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Hospital Quality and Selective Contracting: Evidence from Kidney Transplantation*

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Abstract

Most private health insurers offer a limited network of providers to enrollees. Critics have questioned whether selective contracting benefits patients. Plans counter that they take quality into account when choosing providers. Using data on five plans' networks for kidney transplant hospitals, this study shows that in-network hospitals have better outcomes than out-of-network facilities. Conditional logit estimates using patient level data confirm this result: compared to Medicare patients, privately-insured patients are more likely to register at hospitals with higher survival rates. Restricting choice has the potential to improve patient welfare if plans steer uninformed patients to high quality hospitals and physicians.

Keywords

managed care; transplantation; hospital quality

1. INTRODUCTION

Managed care plans in the United States maintain networks of physicians and hospitals and require enrollees to pay substantially higher out-of-pocket costs if they visit providers outside the networks. Critics have questioned whether selective contracting provides value to consumers or is simply a mechanism to transfer profits from providers to health plans, leaving total social welfare unchanged. If plans select providers mainly based on price, then competition may lead to a "race to the bottom" where providers under-invest in quality (Dranove and Satterthwaite 1992; Ginsburg and Hammons 1998; Lyon 1999). Plans counter that they take quality into account when choosing providers and pass the discounts on to consumers and employers in the form of lower premiums. Thus, networks enable consumers to receive better quality care at a lower price.

The controversy over selective contracting can be viewed as part of a larger debate over the degree to which institutions such as health plans and government should mediate between patients and providers. Reformers would like to use tax-advantaged medical savings accounts to empower patients to transact directly with providers. Skeptics doubt that patients are able to make intelligent choices on their own, pointing to studies that find that few patients use

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quality report cards (Schneider and Epstein 1999) and patients' subjective ratings of their health care are uncorrelated with technical quality (Chang 2006).

For selective contracting to improve patient welfare, it must be the case that 1) patients do not give sufficient weight to quality when choosing a provider (or, alternatively, they are unable to evaluate quality) and 2) health plans take quality into account when selecting providers for exclusive networks. The purpose of this study is to test whether health plans consider quality, as measured by survival rates, when contracting with hospitals for kidney transplant services. I present both direct evidence from plans' kidney transplant networks and indirect evidence from patient-level choice data. Both sets of results are consistent with plans' claims that they consider quality when developing transplant provider networks. I do not have data on plans' reimbursement rates and so I am unable to evaluate whether high quality hospitals command higher prices.

2. BACKGROUND

There are several reasons why health plans may seek out high quality physician groups and hospitals for provider networks. Some plans are non-profit and may care about quality for its own sake. Both for-profit and non-profit plans may perceive a connection between demand and the quality of their provider networks. Demand in this case refers to demand among consumers buying individual policies, employers buying group policies, and employees in firms that offer multiple plans. One caveat is that plans may avoid high quality providers if including those providers disproportionately attracts high cost enrollees (Frank et al. 2000).

For some clinical services, patients treated at high quality providers may experience fewer complications and require less follow-up care. Plans that steer patients to high quality providers will incur lower costs. This appears to be the case for kidney transplantation; projected costs over a 10 year period for patients with successful transplants are \$147,745 but \$165,869 for patients whose transplants fail within three years (Gilmore et al. 2007).

Reimbursement rates (i.e. prices) between plans and providers are set via negotiation. To the extent that health plans prefer to include high quality providers in networks, one would expect that high quality providers are able to negotiate higher reimbursement rates. The degree to which high quality providers are able to extract the value they add to the network will depend on their bargaining power vis-à-vis health plans. Generally, one would not expect that high quality providers have so much bargaining power that plans are indifferent between high and low quality providers.

3. LITERATURE REVIEW

The most direct method of determining whether plans consider quality when forming networks is to compare quality between in- and out-of-network providers. Gaskin et al. (2002) and Mukamel et al. (2002) find that hospitals and physicians with superior outcomes are more likely to be included in provider networks for coronary artery bypass graft surgery. One limitation of this type of analysis is that it is impossible to determine if plans actively seek out high quality providers or if plans' members just happen to live in areas with many high quality providers.

Some studies infer the role of quality in contracting decisions from patient flows. Escarce et al. (1999) and Chernew et al. (1998) estimate conditional logit models of hospital choice for coronary artery bypass surgery where mortality measures are interacted with indicators for patients' insurance type. They find that patients with managed care insurance are more likely to receive care in hospitals with lower mortality rates, controlling for other hospital attributes such as distance. Feldman and Sharfstein (2000), by contrast, find that managed care patients

with cancer are less likely to be treated at providers with high volumes, an indirect measure of quality.

