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Variation in Structure and Delivery of Care between Kidney Transplant Centers in the United States

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Abstract

Although the United States possesses one of the most comprehensive transplant registries in the world, nationally representative data on how transplant care is structured and delivered is lacking. Therefore, we surveyed all 208 adult kidney transplant centers in the United States, excluding 37 pediatric and 58 inactive adult centers. Respondents were asked about the characteristics of their kidney transplant programs (25 items), the structure and process of care (18 items), coordination of care (10 items) and the characteristics of transplant physicians and surgeons (9 items).

The survey was completed by directors of 156 transplant centers (75% response). The results demonstrated significant variation between centers in several domains. Sixty-five percent of transplant centers do not have a dedicated transplant pharmacist in outpatient care. Two-thirds of transplant centers do not see the kidney transplant recipients at least monthly during the first year. Less than 30% of centers perform either joint sit-down or walking rounds between nephrology and transplant surgery.

There was significant variation in the structure and process of care in kidney transplantation. This implies variation in the use of resources at the transplant centers. This variation should be studied to determine best practices associated with optimal kidney allograft and patient survival.

Keywords

Transplant; Kidney; Structure of Care; Pharmacist; Providers

Introduction

The United States possesses one of the most comprehensive kidney transplant registries in the world [i.e., Scientific Registry of Transplant Recipients (SRTR) and United States Renal Data System (USRDS)]. Despite the availability of such a rich data source, nationally representative data on how transplant care is structured and delivered is lacking. There are 208 adult kidney transplant centers in the United States that performed 79,756 transplants from 2007–2011 (www.srtr.org). As more clinical trials and observational data become available, the care of KTRs has become increasingly complex and expensive. The Kidney Disease: Improving Global Outcomes (KDIGO) has proposed guidelines to assist practitioners who care for KTRs. (1) These guidelines are comprehensive and based on the best available evidence.

The KDIGO guidelines are less specific, however, on how this care should be delivered at specific transplant centers, and previous efforts to characterize the practice patterns in the transplant centers were not found in the literature. The variation between transplant centers in approaches to donor and recipient evaluations, in-patient health care delivery, treatment team composition, coordination of care, relationship and communication between medicine and surgery teams, and frequency of follow up are all unknown. Furthermore, these variations in practice affect the cost of care and resources consumed by transplant programs. Through a survey distributed to the surgical and medical directors of all active transplant centers in the United States, we collected comparative data regarding these variations in the structure and delivery of care to KTRs.

Results

The survey was completed by the surgical and/or medical director of 156 transplant centers (75% response rate). The characteristics of transplant centers and the providers completing the survey are shown in Tables 1 and 2, respectively. The survey results were divided into the following domains: structure and process of care, frequency of follow-up visits, and coordination of care.

Structure and Process of Care

In this domain, we assessed the availability of ancillary providers. Availability of a dedicated transplant pharmacist varied greatly between programs surveyed. Nearly as many programs had a dedicated transplant pharmacist available in both inpatient and outpatient settings as had no dedicated pharmacist available at all. (Figure 1) In a majority of centers, nephrology fellows and general surgery residents provided medical care to KTRs. Internal medicine residents were involved in 48.1% of centers. (Table 3) The composition of the outpatient care team differed from the inpatient team as the presence of general surgery residents markedly decreased from 71.8% in the inpatient setting to 25.0% in the outpatient setting. In contrast, nephrology fellows were well-represented on both outpatient and inpatient care teams at 59.0% and 60.3%, respectively. Physician extenders [Certified Nurse Practitioner (CNPs) and Physician Assistants (PAs)] maintained a role in approximately two-thirds of all care teams in both inpatient and outpatient settings.

