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The cost of procuring deceased donor kidneys: Evidence from OPO cost reports 2013-2017

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Using 5 years of US organ procurement organization (OPO) data, we determined the cost of recovering a viable (ie, transplanted) kidney for each of 51 OPOs. We also examined the effects on OPO costs of the recovery of nonviable (ie, discarded) kidneys and other OPO metrics. Annual cost reports from 51 independent OPOs were used to determine the cost per recovered kidney for each OPO. A quadratic regression model was employed to estimate the relationship between the cost of kidneys and the number of viable kidneys recovered, as well as other OPO performance indicators. The cost of transplanted kidneys at individual OPOs ranged widely from $24 000 to $56 000, and the average was $36 000. The cost of a viable kidney tended to decline with the number of kidneys procured up to 549 kidneys per year and then increase. Of the total 81 401 kidneys recovered, 66 454 were viable and 14 947 (18.4%) were nonviable. The costs of kidneys varied widely over the OPOs studied, and costs were a function of the recovered number of viable and nonviable organs, local cost levels, donation after cardiac death, year, and Standardized Donor Rate Ratio. Cost increases were 3% per year.

KEYWORDS

donors and donation: deceased, economics, ethics and public policy, health services and outcomes research, kidney transplantation/nephrology, organ procurement and allocation, Organ Procurement and Transplantation Network (OPTN), organ procurement organization, organ transplantation in general

1 | INTRODUCTION

The 58 US organ procurement organizations (OPOs) are not-for-profit entities with a federal contract to cover a specific geographic area over which the OPO is granted exclusive responsibilities, that is, a monopoly. Required OPO tasks include assessment of potential organ donors, obtaining consent for organ donation from next of kin, surgical recovery and preservation of viable organs, and transport of organs to transplant center hospitals. Allocation of any organ to a specific recipient is directed through the Organ Procurement Transplantation Network (OPTN) and the United Network for Organ Sharing (UNOS), which holds the federal contract from the OPTN. Transplant center professionals make the final decision to accept and transplant or reject and discard any individual organ.

Whereas the costs for most aspects of the organ transplant process have been reported,[1-3] the functional OPO cost, generally referred to as the organ acquisition cost (OAC), has not been widely researched.[4] As a consequence of the National Organ Transplantation Act (NOTA),[5] OPOs have a defined method of assessing OAC, and the aggregate costs incurred by any OPO are unique to that OPO. Because all areas of the United States are the responsibility of some OPOs, there are many potential variations in

Abbreviations: CMS, Centers for Medicare and Medicaid Services, a part of the US Department of Health and Human Services; COL, cost of living; DCD, donation after cardiac death; NOTA, National Organ Transplantation Act; OAC, organ acquisition costs; OPO, organ procurement organization; OPTN, Organ Procurement and Transplantation Network.

expenses including local labor costs, the number of potential and actual donors, the number of transplant hospitals in the OPO service area, hospital charges for maintaining donor organ function after brain death (prior to organ recovery), and other costs.

Among US OPOs, the number of kidneys recovered annually varies from fewer than 100 to over 800 kidneys procured and transplanted. In this analysis, we have sought to describe variations in kidney procurement costs across the United States and differences in kidney cost by OPO size (hereafter defined by the number of kidneys procured annually). Kidney acquisition costs related to transplanted (viable) organs and of those related to discarded, "nonviable" kidneys (ie, organs recovered for transplantation but not transplanted) on cost and OPO outcomes were also examined. Understanding cost variations among US OPOs could allow for pragmatic assessments regarding OPO efficiency, economies of scale, and other matters related to policy issues affecting OPOs and the patients ultimately served.

2 | METHODS AND DATA

2.1 | Data

Of the 58 US OPOs, six are hospital based, and specific OPO cost data were not available. Annual cost reports from the remaining 51 independent OPOs were analyzed with data from Form CMS 216-94[6,7] for the 5 years 2013 through 2017. The maximum possible OPO annual reports would be 255 (5 years × 51 OPOs); however, only 40 reports for 2013 and 48 for 2017 were available resulting in a working sample of 241 (95%) OPO annual reports for the study period.

Unless noted otherwise, the number of counted kidneys is for "viable" organs, which are those kidneys that are ultimately transplanted (Worksheet S-1; Part 1, Line 3; Column 3; Form CMS 216-94; all viable kidneys, local and imported). OPO costs incurred in the procurement and sale of tissues are removed by the Centers for Medicare and Medicaid Services (CMS) from their general accounting system, which focuses exclusively on organs via Worksheet B-1 and are excluded from this analysis. Organ procurement direct costs (eg, hospital charges, surgeon fees etc) are aggregated by organ type (kidney, liver, etc) and indirect costs (overhead) are aggregated across all organ types and allocated as a linear function of the sum of organ counts of all types. When multiple organs are removed from a donor, those costs specific to an organ are assigned to the direct cost for that organ, whereas other direct costs are divided equally by the number of organs from that donor.

