Quality of Cardiac Surgeons and Managed Care Contracting Practices

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Objective. To evaluate the association between contracting practices of managed care organizations (MCOs) with cardiac surgeons and the quality of the cardiac surgeons.

Data Sources/Study Setting. The study included all cardiac surgeons offering coronary artery bypass graft (CABG) surgery and 78 percent of MCOs in New York State in 1998. Primary data: The MCOs' panel composition with respect to hospitals and cardiac surgeons. Secondary data: New York State (NYS) Cardiac Surgery Reports.

Study Design. Statistical analyses of the probability of a contract between cardiac surgeons and MCOs conditional on the surgeon's risk-adjusted mortality rates (RAMR), outlier and low volume status, and controlling for other confounding variables, were performed.

Principal Findings. Contract probability exhibited a tendency to decrease with RAMR, low volume and low-quality outlier status and to increase with high-quality outlier status. These effects were statistically significant for RAMR and high-quality outliers in Downstate and for low volume in Downstate and Upstate.

Conclusions. In some, but not all cases, MCOs are seeking higher-quality providers. Further research is required to understand regional variability and the effect of market structure on the quality profile of MCOs.

Key Words. Quality report cards, managed care, quality of care, CABG, selective contracting

Managed care organizations (MCOs), with more than 150 million enrollees (Dranove, Simon, and White 1998), have become the dominant type of health delivery system in the United States. The service delivery practices they adopt define the quality of care that is available to the majority of the population. Because of the focus of many MCOs on cost containment, public concerns regarding the quality of care that MCO enrollees receive has been increasing. These concerns have spilled from the front pages of the national press to the Congress, culminating in a debate over the "Patient's Bill of Rights."

One way in which MCOs influence the quality of its enrollees' care is through the choice of providers to be included in its panels. Studies to date

have investigated primarily the role of hospital quality in MCO contracting and referral patterns. They found no evidence for systematic bias toward contracting with poor quality hospitals. Some have found evidence for a bias toward higher than average quality and some found no association with quality at all, suggesting that the role of quality in MCOs' contracting decisions may vary. Schulman et al. (1997) interviewed HMOs in three market areas about the process they use to identify tertiary care hospitals for contracting. They found that while HMOs considered both price and quality, quality assessment was the least developed component in the contracting process. Escarce et al. (1997) studied practices of HMOs in Southeast Florida. They did not find any evidence that HMOs preferentially channel their enrollees to high-quality hospitals for cardiac artery bypass graft (CABG) surgery. In a more recent study, Escarce et al. (1999) found that while HMO patients in California were more likely to be treated in higher-quality hospitals compared with non-HMO insured patients, in Florida there were no differences in access to high-quality hospitals between HMO and non-HMO patients in the commercial population and a bias toward lower-quality hospitals among Medicare HMOs. Chernew et al. (1998) studied HMO patient referral patterns for CABG in California. Their findings indicate that in some, but not all cases, HMO enrollees were more likely to receive care in higher-quality hospitals. Similarly, Mukamel, Murthy, and Weimer (2000) found that access to high-quality cardiac surgery in New York State (NYS) by HMO enrollees, as compared to fee-for-service enrollees, varied by region. A study by Gaskin et al. (1999), based on a nationally representative sample of HMOs, concluded that HMOs were more likely to contract with hospitals with better than average CABG quality, although quality seemed to be less important than location. Only one study investigated the factors that influence selection and exclusion of physicians by MCOs. Bindman et al. (1998) report, based on a survey of primary care physicians in California, that between 0 and 4 percent of physicians were either denied inclusion in an MCO panel or were

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terminated because of their malpractice history or because their care did not meet the standards of the MCO. These percents were relatively small compared with other reasons given for denial of participation or termination.