There was significant variation in both the use of various types of hospital units and primary attending physicians for inpatient care. KTRs were fairly evenly distributed between nursing units that housed other transplant patients, other kidney (but non-transplant) patients, as well as on units that housed patients who did not have kidney-related disorders. The primary attending physician for a recent kidney transplant recipient who required intensive care unit (ICU) care was most frequently a transplant surgeon (39.1%). Slightly less frequently, the ICU attending physician was a surgical or medicine-trained intensivist (31.4%) or a transplant nephrologist (19.9%). When the need arose, regular consultations for non-renal medical issues in recipients were performed in > 50% of transplant centers (typically by cardiologists and infectious disease specialists). (Table 3)

Frequency of follow-up visits

Variation in frequency of follow-up during the first and subsequent years was reported. (Table 3) During the first year post-transplant, patients were most frequently seen at least every 3 months but a near equal percentage were seen as frequently as every month. Follow-up after the first year continued to vary with nearly equal percentage of centers reporting follow-up visit frequency to be every 3, 6, or 12 months. While timing of referral of stable patients back to their primary nephrologists varied from 0–12 months among centers studied, patients were most frequently referred back between 4–6 months after transplant. Initial contact for after-hours questions or emergencies was primarily directed to nursing staff at the transplant centers (51.9%).

Coordination of Care

Both medical and surgical teams performed pre-transplant evaluations of donors and recipients in a majority of centers. (Table 4) During the admission for the transplant, transplant surgery was the primary admitting team in a majority of centers (67.9%), followed by joint surgery/nephrology transplant teams (18.6%), and quite infrequently (9.6%) nephrology teams. When readmission within the first 3 months was required, surgical teams were most frequently the admitting team (45.5%). After 3 months, transplant nephrology was the admitting team in most centers. The primary outpatient follow up team was most frequently transplant nephrology, both in the initial 3 months and after 3 months post-transplant. The overall working relationship between medical and surgical teams was characterized as either “very good” or “excellent” in total of 84% of centers. The prevalence of combined joint sit-down rounds with medical and surgical teams varied greatly between centers. (Figure 1)

Subgroup analysis

The following characteristics were more frequently observed in transplant centers affiliated with a medical school compared to centers not affiliated: transplants other solid organs in addition to kidneys [pancreas ($p=0.038$), liver ($p=0.01$), heart ($p=0.001$), and lung ($p=0.005$)], onsite Human Leukocyte Antigen (HLA) laboratory ($p<0.001$), patients are enrolled in a formal research protocol ($p=0.037$), center offers ABO-incompatible or cross-match positive transplants ($p=0.009$), more nephrologists and transplant surgeons have full-time academic appointments ($p<0.001$), more nephrologists and transplant surgeons are involved in clinical and basic research ($p=0.001$), more nephrologists are principal

investigators ($p=0.011$), availability of specialty consult physicians dedicated to transplant recipients ($p=0.011$), more often an intensivist was the primary MD in the ICU for transplant recipients ($p<0.001$), and the primary physician contact after hours was not the attending surgeon or nephrologist ($p=0.043$). (Supplemental Table 1)

The following factors were more likely to be associated with increased volume of transplants performed: program transplants other solid organs in addition to kidneys ($p=0.008$), patients enrolled in a formal research protocol ($p=0.006$), use of EMR ($p=0.008$), availability of dedicated transplant pharmacist ($p=0.024$), and presence of a transplant nephrology fellowship ($p<0.001$). (Supplemental Table 2)

The following factors were more likely to be associated with multi-organ transplant centers compared to kidney-alone transplant centers: presence of an HLA or tissue typing laboratory ($p=0.001$), formal research protocols ($p<0.001$), full-time research coordinators ($p=0.001$), offer ABO-incompatible or cross-match positive transplants ($p=0.019$), offer laparoscopic living donor nephrectomies ($p=0.002$), be affiliated with a medical school ($p=0.022$), more nephrology ($p<0.001$) and surgery ($p<0.001$) involvement in clinical and basic research, more FTE surgeons ($p=0.001$), and more surgeons as principal investigators in industry sponsored basic science or clinical research ($p<0.001$). (Supplemental Table 3)

The following factors were different across Organ Procurement and Transplantation Network (OPTN) regions: affiliation with a medical school ($p=0.003$), participation in the paired kidney exchange (PKE) ($p<0.001$), formal protocol for post-transplant BK screening ($p=0.005$), use of corticosteroids ($p=0.007$) and sirolimus ($p=0.017$) as first-line, maintenance immunosuppression regimen for low-risk patients, and use of tacrolimus for high risk patients ($p=0.014$). (Supplemental Table 4)