Costs were calculated as the total expenses an OPO incurred for kidney procurement through delivery to a transplant center. These costs included all direct costs as well as allocated indirect costs. Total costs for kidney procurement within an OPO were divided by the number of viable kidneys to obtain cost per kidney for that OPO and then in the case of the simple mean model averaged for the years of available data with a resulting cost per kidney procured for that OPO. In the repeated measures model (which is the primary model in this manuscript) the cost data were analyzed on a yearly basis.

We adjusted input labor costs by the local price index for each OPO headquarters city using the Expatistan[8] index, which is a cost of living (COL) database comparing cities worldwide. A second adjustment of local input costs used the CMS Wage Index[9] for the year 2015 for the county in which the OPO is headquartered.

We examined OPO performance measures including the Standardized Donation Rate Ratio (SDRR) as reported for each OPO by the Scientific Registry of Transplant Recipients.[10] Because there is controversy regarding this measure, we also examined donors per 1000 deaths of patients under 75 years of age who were likely possible donors (data limited to calendar year 2015) as a potential OPO performance measure recognizing the importance of standardized, verifiable, and objective metrics of OPO performance.[11]

2.2 | Statistical analysis

For all OPO years, descriptive statistics for cost of kidneys and potential predictors of cost included the following: number of transplanted kidneys, two COL measures, percentage of nonviable kidneys, percentage of donation after cardiac death (DCD) donors, 25th percentile of wait times (in months), number of transplant programs in the OPO, percentage of donors >65 years of age, SDRR, and donors per 1000 deaths under age 75 (year 2015). Two statistical models employing linear regression were examined. In model 1, we averaged the total cost of kidney acquisitions and number of viable kidneys recovered over the 5 years resulting in a single measure of cost and a single measure of viable kidney count for each OPO. In model 2 we used a repeated measures approach in which we considered each set of annual OPO data as a separate observation and used generalized estimating equations to account for the correlation between repeated OPOs, employing a compound symmetry covariance matrix. Results proved robust between the two models, so with a few exceptions as noted, only the repeated measures estimates (model 2) are reported.

These models examined the relations among selected covariates, where cost per kidney was the dependent variable. The independent variable of average number of kidneys procured was examined in linear, squared, and cubic form, after Dor et al.[12] Other covariates included percentage of nonviable kidneys, year, percentage of donors >65 years of age, measures of wait times, number of transplant programs in the OPO, and donors per 1000 deaths age less than 75.[11] Models adjusted for local input costs using either the COL index[8] or the CMS Wage Index.[9] Because results were virtually identical with either adjustment, estimates are displayed only for the COL index adjusted model.

The cost curve of expected cost per kidney by count of kidney transplants is displayed unadjusted, adjusted to the mean COL index (157.6), and to three levels of percentage of nonviable kidneys (the 5th percentile, median, and 95th percentile) to display the potential role these variable play in determining cost of a kidney. In effect, this estimation adjusted each OPO's cost to the mean (average) of input cost levels to allow for comparison as if all OPOs faced the same input cost level.

Due to the missing values in 2013 and 2017, we performed a sensitivity analysis examining only those OPOs with complete data for all 5 years (n = 40) to ensure that results were consistent. No meaningful differences were found in this subanalysis.

3 | RESULTS

There is wide variation in costs per organ and the number of viable kidneys procured among US OPOs (Table 1). The average cost of a transplanted kidney over the 5-year period was $36 027 (range: $24 231-$55 995; interquartile range [IQR] was from $31 607 to $40 319) and the average number of kidneys transplanted per OPO was 274 (range: 48-931; IQR = 127-361) across the 238 OPO-years. The number of nonviable kidneys averaged 17.8%. Fifty percent of OPOs (using IQR) recovered between 37 (13.5%) and 60 (21.9%) nonviable kidneys per year. The average OPO retrieved 44 DCD kidneys per year and 50% of OPOs (using IQR) would have retrieved between 27 and 58 DCD kidneys annually.

The number of nonviable kidneys procured was positively associated (slope = 0.2438 with the number of viable kidneys procured (Figure 1), with an R^2 = .74, P < .0001). By simple linear regression, the model suggests that for every 10 viable kidneys there is an expectation that 2.4 nonviable kidneys are recovered.

