Competition, Payers and Hospital Quality[1]

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Abstract

Objective. To estimate the effects of competition for both Medicare and HMO patients on the quality decisions of hospitals in Southern California.

Data Source. Secondary discharge data from the Office of Statewide Health Planning and Development for the State of California for the period 1989-1993.

Study Design. Outcome variables are the risk-adjusted hospital mortality rates for pneumonia (estimated by the authors) and acute myocardial infarction (reported by the state of California). Measures of competition are constructed for each hospital and payer type. The competition measures are formulated to mitigate the possibility of endogeneity bias. The relationships between risk-adjusted mortality and the different competition measures are estimated using ordinary least squares.

Principal Findings. The study finds that an increase in the degree of competition for HMO patients is associated with a decrease in risk-adjusted hospital mortality rates. Conversely, an increase in competition for Medicare enrollees is associated with an increase in risk-adjusted mortality rates for hospitals.

Conclusions. In conjunction with previous research, the estimates indicate that increasing competition for HMO patients appears to reduce prices and save lives and hence appears to improve welfare. However, increases in competition for Medicare appear to reduce quality and may reduce welfare. Increasing competition has little net effect on hospital quality in our sample.

Key Words. Competition, Hospitals, Medicare, HMO, Mortality, Pneumonia, AMI.

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Introduction

Two types of insurers dominate the U.S. health care economy: the federal and state governments, through the Medicare and Medicaid programs, and privately purchased managed care or HMOs. These insurance systems reimburse health care providers differently, which gives providers different and potentially offsetting incentives to deliver quality care. Some argue that in a managed care environment competition will provide the appropriate incentives for insurers and providers to deliver the optimum level of care at prices that approach marginal cost (Enthoven (1993)). In contrast, hospitals will have different incentives to provide quality care to Medicare patients since they have little control over the reimbursement rates they receive from Medicare.[2] There is substantial evidence that since the rise of managed care, increasing competition in hospital markets has led to lower prices.[3] The incentives for hospitals to make quality-enhancing investments will be affected by their return on quality. That return will be a function of the competitive environment and the mechanisms and generosity of reimbursement. Thus, competition for Medicare and HMO patients may have differing impacts on hospital quality.

In this paper we seek to estimate the effects of competition for both Medicare and HMO patients on the quality outcomes of hospitals in Southern California. We examine two diagnoses, pneumonia and acute myocardial infarction (AMI). Our basic method of analysis is simple: we regress quality of care on levels of competition. However, we address a number of issues that complicate this analysis.

First, standard measures of competition are likely to be endogenous. This is because high, unobserved quality for a hospital is likely to lead it to have a large market share which will make it appear to have a high measure of market power. To address this issue, we develop measures of competition based on patient flows that are predicted using only exogenous characteristics.[4] Second, we account for competition for both HMO and Medicare patients by measuring quality as a function of the level of competition for each payer type multiplied by the predicted fraction of patients of that payer type. Third, we use measures of hospital quality (in our case risk-adjusted mortality) that control for observed and unobserved severity. For our estimation, we focus on a single geographic area, Los Angeles County, and pool data from a four-year period. Thus, the parameters will be identified from the relation between hospital quality and the degree of competition and patient types across different parts of the area.

In contrast to the large body of work on the pricing effects of competition, the literature on the effect of hospital competition on medical outcomes is relatively sparse. Shortell and Hughes (1988), Ho and Hamilton (2000), and Mukamel, Zwanziger, and Tomaszewski (2001) find no significant relation between hospital competition and quality. In contrast, Kessler and McClellan (2000) find that increases in competition increased patient mortality from 1986-1989, but decreased patient mortality from 1991-1994. Additionally, they find that competition unambiguously reduced mortality only in states with above-median HMO penetration. Propper, Burgess, and Green (2002) find that increased competition between hospitals in Britain's National Health Service reduced mortality rates for AMI. Our analysis is most similar to the Kessler and McClellan study. However, our work differs from theirs in several important ways as we examine the effects of competition for patients with different types of insurance, and over two very different diseases. Moreover, our findings imply different relationships between competition and hospital quality.

Background

We examine the relationship between competition for patients with differing insurance arrangements and hospital quality. It is reasonable to ask why competition over different payer classes may have differential impacts on hospital quality. There are two key assumptions that, if met, imply that competition for different payer types will impact the optimal, profit-maximizing hospital quality. First, that patients (or their agent physicians) directly or indirectly through their insurance choice select hospitals, at least in part, on the basis of perceived quality. Second, that hospitals cannot choose to offer different quality levels to patients based on their insurance type. If these conditions hold and increasing quality is costly, then hospitals will have an incentive to adjust their quality for all patients in response to changes in their competitive environments. A more rigorous statement of these ideas can be found in Glazer and McGuire (2002).

