–/R+ transplants (Table 4).

Perceived Risks of HIV D+/R+ transplants compared to HIV D-/R+ transplants

The risk of HIV superinfection, defined as infection with a second distinct strain of HIV in HIV D+/R+ transplants, was perceived to be a moderate and clinically manageable risk by 72.5% of respondents; only 6.6% perceived the risk to be high and clinically dangerous. Of respondents, 21.9% perceived the risk of HIV-associated nephropathy to be higher in HIV D+/R+ transplants compared to HIV D-/R+ transplants; 30.8% said they did not know how the risks would compare (Figure 1). The risks of acute rejection and infections/hospitalizations were perceived to be comparable to HIV D-/R+ transplants by 70.3% and 71.4% of respondents, respectively (Figure 1). There were no significant differences in perceived risks of HIV D+/R+ transplants between centers planning and not planning HOPE protocols.

Perceptions of HIV+ Candidates Willingness to Accept HIV D+/R+ transplants and Anticipated Access to HIV+ Living Donation

Of respondents, 50.0% anticipated that at least half of their HIV+ waitlist patients would be willing to accept an HIV+ deceased donor organ, and 45.0% anticipated that at least half of their HIV+ waitlist patients would be willing to accept an HIV+ living donor organ. However, 17.0% of respondents anticipated that none of their HIV+ waitlist patients would be willing to accept an HIV+ deceased donor organ, and 26.2% anticipated that none of their HIV+ waitlist patients would be willing to accept an HIV+ living donor (Figure 2). Respondents reporting that more than half of their HIV+ waitlist patients would be willing to accept HIV+ deceased donor organs were more likely to be planning to perform HIV D+/R+ transplants (68.8% vs. 27.5%, $p < 0.001$).

Thirteen centers reported that none of their patients would accept either HIV+ living or deceased donors. Of those who reported that none of their patients would accept an HIV+ living donor, four were planning HOPE protocols. Of those who reported that none of their patients would accept an HIV+ deceased donor, one was planning a HOPE protocol.

No respondents believed that most or all of their HIV+ waitlist patients have potential HIV+ living donors, and 58.0% believe that none of their HIV+ waitlist patients have potential HIV+ living donors. Likewise, only 10.2% believe that at least half of their HIV+ waitlist patients have potential HIV- living donors and 42.0% believe that none of their HIV+ waitlist patients have potential HIV- living donors (Figure 2).

Agreement with the HOPE Safeguards and Research Criteria

Most respondents agreed with the HHS deceased donor criteria regarding excluding donors with opportunistic infections (92.7%) and the requirement to obtain pre-implantation donor organ biopsies (71.9%, Table 5). However, 22.9% of respondents believed the criterion allowing deceased donors with any HIV viral load was too lenient (Table 5). Of those believing this criterion was too lenient, 16 (76.2%) said they would only allow donors with low or undetectable viral loads. Of respondents, 53.2% disagreed with the criteria for center and study team experience with HIV+ transplantation (Table 5); 40.4% of respondents believed the criteria should not be organ specific, and 12.8% of respondents believed there should be no experience criteria (Table 5). Respondents from centers planning to perform

HIV D+/R+ transplants were more likely to agree with the general center experience criteria with HIV+ recipients (56.0% vs 22.5%) than centers not planning protocols but they were less likely to believe that the required experience should be organ specific (28.0% vs 40.0%) ($p=.011$).

Of centers planning HIV D+/R+ protocols, 6 (12%) reported planning to implement protocols more restrictive than the minimum HHS Safeguards. Three plan to include additional viral load requirements, one to exclude HCV co-infected donors, and one to exclude living donors.

Opinions on HIV+ Living Donation

Among respondents, 83.2% believed HIV+ living donors should be allowed to donate to an HIV+ recipient given a certain set of criteria. Most respondents agreed with existing HHS criteria on HIV living donation, including excluding donors with opportunistic infections, requiring a CD4+ T-cell count over 500 cells/ μ L and an undetectable HIV viral load (Table 5).