Figure 2 depicts the OPOs with the most and least costly kidneys. A total of 13 OPOs reported procurement costs below $32 000 and 12 OPOs reported procurement costs above $40 000 per transplanted kidney. (These statistics are from the simple mean for each OPO for the 5 years.) The nine donor service areas with the costliest kidneys included Buffalo, NY; North Liberty, IA; San Ramon, CA; Honolulu, HI; Los Angeles, CA; Las Vegas, NV; Troy, NY; Greenville, NC; and Bloomfield, CT. The seven OPO service areas with the least costly kidneys included Tampa, FL; Indianapolis, IN; North Charleston, SC; Nashville, TN; Pittsburgh, PA; San Antonio, TX; and Philadelphia, PA.

Table 2 presents the basic estimated least squares models with the same dependent variable of average cost per viable kidney. Mean cost per kidney across OPOs = $36 102, n = 234 The R^2 is .32 with 237 observations in this repeated measure model clearly suggesting a quadratic relationship with the coefficient on the count of organs procured and organs squared being substantial and statistically significant. Addition of a cubic term to a model with linear and quadratic terms failed to improve the model fit. The *full model* contains 14 covariates that include a range of measures reporting on a series of hypotheses regarding OPO operations. The left side of Table 2 presents the results for this *full model* and the right side presents the model limited to the 7 of 14 covariates that passed the test of significance at P < .05.[13]

The results indicate that OPOs in areas of the country with higher COL have higher kidney costs (+$94.89 higher cost per kidney per 1-unit higher COL, P = .002). OPOs located at the 75th percentile of COL would have an average higher cost per kidney of $2087 than OPOs at the 25th percentile of COL.

OPOs that retrieved more nonviable kidneys experienced higher cost per viable kidney. As shown in Table 2 (right side), in comparing OPOs with the same number of procured kidneys, having 1% more nonviable kidneys is associated with a $275 higher cost per viable kidneys. Comparing the IQR for percentage of nonviable kidneys, which is 7.7% (21.2%-13.5%), translates into an increased cost of $2121 per viable kidney (ie, comparing an OPO at the 75th percentile of percentage of nonviable vs the 25th percentile of percentage of nonviable kidneys).

TABLE 1 Basic sample/census statistics, organ procurement organization (OPO) unit of observation, 2013-2017[a]

Variable	Mean	SD	Interquartile range	Minimum	Maximum
Average kidney count/y/OPO	274	177	127-361	48	931
Average cost per kidney/OPO	$36 026	$5989	$31 607-$40 319	$24 231	$55 995
Cost of living in the city where OPO is headquartered	157	24	142-164	124	239
Centers for Medicare and Medicaid Services Wage Index in the county where OPO is headquartered	1.01	0.17	0.90-1.04	0.82	1.71
Nonviable organs (%)	17.8	5.7	13.5-21.2	4.3	39.6
Donation after cardiac death (%)	16.0	8.4	9.9-21.9	0	42.4
25th percentile of wait times (mo)	15.7	8.1	10.4-19.2	4.2	47.5
Transplant programs in the OPO	12.8	8.9	9.0	6-15	42
Donor age >65 (%)	6.3	3.9	3.3-9.1	0	20.2
Standardized donation rate ratio	0.99	0.09	0.95-1.03	0.69	1.40
Donors per 1000 deaths <75 y with likely donor possibility (2015 only)[11]	111	29	93-129	53	199

[a]Count (n) of OPOs each year: 2013:40, 2014:51, 2015:51, 2016:51, 2017:48: Average model over the 5 y, that is, not the repeated measures model.