Plan-provider reimbursement rates are difficult to obtain, and so most studies do not examine the association between price and quality. An exception is Bridges et al. (2005), who estimate the relationship between risk-adjusted mortality measures for cardiac bypass surgery and reimbursement rates. They find that hospitals with higher mortality actually receive higher payment rates, possibly due to unmeasured patient severity.

The studies discussed above address the static, allocative impact of selective contracting on quality. The dynamic effect is important to consider as well. If insurers are more likely to include high-quality hospitals in networks, then hospitals will expend resources on quality to increase their chances of winning contracts. Kessler and McClellan (2000), Gowrisankaran and Town (2003), Rogowski et al. (2007), and Humamel et al. (2001) test the relationship between competition for managed care patients and outcomes and find that competition is associated with higher inpatient survival rates. Outcomes are better for both managed care and non-managed care patients, suggesting that selective contracting is associated with a spillover benefit.

4. SELECTIVE CONTRACTING IN TRANSPLANTATION

Most if not all private insurers restrict coverage to a few centers in each geographic area under the guise of “centers of excellence” programs. Transplant contracting operations are usually performed by a distinct business unit with a dedicated staff. Plans claim that quality plays an important role in network development. For example, Cigna¹ states, “Each facility in our network is carefully chosen and must continue to meet our stringent quality standards.” United Healthcare² states:

Programs that participate in both The Transplant Centers of Excellence network and The Pediatric Transplant Centers of Excellence network are selected according to criteria in three areas: transplant program outcomes, transplant program structure and transplant program process.

Plans may infer quality from center-specific survival reports, which are publicly available on the Internet, the survival experience of plan members, direct observation of the processes of care, the experience of the transplant team, the availability of support services, and research output.

Critics charge that plans focus on price at the expense of quality (Burns et al. 2000). Kaiser Permanente of Northern California received national media attention in 2006 for deficiencies in its kidney transplant program. Kaiser’s situation is somewhat unique in that it operates its own hospitals, but the charges leveled at Kaiser reflect the public’s uneasiness with selective contracting in general.

Medicare covers non-elderly patients with end-stage renal disease through its end-stage renal disease program. All patients are eligible, subject to waiting and coordination periods, described below. Medicare beneficiaries with end-stage renal disease are prohibited from joining a Medicare managed care plan unless they were a member prior to enrolling in the Medicare program.

¹See <http://www.cigna.com/health/provider/medical/transplant.html>. Accessed September 1, 2005.

²See <http://www.urnweb.com/gateway/public/transplants/providers.jsp>. Accessed September 1, 2005.

The traditional Medicare program will pay for transplant surgery at any hospital meeting a fairly minimum set of standards. Because Medicare covers so many patients, it would be difficult for a transplant center to remain in business if it is excluded from the program. Historically, enforcement of the standards was lax, but in the last year Medicare stopped paying for heart transplants at three hospitals with poor outcomes. The action followed a *Los Angeles Times* article documenting low survival rates and procedure volumes in many Medicare-approved transplant centers (Weber and Ornstein 2006). The Medicare program recently announced new standards for transplant centers. According to a story in the *Times* (Weber and Ornstein 2007), “Medicare officials believe that the new regulations will result in ‘up to 2% or approximately 10 centers’ a year losing their certification.”

5. MEASURING QUALITY

Transplant center quality is measured by taking the difference between each center’s observed and expected one year graft survival rates. The term “graft” refers to the transplanted kidney. The one year graft survival rate is the proportion of kidney transplant recipients whose grafts are functioning at one year post-transplant. Patients are counted against a center’s graft survival rate if they die, regardless of the cause of death, or their body rejects the donor organ and they are placed on dialysis or receive a second transplant.

Survival rates were obtained from the Scientific Registry of Transplant Recipients, which calculates observed and expected graft survival rates for every center in the U.S. using data from a national patient registry. Transplant centers are required to report patient-level data to the registry, and so the database includes 100% of transplant recipients. The Scientific Registry publishes center-level outcomes data on the Internet biannually.³ Nationally, the one year graft survival rate was around 92% during the period covered by this study.