DISCUSSION

In a national survey, 50 transplant centers reported plans to perform HIV D+/R+ transplants. Although many programs plan to implement HIV D+/R+ protocols, most reported planning to perform kidney (98.0%) and liver (68.0%), while few centers reported planning pancreas, heart and liver transplants. This raises concerns that OPOs may not invest resources in evaluating HIV+ potential donors who would likely only be able to donate three organs. In addition, there was regional clustering of centers planning protocols. While ≥ 1 center in every UNOS region reported planning HIV D+/R+ protocols, fewer centers in the west coast or middle of the U.S. were planning protocols, compared to the eastern US. Patients in those areas may have lower access to HIV D+/R+ transplants, and OPOs in those regions may be less likely to evaluate potential HIV+ donors if local transplant programs will not use the organs.

Many centers (56.2%) reported no plans to perform HIV D+/R+ transplants. Unsurprisingly, centers not planning HIV D+/R+ protocols had lower median transplant volume, lower median volume of HIV+ transplant recipients, lower proportion of transplants using IRD organs, and lower HIV prevalence in their surrounding county ($p<0.01$). Centers not planning HIV D+/R+ protocols were more likely to believe their HIV+ candidates would be unwilling to accept HIV+ donor organs compared to centers planning protocols ($p<0.001$). On the contrary, recent studies indicate high willingness to accept HIV+ organs among people with HIV^{25,26}. Broader dissemination of these findings combined with advocacy from the HIV+ community could address this potential barrier to implementation.

Overall, centers planning HIV D+/R+ protocols were informed about the HOPE Act and HIV D-/R+ transplants, indicating that these centers are aware of the restrictions of HOPE protocols and the challenges of HIV+ transplantation. Furthermore, respondents reported agreement with most of the HHS safeguards and research criteria required to carry out HOPE transplants.

Despite broad knowledge and support of the HOPE act safeguards and criteria, there was ambivalence or disagreement surrounding the criterion limiting HIV D+/R+ transplants to centers where the transplant and HIV physician collectively have experience with at least 5 HIV D-/R+ transplants with the designated organs within the past four years. Likewise, among centers planning HIV D+/R+ transplants, many were unaware that center number of HIV D-/R+ transplants has not been associated with recipient outcomes¹⁸. Transplant community stakeholders voiced equipoise regarding this criterion prior to the publication of the Safeguards and Research Criteria; our survey further reflects this controversy. Disagreement over this requirement may partially explain why most planned HIV D+/R+ protocols are limited to kidney and liver.

The inclusion of HIV+ living donors in the HHS Safeguards and Research Criteria was also controversial, given concerns about potentially increased risk of end-stage renal disease after nephrectomy for HIV+ living donors^{22,27}. However, our study found that most centers (83.2%) support HIV D+/R+ living donation. This perception is supported by a recent study demonstrating that HIV+ individuals with well-controlled HIV have a similar risk of ESRD as their HIV-uninfected counterparts²⁸. Furthermore, recent studies have found that people living with HIV are willing to be living organ donors^{26,29}.

This study has several limitations. We were limited by a response rate of 55%; however, this is a higher response rate than typically seen from transplant center surveys, and there was representation from all UNOS regions. Furthermore, respondents were asked to respond as a representative of their center's opinions, however it is possible they did not accurately reflect their center's positions or intended practice. The convenience sample and distribution method, where recipients were asked to forward the survey to the best representative of their center's HIV+ transplant practice, may have caused response inaccuracies. However, we felt transplant centers were best able to identify the individual at their center most knowledgeable about HIV+ transplantation and thus selection based on these criteria was encouraged.