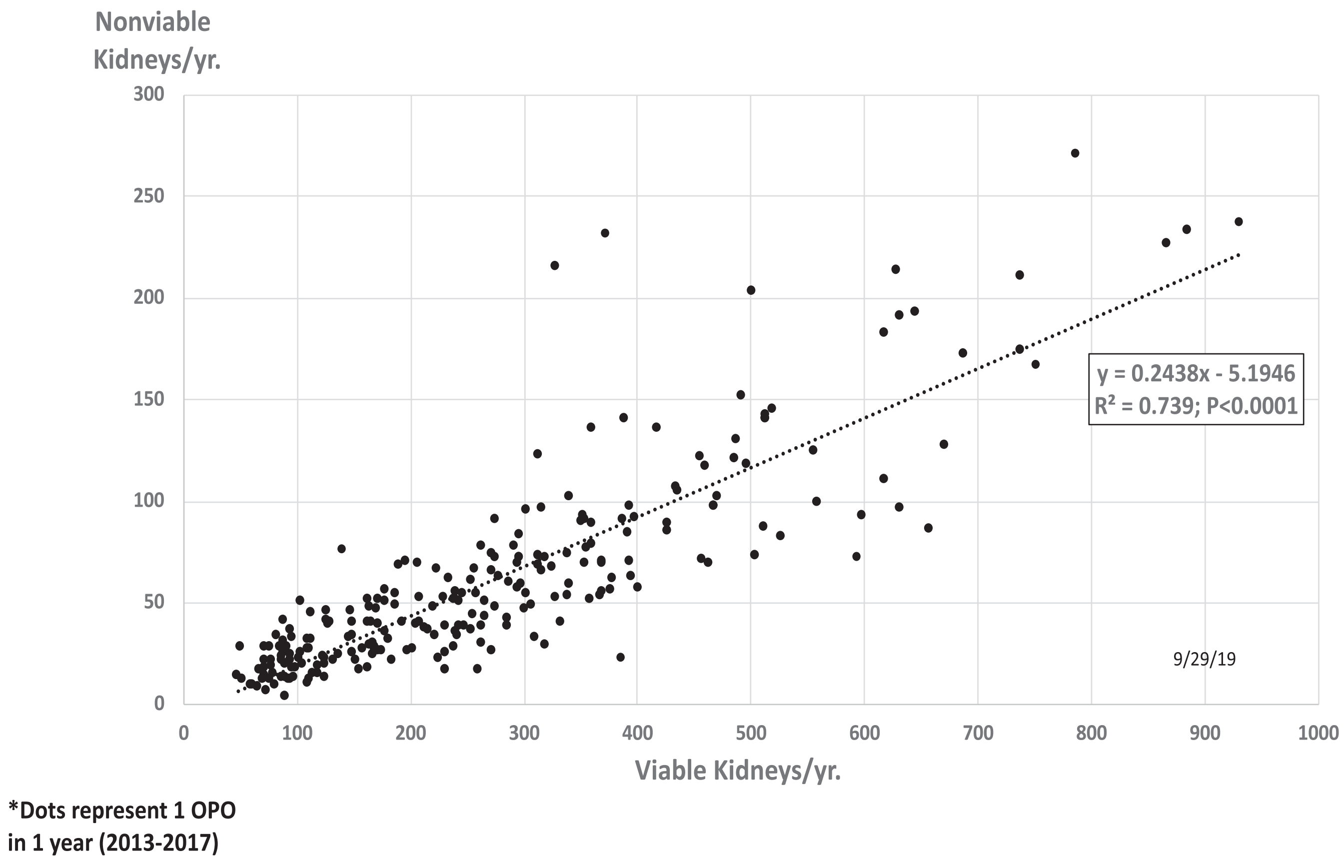


FIGURE 1 Correlation between count of viable kidneys and count of nonviable kidneys