Centers with financial structure organized with all resources going through departmental structures compared to resources going to a group (transplant) practice under the same budget, were more likely to have: an onsite HLA or tissue typing laboratory ($p<0.001$), affiliation with a medical school ($p<0.001$), higher number of full-time equivalent (FTE) nephrologists ($p=0.002$), more nephrologists with full-time academic appointments ($p=0.001$) and the primary physician contact after hours was not the attending surgeon or nephrologist ($p=0.02$). (Supplemental Table 5)

Discussion

To our knowledge, this is the first study to collect nationally representative data on how transplant care is structured and delivered and similar data is not available for other countries. The major finding of this survey was the significant variation between different transplant centers in the domains of structure and processes of care, frequency of follow-up visits, and coordination of care. Two-thirds of kidney transplant centers do not use clinical pharmacists dedicated to the outpatient setting (Figure 1). Only two-thirds of kidney transplant centers have incorporated physician extenders in their treatment teams (Table 3). Two-thirds of kidney transplant centers do not see their KTRs at least monthly during the first year post-transplant (Table 3).

Despite published literature including several randomized control trials (2–4) to support the use of clinical pharmacists in the care of KTRs to minimize side effects, decrease cost, and improve adherence to immunosuppressive medications, many centers have not incorporated this vital component to their treatment team. A recent prospective, observational study demonstrated significant decreases in errors upon discharge following transplantation when the medication regimen was reviewed by a transplant pharmacist.(5) Our survey found that 35% of programs used pharmacists in both inpatient and outpatient areas and 24% used them only for the inpatient setting. Sixty five percent of programs do not use pharmacists in the outpatient setting, where the utility has been demonstrated and where the patients are at highest risk to demonstrate non-adherence.

Numerous studies have correlated non-adherence to prescribed treatment plans with early and late allograft rejection and graft loss.(6–10) In attempts to prevent this rejection and graft loss, the KDIGO guidelines recommended providing all KTRs and family members with education about the importance of medical adherence, implement preventive measures to minimize non-adherence, and increase screening for non-adherence.(11) Furthermore, KDIGO has recommended a “team approach” based on literature that has shown positive outcomes associated with the use of multidisciplinary teams that combine educational, behavioral, and social support systems.(12, 13) Risk factors for non-adherence such as lack of adequate follow-up with transplant specialists, multiple adverse effects from medications, and complex drug regimens have been previously identified. (14, 15)

It has also been shown by Weng et al that non-adherence varies between transplant centers. (16) The present study shows that there is an opportunity to increase the utilization of physician extenders to assist in improving outcomes. It is reasonable to speculate that physician extenders may fulfill the role of educating and monitoring patients in the setting where physicians may be overextended or unavailable.

In attempts to improve patient and medical provider satisfaction, outcomes, and overall care, a multidisciplinary approach has been tried in many areas of medicine including heart failure, chronic kidney disease, and others.(17–22) These studies have shown positive outcomes in mortality, metabolic and blood pressure control, readmission rates, and medication optimization.(18–20, 22) Such issues have not been adequately studied in kidney transplant patients. Our study is the first to describe the variable use of pharmacists, PAs, and CNPs, as members of multidisciplinary teams in this setting. To the best of our knowledge, only one previous study in 2004 addressed use of multidisciplinary teams in kidney transplant centers and focused on the integration of clinical pharmacists.(23) With data from 36 centers, this study found that 73% of kidney transplant centers had pharmacists. Of these centers, pharmacists reported dedicating 43% of their time to inpatient care and only 15% to outpatient care. This finding is consistent with our data that suggests underutilization of clinical pharmacists in the outpatient care of KTRs.

Considering the prior or underlying disease and comorbidities of the patient, the complexity and hazards of ongoing immunosuppression, the risk of acute rejection, and the need for optimized general health care, adequate follow up of KTRs is essential. The 2000 AST recommendations for outpatient surveillance of KTRs recommend routine post-transplant

visits 2–3 times per week during the first 30 days, every 1–3 weeks in months 1–3, expanded to every 4–8 weeks during months 4–12, and ultimately every 2–4 months thereafter. These visits may be for laboratory tests only or may include contact with transplant nurse coordinators and/or physicians.(24) The 2009 KDIGO guidelines do not make specific recommendations on the frequency and timing of outpatient visits.(25) Previous work has demonstrated significant variation in the frequency of outpatient visits between patients, centers, and regions of the country.(26) Lower kidney transplant survival is associated with a lower frequency of nephrology visits.(27) The survey data shows that two-thirds of kidney transplant centers do not see their KTRs at least monthly during the first year post-transplant.