This study extends this line of research by examining contracting patterns with individual cardiac surgeons rather than hospitals or primary care physicians. Furthermore, it uses one of the more reliable and less controversial risk-adjusted outcome measures of quality developed to date—the NYS CABG measures. These measures are based on clinical factors specifically developed for the purpose of CABG mortality risk adjustment, and have been extensively validated (Hannan et al. 1990, 1997). Another important aspect of this study is that the MCOs we studied had access to public information about the quality ranking of surgeons at the time they made their contract decisions. The surgeon-specific risk-adjusted mortality rate (RAMR) and outlier status were published in the annual NYS Cardiac Surgery Report, and were available to all MCOs, employers, and prospective patients. In a recent survey of NYS MCOs, 64 percent indicated that they have indeed reviewed this report (Mukamel, Mushlin et al. 2000). Thus, unlike all the prior studies cited above, the measure of quality used in the statistical analyses was also readily available to the MCOs.

METHODS

Overview

To investigate the role of surgeons' quality in MCO contracting choices we estimate models predicting the probability of a contract between an MCO and a cardiac surgeon as a function of several measures of surgeon's quality and other potentially confounding variables. The probability of a contract between an MCO and a surgeon depends on factors influencing MCOs preferences for surgeons with specific attributes, such as quality, and on factors influencing surgeons preferences for MCOs, such as the pecuniary and administrative relationships the MCO establishes with its providers. We estimate reduced form models that include variables designed to capture these factors.

Because CABG surgery is an inpatient procedure, MCOs can contract with surgeons only if they also have a contract with the hospital in which the surgeon practices. And because MCOs rely on hospitals for a large array of services, not only CABG surgery, it is likely that MCOs' choice of hospitals depend on hospitals' overall cost, quality, and scope of services, rather than just on performance with respect to CABG. We, therefore, assume that MCOs

choose hospitals first based on all the services they provide, and then choose cardiac surgeons from among those practicing in these hospitals. We thus model the choice of surgeon as conditional on the choice of hospitals. This assumption is motivated by two findings. First, an analysis of patient migration patterns for CABG surgery revealed that most patients do not travel outside their area of residence (Mukamel, Mushlin et al. 2000). Thus, the MCO choice set should not include all surgeons statewide. Second, the average percent of surgeons in a hospital who had a contract with the MCO was 60 percent, indicating that MCOs are selective even within the hospitals with which they contract.¹

We, therefore, define the choice set for each MCO separately, to include only surgeons practicing in hospitals with which the MCO has contracted. We estimate the probability of a contract between an MCO and a surgeon conditional on that MCO choice set, using panel conditional logit models. These models are also conditional on the number of surgeons the MCO is choosing and account explicitly for the “attractiveness” of the surgeons in the choice set relative to each other. We do not model the MCO decision on its surgeon panel size, which determines the total number of contracts it seeks. (See further discussion of the selectivity issue later in this article).

It should be noted that the behavioral model we present assumes that the contracting process is asymmetric, namely that the MCO chooses the surgeon and the surgeon abides by the MCO's decision. While this is probably the more typical case, it is possible that some surgeons may decline a contract when offered one. We do not investigate this hypothesis in this paper. To the extent that surgeons reject offered contracts, our estimated equations would be misspecified. As we believe the MCO is the dominant decision maker, any misspecification error is likely to be small.

Data and Variables

Measuring Surgeons' Quality. Surgeons' quality variables were derived from the NYS Cardiac Surgery Report, published in December of 1997. The report includes for each hospital and for each surgeon the number of cases, the RAMR, and a designation of outlier status based on a 95 percent confidence interval around the statewide average RAMR. Recognizing the limited accuracy of these measures when samples are small, the report only includes RAMR for surgeons who performed at least two hundred procedures over the three-year reporting period. RAMR for low volume surgeons is only reported as an average over all low volume surgeons within each hospital. We used data

from the report published at the end of 1997, which covers the 1993–1995 period, because this is the information that was available to MCOs in 1998, the period for which we obtained contracting data.

The RAMR is defined in the NYS report as the state average mortality rate multiplied by the ratio of a surgeon's observed mortality rate to the surgeon's predicted rate. The predicted rate controls for the risks of the patients treated by the surgeon: age, gender, hemodynamic state, comorbidities, severity of the arteriosclerotic process, ventricular function, and previous open-heart operations (New York State Department of Health 1997). It is calculated as the average of predicted mortality probabilities of all patients treated by the surgeon. The individual predicted probabilities are estimated by NYS using logistic regression models.