The Scientific Registry computes the expected graft survival rate for each center by 1) estimating survival time as a function of donor and recipient characteristics using national data, 2) predicting the likelihood of surviving longer than one year for each of the patients transplanted at the center, and 3) summing over patients. The expected graft survival rate is the graft survival rate that would be expected given the types of patients transplanted at the center based on the experience of transplant recipients nationwide. A center whose observed survival rate exceeds its expected survival rate is performing better than expected. The model used to calculate expected graft survival rates includes an extensive set of controls for donor and transplant recipient characteristics, including recipients’ kidney function at transplant, primary diagnosis, functional status, and insurance (private versus other) and donors’ comorbidities and the immunological compatibility between donor and recipient. Complete details are available in the Technical Methods section of the Scientific Registry website.⁴

6. ANALYSIS OF TRANSPLANT NETWORKS

Lists of five health plans’ kidney transplant networks were obtained from the Internet.⁵ Collectively, these large, for-profit plans cover over 50 million persons. These network lists were merged with outcomes data for in-network centers and out-of-network centers in the same states as the in-network facilities. Health plans that do not contract with any of the transplant hospitals in a state are assumed not to have membership in that state. Children’s hospitals, Veterans Administration hospitals, and the Walter Reed Army Medical Center are excluded.

³Reports can be viewed at <http://www.ustransplant.org/csr/current/csrDefault.aspx>.

⁴<http://www.ustransplant.org>.

⁵Blue Cross and Blue Shield and Kaiser Permanente delegate kidney transplant contracting to regional sub-units, and so comprehensive national lists for these plans were unavailable.

In this analysis, outcomes reflect the experience of adult kidney recipients transplanted between January 1, 2002 and June 30, 2004.

Table 1 reports quality measures for in- and out-of-network transplant centers and the number of hospitals in each plan's network. Of the 207 total non-federal adult kidney transplant centers, 3 are all five networks and 19 are in four networks. One-hundred and seven (107) centers are not in any of the five networks. A quick glance at the networks reveals that they typically include the older, more established transplant programs in each state (for example, University of Alabama at Birmingham, University of California at Los Angeles, Barnes Jewish Hospital in St. Louis). Plans include 21% to 38% of the centers in their service areas.

The first row under each plan, labeled "O-E graft survival", displays observed minus expected graft survival averaged across hospitals. For all plans, in-network centers have better outcomes than out-of-network centers, on average. It is easier to interpret these results if one assumes for the moment that all hospitals have the same expected graft survival rate of 90%. Then the observed graft survival rate for centers in BeechStreet's network would be 90.9%, and the observed graft survival rate for programs excluded from BeechStreet's network would be 89.42%. Receiving care at a randomly-selected in-network facility increases the chances of having a functioning graft at one year post-transplant by over one percentage point.

The second row under each plan, labeled "Weighted O-E graft survival", displays the volume-weighted average observed minus expected graft survival. Transplant volume at each hospital is used like a sample weight to give greater influence to hospitals that treat more patients. P-values are adjusted accordingly. Results are not substantively different from those based on the unweighted average.

The third row displays the "z-score", which equals the observed minus expected survival rate divided by the standard error of the difference (see Luft et al. 1990). The z-score reflects the degree of confidence, statistically speaking, that the difference between the observed and expected graft survival rate is real and will be higher in absolute terms for centers with larger numbers of patients. The fourth and fifth rows display average transplant volume and the number of in- and out-of-network centers.

All of the differences in the measures are consistent with the hypothesis that plans prefer to include high quality transplant centers in their networks. A possible source of bias is that by directing more patients to specific centers, plans will increase transplant volume at those centers and decrease it at others. If higher volumes lead to better outcomes – a common finding in the medical literature on surgical survival rates – then the high-volume, in-network facilities will have better outcomes even if plans do not actively seek out high quality providers. In effect, the relationship is endogenous. A regression of observed minus expected survival on volume indicates that each additional transplant increases the quality measure by 0.006 ($p = 0.004$). Instrumenting volume with the total number of transplant registrants residing within 100 miles of each center yields a coefficient of a similar magnitude but it is no longer significant ($p = 0.35$). In either case, the size of the relationship is not enough to account for the quality differences displayed in Table 1.

Note that the model used to compute expected graft failure rates includes insurance status as a control. Thus, the fact that in-network facilities have higher quality than out-of-network facilities is not because privately-insured patients have better post-transplant outcomes. In fact, in-network centers have higher quality even when quality is measured using only outcomes data from patients with Medicare.

Another source of bias is the failure to control for the location of plans' enrollees. If enrollees happen to live near transplant centers with good outcomes, then it will appear that plans

consider quality even if they do not. For this reason, it is important to consider patient-level data that include information on residential location.

7. ANALYSIS OF PATIENT-LEVEL DATA

7.1 Overview

This goal of this analysis is to determine whether non-elderly, privately-insured adults, whose choices are constrained by exclusive networks, are more likely than non-elderly Medicare beneficiaries to select high-quality transplant centers. Medicare beneficiaries may freely register at any transplant center certified under Medicare's End Stage Renal Disease Program. Patients' choices are modeling using a conditional logit model where hospital quality and distance are interacted with patient characteristics, including insurance type.