It is reassuring that the working relationship between transplant surgery and nephrology teams is “very good” or “excellent” in total of 84% of centers (Table 4). At a time when the recently transplanted kidney patient is at high risk for both medical and surgical complications, they are unfortunately shifting from surgical to medical services. For example, transplant surgery is the admitting service for 67.9% of KTRs at the time of transplantation and for 45.5% of KTRs during the first three months post-transplant (Table 4). However at 3 months post-transplant, the admitting service becomes most frequently transplant nephrology (57.7%) (Table 4). A similar shift from transplant surgery to nephrology is also seen in the outpatient setting. This poses a unique challenge for patient care, and it is clear that collaboration and communication is vital. An area to increase communication could be greater utilization of joint sit-down or walking rounds between the services. However, we found that only 29.5% of centers regularly conducted sit-down rounds and 25.0% of centers regularly did joint walking rounds. (Figure 1) The survey did not measure the proximity of surgery and nephrology offices and clinics. It is possible that close physical proximity may reduce the need for formal interactions. Sub-group analysis of the survey responses demonstrated several predictable trends. Programs affiliated with a medical school were more often involved in research, had more academic affiliations, and transplanted a greater variety of organs. Overall, minimal variation in delivery of care was observed across OPTN regions. Centers that distribute resources through department structures had more academic nephrologists. Not surprisingly, multi-organ transplant centers demonstrated more involvement in research. As predicted, high volume centers more often also transplanted organs other than kidneys, had available transplant pharmacists and supported a transplant nephrology fellowship.

Our study has several limitations. At this time, it is not known if the centers that utilized pharmacists and mid-level providers such as physician extenders had better post-transplant outcomes or whether satisfactory professional relationships between nephrologist and surgeons actually were associated with better post-transplant outcomes. Our data does however show that the previously described differences in both treatment adherence and long-term outcomes (16) may in part be related to significant differences in the structure and coordination of care. Randomized control trials would be necessary to determine if a specific intervention, such as joint rounding between surgeons and nephrologists or increased utilization of mid-level providers, does indeed improve outcomes for KTRs. However it is likely that the volume of transplants and number of patients per nephrologist and surgeon may make some of the interventions logistically difficult or unnecessary to use.

With regards to the frequency of outpatient visits, our survey only covered visits to the transplant center and did not quantify frequency of visits to the referring nephrologist or primary care physicians. However, as previous work has shown, follow up of recently transplanted patients by primary care physicians was quite infrequent (26), thus we can assume these primary care visits represent a minority of total outpatient visits. An additional limitation is that not all centers who responded provided completed surveys from both the medical and surgical directors. Since not all transplant physicians and surgeons were surveyed at each center, the responses reflect the opinions of only the transplant clinicians who actually filled out the survey. The nature of a particular transplant program, academic versus private, and overall budget may affect the ability of that center to support ancillary staff, including transplant-specific pharmacists. This survey did not collect data on the annual budgets of the respective programs.

In conclusion, this study determined that significant variation occurs in the structure of care, frequency of follow up, and coordination of care between kidney transplant centers. These variations may partially explain the disparate long-term allograft outcomes that have been observed among transplant centers and between some types of KTRs (28–30). Additional research, in the form of prospective observational cohort studies and randomized control trials of interventions to increase the integration of mid-level providers or improve coordination of care between nephrologists and surgeons, are needed to determine if changes in these areas will lead to improvements in long-term allograft and patient outcomes.

Methods

Study Design and Population

This observational cross-sectional study sought to acquire information from all active, adult, OPTN-affiliated kidney transplant programs in the United States. In total, 208 kidney transplant centers fulfilled the criteria for study inclusion at the time of first mailing (March 1, 2007). A partial contact list of medical and surgical directors of U.S. kidney transplant programs was acquired from the United Network of Organ Sharing (UNOS). This list was updated using information from the internet and directly contacting eligible kidney transplant programs by telephone.