As an example, consider two hospitals, A and B. Suppose hospital A faces substantial competition for Medicare patients, while hospital B does not. Hospitals, in general, cannot affect their Medicare payment level. If Medicare reimburses hospitals below some threshold at which it is undesirable to attract Medicare patients, the hospital will have an incentive to reduce overall quality to shed patients.[5] The ability of the hospital to shed patients will depend on the options these patients face. Because patients at hospital A have more choices, it will be easier for hospital A to shed patients by reducing quality than for hospital B. Thus, all else being equal, A will have an incentive to have lower quality than B. Conversely, if Medicare pays above the threshold, then A will have an incentive to have higher quality than B.

Theoretically, the impact of competition on quality for patients enrolled in managed care plans is less clear. Different economic models yield differing predictions on the relationship between competition and price because they incorporate different underlying assumptions.[6] As it is very difficult to determine which assumptions are likely to be empirically correct, we have no clear guidance on the directional impact of increased hospital competition on hospital quality.

The incentive to increase quality may also vary by diagnostic and procedure category. The margins on Medicare payments vary considerably across DRGs (McClellan 1997), and the profitability of treating a given diagnosis varies across payers (Chernew, Gowrisankaran, and Fendrick 2002). Hospital reputations differ across disease classes, implying that they can affect the quality of care in specific areas.

In this paper we focus on the relationship between competition and hospital quality for two diagnoses: AMI and pneumonia. In general, pneumonia patients may have discretion over the hospital to which they are admitted. A difference of an hour in transportation time is not likely to directly impact the patient's prognosis. Thus, our measures of competition for pneumonia should directly capture the competitive environment for this disease. However, this is not true for AMI where a delay of several minutes in treatment can have a substantial impact on the patient's outcome.

Since patients have less discretion in selecting their hospital when they suffer an AMI, it is reasonable to ask what competitive forces affect hospitals' incentives to provide quality care for AMI. We believe that there are at least two important forces. First, while hospitals may not compete directly for AMI patients, they do compete to be part of an HMO's network and, insofar as quality of care impacts the HMO's decision to include the hospital in the network, it will affect the hospital's incentive to provide quality care. Second, the quality of care for AMI is likely positively correlated with quality of care for other heart procedures and diagnoses, and for most of these diagnoses patients do have discretion over the choice of hospital. Chernew, Scanlon, and Hayward (1998) find that HMO enrollees are more likely to be admitted to better hospitals for coronary artery bypass graft (CABG) surgery.

Methodology

The purpose of this paper, which is to estimate the relationship between hospital quality and competition for different payer types, requires the formulation of measures of competition for each payer group. Besides controlling for payer groups, we have two other broad concerns in measuring the level of competition. Traditionally, measures of competition are formulated using a two-step method. The first step defines the extent of the geographic and product market. In studying hospital competition, this is generally done by defining the geographic markets (e.g., counties) in which hospitals compete. The product market usually is a set of inpatient services. The second step involves measuring market shares given the market definition.

Both steps may introduce significant biases to the competition measure. For example, the definition of the geographic market is usually based on geopolitical boundaries (e.g. counties or standardized metropolitan statistical areas (SMSAs)) instead of economic notions of markets and thus is often *ad hoc* and can lead to substantial biases in the parameters of interest. It is also difficult to model the fact that hospitals are geographically dispersed within a given market with substitutability of hospitals varying substantially within the market.

The second problem in formulating measures of competition is that one must construct measures of hospital size. Measures of size that are based on actual patient flows will be endogenous: high quality hospitals may attract more patients from farther away. Thus, an increase in the quality of a hospital would cause it to appear to have more market power. This problem will be exacerbated with HMO patients because HMOs generally form hospital networks, where the networks typically include only a subset of the total set of hospitals. For example, consider a region with one HMO and two hospitals. If the HMO negotiates a favorable rate with one hospital and includes it in its network, a Hirschman-Herfindahl Index (HHI) measure of market concentration based on actual HMO patient flows will be extremely high and will underestimate the intensity of the actual hospital competition.

Following Kessler and McClellan (2000) and Town and Vistnes (2001), we compute a measure of competition that is based upon the results of a multinomial logit model of hospital choice. Our specification for the choice model explicitly accounts for geographic and product differentiation but is not based on endogenous hospital variables. This allows us to formulate hospital–specific measures of competition for the different insurance categories that satisfy both of our concerns. In the remainder of this section, we discuss our model of hospital choice and our construction of competition and quality measures.

Model of Hospital Choice

We now detail our exact choice model. We posit that the indirect utility that a patient with diagnosis *s* receives from being admitted to hospital $j \in J$, conditional on deciding to be admitted to a hospital, is given by

$$(1) \qquad u_{ij}^{s} = \lambda_1^s d_{ij} + \lambda_2^s beds_j + \lambda_3^s close_{ij} + \lambda_4^s d_{ij} \times emerg_i + \lambda_5^s close_{ij} \times emerg_i + e_{ij}^{s},$$

where d_{ij} is the distance from the center of the patient's zip code to the center of the hospital's home zip code, $beds_j$ is the number of beds at hospital *j*, $close_{ij}$ is an indicator variable taking the value of one if the hospital is the closest one to the patient's home zip code and zero otherwise, and $emerg_i$ is an indicator variable taking the value of one if the patient had an emergency admittance and zero otherwise. The error term, e_{ij}^{s}, is iid, Type I extreme value and captures the effects of unobservable attributes on patient choice.