The rules governing enrollment in Medicare are complicated. Most patients do not become eligible for Medicare until three months after the initiation of dialysis. The three month waiting period is waived for patients who undergo kidney transplantation and patients trained for home dialysis. After the three month waiting period, patients enroll in Medicare. For patients with pre-existing employer group coverage, Medicare becomes the secondary payer for a 30 month "coordination" period. After 30 months, Medicare becomes the primary payer.⁶ During this 30 month coordination period, patients are subject to the network restrictions of their private health insurers. For patients without pre-existing coverage, Medicare becomes the primary payer immediately after the 3 month waiting period.

Given these rules, registrants with private insurance at registration are those who 1) had private insurance at diagnosis, 2) are able to maintain coverage, and 3) register soon after being diagnosed with kidney failure. Ideally, all medically-suitable kidney failure patients should register for transplantation immediately following diagnosis. However, delays are common. Some nephrologists are slow to refer patients, some patients are slow to schedule the battery of pre-registration tests, and uninsured patients must wait until they have coverage to pay for the pre-transplant workup. The relationship between insurance coverage and time on dialysis at registration is displayed in Figure 1 for patients age 18 to 64 with either Medicare or private insurance. Slightly more than 60% of patients who registered within six months after diagnosis were privately insured, but only 25% of patients who registered after two years on dialysis had private insurance.

7.2 Patient-level registration data

The main study sample consists of non-elderly adults (aged 18 to 64) registering for kidney transplants between January 1, 2000 and October 31, 2002. Because the choice of transplant center is made at the time of registration, not the time of transplant, registration data are appropriate for this analysis. The data were obtained from the Scientific Registry of Transplant Recipients. Registration is mandatory, and so the database includes the universe of candidates for deceased donor transplants in the United States. Some registrants in the sample have since received transplants, some died on the waiting list, and others are still waiting. The database also includes about 30 percent of living-donor transplant recipients, who are not required to register but may do so in case their living donor is unable to donate.

The following groups of patients were excluded from the analysis: patients residing outside the continental United States, candidates for multi-organ transplants, (who must choose from a much narrower set of hospitals, those that perform liver, lung, pancreas, or intestine

⁶Private insurers and employers typically discontinue primary coverage for enrollees who qualify for Medicare, though they may continue to serve as the "secondary" payer.

transplants), patients who have been transplanted previously (the vast majority of whom register at the institution where they received the first procedure), patients registering at transplant centers that were not in operation long enough to be included in the most recent center-specific survival report, patients with only one transplant center in their choice set, patients who registered at a transplant center not included in their choice set, and patients for whom neither private insurance nor Medicare was the primary payer.

7.3 Variable construction

The conditional logit model includes quality, as measured by the difference between the observed and expected one-year graft survival rate, and travel distance as hospital attributes. Actual and expected graft survival rates were obtained from the July 2003 center-specific survival report of the Scientific Registry of Transplant Recipients. Travel distance in miles from patient i to hospital j is measured by the great circle distance in miles from the center of patient i 's home zip code to the center of the zip code in which hospital j is located. Distance is highly correlated with actual travel times (Phibbs and Luft 1995). Following Luft et al. (1990), distance was log-transformed to account for the fact that the marginal disutility of traveling 10 versus 5 miles is greater than the marginal disutility of traveling 105 versus 100 miles.

Both quality and distance are interacted with the following patient characteristics: age, male, race (white versus non-white), current therapy (dialysis versus none), donor type (living versus deceased), comorbidities (diabetes, cardiac conditions), functional limitation (limited in one activity of daily living [ADL] versus no limitations), educational attainment (high school graduate, college graduate, missing), employment status (employed versus not working), and insurance type (private versus Medicare). Insurance type is based on the primary payer, so a patient in the 30 month coordination period would be counted as having private insurance. Including two transplant center attributes as levels and interactions with thirteen patient characteristics generates a model with 28 ($= 2 \times [1 + 13]$) variables. The coefficient on the interaction of quality with private insurance is of primary interest. Table 2 displays summary statistics by insurance status.

7.4 Statistical analysis

Choice sets consist of the 20 transplant centers closest to each patient. Choice sets constructed in this manner include the actual choices of all but 259 registrants, who were excluded. The final sample includes 37,903 registrants and 758,060 registrant-hospital pairs ($= 20 \times 37,903$).