Overall, we found broad support for HIV D+/R+ transplantation among US transplant centers, and centers planning HOPE protocols appear to be well-informed regarding HIV D+/R+ and HIV D-/R+ transplants. However, transplant center barriers to implementation of the HOPE Act exist, such as regional clustering of participating centers, a focus on kidney and liver transplantation, the perception that center experience with HIV D-/R+ transplants is associated with superior outcomes, and perceptions that HIV+ transplant candidates would not accept HIV+ donor organs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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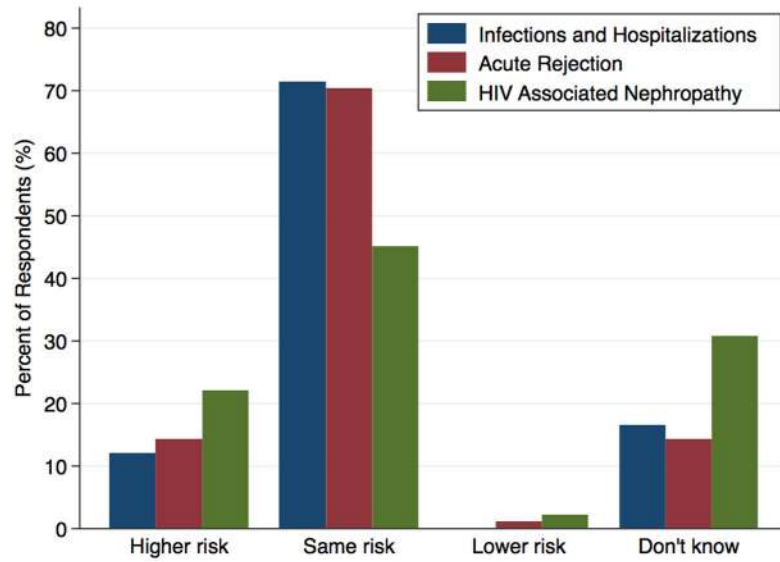


Figure 1: Perceived risk of HIV positive-to-positive transplants compared to HIV negative-to-positive.

Respondents were asked to predict the risk of HIV D+/R+ transplants compared to HIV D-/R+ transplants in terms of three outcomes: infections and hospitalizations; acute rejection; and HIV associated nephropathy.

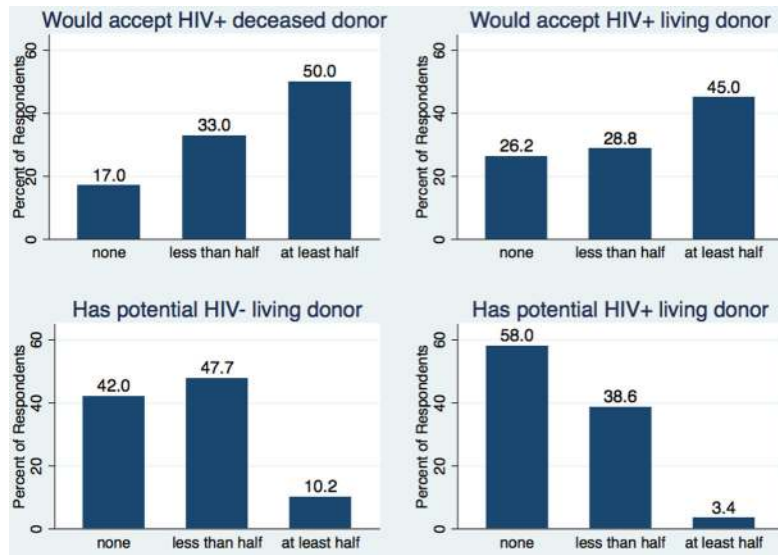


Figure 2: Respondent Perceptions of HIV+ Patients on Organ Waitlists
 Respondents were asked to predict what proportion of the HIV+ patients on waitlists at their center would accept an HIV+ deceased or living donors, and what proportion have access to living donation.

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Table 1:

HOPE Safeguards and Research Criteria, as published by the Secretary of the Department of Health and Human Services (HHS) as a Final Rule in November 2015

