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The Effects of Donor and Recipient Practices on Transplant Center Finances

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Over the past several years we have noted a marked decrease in this profitability of our kidney transplant program. Our hypothesis is that this reduction in kidney transplant institutional profitability is related to aggressive donor and recipient practices. The study population included all adults with Medicare insurance who received a kidney transplant at our center between 1999 and 2005. Adopting the hospital perspective, multi-variate linear regression models to determine the independent effects of donor and recipient characteristics and era effects on total reimbursements and total hospital margin. We note statistically significant decreased medical center incremental margins in cases with ECDs (−$5887) and in cases of DGF (−4937). We also note an annual change in the medical center margin is independently associated with year and changes at a rate of −$5278 per year, related to both increasing costs and decreasing Medicare reimbursements. The financial loss associated with patient DGF and the use of ECD kidneys may resonate with other centers, and could hinder efforts to expand kidney transplantation within the United States. The Centers for Medicare and Medicaid Services (CMS) should consider risk-adjusted reimbursement for kidney transplantation.

Key words: Delayed graft function (DGF), economic analysis, expanded criteria donors, kidney transplantation

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Introduction

Kidney transplantation is a life-saving treatment for most patients receiving dialysis. Transplantation is associated with a 68% reduction in long-term mortality among patients who receive deceased donor renal transplants, compared to patients who stay on dialysis (1). Unfortunately, need for transplantation continues to outpace the supply of these vital organs, leading to an 11% annual growth in the number of registrants joining the renal transplant wait list (2). Fueled by this growing shortage of kidneys for transplantation, the Department of Health and Human Services has encouraged expanding the donor pool, in part by encouraging aggressive organ acceptance practices. Center-specific reports of organ acceptance practices are now available to the general public and 'nonaggressive' centers may be penalized (3). Among the most successful policies to expand the organ donor pool have been efforts to use kidneys from expanded criteria donors (ECDs). There has been an approximately 3-fold increase in the use of ECDs in the past 10 years and they now represent 17% of the donor organs (2,4,5).

Like many other kidney transplant programs, our program has historically been very profitable for our medical center. Over the past several years we have noted a marked decrease in this profitability. Our center has become more aggressive, transplanting sicker patients and using more 'marginal' deceased donor kidneys. For example, in 1999, 7% of our deceased donor kidney transplants were from ECDs, while in 2005, ECDs represented 21% of the donors utilized by our center. Similarly, our delayed graft function (DGF) rates among deceased transplant recipients have increased over this period. Presumably, the recipients of these kidneys will require more peri-operative care (6). Since hospitals are paid a single price, regardless of the risk or complexity of the kidney transplant, there may be a strong financial disincentive to use 'high risk' kidneys and transplant sicker patients, particularly as reimbursements for renal transplantation continues to decrease.

Our hypothesis is that the reduction in kidney transplant surgical care profitability is related to aggressive donor and recipient practices.

Materials and Methods

Following Institutional Review Board approval, we retrospectively reviewed the electronic records of all patients who received a kidney transplant at the University of Michigan Health System (UMHS) between 1999 and 2005. Our population was further restricted to those who had deceased donors and were 18 years or older. Review of the electronic medical records revealed data regarding recipient and donor characteristics: demographics, health status and previous medical conditions. Information was also collected on

graft and patient outcomes as well as all financial data from UMHS for 90 days following the kidney transplant.

Patients with DGF were defined as those who required dialysis within the first 7 days after a kidney transplant operation. ECD kidneys were defined as having a risk of graft failure ≥ 1.7 times that of ideal donors. ECDs include any donor ≥ 60 years old and donors 50–59 years old with at least two of the following: terminal creatinine >1.5 mg/dL, history of hypertension or death by cerebrovascular accident (7).