The estimating equation is

$$U_{ij} = \beta_{01}q_j + \beta_{02}q_jAGE_i + \beta_{03}q_jMALE_i + \dots + \beta_{14}q_jPRIV_i + \beta_{13}d_{ij} + \beta_{14}d_{ij}AGE_i + \beta_{15}d_{ij}MALE_i + \dots + \beta_{28}d_{ij}PRIV_i + \varepsilon_{ij}, \quad [1]$$

where q_j is the quality of center j , d_{ij} is the distance from patient i to center j , and $PRIV_i$ is one if i has private insurance and zero if i is enrolled in Medicare. Parameters are estimated via maximum likelihood.

For Medicare patients, the coefficients identify the preferences of patients and their referring physicians. The utility of patient i at center j , given his ex ante knowledge of quality at j , is U_{ij} . For patients with private insurance, the coefficients identify the combined preferences of patients and their referring physicians and health plans.

To test the sensitivity of results to the independence of irrelevant alternatives axiom, which is implicit in the structure of conditional logit choice probabilities, I estimated a mixed logit model (Train 2003), allowing different combinations of parameters to vary randomly in the

population. Results from mixed logit models were qualitatively similar to those from the standard conditional logit model, and so only the conditional logit results are presented for ease of explication.⁷

Table 3 displays characteristics of the choice sets (the top panel) and the centers in the choice sets that were actually chosen (the lower panel) by insurance type. The data indicate that quality does not differ between the choice sets of privately-insured patients and patients with Medicare. In both cases, observed minus expected graft survival is -0.006 . Privately insured patients tend to live closer to transplant centers; the average distance from each privately-insured patient's home to the centers in his or her choice set is 162 miles versus 172 miles for patients insured by Medicare. Data on actual choices indicate that privately-insured patients register at higher quality hospitals. The quality measure is 0.005 for privately-insured patients versus 0.001 for Medicare patients.

7.5 Coefficient estimates

Table 4 displays parameter estimates from the conditional logit model. Most are in the expected direction. The interaction of private insurance and quality is positive, indicating that privately-insured patients are more likely to register at centers with better outcomes. The interaction with distance is also positive, indicating that privately insured patients register at facilities farther away from home.

White patients and patients with at least one activities of daily living limitation appear to be attracted to high quality facilities. Minority patients may be disproportionately attracted to hospitals that serve minority populations. Interestingly, the interactions of quality with education and employment status do not suggest that patients with college degrees or employed patients are differentially attracted to hospitals with better graft survival rates.

The coefficient on the private insurance-quality interaction, the primary variable of interest, is identified from the within choice-set variation in quality and the cross-sectional variation in insurance type. Selection bias is not a problem; the insurance status of registrants is determined via exogenous programmatic rules. However, results will be subject to omitted variable bias if there are unobserved patient characteristics that are correlated with both insurance status and preferences for or ability to evaluate quality. As shown in Table 2, there are large differences between privately-insured and Medicare registrants in terms of race, the proportion on dialysis, educational attainment, and, not surprisingly, employment status. These figures indicate that the private insurance-quality interaction coefficient may be biased upwards.

To examine the significance of this bias, I re-estimated the model using the subsample 18,344 registrants who received a transplant by the end of 2004 and entered each transplant recipient's actual outcome (1 if the patient's graft was functioning at one year post-transplant, 0 otherwise) into the model as an interaction term with quality and distance. These terms capture the impact of unobserved patient characteristics that influence outcomes on preferences for quality and distance. Results are displayed in the third and fourth columns of Table 4. Compared to the baseline model, the level coefficient on quality is much smaller and insignificant, but the coefficient on the interaction of private insurance and quality remains positive and significant. Not surprisingly, the coefficient on the interaction of registrants' actual outcomes and quality is positive and significant.

⁷It is not surprising that the conditional and mixed logit results are similar. Hospital attributes are fully interacted with patient characteristics, allowing for heterogeneity in substitution patterns across observable patient types. Also, the large, mostly academic hospitals that perform transplants are fairly good substitutes for one another. If one thinks about violations of the axiom as an omitted variables problem, then the types of violations that might arise in a choice set consisting of, say, a Mercedes, BMW, and Ford, where "German luxury car" is the omitted variable, do not apply in this context.

7.6 Marginal effects

Marginal effects are calculated by calculating the average treatment effect of private insurance on quality, q , and distance, d . Define $PRIV$ as the variable measuring insurance status (1 if private, 0 otherwise), U_{ij}^z as the utility of patient i at hospital j with $PRIV$ set to z , and N as the sample size. Letting i index patient and j index hospital, the marginal effects are:

$$E(q \mid PRIV=1) - E(q \mid PRIV=0) \quad [2]$$

and

$$E(d \mid PRIV=1) - E(d \mid PRIV=0) \quad [3]$$

where

$$\begin{aligned} E(q \mid PRIV=z) &= \frac{1}{N} \sum_i \sum_j P_{ij}(PRIV=k) q_j \quad z=0,1. \\ E(d \mid PRIV=z) &= \frac{1}{N} \sum_i \sum_j P_{ij}(PRIV=k) d_{ij} \quad z=0,1 \end{aligned} \quad [4]$$

and

$$P_{ij}(PRIV=z) = \frac{\exp(U_{ij}^z)}{\sum_k \exp(U_{ik}^z)}. \quad [5]$$

The P_{ij} 's are the traditional conditional logit choice probabilities. Standard errors for [2], [3], and [4] are computed using the delta method.