We estimate (1) using the hospital selection decisions of Medicare enrollees in California. We use this group because, in general, individuals in this group are free to choose any hospital and the price they pay for inpatient services (essentially a small deductible) does not differ by hospital.[7] We then use the parameter estimates of (1) to derive predicted patient flows for all payer groups. Previous work (Town and Vistnes (2001)) finds that the Medicare-based choice model translates quite well to the younger Medicaid population.

<u>Formulating Measures of Market Concentration and the Geographic Dispersion of Patients</u>

We use the estimated parameters of (1) to formulate hospital–specific measures of competition for each payer type. For a given hospital choice set *J*, let $\hat{P}_{ij}^{s}$ be the estimated probability that individual *i* with diagnosis *s* will be admitted to hospital *j*. Under the logit assumption, $\hat{P}_{ij}^{s}$ is given by

$$(2)\qquad \hat{P}_{ij}^{s} = \frac{\exp(\hat{u}_{ij}^{s})}{\sum_{k\in J}\exp(\hat{u}_{ik}^{s})},$$

where $\hat{u}_{ij}^{s}$ is the expected mean utility of being admitted to hospital *j* (not including the e_{ij}^{s}) as implied by the parameter estimates of the logit model.

In this framework the HHI for patient *i* is:

$$(3)\qquad HHI_{i}^{s} = \sum_{j\in J}\left(\hat{P}_{ij}^{s}\right)^{2}.$$ [8]

HHI_{i}^{s} measures the degree of competition for individual *i*. A given hospital *j* will concern itself with the nature of competition over those patients that it is likely to attract. Thus, we weight HHI_{i}^{s} for hospital *j* by the relative likelihood that the patient will be admitted to hospital *j*. For a given patient, the likelihood of admission is simply $\hat{P}_{ij}^{s}$. Our measure of competition for hospital *j* for payer type *z* and disease *s*, which we denote H_{jz}^{s}, is the weighted mean of the estimated, patient-level HHI. Thus:

(4) $$H_{jz}^{s} = \frac{1}{N_j^s} \sum_{i \in I_z^s} \hat{P}_{ij}^{s} HHI_i^s ,$$

where I_z^s is the set of patients with diagnoses s and insurance z and $N_j^s = \sum_z \sum_{i \in I_z^s} \hat{P}_{ij}^s$. In the mortality regressions we include the expected volume N_j^s as a regressor. If there are increasing or decreasing returns to scale with respect to quality for treating a condition then it is important to control for volume. We use expected volume because actual patient volume is likely endogenous.

We formulate (4) for five different payer groups for each diagnosis. The five groups are Medicare enrollees (MED), HMO enrollees (HMO), self-pay and indigent patients (IND), traditional indemnity insurance enrollees (IDM), and enrollees in California's Medicaid program, MediCal (MCD).

There are two sources of variation that identify the parameters on H_{jz}^s. First, there is significant variation across zip codes in the number of potential patients by insurance type. The coefficient of variation across zip codes on the number of AMI procedures is approximately 1.0 for all five payer groups. The across zip code correlation in the number of AMIs is 0.59 between the Medicare and HMO categories, 0.47 between the Medicare and Medicaid categories, and 0.35 between the HMO and Medicaid categories. Second, hospitals in our sample face different competitive environments. For instance, Town and Vistnes (2001) find significant differences in hospital bargaining power in the Los Angeles area.

<u>Measures of Hospital Quality</u>

We focus on mortality as our measure of hospital quality, as it is the most common and oldest outcome–based measure. We use different risk-adjusted hospital mortality rates for pneumonia and AMI. The pneumonia rates come from Geweke, Gowrisankaran, and Town

(2003) (hereafter, GGT). GGT estimate a Bayesian model of the 10-day in-hospital mortality that corrects for both observable and *unobservable* severity of illness of the patient. GGT correct for unobservable severity bias using Bayesian techniques that are analogous to the classical econometric method of instrumental variables. Because of the computational complexity of the estimation procedure, they limit their sample to Los Angeles County (*N*=114). The AMI rates come from Luft and Romano (1997) (hereafter, LR). They estimate 30-day risk-adjusted mortality rates for AMI for most hospitals in California. In addition to controlling for patient demographics, LR control for comorbidities by linking up the AMI discharge records with other possible past admissions to California hospitals.