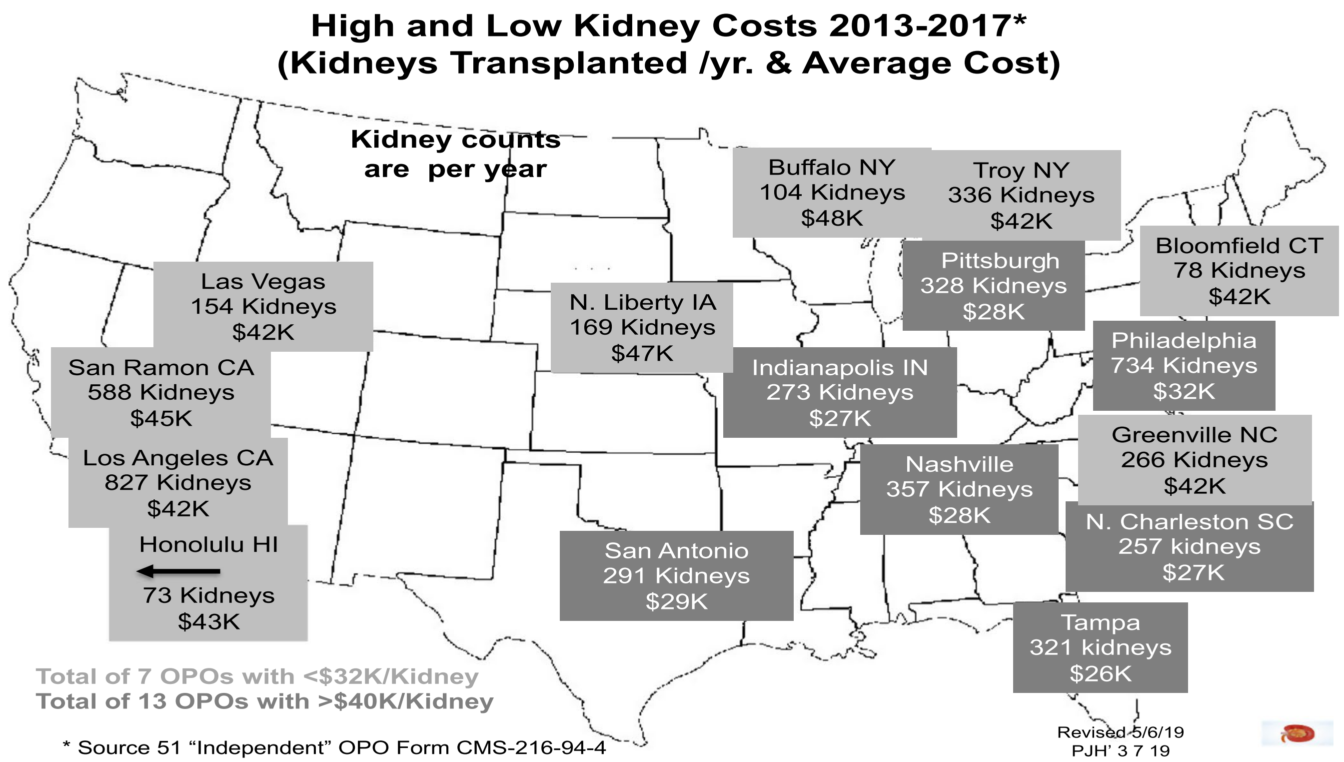


FIGURE 2 Geographic distribution of highest and lowest kidney transplant costs

OPOs that procure DCD kidneys also have higher cost per viable kidney. As indicated, in Table 2, a 1% increase in DCD kidneys procured is correlated with higher cost of $128.53 per viable kidney ($P < .001$). At 16% average DCD kidneys (Table 1) the impact of DCD kidneys would be 16.0 × $128.53 = $2056. At the average OPO size of 331 total kidneys (viable and nonviable) procured per year, there would be approximately 53 DCD kidneys, which suggests that $2056/53 = $39 increase in the average cost per viable kidney per DCD kidney.

Using the IQR range of SDR of 0.08 (Table 1) and the estimated association between SDR and the cost of a viable kidney of minus $95.08 per 0.01 (Table 2) suggests that the difference in cost for a viable kidney comparing for IQR for SDR equals $760.64. This means that the estimated average cost of a viable kidney for an OPO at the 25th percentile of SDR (SDR = 0.95) would be $760.64 more than a viable kidney from an OPO at the 75th percentile of SDR (SDR = 1.03).

The procurement cost of a transplanted kidney has become more expensive over the 5-year of this study, costing approximately $1078 (Table 2), more each year ($P < .0001$). This would suggest at $36 102 average cost per viable kidney that the inflation rate in procurement cost per kidney is approximately 3.0% per year.

Figure 3 displays the quadratic nature of the cost curve in respect to the number of kidneys transplanted per OPO-year. The figure displays the range of viable kidneys from approximately 50-900 kidneys per year. The cost of a kidney declines from the highest estimates for the smallest OPOs to a low point, which ranges between 500 and 600 transplanted kidneys, depending on adjustments. The unadjusted model estimates the highest cost for an OPO with 50 viable kidneys ($55 995/kidney) to the lowest cost for an OPO with 272 transplants ($24 289/kidney). In OPOs with >549 transplants, costs began to rise with increasing number of transplants, reaching a cost of $41 140 for an OPO with 910 transplants. Adjustment for COL, percentage of nonviable kidneys, and percentage of DCD donors changed the shape of the curve slightly, moving the lowest cost per kidney further to the right (OPOs with more kidney transplants per year) and with less cost increase for OPOs with the largest volume of transplants.

There is a computed minimum cost as related to OPO size derived from the estimated quadratic cost parameters (Table 2). Depending on the adjustments to the model, the cost minimum occurs between 500 and 600 viable kidneys per year. The unadjusted model predicts a minimum cost at 549 viable kidneys per year at an average cost of $33 910.