Results for the baseline specification and a few alternative specifications are displayed in Table 5. Each set of results was constructed by re-estimating the conditional logit model and re-computing the choice probabilities and expected quality and distance measures.

The first and second row present expected quality and distance if every registrant were in private insurance or Medicare, respectively. The third row presents the difference, which can be interpreted as the sample average treatment effect of private insurance. Results show that if every registrant had private insurance, expected quality would increase by about one-third of a percentage point, or 57% of the standard deviation of the quality measure, and registrants would travel 8.3 miles further. If successful kidney transplantation is associated with a gain of 8 life years⁸, then these results imply that registrants who are willing to trade off one mile of travel distance for an expected day of survival time should prefer private insurance over Medicare.⁹

The second set of results is based on the model estimated on the subsample of registrants ($N = 18,344$) who received transplants by December 31, 2004. The model includes the interactions between quality and distance and transplant recipients' actual outcome. The third set of results is based on a sample of registrants ($N = 36,748$) who reside in a metropolitan statistical area where at least 25% of registrants were either in private insurance or Medicare and where there were at least 10 total registrants. Restricting the analysis to these "mixed markets" is meant to address the concern that results are driven by differences in choice sets and not actual choices. Results are similar to the baseline model.

The fourth set of results was constructed by limiting the sample to registrants who received a kidney from a living donor recipient ($N = 4,527$). The conditional logit model does not include

⁸This seems like a reasonable figure based on results reported by Schnitzler et al. (2005), but it is difficult to estimate the gain in life expectancy for kidney recipients whose grafts are functioning at one year post-transplant precisely based on results in the medical literature.

⁹ $0.0027 \times 8 \text{ years} \times 365 \text{ days} \div 8 \text{ miles} \approx 1 \text{ day per mile}$.

waiting time as a transplant center attribute. The length of time registrants can expect to wait before they are offered a kidney from a deceased donor varies significantly by region but not much within regions. Not all living donor recipients know that they will have a living donor at the time of registration, but many do. Thus, most do not consider expected time to a deceased donor transplant when choosing a transplant center. The marginal effects are similar to those from the baseline model, but the lower bound of the 95% confidence interval for the difference in expected quality is just below zero.

The fifth set of results was constructed by including only those centers in a 120 mile radius in registrants' choice sets ($N = 33,336$). Results for quality are similar to the baseline model, but, not surprisingly, the marginal effect of private insurance on distance is smaller.

8. PATIENT VERSUS PLAN EFFECTS: A TEST

Comparisons of the choices of privately-insured and Medicare patients may be biased by unobserved differences in the ability of privately-insured and Medicare patients to evaluate hospital quality. However, the parameters from the conditional logit model for Medicare patients should be unbiased estimates of their preferences for quality and distance. Using the network lists from Beechstreet, United Healthcare, Cigna, Humana, and Aetna, it is possible to simulate how restricting Medicare registrants' choices to these plans' networks would affect expected quality and distance. A finding that the network restrictions increase expected quality provides evidence that the results presented in the previous section reflect the causal effect of network restrictions on quality rather than the effect of omitted patient characteristics.

For each plan, I limited the sample to Medicare beneficiaries who live in a state where the plan contracts with at least one transplant center. I re-estimated the conditional logit model on this sample (excluding the interactions with insurance type) and computed expected quality and distance using the formulae described in [4]. I simulated the effect of network restrictions by re-calculating expected quality and distance by setting the choice probabilities, [5], for out-of-network transplant hospitals to 0 and re-calculating probabilities for in-network hospitals so that $\sum_i P_{ij} = 1$.

The results of this analysis are displayed in Table 6. For example, Medicare beneficiaries who live in Beechstreet's service area chose hospitals with an average quality of 0.0037 and a distance of 54 miles. If these registrants were limited to the transplant centers in Beechstreet's network, then we would expect that the average quality of and distance to their chosen center would increase to 0.0071 and 101 miles. Results are similar for other plans.

In general, restricting patients' choices to these exclusive networks increases expected quality by between one-third and two-thirds of a percentage point. This is very similar to the marginal effect of private insurance on expected quality calculated using only the patient level results (Table 5). Restricting patients' choices to these networks increases distance traveled by between 13 and 47 miles.