Several variables measuring surgeon's quality were constructed from the information available in the report. The first is a continuous variable equal to each surgeon's excess RAMR. Excess RAMR was defined as the difference between the surgeon's RAMR and the average RAMR for the relevant choice set. For low volume surgeons we used the RAMR reported for all low volume surgeons in the hospital in which the surgeon performed.

Two dichotomous variables, which indicate if the surgeon was designated in the NYS report as a high or a low-quality outlier, were included in the analyses (the omitted category is surgeons who are not designated outliers). A priori it is unclear whether RAMR or outlier status may be more meaningful to MCOs when making their choices. While their relative sophistication would lead us to expect that they pay more attention to statistical outliers, as indeed was indicated by many MCOs in a recent survey (Mukamel, Mushlin et al. 2000), in some markets in Upstate New York there were no outliers and in others the number of outliers was small. When faced with a choice set that does not include statistical outliers, or if seeking more contracts than there are outlier surgeons, MCOs might base their decisions on the surgeon's RAMR.

We also included a dichotomous variable indicating if the surgeon is a "low volume" surgeon as defined by the NYS report. This is another measure of quality. Several studies (Hughes, Hunt, and Luft 1987; Hannan 1989) have found that risk adjusted mortality rates for CABG surgery are significantly associated with the volume of procedures performed. MCOs may, therefore, interpret low volume as a signal for poor quality.

The inclusion of low volume as an explanatory variable of the probability of a contract may raise concerns about endogeneity bias. It should be noted, however, that surgeries done under contract for MCOs account for

relatively small fractions of surgeons' volumes: The median was 13.6 percent, the 75th percentile was 22.1 percent, and the maximum was 50 percent. Thus, the existence or absence of a contract with a specific MCO is unlikely to have a substantial influence on surgeons' low volume status. Therefore, if there is endogeneity, it is likely inconsequential. Ideally we would have liked to instrument the low volume variable and formally test for endogeneity. As we were not successful in identifying appropriate instrumental variables, we re-estimated the models without the low volume variable. Estimates for all variables, except excess RAMR, were similar in both models. The estimates for RAMR were qualitatively the same but, as expected, larger in magnitude and reached statistical significance in most cases.

In addition to variables capturing information about the surgeon's performance in terms of RAMR, we also included a variable measuring the years since the surgeon graduated from medical school. This variable was motivated by the hypothesis that MCOs may consider alternative measures of surgeon's quality, such as experience. We included the square of years since graduation to allow for decreasing returns to experience. This information was obtained from the HCFA Medicare Physician Identification and Eligibility Registry (MPIER) file.

MCO Selectivity. We define a variable measuring the selectivity of the MCO as the percent of surgeons included in the MCO panel from the total number of surgeons available in its choice set. Selectivity is important because the less selective the MCO is, the less would contract probabilities be related to surgeon's attributes. In fact, an MCO that is completely nonselective, that is, includes in its panel all surgeons in its choice set, would exhibit no observable preferences for surgeon characteristics. Selectivity may be endogenous with contract probability if MCOs, rather than seeking contracts to create a surgeon panel of a given size, determine panel size based on the number of surgeons meeting a minimum quality threshold. Our earlier analyses (Mukamel, Mushlin et al. 2000) of the relationship between selectivity and surgeon quality suggests that selectivity is not related to the quality of surgeons in the choice set, and hence is not likely to be endogenous. We do, however, present models with and without the selectivity variable. The results are qualitatively the same.

Contracting Variable. We obtained provider lists from 42 of the 53 (78 percent) staff model HMOs, IPAs (Independent Practice Associations), and PPOs (Preferred Provider Organizations) licensed to operate in New York State. These are the lists that MCOs make available to their subscribers at enrollment to inform them about the providers included in the MCO's panel. Lists were obtained for the 1998 panel of each MCO. These data were used to

create a dichotomous variable for all relevant surgeon/MCO combinations (i.e., all the surgeons practicing in hospitals in the region with whom the MCO has contracts), indicating whether the surgeon was included in the MCO panel or not. The resulting sample included 1,709 surgeon/MCO combinations; of those 60 percent had contracts.