Survey Development and Content

The survey was developed by S.J.K. and N.R.P., in consultation with a transplant physician (HR) and transplant surgeon (LER) at the Johns Hopkins Hospital and Columbia University Medical Center, respectively. A number of the questionnaire items were adapted from a survey instrument that was developed by Loberiza et al.(31) Our questionnaire had four sections (see Appendix for the full questionnaire).

Survey Administration

A letter describing the study was sent one week in advance of the first survey mailing to the medical and surgical directors of all eligible U.S. adult kidney transplant programs. Respondents were given the option of completing the self-administered questionnaire via paper or on-line formats. The total time from the first survey mailing to the end of the study

period which included several reminders and subsequent re-sending of surveys, was 24 weeks.

Analytical Methods

Frequency of responses was analyzed by t-test for continuous variables and by chi-square test (and fisher's exact test if there are cells with less than five responses) for categorical variables. All analyses were conducted in SAS 9.4 (SAS Institute, North Carolina) and STATA 12 (Statacorp, College Station, Texas). Responses from medical directors were used first and supplemented with surgical director responses if the medical director had not responded.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Abbreviations

CNP	Certified Nurse Practitioner
HLA	Human Leukocyte Antigen
ICU	Intensive Care Unit
KDIGO	Kidney Disease: Improving Global Outcomes
KTR	Kidney Transplant Recipient
OPTN	Organ Procurement and Transplantation Network
PKE	Paired Kidney Exchange
PA	Physician Assistant
SRTR	Scientific Registry of Transplant Recipients
UNOS	United Network of Organ Sharing
USRDS	United States Renal Data System
ASHI	American Society of Histocompatibility and Immunogenetics

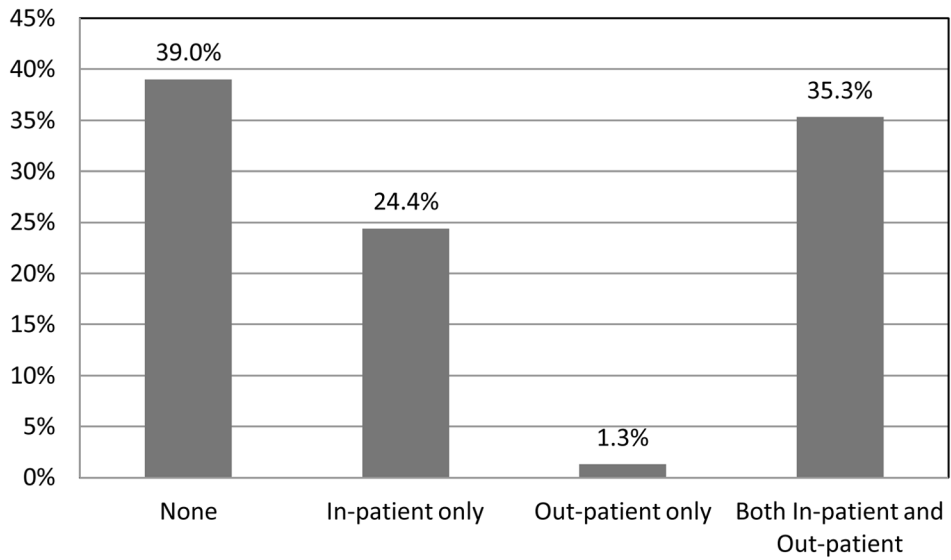
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Panel A: Percentage of Programs that Employ a Dedicated Transplant Pharmacist in In-patient and Out-patient Settings, $p < 0.001$



Panel B: Percentage of Programs that Perform Joint Medical and Surgical Sit-Down Rounds, $p = 0.001$