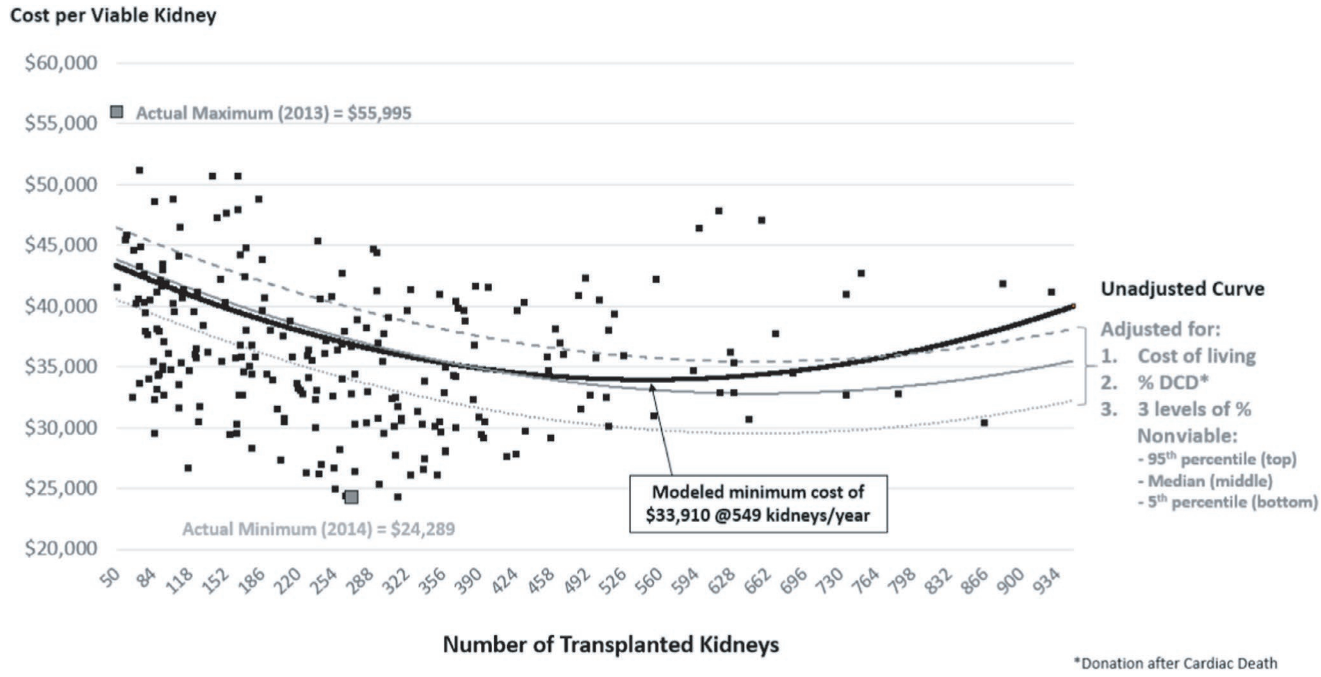
The model predicts that OPOs that procure more than 549 kidneys experience a cost per kidney higher than the minimum; that is, the cost curve rises after the minimum. And the model predicts that

TABLE 2 Quadratic estimation of the mean cost per kidney procured 2013-2017

	Full model			Parsimonious model[a]		
OPO measures	β	95% CI	*P* value	β	95% CI	*P* value
Kidney count/y (per kidney)	−52.63	−73.64 to −31.62	<.0001	−39.71	−57.08 to −22.35	<.0001
(Kidney count/y)^2 (per kidney)	0.04	0.02 to 0.06	.001	0.03	0.01 to 0.05	.005
Cost of living in the city where OPO is based (per 1 unit)	100.26	24.30 to 176.22	.01	94.89	36.75 to 153.03	.001
Nonviable organs (per 1%)	255.07	132.02 to 378.11	<.0001	274.51	176.39 to 372.63	<.0001
Donation after cardiac death (per 1%)	114.07	27.37 to 200.77	.01	128.53	49.75 to 207.32	.001
Standardized donation rate ratio (per 0.01)	−95.23	−163.63 to −26.83	.01	−95.08	−155.81 to −34.35	.002
Year (per year)	1077.86	704.58 to 1451.15	<.0001	1042.16	682.90 to 1401.42	<.0001
25th percentile wait time (per mo)	−125.41	−283.94 to 33.12	.12	—	—	—
Transplant programs (per 1)	196.23	−15.40 to 407.87	.07	—	—	—
Age >65 y (per 1%)	−68.58	−225.64 to 88.48	.39	—	—	—
Land area (per natural log mile$_2$)	392.48	−671.95 to 1456.90	.47	—	—	—
White donor (per 1%)	−45.88	−99.59 to 7.84	.09			
Male donor (per 1%)	34.77	−44.48 to 114.01	.39			
Total kidneys/donor (per 1)	−1514.11	−6428.70 to 3400.48	.55			

OPO, organ procurement organization.