Other Variables. The reduced form models we estimated included several MCO characteristics. The MCOs were classified as staff-model HMOs, PPOs, IPAs, and other. Other types included POS (Point of Service) plans and mixed models. The omitted category in the estimated models was IPAs. We also included a variable indicating if the MCO was a for-profit organization.

To capture competition among surgeons, we include the surgeons' Herfindahl Hirschman index (HHI), defined as the sum of the square of market shares (based on number of procedures performed) for all surgeons in the choice set for each MCO. This variable therefore had the same value for all surgeons in the same choice set but varied across choice sets.

Estimated Models

The unit of analysis was the surgeon/MCO combination. We estimated panel conditional logit models where the dependent variable is a dichotomous variable that obtains the value 1 if there was a contract between the MCO and the cardiac surgeon, and 0 otherwise and where the attributes of each surgeon are compared to the attributes of all other surgeons in the MCO's choice set. As panel conditional logit models do not allow separate estimates of attributes of the chooser (the MCO), MCO characteristics were interacted with characteristics of the choice.

A prior study of NYS MCOs (Mukamel, Murthy, and Weimer 2000) suggested that MCO behavior with respect to surgeons' quality may differ across regions in the state. Therefore, the estimated models included interaction terms between the quality variables (excess RAMR, high-quality outlier, low-quality outlier, and low volume) with an Upstate indicator variable (defined as all regions other than NYC, Nassau, Suffolk, and Westchester counties). Because of the sparsity of data in some Upstate regions, we were not able to disaggregate regions further.

We present three estimated models: an unadjusted model, a model adjusted for the selectivity of the MCO, and an unadjusted model estimated on a subset of the data that excludes observations of MCOs that are not selective—that is, those contracting with more than 80 percent of surgeons in their choice sets. Selectivity of the MCO is important when investigating

choices. The more selective the MCO, the more likely are the attributes of the choice to play a role in influencing it. Conversely, for an MCO that contracts with all surgeons, choice attributes have no impact on the probability of the contract. (Indeed these MCOs are dropped from the likelihood function during estimation.) Selectivity was introduced into the adjusted model by multiplying all independent variables, namely choice attributes, by 1 minus the selectivity.² The unadjusted regression on the subset of MCOs that are selective offers another perspective, if selectivity has a threshold effect rather than a continuous effect.

It should be noted that the conditional logit models we estimate do not allow for possible correlation in the error terms for the same surgeons across different MCOs. If there are surgeon characteristics that we do not account for explicitly in our model and which are also associated with contract probabilities, and if those are correlated with the surgeons characteristics that we do include in the models, our estimates may be subject to omitted variable bias.

RESULTS

Descriptive Statistics

Table 1 presents descriptive statistics for the sample used in the analyses. Only 59.9 percent of the potential 1,709 combinations of MCOs and surgeons have resulted in a contract, indicating that MCOs were selective in contracting with cardiac surgeons.

By definition, average risk-adjusted excess mortality was zero. The variation, however, was substantial with a standard deviation of 1.57 percentage points, which is 62 percent of the statewide average mortality rate of 2.55 percent. High-quality outliers accounted for 8.1 percent of the observations, more than twice as many as low-quality outliers, at 3.1 percent. Low volume surgeons comprised 35.5 percent of the observations.

Table 2 presents information about the distribution of quality by region. The variation in excess RAMR was substantial in both regions. The percent of observations with outlier status, both high quality and low quality, was higher in Upstate. Overall, there were more high-quality outliers compared with low-quality outliers. Low volume surgeons were more likely in Downstate, at 40.0 percent compared with 23.7 percent in Upstate.