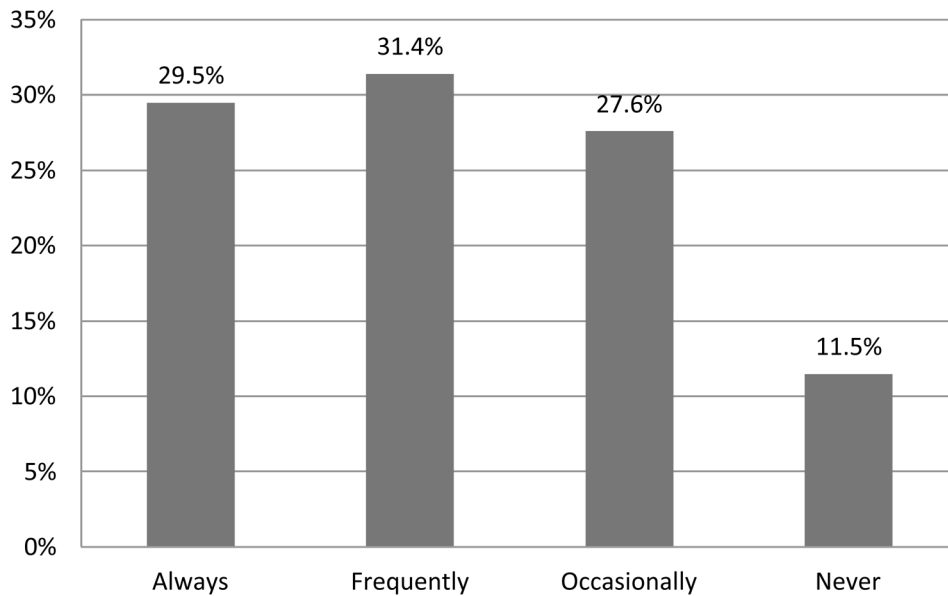


Figure 1.
Differences in use of pharmacist and use of joint medical and surgical rounds

Table 1

Characteristics of Transplant Centers

	Percentage	p-value
Kidney Transplant Program Characteristics From Survey (n=156 centers)		
Organs transplanted:		p<0.001
Kidney	100.00	
Pancreas	66.0	
Liver	44.9	
Heart	35.3	
Lung	23.1	
Other	5.1	
On-site/on-campus HLA or tissue typing laboratory:		p<0.001
Yes	30.1	
No	69.9	
I don't know	0.0	
Tissue typing laboratory accredited by ASHI:		p<0.001
Yes	94.9	
No	0.6	
I don't know	3.8	
Percentage of recipients enrolled in a clinical trial:		p<0.001
None	23.1	
1–10%	27.6	
11–25%	26.3	
26–50%	14.7	
>50%	8.3	
Number of FTE clinical research coordinators:		p<0.001
None	35.9	
0.5 FTE	10.3	
1.0 FTE	16.0	
1.5 FTE	10.9	
2.0 FTE	26.3	
ABO-incompatible or crossmatch positive transplants:		p<0.001
ABO-incompatible	3.2	
Crossmatch positive	21.8	
Both	20.5	
Neither	54.5	
Participate in PKE and LPE:		p<0.001
PKE	29.5	
LPE	1.9	
Both PKE and LPE	25.6	
Neither	41.0	
Laparoscopic living donor nephrectomy:		p<0.001

	Percentage	p-value
Yes	93.6	
No	5.8	
Proportion of laparoscopic nephrectomies:		p<0.001
None	4.5	
1–10%	5.1	
11–25%	3.2	
26–50%	5.1	
Greater than 50%	77.6	
Use of electronic medical records:		p<0.001
Laboratory data	79.5	
Diagnostic imaging data	71.8	
Medical history data	67.9	
Physician order entry	42.9	
Consultation notes	59.0	
Evaluate own program's outcomes regularly:		p<0.001
Yes	91.0	
No	8.3	
Affiliated with a medical school		p<0.001
Yes	77.6	
No	22.4	
Induction therapy used		p<0.001
Used in essentially all patients	80.1	
Used on in "high risk" patients	17.9	
Used hardly ever	1.3	
First line maintenance for low risk KTRs		p<0.001
Cyclosporine	17.3	
Tacrolimus	91.7	
Mycophenolate mofetil	95.5	
Azathioprine	1.3	
Sirolimus	8.3	
Corticosteroids	62.8	
Others	3.8	
First line maintenance for high risk transplant recipients		p<0.001
Cyclosporine	7.7	
Tacrolimus	96.8	
Mycophenolate mofetil	95.5	
Azathioprine	0.0	
Sirolimus	12.8	
Corticosteroids	81.4	
Others	1.9	
Formal protocol for post-transplant procedures		
Cardiovascular disease	53.8	(p=0.337)