Financial Data was collected using the Transitions Systems Inc. (TSI) (Chicago, IL) to identify hospital costs and reimbursements. Reimbursements to the medical center were calculated based on modeled revenue for reimbursements (constantly updated average for a payer based on hospital charges). The TSI system tracks the use of all resources and assigns estimates of cost based on direct acquisition costs for supplies and time-and-motion studies for labor costs. This method of activity-based cost accounting is widely believed to be the most accurate method of estimating the true economic cost of an episode of care. Hospital Margins were calculated using the formula (hospital reimbursements−hospital total costs). To reiterate, this is not the margin for the operation but rather for all care provided in the 90 days following the transplant. Considering the complexity and variation involved in accounting for donor acquisition costs, we decided to limit all financial analysis to Medicare patients. In TSI, we adjust the Medicare organ acquisition add-on payment based on the final Medicare Cost Report. Specific cost buckets were broken down into: pharmacy costs, inpatient costs (respiratory therapy, rehabilitation, nursing, operating room, supplies and dialysis), outpatient costs (clinic visits, emergency room visits), and transplant center costs (organ acquisition and pretransplant patient care). Costs of care outside of UMHS were not obtained. Physician costs and reimbursements were not collected. All data was adjusted to 2004 U.S. dollars by using the Producer Price Index for the Direct Health and Medical Insurance Carriers (8).

Statistical analysis

Differences in financial data were assessed via unpaired *t*-test. The dependant variables (total reimbursements and total margin) were noted to be of normal distribution, so no transformations were done. Simple linear regression analysis was used to identify donor and recipient variables affecting total reimbursements and total margin. Era effects were estimated by using the year of transplant as a variable. Variables significant to a level of $p < 0.20$ were potential candidate variables for multi-variate linear regression models, assessing the independent effects of covariates on total reimbursements and total hospital margin. ECD and the individual components of ECD status were considered in the univariate analysis. If ECD was entered into the multi-variate model, covariates that are components of ECD status were excluded from the model. All analysis was completed using SPSS 14.0 (Chicago, IL).

Results

The baseline characteristics of the study population (411 consecutive adult deceased donor kidney transplants done between 1999 and 2005 on patient with Medicare) are detailed in Table 1. We note that 37 (11.7%) recipients received kidneys from ECD donors and 91 (22.1%) recipients had DGF.

Between 1999 and 2005, we note a trend toward decreasing reimbursements from Medicare for the first 90 days of care following a kidney transplant (Figure 1). Consequently, we note an impressive downward trend Medical Center reimbursements and margins over the study period. These trends are similar in both ECD and non-ECD kidney transplants.

Table 1: Donor and recipient characteristics among 411 consecutive renal transplant operations on patients with Medicare insurance

Patient characteristic	Mean ± STD or N (percent of sample)
Recipient age	48.6 ± 13.5
Recipient sex (male)	249 (60.6%)
Recipient race	316 non-Black (76.9%)
Recipient diabetes mellitus	108 (26.3%)
First transplant	335 (81.5%)
Recipient BMI (kg/m^2)	28.7 ± 7.9
Donor age	35.7 ± 13.4
Donor sex (male)	246 (59.9%)
Donor race	371 non-Black (90.3%)
Donor BMI (kg/m^2)	26.0 ± 5.8
Extended criteria donor	52 (12.6%)
Delayed graft function	91 (22.1%)

Reimbursements

Using simple linear regressions, we noted variables with a significant effect on total Medicare reimbursements (Table 2). We note an annual reduction in Medicare reimbursement of $1319 over the period of the study. These variables were used as candidate variables in a multivariable linear regression model to determine the incremental costs of significant donor and recipient characteristics. We note increased incremental reimbursements (or Medicare costs) of $13 163 in cases of DGF, $12 499 in male recipients (compared to female), and $6900 in cases when the donor cause of death was a stroke. ECDs were not associated with a statistically significant increase in reimbursements from Medicare to the medical center.

Margins

Using simple linear regressions, we report variables with a significant effect on total medical center margins (profits) (Table 3). These variables were used as candidate variables in a multivariable linear regression model to determine the incremental costs of significant donor and recipient characteristics. We note statistically significant decreased medical center incremental margins in cases with ECDs (−$5887) and in cases of DGF (−4937). We also note an annual change in the medical center margin is independently associated with year and changes at a rate of −$5278 per year.