We focus our attention on the Los Angeles region, for three reasons. First, GGT limit their study to Los Angeles County. Second, in previous work, Town and Vistnes (2001) have analyzed the pricing behavior of hospitals in this region over this time period. They found that the price that a hospital charges an HMO decreases in the ability of the HMO to drop or replace the hospital from its network. Thus, we can link our measures of concentration and quality to the pricing behavior of these hospitals. Finally, by limiting our geographic focus, our results likely will not be driven by geographic variation in unobservable characteristics that may affect mortality but are unrelated to hospital competition.

Our empirical strategy is straightforward. For each disease, we formulate the measures of market concentration H^s_{jz} and obtain the measures of hospital quality. We then perform an OLS regression of quality on H^s_{jz} with controls for hospital ownership status, size and N^s_j. We use a log — log specification; i.e. we transform all the continuous variables by the natural logarithm.

Data

Our principal data comes from the State of California Office of Statewide Health Planning and Development (OSHPD) patient discharge database, which records information for every individual who was discharged from an acute care facility in the state. Both LR and GGT use OSHPD data to formulate their risk-adjusted mortality rates. LR estimate each hospital's average AMI mortality rate for 1991-1993. Similarly, GGT formulate each hospital's relative contribution to patient mortality for 1989-1992. Thus, there is substantial overlap in the time frames used by both studies in formulating their measures of hospital mortality rates.

The parameters from (1), the hospital choice problem, are also estimated using the Version B patient discharge data from OSHPD. We estimate the parameters of (1) for two different types of conditions: AMI and pneumonia. For this purpose, the data provide patient-level information on zip code of residence, DRG, race, sex, age (by classes), hospital that the patient was admitted to, source of admittance (emergency room, etc.), and disposition (normal discharge, death, etc.). From these data we kept those patients who were admitted to a hospital in Los Angeles, Orange, Riverside, San Bernardino, and Santa Barbara counties and who were coded as Medicare enrollees. We removed from the data set any patient whose source of admission was other than the emergency room or routine and any patient with missing zip code information.[9] All of the hospitals for which we have mortality data are located in Los Angeles County. We include patients and hospitals from the surrounding counties in this sample to avoid biases that may occur for those hospitals located near the county border.

In addition to the patient level data, OSHPD is the source of our hospital-level controls. We measure hospital size by the number of staffed beds, and include four categorical controls (150 or fewer beds, 151-200, 201-300, and greater than 300 beds).[10] We also use the profit and teaching statuses as regressors. We define a hospital to be a teaching hospital if it is a member of the Council of Teaching Hospitals. Our data also include the longitude and latitude for the center of each zip code, which we obtained from the TIGER database.[11] This longitude/latitude data allows us to calculate straight-line distances using the great circle formula between hospitals' and patients' home zip codes.[12] Lastly, there is significant cross–ownership of hospitals in Los Angeles County. We obtained cross ownership data from OSHPD and account for it in our calculations of concentration.[13]

Table 1 presents summary statistics for the different data sets used in the analysis. The top half of the table presents the summary statistics for the Medicare discharge data for the AMI and pneumonia diagnoses. The typical AMI patient is younger (75 versus 76.5 years), travels slightly further to her chosen hospital (7.7 versus 7.5 km), and is more likely to be admitted via the emergency room (63% versus 20%) than her pneumonia counterpart. Over a third of both AMI and pneumonia patients are admitted to the closest hospital.

The hospital data is presented in the bottom half of Table 1. Both AMI and pneumonia carry a significant likelihood of death, with the AMI mortality rate being higher than the pneumonia mortality rate (14.9% versus 9.5%). The relatively high likelihood of death for these conditions suggests that mortality is an appropriate measure of hospital quality. There is also significant variation in the mortality rates for both diagnoses across hospitals. The standard deviations are 3.9% and 2.3% for AMI and pneumonia, respectively.

[Table 1 about here]

Results

Hospital Choice and Estimates of $\underline{H^{d}_{jz}}$

Table 2 presents the coefficient estimates of (1) for the Medicare population for both AMI and the pneumonia diagnoses. The coefficient estimates are roughly as expected. The coefficient on the impact of distance on hospital choice is negative and significantly different from zero for both diagnoses. Larger hospitals are more attractive for both conditions—the coefficient on number of beds is significant and positive. Patients are inclined to go to the closest hospitals for the treatment of both AMI and pneumonia. AMI patients who are admitted via the emergency room are more likely to go to hospitals that are closest to their home. The coefficient on $Emergency \times Distance$ is significantly negative in both samples. The coefficient on $Emergency \times Distance$ in the AMI sample is larger than the one in the pneumonia sample. The coefficient on $Emergency \times Close$ is not significantly different from zero at traditional confidence levels for either diagnosis.