Category	Criteria
Donor Eligibility	
<i>All HIV-positive deceased donors</i>	No evidence of invasive opportunistic complications of HIV infection. Pre-implant donor organ biopsy. Viral load: no requirement. CD4 count: no requirement.
<i>Deceased donor with known history of HIV infection and prior antiretroviral therapy (ART)</i>	The study team must describe the anticipated post-transplant antiretroviral regimen(s) to be prescribed for the recipient and justify its conclusion that the regimen will be safe, tolerable, and effective.
<i>HIV-positive living donor</i>	Well-controlled HIV infection defined as: <ul style="list-style-type: none"> • CD4+ T-cell count $\geq 500/\mu\text{L}$ for the 6-month period before donation • HIV-1 RNA < 50 copies/mL • No evidence of invasive opportunistic complications of HIV infection Pre-implant donor organ biopsy
Recipient Eligibility	CD4+ T-cell count $\geq 200/\mu\text{L}$ (kidney) CD4+ T-cell count $\geq 100 \mu\text{L}$ (liver) within 16 weeks prior to transplant and no history of opportunistic infection (OI); or $\geq 200 \mu\text{L}$ if history of OI is present. HIV-1 RNA < 50 copies/mL and on a stable antiretroviral regimen.* No evidence of active opportunistic complications of HIV infection No history of primary central nervous system (CNS) lymphoma or progressive multifocal leukoencephalopathy (PML).
Transplant Hospital Criteria	Transplant hospital with established program for care of HIV-positive subjects HIV program expertise on the transplant team. Experience with HIV-negative to HIV-positive organ transplantation. Standard operating procedures (SOPs) and training for the organ procurement, implanting/operative, and postoperative care teams for handling HIV-infected subjects, organs, and tissues. Institutional review board (IRB)-approved research protocol in HIV-positive to HIV-positive transplantation. Institutional biohazard plan outlining measures to prevent and manage inadvertent exposure to and/or transmission of HIV Provide each living HIV-positive donor and HIV-positive recipient with an “independent advocate”. Policies and SOPs governing the necessary knowledge, experience, skills, and training for independent advocates.
OPOPO Responsibilities	SOPs and staff training procedures for working with deceased HIV-positive donors and their families in pertinent history taking; medical chart abstraction; the consent process; and handling blood, tissues, organs, and biospecimens. Biohazard plan to prevent and manage HIV exposure and/or transmission
Prevention of Inadvertent Transmission of HIV	Each participating Transplant Program and OPO shall develop an institutional biohazard plan for handling organs from HIV-positive donors that is designed to prevent and/or manage inadvertent transmission or exposure to HIV. Procedures must be in place to ensure that human cells, tissues, and cellular and tissue-based products (HCT/PS) are not recovered from HIV-positive donors for implantation, transplantation, infusion, or transfer into a human recipient; however, HCT/PS from a donor determined to be ineligible may be made available for nonclinical purposes.

Category	Criteria
Required Outcome Measures	
<i>Waitlist Candidates</i>	HIV status
	CD4+ T-cell counts
	Co-infection (hepatitis C virus [HCV], hepatitis B virus [HBV])
	HIV viral load
	ART resistance
	Removal from waitlist (death or other reason)
	Time on waitlist
<i>Donors (all)</i>	Type (Living or deceased)
	HIV status (HIV-infected [HIV-positive] new diagnosis, HIV-positive known diagnosis)
	CD4+ T-cell count
	Co-infection (HCV, HBV)
	HIV viral load
<i>Living Donors</i>	ART resistance
	Progression to renal insufficiency in kidney donors
	Progression to hepatic insufficiency in liver donors
	Change in ART regimen as a result of organ dysfunction
	Progression to acquired immunodeficiency syndrome (AIDS)
	Failure to suppress viral replication (persistent HIV viremia)
<i>Transplant Recipients</i>	Death
	Rejection rate (annual up to 5 years)
	Progression to AIDS
	New OI
	Failure to suppress viral replication (persistent HIV viremia)
	HIV-associated organ failure
	Malignancy
	Graft failure
Mismatched ART resistance versus donor	
Death	

* Patients who are unable to tolerate ART due to organ failure or who have recently started ART may have an HIV > 50 copies/mL and still be eligible if the study team anticipates an effective antiretroviral regimen for the patient after transplantation.

Table 2:**Study Population**

Characteristics of respondents and their centers. Center characteristics were found using SRTR and AIDSvu data.

Respondent Characteristics	N=104 (%)
Surgeon	51 (49%)
<i>Transplant Surgeon</i>	<i>50* (48%)</i>
<i>Vascular Surgeon</i>	<i>1 (1%)</i>
Physician	34 (32%)
<i>Infectious Disease</i>	<i>16 (15%)</i>
<i>Hepatology</i>	<i>8 (8%)</i>
<i>Nephrology</i>	<i>7* (6%)</i>
<i>Cardiology</i>	<i>1 (1%)</i>
<i>Transplant physician (not specified)</i>	<i>2 (2%)</i>
Nurse or Coordinator	9 (9%)
Pharmacist	8 (8%)
Administrator	3 (3%)
Transplant Center Characteristics	Median (IQR)
Annual Transplant Volume (all organs)	93 (33-189)
Volume of HIV+ recipients (all organs)	0 (0-1)
Proportion IRD Organs (all organs)	14% (11%-17%)
County HIV Prevalence (per 100,000)	418.5 (238-641)

* One respondent reported being both a transplant surgeon and nephrologist

Table 3:
Center level characteristics among centers planning and not planning HIV positive-to-positive transplants (Median (IQR))

The mean annual transplant volume, mean annual number of HIV+ recipients, and proportion of organs from each center that were IRD at each center from 1/1/2010-12/31/2015 was calculated. The median (IQR) of these means and proportions is presented.