Finances of ECD kidneys

Among the group of patients who received kidneys from ECDs, we note significantly higher mean fixed direct costs ($3827 difference) and mean total direct costs ($7225), and a lower mean total hospital margin (−$8877 difference).

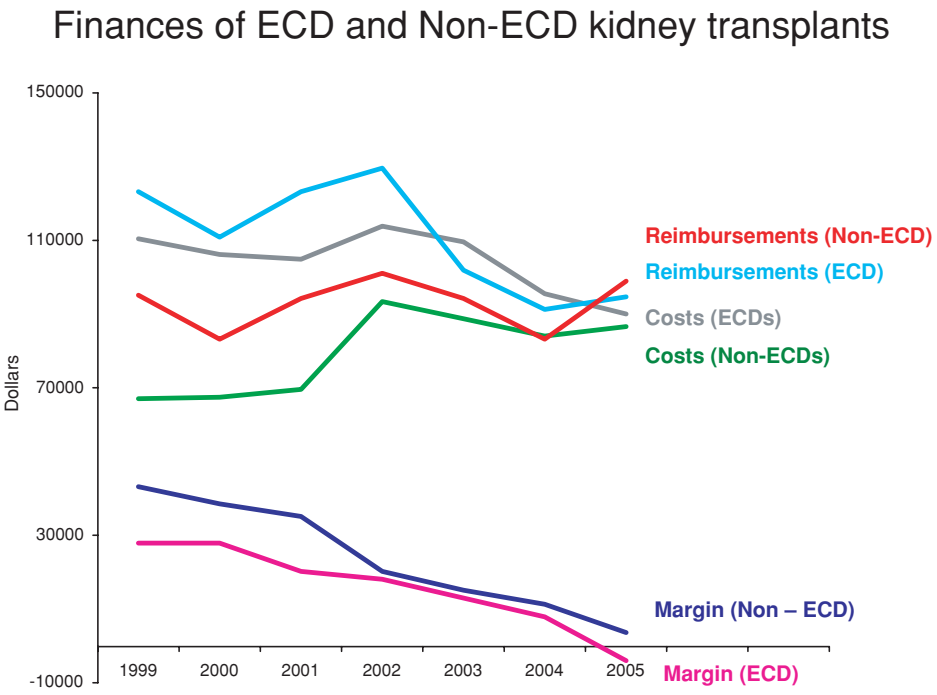

Figure 1: The reimbursements, total costs and margins for ECD and Non-ECD kidney transplants on Medicare patients from 1999 to 2005 at the University of Michigan.

There was no significant difference in Medicare reimbursements between patients who did and did not receive kidneys from ECDs in this univariate analysis. When stratified by year, we note a trend of decreasing margins for both ECD and non-ECD deceased donor renal transplants. (Figure 1) In 2005, our center had a margin of −$3958 when using ECD kidneys for transplant.

We then assessed trends in cost 'buckets' between ECD and non-ECD kidney transplants. Specifically, we note a sharp increase in organ acquisition and pretransplant costs between both ECD and non-ECD kidney transplant recipients. (Figure 2) In general, costs were higher for ECD kidney transplants with respect to pharmacy costs (Figure 3), inpatient costs (Figure 4) and outpatient costs (Figure 5), but there was significant year-to-year variation in these costs.

Discussion

Historically, transplantation services have been very profitable for medical centers (9). As a result of this, transplant programs have been given encouragement and resources to expand their clinical activities, and patients have benefited. Our group has noted in recent years a significant reduction in the profitability of our kidney transplant program. With this analysis, we attempt to characterize the cause of these lower institutional margins for kidney transplant surgical care. This study concludes that institutional margins are decreasing largely because of decreasing Medicare reimbursements and increasing organ acquisition costs. In addition, institutional margins were affected when patients have DGF and when we used kidneys from ECDs. Now that kidney transplantation has such a small margin for our center, it is important to note that ECD kidney

Table 2: Medical center reimbursements: univariate and multi-variate analysis of renal donor and recipient variables affecting total Medicare reimbursements (incremental dollars) to the medical center