[Table 2 about here]

Using the coefficient estimates in Table 2, we formulate our measures of competition for the five payer groups for both medical conditions. Table 3 presents the summary statistics of the measures of weighted competition by diagnosis, *H*, for each payer group. There is significant variation across hospitals in these measures. In general, the standard deviations are larger than the means and the maximum value for each measure is over ten times the mean value for each measure. In Table 3 we present the hospitals that correspond to the maximum and minimum below their respective values. The hospitals with the minimum values are small hospitals or are located near other large hospitals (e.g., Pacifica Hospital; beds = 242), while hospitals with the maximum values are geographically isolated (Westlake Medical Center; beds =115) institutions. Also, the measures of market power for well-known hospitals reveal interesting properties of our measures. For example, Cedars Sinai and UCLA Medical Center have H_{MED}^{AMI} values (0.17 and 0.13) that are at approximately the 85th and 90th percentiles of the distribution, respectively. However, these hospitals have H_{HMO}^{AMI} measures of 0.018 and 0.015 respectively—placing them at approximate median of that distribution and indicates that these hospitals compete more intensely for HMO patients.

The measures of *H* across payer categories are highly but imperfectly correlated. OLS regressions of *H* for one payer group on *H* for *all* other payer groups for the same diagnoses yield an average R^2 of 0.85. Within diagnoses, differences in *H* are due solely to differences in the geographic distribution of patients. This suggests that even in an urban area such as greater Los Angeles, hospitals will face differences in patient mix and competition for patients from different payer groups.

[Table 3 about here]

Hospital Competition and Hospital Quality

Next we examine the multivariate relationship between the measures of hospital quality and hospital concentration for AMI and pneumonia diagnoses. We control for similar hospital-specific characteristics as in (1) to avoid any endogeneity of the competition measures. Table 4 reports regressions that examine the relationship between measures of competition and mortality for AMI and pneumonia separately. We transform all continuous variables by the natural logarithm in these regressions.

The main findings of this paper are captured in the regression results in Table 4. Hospital quality is correlated with the weighted measure of competition and the nature of that correlation differs across payer groups. The estimates imply that holding the size of the patient population constant, increased competition for Medicare enrollees decreases hospital quality. This is true for both diagnoses. The coefficient on H_{MED} is negative and significantly different from zero at traditional levels of confidence in both regressions. A 10% increase in H_{MED} is associated with a decrease in hospital mortality of 3.3% for AMI and 3.5% for pneumonia. Thus, increasing H_{MED}

from the median level to the top quartile decreases expected mortality by about 19% for AMI and 16% for pneumonia. The estimated effect of competition on hospitals in markets where there is administrative pricing is consistent with the findings of Propper, Burgess, and Green (2002) for Britain's National Health Service. They find that hospitals that face more competition have lower quality.

[Table 4 about here]

An increase in the weighted measures of competition for HMO patients (a decline in *H*) is correlated with an increase in hospital quality. In the AMI regression the coefficient on H_{HMO} is positive and significant at the 1% level. In the pneumonia regression the coefficient is positive but just insignificant at traditional levels—p-value = 0.11. A 10% increase in H_{HMO} is associated with an increase in hospital mortality of 2.3% for AMI and 1.5% for pneumonia. That is, increasing H_{HMO} from the median level to the top quartile increases expected mortality by about 12% for AMI. Given that severe pneumonia is a relatively infrequent occurrence for the population that is likely to enroll in HMOs, it is not surprising that the relationship between H_{HMO} and pneumonia mortality is weaker than for AMI mortality.[14]

For both diseases, the coefficients on the other payer group *H*'s are all insignificant at traditional levels of confidence. In the AMI regression, the coefficients on hospital characteristics are all insignificant. In the pneumonia regression, the coefficient on the 151-200 category is positive (relative to the excluded category of 150 or fewer beds) and significantly different from zero, while all the included ownership categories are negative and significant (relative to the excluded category of public hospitals). For both diagnoses, there is no significant difference between the qualities of not-for-profit and for-profit hospitals, conditioning on other variables.

The coefficient estimates indicate that the effect of changes in the competitive environment (e.g., from a merger) on hospital quality depends upon the relative impact of the change on the opposing forces of competition for HMO patients and competition for Medicare patients, which in turn depends on the geographic distribution of patients by payer type.

As an illustration of the opposing forces of Medicare and HMO competition, we compare the implied impact of a change in competition for AMI on hospital mortality with those of Kessler and McClellan (2000). Kessler and McClellan find that a decrease in competition from the 2nd to the 1st quartile of the HHI distribution is expected to increase mortality by 1.60 percentage points in high HMO penetration states. We perform a similar hypothetical experiment with our data by estimating the net impact of moving all hospitals in the 2nd quartile to the median of the 1st quartile for both H_{MED} and H_{HMO} for AMI. In contrast to Kessler and McClellan, our results indicate that an increase in measured market power from the 2nd to the 1st quartile of the distribution will leave expected mortality essentially unchanged. In this experiment, the Medicare and HMO effects exactly offset one another.