	Percentage	p-value
CMV infection and disease	84.6	(p<0.001)
EBV infection and disease	45.5	(p=0.296)
Influenza	46.8	(p=0.519)
Polyoma virus nephropathy	62.2	(p=0.002)
Skin cancer	46.2	(p=0.337)
Other malignancies	41.0	(p=0.025)
Steroid-induced osteoporosis	57.7	(p=0.055)

Abbreviations: HLA=human leukocyte antigens; FTE=Full-time equivalent, PKE= paired kidney exchange; LPE= List paired exchange; ASHI= American Society of Histocompatibility and Immunogenetics; KTR= kidney transplant recipients

Table 2

Characteristics of Physicians Completing Survey

	Percentage	p-value
Transplant Nephrologists Completing Survey (n=118)		
Years worked at center:		p<0.001
< 1 year	0.8	
1–3 years	9.3	
3–5 years	5.9	
5–10 years	21.2	
> 10 years	62.7	
Mean Number of FTE Nephrologists (\pm SD):	4.0 \pm 3.7	
Proportion of nephrologists with full time academic appointments		p<0.001
None	30.5	
1–25%	3.4	
26–50%	1.7	
51–75%	3.4	
76–100%	60.2	
Type of research by nephrologists		p<0.001
None	11.9	
Clinical	56.8	
Basic	0.0	
Both clinical and basic	31.4	
Proportion of nephrologists who are principal investigators for federally funded research		p<0.001
None	52.5	
1–25%	24.6	
26–50%	11.9	
51–75%	8.5	
76–100%	1.7	
Proportion of nephrologists who are principal investigators for industry sponsored research		p=0.004
None	24.6	
1–25%	30.5	
26–50%	18.6	
51–75%	13.6	
76–100%	11.0	
Proportion of nephrologists who are board certified		p<0.001
None	0.0	
1–25%	0.0	
26–50%	0.0	
51–75%	4.2	
76–100%	94.9	
Transplant Surgeons Completing Survey (n=106)		
Years worked at center:		p<0.001

	Percentage	p-value
< 1 year	4.7	
1–3 years	11.3	
3–5 years	6.6	
5–10 years	29.2	
> 10 years	48.1	
Mean Number of FTE Surgeons:	3.8 ± 6.6	
Proportion of surgeons with full time academic appointments		p<0.001
None	25.5	
1–25%	2.8	
26–50%	2.8	
51–75%	3.8	
76–100%	65.1	
Type of research by surgeons		p<0.001
None	11.3	
Clinical	50.9	
Basic	0.9	
Both clinical and basic	36.8	
Proportion of surgeons who are principal investigators for federally funded research		p<0.001
None	57.5	
1–25%	17.9	
26–50%	14.2	
51–75%	8.5	
76–100%	1.9	
Proportion of surgeons who are principal investigators for industry sponsored research		p=0.108
None	29.2	
1–25%	17.9	
26–50%	21.7	
51–75%	13.2	
76–100%	17.9	
Proportion of surgeons who are board certified		p<0.001
None	1.9	
1–25%	0.0	
26–50%	1.9	
51–75%	5.7	
76–100%	90.6	

Abbreviations: FTE=Full-time equivalent

Table 3

Structure and Process of Care and Frequency of Outpatient Follow-up Visits

	Percentage	p-value
Recipients stay as inpatients in:		p<0.001
Unit dedicated to transplants	24.4	
Unit only with patients with kidney-related disorders	31.4	
Unit other patients with non-kidney-related disorders	35.9	
Various units	5.1	
Other	3.2	
Dedicated physicians who regularly consult:		p<0.001
None	23.7	
Cardiologist	52.6	
Infectious diseases	62.2	
Psychiatry	34.0	
Endocrinology	31.4	
Other	15.4	
Health care professionals on in-patient transplant service:		p<0.001
Transplant surgery fellows	29.5	
Nephrology fellows	60.3	
General surgery residents	71.8	
Urology residents	24.4	
Internal medicine residents	48.1	
Physician assistants	28.2	
Nurse practitioners	35.9	
Other	22.4	
Health care professionals on out-patient transplant service:		p<0.001
Transplant surgery fellows	19.9	
Nephrology fellows	59.0	
General surgery residents	25.0	
Urology residents	7.7	
Internal medicine residents	10.9	
Physician assistants	21.8	
Nurse practitioners	40.4	
Other	37.8	
Primary attending physician in ICU:		p<0.001
Transplant surgeon	39.1	
Transplant nephrologist	19.9	
Intensivist	31.4	
Other	9.6	
Transplant fellowship offered:		p<0.001
Yes	69.2	
No	30.8	