Covariate	Incremental dollars univariate	p-Value	Incremental dollars multivariate	p-Value
Delayed graft function	4219	0.0013	13 163	0.0017
Recipient male sex	12 855	0.0004	12 499	0.0005
Donor cause death stroke	6898	0.0555	6900	0.0498
Post-op urinary complication	28 095	0.0144	NS	NS
Number of transplants (per transplant)	6265	0.1051	NS	NS
Donor age (per year)	188	0.1019	NS	NS
Transplant year (per year)	−1319	0.0867	NS	NS
Recipient diabetes mellitus	−5369	0.1826	NS	NS
Donor race black	−10 438	0.0801	NS	NS

Table 3: Medical Center Financial Margins: Univariate and multi-variate analysis of renal donor and recipient variables affecting total medical center financial margins (incremental dollars)

Covariate	Incremental dollars univariate	p-Value	Incremental dollars multivariate	p-Value
Extended criteria donor	−8876	0.0047	−5887	0.0228
Transplant year (per year)	−5287	0.0001	−5278	0.0001
Delayed graft function	−1644	0.0516	−4937	0.0176
Donor race black	−8051	0.0228	NS	NS
Donor hypertension	−7283	0.0089	NA	NA
Recipient black race	−6116	0.0138	NS	NS
Recipient diabetes mellitus	−4861	0.0414	NS	NS
Donor BMI (per 5 kg/m^2)	−1890	0.0379	NS	NS
Recipient age	−184	0.0067	NS	NS

transplants actually have a negative margin for our Medical Center.

The financial implications of policy changes, such as expanding the organ donor pool, are intimately related to patient care and must be addressed. The significant organ shortage leaves many potential kidney transplant recipients waiting for years, with significant waiting list mortality (1,2,5,10). Appropriately, efforts have been made to optimize the donor pool in order to maximize the number of transplants being done (11,12). These efforts are with the best intentions for the patients, but these policies seem to be having financial implications on our center. In view of decreasing Medicare reimbursements for kidney transplantation, the financial loss associated with patient DGF and the use of ECD kidneys may resonate with other centers, and could hinder efforts to expand the renal donor pool within the United States.

It is important to briefly discuss our analytic approach. Considering only the financial data associated with a single variable, such as ECDs, does not consider the complex interactions between ECDs, recipient characteristics and time. Surgeons transplant ECD kidneys into specific types of recipients, and the clinical characteristics of these recipients might be the primary cost drivers of the ECD transplant event. One might consider this simple analysis as superior in that it represents the clinical reality of ECD kidneys.