Discussion

Using data from the same geographic region over the same time frame, Town and Vistnes (2001) found that the bargaining power of an HMO with a hospital increases with the ability of the HMO to replace or remove a hospital from its network of hospitals. Thus, our findings in conjunction with the work of Town and Vistnes imply that increased hospital competition for HMO patients leads to lower hospital prices paid by the HMO and to higher hospital quality. However, the results indicate that competition among hospitals for patients whose costs are controlled by the government – as through Medicare – reduces hospital quality.

The finding that vigorous competition for Medicare patients is associated with high mortality rates suggests that Medicare margins are small. This finding is consistent with the work of Chernew, Gowrisankaran and Fendrick (2002). Small (or negative) Medicare margins are sufficient to account for our results, but there are other possibilities. For example, this result may also be due to deviations from profit-maximizing behavior on the part of hospitals.

Our results contrast with and clarify the findings of Kessler and McClellan (2000). They find that competition unambiguously improved welfare for AMI patients only in the post-1990 period. Our findings indicate that the story of hospital competition is not that simple. Interpreting their conclusions using our results, the reason for the change in the effect of competition may be the large increase in the percent of HMO patients during the late 1980s and early 1990s.

Moreover, Kessler and McClellan (2000) report that increases in hospital competition significantly improved hospital quality for Medicare patients in those states with above median HMO enrollment, while in states in which the HMO penetration was below the median, the effect of competition on mortality was not significant. That is, they find an HMO penetration / hospital competition interaction spillover effect for Medicare enrollees. Our results indicate the mechanism behind these spillovers: an increase in the competition for HMO patients directly leads to improved hospital mortality rates. Furthermore, the effects of competition depend upon the type of payer and the generosity of those payments.

Our results are also consistent with the works of Chernew, Scanlon, and Hayward (1998) and Escarce, et al. (1999). They find that HMO patients in California are more likely to be admitted to higher quality hospitals for coronary artery bypass graft surgery than non-HMO patients. The results of these papers along with our findings suggest that HMOs have preferences for higher quality hospitals. Thus, increased competition for HMO patients places more pressure on hospitals to improve their quality.

The findings suggest that the incentives for hospitals to reduce mortality rates differ according to the method of reimbursement. This, in turn, implies that both antitrust and Medicare policies will play a role in determining hospital quality. Increases in market concentration, as would occur following a merger, can lead to either increases or decreases in hospital mortality and the net effect will depend upon the geographic distribution of the Medicare and managed care populations about the hospitals. Also, the impact of the merger may vary across different types of medical conditions with different Medicare margins. This conclusion differs somewhat from Kessler and McClellan (1999) whose results imply that hospital mergers can only reduce hospital quality.

References

Chernew, M., G. Gowrisankaran and A.M. Fendrick (2002) "Payer Type and the Returns to Bypass Surgery: Evidence from Hospital Entry Behavior." Journal of Health Economics 21(3): 451-474.

Chernew, M., D. Scanlon, and R. Hayward (1998) "Insurance Type and Choice of Hospital for Coronary Artery Bypass Graft Surgery." Health Services Research 33(3): 447-66.

Dranove, D. and M. Satterthwaite (2000) "Industrial Organization," in Handbook of Health Economics, A. Culyer and J. Newhouse, eds., Amsterdam: North Holland.

Dranove, D. and W. D. White, (1998) "Medicaid-Dependent Hospitals and Their Patients: How Have They Fared?" Health Services Research 33(2, Part 1): 163-185.

Escarce, J., L. Van Horn, M. Pauly, S. Williams, J. Shea, W. Chen, (1999) "Health Maintenance Organizations and Hospital Quality for Coronary Artery Bypass Surgery." Medical Care Research and Review 56(3): 340-362.

Enthoven, A. (1993) "The History and Principles of Managed Competition." Health Affairs 12, (supplement): 24-48.

Gaynor, M. and W. Vogt, (2000) "Antitrust and Competition in Health Care Markets." in Handbook of Health Economics, A. Culyer and J. Newhouse, eds., Amsterdam: North Holland.

Geweke, J., G. Gowrisankaran and R. Town (2003) "Bayesian Inference for Hospital Quality in a Selection Model." Econometrica 71(4) forthcoming.

Glazer, J. and T. McGuire (2002) "Multiple Payers, Commonality and Free-Riding in Health Care: Medicare and Private Payers." Journal of Health Economics 21(6): 1049-1069.

Gowrisankaran, G., and R.J. Town, 1999, "Estimating the Quality of Care in Hospitals Using Instrumental Variables." Journal of Health Economics 18(6): 747-67.

Ho, V. and B. Hamilton (2000) "Hospital Mergers and Acquisitions: Does Market Consolidation Harm Patients?" Journal of Health Economics 19(5):767-791.

Iezzoni, L., ed., (1997) Risk Adjustment for Measuring Healthcare Outcomes. 2nd edition. Chicago: Health Administration Press.

Kessler, D.P. and M. McClellan (2000) "Is Hospital Competition Socially Wasteful?" Quarterly Journal of Economics 115(2): 577-615.