9. CONCLUSION

Health plans' restrictions on patients' choice of provider are unpopular, but, given that patients may find it difficult to evaluate providers' technical quality, it is a mistake to conclude that these restrictions are unambiguously welfare-reducing. If plans give sufficient weight to quality when forming networks, then restrictions on choice have the potential to improve patient welfare.

To address the role of quality in contracting decisions, this paper presents three analyses. The first shows that in-network hospitals have better outcomes than out-of-network facilities, the

second demonstrates that privately-insured patients receive treatment at hospitals with better outcomes compared to patients on Medicare, and the third shows that patients on Medicare would receive treatment at hospitals with better outcomes if they were restricted to plans' networks. Though each analysis has its limitations, collectively all are consistent with the hypothesis that plans consider quality when forming networks.

The results of this study strengthen the case for permitting Medicare beneficiaries with end-stage renal disease to freely enroll in Medicare managed care plans. Currently, the Center for Medicare and Medicaid Services is conducting a demonstration project to examine the feasibility and impact of enrolling end-stage renal disease patients in capitated managed care plans. By steering patients to high quality transplant centers, these plans can improve outcomes among transplant recipients. The impact of networks on patient welfare depends on the willingness of patients to trade off health for the inconvenience of travel and possibly worse quality along other dimensions (for example, physicians' "bedside manner"). This study has not evaluated the impact of networks on hospitals' incentives, but obviously forming networks based on quality will promote quality competition between providers.

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Figure 1.
Insurance status and time on dialysis at registration

Table 1
Quality differences between in- and out-of-network hospitals

Health plan	Center in network?		Diff.	P-value
	Yes	No		
BeechStreet				
O-E graft survival	0.90	-0.58	1.47	0.10
Weighted O-E graft survival	1.22	-0.18	1.40	0.07
Graft survival z-score	0.37	-0.14	0.51	0.07
Transplant volume	257	151	105	<0.01
Number of centers	28	133		
United Healthcare				
O-E graft survival	1.39	-1.19	2.58	<0.01
Weighted O-E graft survival	1.41	-1.06	2.47	<0.01
Graft survival z-score	0.69	-0.33	1.03	<0.01
Transplant volume	293	123	170	<0.01
Number of centers	55	168		
Cigna				
O-E graft survival	0.50	-0.92	1.42	0.05
Weighted O-E graft survival	0.83	-0.23	1.07	0.08
Graft survival z-score	0.49	-0.26	0.75	<0.01
Transplant volume	279	141	138	<0.01
Number of centers	40	138		
Humana				
O-E graft survival	1.40	-1.14	2.54	<0.01
Weighted O-E graft survival	1.29	-0.61	1.90	<0.01
Graft survival z-score	0.53	-0.28	0.81	<0.01
Transplant volume	259	138	121	<0.01
Number of centers	49	140		
Aetna				
O-E graft survival	0.74	-1.28	2.02	<0.01
Weighted O-E graft survival	1.03	-1.04	2.07	<0.01
Graft survival z-score	0.46	-0.39	0.85	<0.01
Transplant volume	259	126	133	<0.01
Number of centers	66	175		

O-E: Observed minus expected

Table 2

Summary statistics by insurance status

	All candidates		Transplant recipients	
	Private	Medicare	Private	Medicare
Age	49	50	48	49
Male	0.59	0.59	0.60	0.61
White	0.58	0.41	0.65	0.48
On dialysis	0.71	0.93	0.68	0.92
Living donor	0.16	0.07	0.31	0.16
Diabetic	0.35	0.41	0.28	0.35
Cardiac condition	0.15	0.21	0.13	0.18
ADL limitation	0.04	0.08	0.03	0.07
Education: HS degree	0.56	0.61	0.55	0.62
Education: College degree	0.21	0.10	0.22	0.11
Education: Unknown	0.21	0.22	0.20	0.20
Employed	0.53	0.20	0.57	0.24
N	19,467	18,436	10,291	8,053

Table 3

Choice set characteristics by insurance status

	Overall	By insurance type	
		Private	Medicare
Choice sets			
Observed-expected graft survival	−0.006 (0.047)	−0.006 (0.046)	−0.006 (0.048)
Distance in miles	167 (131)	162 (133)	172 (128)
Volume	163 (143)	165 (145)	162 (142)
N	758,060	389,340	368,720
Actual choices			
Observed-expected graft survival	0.003 (0.035)	0.005 (0.033)	0.001 (0.037)
Distance in miles	44 (58)	41 (56)	47 (59)
Volume	267 (200)	274 (194)	259 (206)
N	37,903	19,467	18,436

Standard deviations are in parentheses.