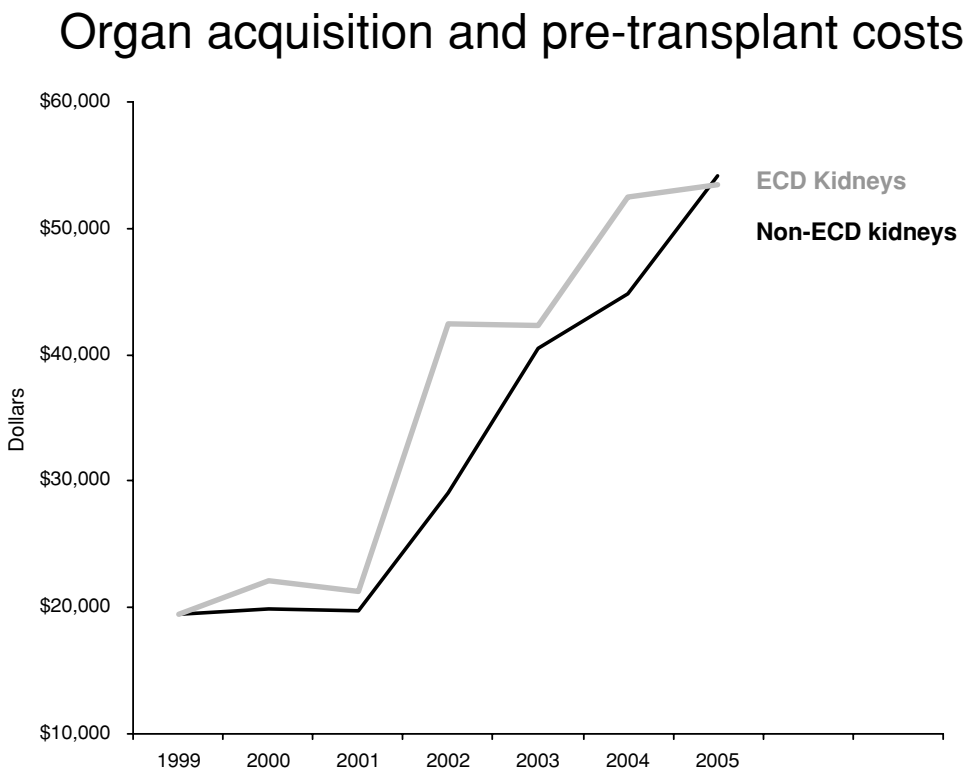

Figure 2: Organ acquisition and pretransplant costs for ECD and non-ECD kidney transplant on Medicare patients from 1999 to 2005 at the University of Michigan.

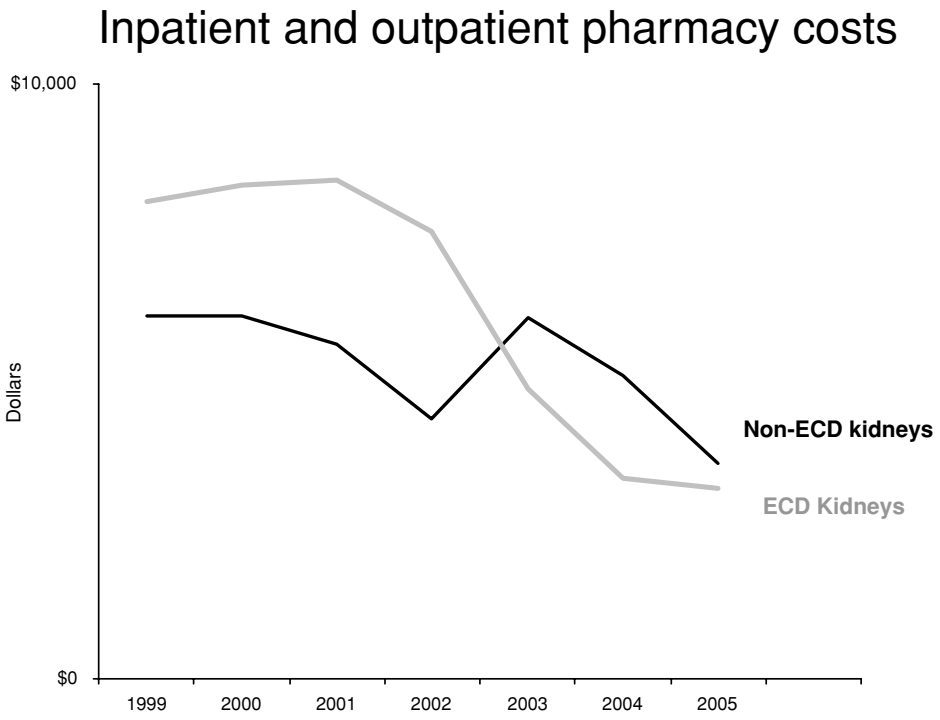

Figure 3: Inpatient and outpatient pharmacy costs for ECD and non-ECD kidney transplant on Medicare patients from 1999 to 2005 at the University of Michigan.

Alternatively, using multivariable modeling, we control for the confounding variables and assign incremental costs to ECDs. The multivariable analysis also controls for the relationship between time and changes in practice patterns, namely more ECD donors recently in an era of lower margins. It is unclear why ECDs are associated with lower margins independent of time and the occurrence of DGF. ECDs may be transplanted into sicker patients and we have not controlled for some indicators of severity of the recipient's illness. Attempts were made to control for recipient diabetes, age, race, sex and BMI, but none of these characteristics had a statistically significant effect on margin, and were excluded from the margin statistical model. Nonetheless, this analysis indicates that ECD kidneys do not cost