[a]Mean cost per kidney across OPOs = $36 102, n = 234; Intercept = −2 068 400, $P < .0001$. 9/23/19.



(Repeated Measures Model; n = 238)

FIGURE 3 Cost per viable kidney with selected adjustments

those OPOs recovering fewer than 549 kidneys annually would also experience on average, a cost per kidney higher than the computed minimum.

The small squares in Figure 2 are individual OPO-Yr data points. The estimated effects of the correction for local labor cost (COL) is to shift the minimum cost somewhat to the right (higher procurement levels) and to lower somewhat the increasing cost per average kidney recovered beyond the minimum. When an OPO gains entry into the 70-80th percentile of OPO size, not only do economies of scale disappear, but costs rise.

The total number of kidneys recovered with the intent of transplantation was 81 401, as reported by our dataset. Of these, 66 454 underwent transplantation and 18.4% (14 947) were discarded (nonviable). Because donor age is a strong predictor of kidney discard,[14] we examined the effect of donor age on viable and nonviable kidneys. There was a correlation between donor age and the percentage of nonviable kidneys (0.36, $P < .01$) and the donors over the age of 65 (0.40, $P < .01$). There was also a correlation with mean number of viable kidneys) and donors over the age of 65 (0.18, $P < .01$). We found a correlation with the donors per 1000 deaths less than 75 years for deceased likely to be a donor candidate and the count of viable kidneys (0.30, $P < .04$),[11] but not with the SDRR (0.22, $P < .09$).

4 | DISCUSSION

For decades, OPO cost reports have been filed with and are available from CMS. Yet, information on OPO costs has generally been scant. There are numerous reports focused on procured organs as well as performance standards, such as ratios of the number of consenting donors to potential donors.[15-19] Understanding the expenses of organ procurement may shed light on areas in which organ recovery might improve in terms of cost and efficiency. The average cost per kidney and related measures reported in this analysis are based on a robust set of data. Averages were based on 5 years of cost data reported from essentially all US non-hospital based, that is, independent OPOs.

A current issue in kidney transplantation is the discarded, that is, nonviable kidney. Recovery costs for discarded kidneys appear to be built into total kidney procurement costs: total viable and nonviable organ recovery cost divided by the count of viable organs. In effect the costs of nonviable organs (and the cost for the viable organs) are distributed over the OPOs' sum of viable organs. Although it is often implied that Medicare does not pay for nonviable kidneys, the OPO cost forms (Worksheet C) suggest that Medicare does cover OPO costs for such organs.

A second issue with regard to nonviable organs is whether they may be the result of overzealous procurement policies or some other approach to recruiting donors that leads to discard and associated procurement costs. Shown in Figure 1 is a plot and statistical fit of viable vs nonviable organs at the same OPO. There are 241 observations (OPOs by year), which yields a definitive fit to the estimated line. This fitted line has a slope of 0.24 ($P < .0001$), which suggests that the count of nonviable organs is a reasonably constant fraction (or percentage) of the viable organs procured. On average for every 10 viable procurements the typical OPO will incur 2.4 nonviable kidneys. The rather high R^2 (.74) for a cross-section model like this is noteworthy.

A third issue regarding nonviable kidneys is our suggestion that the small cost of nonviable kidneys often receives undue emphasis compared with the higher value of viable kidneys. It may be that OPOs, in correctly seeking to maximize the number of highly valuable viable kidneys, may also inadvertently increase the number of nonviables. But the great value to society of the former is much larger than the cost of the latter. Earlier research by this team[1] has shown that the net welfare gain to society from a single viable kidney is about $1.1 million and it saves the taxpayer about $146 000, whereas the cost of producing a nonviable kidney is in the neighborhood of only $22 000.

Curves depicted in Figure 3 demonstrate that the computed cost per kidney generally follows a quadratic relationship between average cost per kidney and OPO size. The solid black curve is unadjusted by any other covariate. The other curves reflect the basic relationship to size adjusted by different covariates. The curve labeled adjusted for COL generally has little impact in the smaller sizes of the OPO and in the higher ranges of sizes pulls the unadjusted curve downward. This suggests that larger OPOs to the right of the minimum when adjusted for the COL have lower cost when considering the local price levels they face. The three remaining adjusted lines make adjustment for 3 levels of 2 measures of DCD kidneys procured and percentage of nonviable kidneys procured. The three levels of the two selected covariates are 5th percentile, median (50th percentile), and the 95th percentile. The patterns of the 3 adjusted lines suggest that higher proportions of DCD and nonviable kidneys raise cost.