Table 3 shows contracting probability by region for each of the quality categories. In most cases, the likelihood of a contract was higher in the Upstate

Table 1: Means and Standard Deviations of Dependent and Independent Variables ($N = 1,709$)

	<i>Mean</i>	<i>Standard Deviation*</i>
Contracts between surgeons and MCOs	0.599	—
Excess RAMR	0.000	1.570
Low-quality outliers	0.031	—
High-quality outliers	0.081	—
Low volume surgeons	0.355	—
Selectivity**	0.599	0.183
Years since medical school graduation	24.58	8.945
Upstate	0.274	—
For-profit	0.660	—
IPA	0.130	—
PPO	0.298	—
Other MCO type	0.184	—
Surgeon HHI	0.075	0.065

*Standard deviations are reported only for continuous variables.

** Proportion of surgeons in the MCOs choice set that the MCO contracted with.

Table 2: Mean Quality by Region

	<i>Mean</i>	<i>Standard Deviation*</i>
Excess RAMR (%)		
Upstate	0.00	1.453
Downstate	0.00	1.613
Low-Quality Outliers (%)		
Upstate	4.1	—
Downstate	2.7	—
High-Quality Outliers (%)		
Upstate	16.0	—
Downstate	5.1	—
Low Volume Surgeons (%)		
Upstate	23.7	—
Downstate	40.0	—

*Standard deviations reported only for continuous variables.

region, possibly reflecting the more limited choice sets MCOs in this area were facing. The marginal effect (i.e., the difference in percent compared with the non-outlier cases) of outlier status or low volume were substantial, ranging from 11.2 to 35.6 percentage points. It was positive for high-quality outliers in both areas, indicating a higher likelihood of contracting with a high-quality surgeon. The increase in likelihood was more than twice as large in the

Table 3: Contracting by Quality and Region

	<i>Number of Possible Contracts</i>	<i>Percent with Contract (%)</i>	<i>Difference Relative to Non-outliers in Region (%)</i>
Non-outliers			
Upstate	375	67.7	—
Downstate	1143	53.3	—
Low-quality outliers			
Upstate	19	78.9	11.2
Downstate	34	76.5	23.3
High-quality outliers			
Upstate	75	85.3	17.6
Downstate	63	88.9	35.6
Low volume surgeons			
Upstate	111	46.8	− 20.9
Downstate	496	37.7	− 15.6

Downstate area, at 35.6 percent, compared with Upstate at 17.6 percent. Surprisingly, the probability of a contract was also higher for low-quality outliers, again with a larger marginal effect in Downstate. On the other hand, low volume surgeons had lower contract probability in both regions, by 20.9 percent in Upstate and 15.6 percent in Downstate.

Estimation Results

Table 4 presents estimates for the three models predicting the probability of a contract between the MCO and the surgeon, with and without the selectivity adjustment. The results of all models are similar in terms of direction of the effects. The magnitude of the effects, measured by the absolute value of the coefficients, are similar in the models estimated on the full sample and the sample excluding MCOs contracting with more than 80 percent of the surgeons and are larger in the selectivity adjusted model. All models are highly significant and explain about 11–13 percent of the variation, as measured by the pseudo R^2 , a reasonable level for a discrete dependent variable and a cross-sectional model.

Note that the sample size for the estimated model is 1,588, rather than 1,709, because MCOs that contracted with all surgeons had to be dropped from the analysis. For these MCOs, the dependent variable did not vary across the choice set.

Association between Nonquality Variables and Probability of a Contract. Number of years the surgeon was out of medical school had a very strong association ($p < 0.01$). The quadratic form with a negative squared term