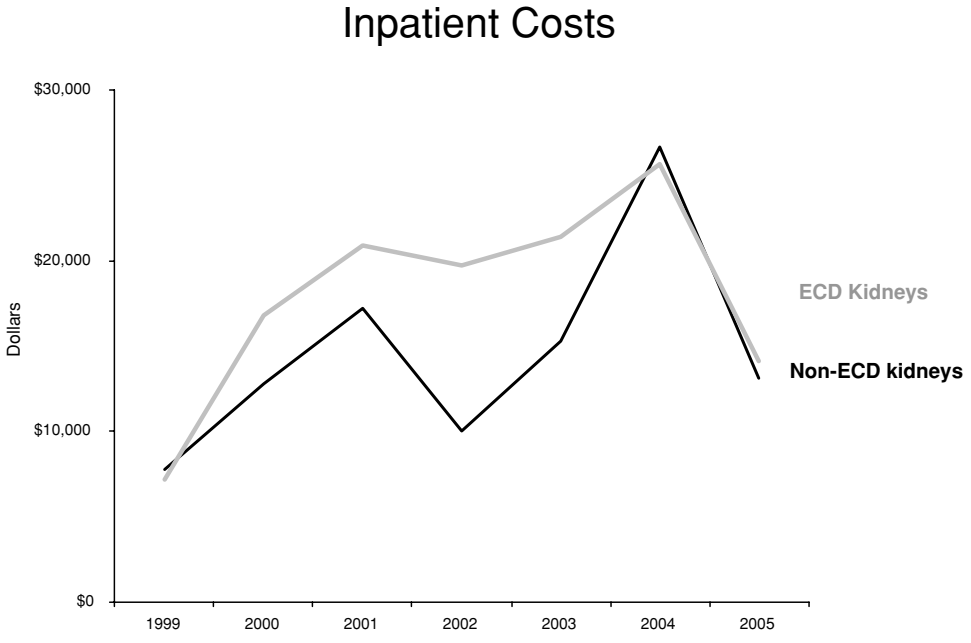

Figure 4: Inpatient costs (excluding pharmacy) for ECD and non-ECD kidney transplant on Medicare patients from 1999 to 2005 at the University of Michigan.

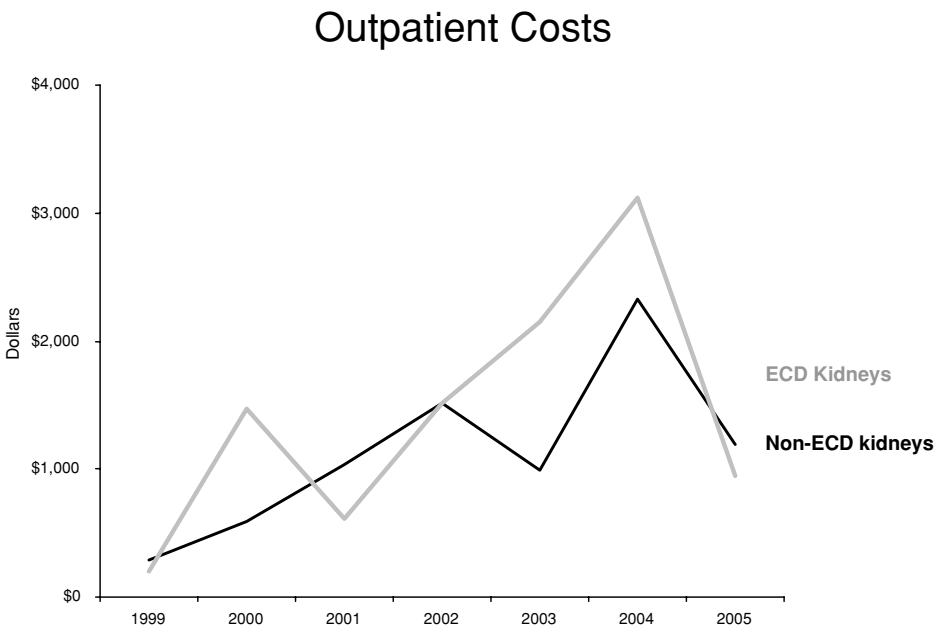

Figure 5: Outpatient costs (excluding pharmacy) for ECD and non-ECD kidney transplant on Medicare patients from 1999 to 2005 at the University of Michigan.