Kessler, D.P. and M. McClellan (1999) "Designing Hospital Antitrust Policy to Promote Social Welfare," NBER working paper 6897.

Luft, H.S. and P.S. Romano (1997) Report on Heart Attack, 1991-1993, Volume 3: Detailed Statistical Results. Sacramento, CA: California Office of Statewide Health Planning and Development.

McClellan, M. (1997) "Hospital Reimbursement Incentives: An Empirical Approach." Journal of Economics and Management Strategy 6(1): 91-128.

Minino, A., and B. Smith. (2001) "Deaths: Preliminary Data for 2000." National Vital Statistics Reports, 49(12) (October 9).

Mitchell S., J. Spetz, and J. A. Seago (2001) "Errors in Data on Hospital Ownership." Inquiry 38(4): 432-9.

Moorthy, K. S. (1988), "Product and Price Competition in a Duopoly." Marketing Science, Spring 1988, 7(2): 141-168.

Motta, M. (1993) "Endogenous Quality Choice: Prices vs. Quantity Competition." Journal of Industrial Economics 41(2): 113-131.

Mukamel, D., J. Zwanziger, and K. Tomaszewski, (2001) "HMO Penetration, Competition, and Risk-Adjusted Hospital Mortality." Health Services Research 36(6): 1019-1035.

Phibbs, C. and Luft, H. (1995) "Correlation of Travel Time on Roads Versus Straight Line Distance," Medical Care Research and Review 52(4): 532–542.

Propper, C., S. Burgess, and K. Green, (2002) "Does Competition Between Hospitals Improve the Quality of Care? Hospital Death Rates and the NHS Internal Market," mimeo.

Shaked, A., and J. Sutton (1983) "Natural Oligopolies." Econometrica 51(5):1469-1484.

Spence, M. (1975) "Monopoly, Quality and Regulation." Bell Journal of Economics, 6(2): 417-29.

Shortell, S. and E. Hughes (1988) "The Effects of Regulation, Competition, and Ownership on Mortality Rates Among Hospital Inpatients." New England Journal of Medicine 318(17): 1100-1107.

Town, R. and G. Vistnes (2001) "Hospital Competition in HMO Networks." Journal of Health Economics 20(5): 755-779.

Table 1

Summary Statistics
Means and Standard Deviations
(standard deviations in parentheses)

Medicare Patient Discharge Data		
	AMI sample	Pneumonia Sample
Age (in years)	75.0 (6.9)	76.5 (6.9)
Percent admitted to closest hospital	37%	36%
Distance to chosen hospital	7.74 km (11.9 km)	7.46 km (10.8 km)
Percent emergency admit	63%	20%
Number of observations	4,153	6,750

Hospital Summary Statistics			
	Mean (Standard Deviation)	Min	Max
AMI mortality rate	14.9% (3.91%)	5.2	26.5
Pneumonia mortality rate	9.5% (1.6%)	5.6	15.5
Staffed bed size	242.0 (222.8)	14	1,879
Percent private, not-for-profit	43.5%	0	1
Percent for-profit	48.7%	0	1
Percent teaching hospital	4%	0	1

Table 2

Parameter Estimates from Multinomial Logit Hospital Choice Model
(standard errors in parenthesis)

Variable	AMI Coefficients	Pneumonia Coefficients
Distance/10	-1.96*** (0.079)	-2.09*** (0.043)
Beds/100	0.11*** (0.0045)	0.083*** (0.0036)
Closest hospital	0.53*** (0.12)	0.55*** (0.062)
Emergency × (Distance/10)	-0.79*** (0.092)	-0.56*** (0.063)
Emergency × close	0.0025 (0.12)	-0.10 (0.076)
N Log-Likelihood	4,153 -11,785	6,750 -20,202

***Significant at the 1% level.

Table 3

Summary Statistics of Concentration by Payer-Group and Condition

Competition Measure × 1,000	Means (Standard Deviations)	Min	Max
AMI Estimates			
H_{MED}^{AMI}	0.072 (0.057)	0.015 (Community Hospital of Gardenia)	0.39 (Westlake Medical Center)
H_{HMO}^{AMI}	0.023 (0.023)	0.0027 (Pacifica Hospital)	0.18 (Westlake Medical Center)
H_{IND}^{AMI}	0.0076 (0.0060)	0.0011 (Bay Harbor Hospital)	0.041 (Westlake Medical Center)
H_{IDM}^{AMI}	0.015 (0.016)	0.0038 (Pacifica Hospital)	0.13 (Westlake Medical Center)
H_{MCD}^{AMI}	0.026 (0.028)	0.0038 (Pico Rivera)	0.18 (Westlake Medical Center)
Pneumonia Estimates			
H_{MED}^{P}	0.070 (0.047)	0.021 (Community Hospital of Gardenia)	0.23 (Antelope Valley)
H_{HMO}^{P}	0.015 (0.012)	0.0035 (Pacifica Hospital)	0.071 (Palmdale Hospital)
H_{IND}^{P}	0.0080 (0.0076)	0.0019 (Pico Rivera)	0.055 (Palmdale Hospital)
H_{IDM}^{P}	0.014 (0.015)	0.0030 (Linda Vista Hospital)	0.10 (Palmdale Hospital)
H_{MCD}^{P}	0.016 (0.014)	0.0042 (Norwalk Community Hospital)	0.081 (Palmdale Hospital)