Table 4: Probability of MCO/Surgeon Contract

Panel Conditional Logit Models

	<i>Unadjusted</i>	<i>Selectivity Adjusted</i>	<i>Unadjusted; Subsample of MCOs with Selectivity < 80%</i>
Excess RAMR	− 0.43**	− 1.10**	− 0.45**
High-quality outlier	1.63**	3.20**	1.81**
Low-quality outlier	− 0.37	− 0.86	− 0.43
Low volume	− 0.75**	− 1.38**	− 0.76**
Upstate*excess RAMR	− 0.13	− 0.37	− 0.19
Upstate*high-quality outlier	− 1.43*	− 3.91**	− 1.83**
Upstate*low-quality outlier	0.32	2.22	0.66
Upstate*low volume	− 0.56	− 2.31*	− 0.51
For-profit*excess RAMR	0.01	0.15	0.03
PPO*excess RAMR	− 0.03	− 0.10	− 0.03
Staff model HMO*excess RAMR	0.02	0.24	0.01
Other MCO*excess RAMR	− 0.01	0.03	− 0.00
Surgeon's HHI*excess RAMR	4.48**	9.16**	4.62**
Surgeon's years since graduation from med. school	0.12**	0.11**	0.13**
Square of years since graduation	− 0.002**	− 0.001	− 0.002**
Number of observations	1588	1588	1458
Model LR χ^2	216.50	196.22	214.29
P value	0.000	0.000	0.000
Pseudo R ²	0.12	0.11	0.13

Significance Level: * 5 percent; ** 1 percent

implies an inverted U-shaped relationship, with highest probability of contracts for surgeons in mid- to late-careers (at around 30 years).

Association between Quality Measures and Probability of a Contract. To determine the effect of the quality measures on contract probability we translated the coefficients reported in Table 4 to incremental contract probabilities by MCO type, ownership, and region, as reported in Table 5 for the unadjusted model and Table 6 for the adjusted model. These tables show the change in probability for a 1 standard deviation increase in excess RAMR and the change in probability due to outlier or low volume status. In all instances an increase of 1 standard deviation in excess RAMR leads to a decrease in the contract probability. Based on the unadjusted model, the association is not very strong and only reaches conventional statistical significance levels of 0.05 for for-profit IPAs and PPOs in Downstate. The

Table 5: Effect of Quality Measures on Contract Probability Calculated from the Unadjusted Model in Table 4, Column 2 (*P* values in Parentheses for One-Tailed Tests of Linear Combinations of Relevant Coefficients*)

I. Effect of Excess RAMR: Change in Contract Probability for an Increase of 1 Standard Deviation in Excess RAMR (1.57%)

	<i>For-Profit MCOs</i>		<i>Nonprofit MCOs</i>	
	<i>Upstate</i>	<i>Downstate</i>	<i>Upstate</i>	<i>Downstate</i>
Staff model	− 0.5% (0.45)	− 4.5% (0.20)	− 0.9% (0.42)	− 5.0% (0.13)
HMO				
IPA	− 1.5% (0.36)	− 5.5% (0.03)	− 1.6% (0.36)	− 5.9% (0.11)
PPO	− 2.8% (0.29)	− 6.7% (0.02)	− 1.6% (0.29)	− 6.4% (0.07)
Other	− 2.3% (0.18)	− 5.9% (0.08)	− 2.0% (0.33)	− 6.5% (0.09)

Note: These effects are larger and statistically significant at the 0.05 level when low volume is excluded from the estimated model.

II. Effect of Outlier or Low Volume Status: Change in Contract Probability Compared to Non-outlier/Non-low Volume

	<i>Upstate</i>	<i>Downstate</i>
High-quality outlier	4.2% (0.33)	33.1% (0.00)
Low-quality outlier	− 1.2% (0.47)	− 9.3% (0.26)
Low volume	− 31.7% (0.00)	− 18.3% (0.00)

* *Example:* The *p* value for a for-profit HMO in Upstate for RAMR is for the hypothesis: $-0.43 - 0.13 + 0.02 + 4.48 * 0.11 + 0.01 < 0$ where 0.11 is the average surgeon HHI in Upstate.

associations are stronger and significant for all of Downstate MCOs except for staff model HMOs when the calculation is based on the selectivity-adjusted model. It should be noted that when the low volume indicator variable was excluded from the estimated model (not shown) the decreases in probability were larger and mostly significant. Low volume in fact had a very large impact on contract probability, both in Upstate and Downstate (part 2 of the table). Outlier status was only significantly associated with contract probability for high-quality outliers in Downstate.