	Percentage	p-value
Number of personnel available:		
Mean number of full-time equivalent transplant nephrologist available	4.0 ± 3.7	
Mean number of full-time equivalent transplant surgeons available	3.8 ± 6.6	
Time when referred back to general nephrologist post-transplant:		
Not referred back	13.5	p<0.001
0–3 months	21.8	
4–6 months	42.9	
7–12 months	12.8	
Other	9.0	
Frequency of follow-up during the first year post-transplant:		
Not seen unless problems arise	1.9	p<0.001
At least every 1 month	34.6	
At least every 3 months	40.4	
At least every 6 months	14.7	
Other	8.3	
Frequency of follow-up after the first year post-transplant:		
Not seen unless problems arise	3.2	p<0.001
At least every 3 months	28.2	
At least every 6 months	24.4	
At least every 12 months	35.9	
Other	8.3	
Initial contact after-hours:		
Nursing staff	51.9	p<0.001
Physician assistant or nurse practitioner	1.3	
Intern and/or resident	5.1	
Transplant fellow (medical or surgical)	10.9	
Attending transplant physician or surgeon	25.0	
Other	5.8	

Table 4

Coordination of Care

	Percentage	p-value
Reporting structure for clinical issues:		p<0.001
Transplant medicine/nephrology reports to transplant surgery	36.5	
Transplant surgery reports to transplant medicine/nephrology	12.2	
Other	48.7	
Financial structure of transplant center:		p<0.001
All resources go into the group practice under the same budget	25.0	
Transplant surgery reports to transplant medicine/nephrology	51.9	
Other	21.2	
Recipient evaluations done by:		p<0.001
Medical transplant team	11.5	
Surgical transplant team	15.4	
Both medical and surgical transplant teams	73.1	
Other	0.0	
Donor evaluations done by:		p<0.001
Medical transplant team	23.1	
Surgical transplant team	6.4	
Both medical and surgical transplant teams	67.3	
Other	3.2	
Admitting service for transplant surgery:		p<0.001
Transplant surgery	67.9	
Transplant nephrology	9.6	
Urology	2.6	
Joint transplant surgery/nephrology	18.6	
General surgery	0.0	
Other	1.3	
Admitting service 3 months post-transplant:		p<0.001
Transplant surgery	45.5	
Transplant nephrology	34.0	
Urology	2.6	
Joint transplant surgery/nephrology	14.7	
General surgery	0.0	
Other	3.2	
Admitting service >3 months post-transplant:		p<0.001
Transplant surgery	18.6	
Transplant nephrology	57.7	
Urology	2.6	
Joint transplant surgery/nephrology	15.4	
General surgery	0.0	
Other	5.8	

	Percentage	p-value
Out-patient team 3 months post-transplant:		p<0.001
Transplant surgery	23.1	
Transplant nephrology	40.4	
Urology	9.6	
Joint transplant surgery/nephrology	26.9	
General surgery	0.0	
Other	0.0	
Out-patient team >3 months post-transplant:		p<0.001
Transplant surgery	6.4	
Transplant nephrology	63.5	
Urology	6.4	
Joint transplant surgery/nephrology	22.4	
General surgery	0.0	
Other	1.3	
Medical and surgical regular joint walking rounds:		p=0.23
Always	25.0	
Frequently	19.9	
Occasionally	31.4	
Never	23.7	
Overall working relationship between medical and surgical teams:		p<0.001
Excellent	60.9	
Very good	23.1	
Good	13.5	
Fair	1.9	
Poor	0.6	