	Planning N=50 55.6%	Not Planning N=40 44.4%	p-value
Annual transplant volume	159 (79-303)	54 (30-123)	<0.001
Volume of HIV+ recipients	1 (0-2)	0 (0-0)	<0.001
Proportion IRD organs	15% (13%-19%)	12% (9%-16%)	0.003
County HIV prevalence (per 100,000)	541 (281-1092)	321 (155-470)	0.003
Reported number of HIV+ patients on the waitlist	8 (3-14)	0 (0-3)	<0.001

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Table 4:
Knowledge of HIV D+/R+ transplants and HIV D-/R+ transplants among centers planning HIV D+/R+ transplants

Overall knowledge scores: Respondents were asked 5 questions regarding about research or reports regarding HIV D+/R+ transplants and the HOPE Act, and 6 questions regarding HIV D-/R+ transplants. Overall knowledge scores are the percent of questions on each of these topics that were answered correctly. The median (IQR) knowledge scores are reported.

Knowledge of HIV D+/R+ transplants, the HOPE Act, and outcomes of HIV D-/R+ transplants: The percent of respondents who answered each question correctly is reported.

Overall knowledge scores	
Overall knowledge score: HIV D+/R+ transplants (median (IQR))	83.3% (50.0%-100%)
Overall Knowledge score: HIV D-/R+ transplants (median (IQR))	83.3% (66.6%-83.3%)
Knowledge of HIV D+/R+ transplants	
Number of HIV D+/R+ transplants reported worldwide	54.0%
Estimated annual size of HIV+ deceased organ donor pool	58.0%
Knowledge of HOPE Act	
Aware that HIV D+/R+ transplants are legal in the US	92.0%
Aware that HIV D+/R+ transplants are restricted to research in the US	90.0%
Have read the HOPE Safeguards and Research Criteria	64.0%
Knowledge of outcomes of HIV D-/R+ transplants	
No difference in outcomes based on center experience	36.9%
No difference in outcomes based on participation in NIH funded multi-site trial of HIV D-/R+ transplants	86.9%
Transplant era associated with HIV D-/R+ transplant outcomes	82.6%
HIV D-/R+ transplants at increased risk of acute rejection compared to HIV D-/R- transplants	84.8%
Graft survival among HIV D-/R+ transplant recipients comparable to HIV D-/R- transplants	78.3%
Patient survival among HIV D-/R+ transplant recipients comparable to HIV D-/R- transplants	89.1%

Table 5:
Attitudes on HIV+ Deceased and Living Donor Eligibility

Respondents degree of agreement with the HOPE Safeguards and Research Criteria.

Transplant Center and Study Team Experience Criteria	Agree	Agree: but should not be organ specific	Neutral	Disagree: should be no experience criteria
Transplant physician and HIV physician collectively have experience with at least 5 HIV D-/R+ transplants with the designated organs over the last four years	35.1	40.4	11.7	12.8
HIV+ Deceased Donor Criteria	Agree	Neutral	Disagree too lenient	Disagree too strict
No evidence of invasive opportunistic infections	92.7	5.2	0	2.1
Pre-implant donor organ biopsy	71.9	22.9	0	5.2
Viral load: any viral load is allowed given effective post-transplant antiretroviral regimen is justified	55.2	20.8	22.9	1.0
HIV+ Living Donor Criteria	Agree	Neutral	Disagree too lenient	Disagree too strict
CD4+ T-cell count >500/ μ L for the 6-month period before donation	84.8	7.6	2.5	5.1
HIV-1 RNA <50 copies/mL	89.9	7.6	2.5	0
No evidence of invasive opportunistic complications of HIV infection	97.5	2.5	0	0
Pre-implant donor organ biopsy	56.9	26.6	0	16.5

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