Table 6: Effect of Quality Measures on Contract Probability Calculated from the Selectivity Adjusted Model in Table 4, Column 3 (*P* Values in Parentheses for One-Tailed Tests of Linear Combinations of Relevant Coefficients)

I. Effect of Excess RAMR: Change in Contract Probability for an Increase of 1 Standard Deviation in Excess RAMR (1.57%)

	<i>For-Profit MCOs</i>		<i>Nonprofit MCOs</i>	
	<i>Upstate</i>	<i>Downstate</i>	<i>Upstate</i>	<i>Downstate</i>
Staff model	− 0.5% (0.45)	− 2.3% (0.31)	− 2.3% (0.32)	− 4.6% (0.09)
HMO				
IPA	− 3.9% (0.19)	− 6.1% (0.01)	− 5.5% (0.14)	− 8.4% (0.03)
PPO	− 6.0% (0.12)	− 7.7% (0.01)	− 4.3% (0.09)	− 9.1% (0.02)
Other	− 4.2% (0.24)	− 5.5% (0.07)	− 4.9% (0.15)	− 7.9% (0.04)

II. Effect of Outlier or Low Volume Status: Change in Contract Probability Compared to Non-outlier/Non-low volume

	<i>Upstate</i>	<i>Downstate</i>
High-quality outlier	− 6.6% (0.26)	27.1% (0.00)
Low-quality outlier	10.6% (0.22)	− 8.6% (0.24)
Low volume	− 35.3% (0.00)	− 13.6% (0.00)

DISCUSSION

The results presented here suggest that a higher reported quality in the NYS CABG reports was associated with increased probability of a contract between a cardiac surgeon and an MCO. While the association did not vary significantly by MCO type and ownership, it did vary by region and type of quality measure. The associations were larger in the Downstate area and the largest impact was due to low volume and high-quality outlier status.

From a policy perspective, it is encouraging that quality indicators seem to influence MCO choices. The strong influence of high-quality outliers in the

Downstate area, and the somewhat more limited influence of RAMR, suggest that despite the increasing dominance of managed care in many health care markets, there may be positive incentives for providers to pursue high quality. These findings, coupled with our earlier findings that many MCOs do consult the NYS reports (Mukamel, Mushlin et al. 2000), suggest that quality report cards could have an important role to play by providing MCOs with information that is relevant to their provider network choices.

The differences in the effect of the quality measures on contract probability in Upstate and Downstate suggest that MCOs' behavior with respect to quality may vary depending on local market conditions. Factors such as competition among MCOs, competition between MCOs and fee-for-service plans, sophistication of individual consumers (measured, for example, in terms of income and education), and sophistication of employers (such as exhibited by industry type and size) are all likely to influence the demand faced by MCOs, and hence their derived demand for quality. In this study we were not able to investigate the effect of such market factors because we were limited to NYS, for which accurate measures of cardiac surgeons' quality exist. The causes for the heterogeneity across regions we observe in this study, as well as in others (Mukamel, Murthy, and Weimer 2000), may however have important policy implications, as they can provide guidance to efforts to improve the functioning of health care markets through such policies as dissemination of quality report cards. Future research should explore the potentially mitigating effect that local market characteristics may have on quality choices made by MCOs.

NOTES

1. We have also estimated models for two other cases. One assumes that the choice set includes all surgeons in the region, not limited only to those hospitals with which the MCO had a contract. The other maintains the assumption that hospital choice is independent of CABG (i.e., the same choice set as in the models we present), but recognizes that hospital characteristics may still be relevant to the choice of surgeons, when an MCO has more than one CABG hospital in its network. These models included variables indicating teaching status and measuring distance between hospitals and relative costs. The latter two variables were calculated with respect to the other hospitals in the MCO's choice set, consistent with the assumption that the choice of hospitals is independent of performance with respect to CABG. The results were qualitatively similar to the models we present here.

2. Note that because selectivity does not vary within the choice set, it could not be included in the model as a main effect, but only as an interaction term. A model which includes excess RAMR as a main effect and interacts all other variables with selectivity had very similar coefficients to those in a model which includes only selectivity interacted variables (presented in Table 4, column 2).

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