The estimated coefficient from (Table 2) of $94.89 ($P < .002$) per one unit on the COL scale indicates that the difference across the IQR of 22 points on the COL index is associated with $22 \times \$94.89 = \$2088$ on the average price per viable kidney. At the overall mean of $36 102 for price per viable kidney, this IQR spread would represent a difference of 6% in the average cost per viable kidney. Although this result is quite precise with very narrow uncertainties about estimated parameters, one might observe that COL differences across OPOs do not explain much of the difference in the cost per kidneys across OPOs. Figure 1, for example, clearly shows a 100% difference in the OPO reported cost per kidney. Certainly, COL is clearly a factor in the cost structure of OPO costs but not a very dominant factor.

The cost of organ procurement is relevant to transplant center operations and the relationships that transplant center surgeons and physicians cultivate with the local OPO. Englesbe et al[18] explain the importance of organ acquisition costs and how clinically oriented physicians and surgeons may benefit from an understanding of transplant center finances. Clinicians should be interested in procuring more organs at lower cost and gaining knowledge about reasonable acquisition costs. An example may be billing acquisition costs in the Kidney Paired Exchange program[19] in the circumstances of which harbor elements important to both clinical transplantation and its financial foundation. In addition, OPO revenue may be earmarked to address problems shared by donors and recipients, such as quality improvement in organ preservation.

4.1 | Limitations of the study

We were unable to assess the quality of kidneys procured by the OPOs, although all viable kidneys in the analysis were not only procured but were actually transplanted. Although OPO size, local input prices, nonviable organs (18.4%), DCD organs (16%), and year were addressed in determining procurement costs, there are undoubtedly many other contributing factors that simply cannot be fully defined. These include specific geographic characteristics, because any OPO is, by regulation, responsible for a defined geographic area. Thus, the volume and type of potential donor deaths and characteristics of the general population as well as other variables may not be measurable in an analysis such as ours. Labor costs are 50% of organ procurement expenses, and there is wide variability in labor costs across the United States;[9] therefore, it is unclear why COL measures do not explain a larger fraction of the variation in procurement costs across OPOs.

We have conducted many quality checks regarding data in the original cost forms, and we have considered the possibility that there may be some double counting of viable kidneys due to transfer of organs among OPOs. Conversations with informed OPO professionals have not affirmed such a possibility. If, however, double counting of viable kidneys is extant, cost estimates per kidney presented in this paper would be biased low. In Appendix S1 we attempt to further explore this matter.

5 | CONCLUSIONS

Every OPO in the United States is required by CMS to file comprehensive cost reports each year. These reports contain extensive cost detail and provide substantial information on organs and tissue recovered from deceased donors. These data sources can yield useful information when subjected to common analytical methods.

We conclude that costs per deceased donor kidney vary considerably over the 51 independent OPOs included in our analysis, with the highest cost OPOs almost twice as costly as the lowest. Much of this variation in cost is related to the size of operations. In addition, our results confirm that COL does affect cost but only in a modest manner. Other factors shown to affect cost include procurement of nonviable organs, DCD kidneys, and year. We tested a long series of hypotheses in which the null hypothesis of no relationship could not be rejected. In spite of failure to pass the *P* test these results sill contributed insight into the functions of OPOs.

Many other exact sources of cost variance have yet to be determined. Possible inefficiencies in the current OPO structure might be mitigated by consolidating smaller programs and assessing growth of larger ones ie larger OPOs are frequently operating in the rising cost sector of results. Understanding the reasons for these inefficiencies may help to model more efficient and less costly systems for procurement of donor kidneys and other solid organs.

DISCLOSURE

The authors of this manuscript have conflicts of interest to disclose as described by the *American Journal of Transplantation*. Thomas Peters was retained in a consultant capacity to manage and develop a research program for DCI Donor Services, a parent organization of three OPOs. The other authors have no conflicts of interest to disclose.

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DATA AVAILABILITY STATEMENT

All independent OPOs annually file FORM CMS-216-94, a 25-page cost form, with a federal contractor (Palmetto GPA) located in South Carolina. These data are available under federal law regarding access to public data. The two local cost indices are available via the World Wide Web: https://www.expatistan.com/cost-of-living/index/north-america#price-index-explanation and 9. https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/SNFPPS/WageIndex.html. 508_compliant_version_of-CMS1605-F_WAGEINDEX_transition.csv. Dr Goldberg, University of Pennsylvania has supplied a limited set of data for 1 year.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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