Note: The superscript "P" denotes pneumonia. The subscripts "MED" denotes Medicare enrollees, "HMO" denotes HMO enrollees, "IND" denotes the self-paying or indigent population, "IDM" denotes those covered by traditional indemnity insurance and "MCD" denotes Medicaid. The hospitals corresponding to the minimum and maximum are listed below the reported figure.

Table 4

OLS Regressions of Hospital Mortality on Hospital Characteristics
(robust standard errors in parentheses)

Variable		Dependent Variable: Log of AMI Mortality (1)	Dependent Variable: Log of Pneumonia Mortality (2)
Weighted Competition	Log of H_{MED}	-0.33*** (0.11)	-0.35*** (0.13)
	Log of H_{HMO}	0.23*** (0.10)	0.15 (0.092)
	Log of H_{IND}	-0.099 (0.089)	0.068 (0.11)
	Log of H_{IDM}	0.13 (0.11)	0.12 (0.088)
	Log of H_{MCD}	-0.0075 (0.062)	-0.075 (0.11)
Log of N_j^z, Total Expected Patients		0.027 (0.057)	0.077 (0.11)
Not-for-profit		0.083 (0.091)	-0.32*** (0.13)
For-profit		0.065 (0.11)	-0.39*** (0.14)
Teaching Hospital		0.098 (0.13)	-0.24 (0.13)
Size Dummies	151 to 200 Beds	0.11 (0.10)	0.19*** (0.034)
	201 to 300 Beds	-0.050 (0.097)	0.045 (0.055)
	Over 301 Beds	-0.0093 (0.10)	-0.015 (0.071)
Constant		2.71*** (0.24)	2.48*** (0.61)
R^2		0.17	0.25
N		107	114

***Significant at the 1% level.
**Significant at the 5% level.
*Significant at the 10% level.

Endnotes

[1] We thank Tom Buchmueller, Vivian Ho, Tom Holmes, Rajiv Tyagi, two anonymous referees and seminar participants at the University of California, Irvine, for helpful comments, and Anita Todd for editorial assistance. The order of authors is alphabetical and does not reflect differential contributions to the paper.
[2] See McClellan (1997) for a discussion of cost sharing under prospective payment and the ability of hospitals to affect the level of reimbursement for Medicare patients.
[3] For recent surveys of the relationship between hospital prices and competition see Gaynor and Vogt (2000) and Dranove and Satterthwaite (2000).
[4] We follow Kessler and McClellan (2000) in using this technique.
[5] It is important to note that this threshold is not necessarily marginal cost. Ultimately, the threshold will depend on the nature of the entire cost relationship, hospital capacity and elasticities of demand of the different payer groups.
[6] See Shaked and Sutton (1983), Motta (1993), Moorthy (1988), and Spence (1975).
[7] As our data are from the early 1990s, the percentage of Medicare beneficiaries that is enrolled in HMOs is small. We include those patients that were admitted to a Kaiser hospital. However, we have performed the analysis excluding them and the results excluding the Kaiser patients are essentially quantitatively identical to the results throughout this paper.
[8] The actual HHI that we use is somewhat different as there is cross-ownership across hospitals. We calculate (3) for each separate hospital corporation, summing the probabilities across hospitals within the corporation to calculate the corporation probability. Likewise, the summation in (4) is over hospital corporations.
[9] This serves to eliminate patients admitted from nursing homes and other care facilities who may have very different choice sets.
[10] Our results are unaffected if we include just the size of the hospital as a regressor.
[11] The longitudes and latitudes of zip code centers can be off when zip codes are very large. By restricting our study to hospitals in the Los Angeles/Orange County metropolitan area, where most zip codes are relatively small, we largely avoid this problem.
[12]Using data from upstate New York, Phibbs and Luft (1995) show a strong correlation between travel times and straight-line distances. We assume the same correlation holds for the metropolitan Los Angeles region.
[13] The OSHPD ownership data contains many errors (Mitchell, Spetz, and Seago (2001)). We obtained the corrected ownership data from Joanna Spetz. We thank her for providing us with this information.
[14] Deaths from pneumonia are a relatively rare event for patients under age 65 compared to AMI. The National Center for Health Statistics finds that pneumonia is the tenth leading cause of death for those 25 to 64 years of age, while heart disease is the second leading cause of death for those 25 to 64 years of age. For the 65 and over population, heart disease is the leading cause of death while pneumonia is the fifth leading cause of death. See Minino and Smith (2001).