Table 4

Estimates from conditional logit models of hospital choice

Variable	Baseline Model		Transplant recipients only	
	Quality	Distance	Quality	Distance
Level	3.258 (1.190)*	-0.021 (0.000)*	-0.187 (1.740)	-0.021 (0.000)*
×Age	-0.011 (0.015)	-0.009 (0.001)*	-0.005 (0.019)	-0.007 (0.001)*
×Male	-0.004 (0.322)	-0.023 (0.018)	-0.145 (0.454)	-0.017 (0.028)
×White	1.420 (0.336)*	-0.025 (0.019)	1.135 (0.463)*	-0.076 (0.029)*
×On dialysis	-0.123 (0.469)	-0.038 (0.023)	-1.010 (0.617)	-0.014 (0.033)
×Living donor	-0.435 (0.503)	-0.060 (0.028)*	-0.565 (0.526)	0.126 (0.031)*
×Diabetic	-0.212 (0.354)	-0.038 (0.021)	-0.705 (0.512)	-0.114 (0.033)*
×Cardiac condition	-0.474 (0.406)	-0.116 (0.025)*	-0.262 (0.612)	-0.113 (0.041)*
×ADL limitation	-5.303 (0.653)*	-0.124 (0.044)*	-3.461 (0.994)*	-0.137 (0.071)
×Survive >1 year	--	--	4.718 (0.719)*	-0.212 (0.042)*
×Education: HS degree	-1.339 (0.789)	-0.324 (0.032)*	-0.942 (1.089)	-0.415 (0.050)*
×Education: College degree	0.913 (0.898)	-0.223 (0.038)*	0.685 (1.212)	-0.309 (0.059)*
×Education: Unknown	-0.816 (0.819)	-0.337 (0.035)*	-1.999 (1.131)	-0.351 (0.055)*
×Employed	-1.203 (0.364)*	-0.132 (0.021)*	-1.012 (0.504)*	-0.093 (0.031)*
×Private insurance	2.609 (0.357)*	0.168 (0.020)*	2.411 (0.498)*	0.182 (0.031)*
N	33,907		18,344	

Standard errors are in parentheses

* P < 0.05.

Table 5
Impact of private insurance on quality and distance traveled

	Transplant center attributes	
	Quality	Distance
Baseline model		
Private	0.0044 [0.0039, 0.0049]	58.9 [58.2, 59.5]
Medicare	0.0017 [0.0012, 0.0022]	50.7 [50.2, 51.3]
Difference	0.0027 [0.0019, 0.0034]	8.1 [7.2, 9.0]
Recipients only		
Private	0.0029 [0.0022, 0.0035]	55.4 [54.6, 56.2]
Medicare	0.0004 [-0.0004, 0.0011]	48.1 [47.4, 48.8]
Difference	0.0025 [0.0014, 0.0036]	7.3 [6.1, 8.4]
Mixed markets		
Private	0.0042 [0.0037, 0.0047]	56.4 [55.7, 57.0]
Medicare	0.0012 [0.0007, 0.0017]	48.9 [48.4, 49.4]
Difference	0.0030 [0.0022, 0.0038]	7.4 [6.6, 8.3]
Living donor recipients		
Private	0.0031 [0.0019, 0.0043]	55.7 [54.3, 57.2]
Medicare	0.0010 [-0.0009, 0.0029]	49.1 [47.3, 50.9]
Difference	0.0021 [-0.0002, 0.0045]	6.7 [4.3, 9.0]
Centers <120 miles		
Private	0.0038 [0.0033, 0.0043]	32.5 [32.2, 32.7]
Medicare	0.0007 [0.0001, 0.0012]	30.8 [30.5, 31.0]
Difference	0.0031 [0.0023, 0.0040]	1.7 [1.4, 2.1]

95% Confidence Intervals are in brackets.

Table 6

Simulated impact of networks on quality and distance for Medicare patients

Health plan	Actual	In-network	Difference [95% CI]
Quality			
BeechStreet	0.0037	0.0071	0.0034 [0.0031, 0.0037]
United	0.0037	0.0113	0.0076 [0.0073, 0.0079]
Cigna	0.0040	0.0079	0.0039 [0.0035, 0.0042]
Humana	0.0035	0.0063	0.0027 [0.0023, 0.0031]
Aetna	0.0014	0.0072	0.0058 [0.0055, 0.0061]
Distance			
BeechStreet	54	101	47 [46, 47]
United	52	66	14 [14, 14]
Cigna	52	65	13 [13, 13]
Humana	54	73	19 [19, 20]
Aetna	50	66	15 [15, 16]