Medicare more money (likely related to the kidney transplant DRG) but have a deleterious effect on our center's financial margin. Conversely, DGF does cost Medicare significantly, but is also independently associated with lower center margins.

Certainly, there are several factors, which limit the scope of our study. Firstly, we do not account for opportunity cost for the medical center, which is always running near full capacity. When a patient with DGF is forced to remain in the hospital for longer than a patient with no postsurgical complications, the hospital is unable to admit new and potentially profitable patients to take his/her bed. In addition, although we quantify financial costs for the medical center and the payer, we make no effort to quantify the cost on the patient's personal life or on society. Postsurgical occurrences like DGF are certain to affect a patient's ability to return as a productive member of society. We also have used the UMHS cost accounting methodology to produce our cost data and accounting assumptions are inherently imperfect and will have significant impact on the data and associated conclusions. Finally, we make no attempt to assess the financial implications on the organ procurement organization (OPO). For example, many ECD protocols include aggressive use of pulsatile pump perfusion of kidneys, and the clinical and financial implications of such clinical measures remains to the determined (13). Similarly, aggressive pursuit of donors will undoubtedly be associated with a higher rate of donor-discarded kidneys, which will presumably affect OPO finances (14,15). These influences likely attribute to the rapidly increasing standard acquisition charge from the OPO for a kidney.

There have been significant changes in transplant finances and practice patterns from the beginning of the study period (1999) to the end of the study period (2005). The most impressive includes an annualized rate of decline on medical center margin of almost $5000/year. This is primarily related to both decreasing reimbursements, rising organ acquisition costs (which are likely related to policies aimed at expanding it organ donor pool, though these changes should be cost neutral) and accounting policies specific to our Medical Center. In 2005, the medical center margin on deceased donor renal transplants reimbursed by Medicare was $719. In an attempt to make our findings as generalizable as possible to other centers, we have limited the study group to Medicare-insured recipients of deceased donor renal transplants. We primarily chose to do this because the organ acquisition reimbursements in non-Medicare payers is complex and makes it difficult to compare financial data among different payers. Similarly, it is also difficult to compare financial data among medical centers, for characterization and assignment of indirect costs is largely policy driven and not data driven. Medicare claims data provides vast data on a large sample size, but is insufficient in informing center-specific financial conclusions. Thus, we chose to use single center data and as a result it is important that the conclusions of this analysis be considered within the context of this relatively small sample size.

For the sake of continuing to expand kidney transplant services for our patients, it is important to focus on what can be done to reduce costs and improve the financial outcomes of kidney transplantation. Every effort should be made to minimize risk of DGF by using kidneys as expeditiously as possible, utilize the least expensive and most efficacious medications, and efficiently utilize laboratory and imaging resources. Unfortunately, our worsening financial outcomes in recent years are largely not manageable. They are related to decreasing reimbursements and

increasing organ acquisition costs. The transplant community can likely have a significant impact on organ acquisition costs, at least in part by assessing the efficiency in which organs are procured. Though organ acquisition costs are reimbursed by CMS, their rapid increase likely indirectly affects the DRG reimbursement for kidney transplant.

As medical center costs continue to rise and medical center reimbursements continue to fall, the deleterious financial impact of expanding the organ donor pool will likely receive more attention from Medical Center administrators. In addition, there will likely be increasing pressure on transplant centers to use more high-risk donors by means of public reporting of transplant and organ turn-down rates (5). This pressure is likely in the best interest of patients on the renal transplant list. Conversely, this pressure can fairly be seen as an unfunded mandate on the individual transplant centers. The financial losses associated with DGF and ECDs could hinder efforts to expand the renal donor pool within the United States. The Centers for Medicare and Medicaid Services (CMS) should consider risk-adjusted reimbursement for kidney transplantation, as they do with prospective payment systems for other types of inpatient hospital care. Considering the costs of long-term dialysis (6,16,17), a financial incentive to use financially 'high risk' kidneys such as ECDs, would likely be a good investment for CMS.

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