Title

Quality report cards, selection of cardiac surgeons, and racial disparities: A study of the publication of the New York State Cardiac Surgery Reports

Journal
Inquiry-The Journal of Health Care Organization Provision and Financing, 41(4)

ISSN
0046-9580

Authors
Mukamel, Dana B
Weimer, David L
Zwanziger, Jack
et al.

Publication Date
2004

Peer reviewed

Dana B. Mukamel
David L. Weimer
Jack Zwanziger
Shih-Fang Huang Gorthy
Alvin I. Mushlin

Quality Report Cards, Selection of Cardiac Surgeons, and Racial Disparities: A Study of the Publication of the New York State Cardiac Surgery Reports

Quality report cards have become common in many health care markets. This study evaluates their effectiveness by examining the impact of the New York State (NYS) Cardiac Surgery Reports on selection of cardiac surgeons. The analyses compares selection of surgeons in 1991 (pre-report publication) and 1992 (post-report publication). We find that the information about a surgeon's quality published in the reports influences selection directly and diminishes the importance of surgeon experience and price as signals for quality. Furthermore, selection of surgeons for black patients is as sensitive to the published information as is the selection for white patients.

Quality report cards have become an integral part of the American health care system. They are published by governments—both state and federal—and the private sector to convey information about health insurance plans, institutional providers (hospitals and nursing homes), and physicians (Marshall et al. 2000). Report cards are intended to facilitate and enhance consumers' ability to compare the quality of competing health plans and providers through easy access to explicit measures of quality (Gormley and Weimer 1999). It is expected that publicly disseminated report cards lead to better informed choices (Mukamel and Mushlin 2001; Mukamel and Spector 2003).

Choice of providers has been shown to depend on quality even in periods prior to the dissemination of quality reports. In a study of hospital choice during the mid-1980s, a period in which quality report cards were not available, Luft et al. (1990) found that hospital choice was positively associated with lower hospital risk-adjusted mortality rates (RAMRs). Chernew, Gowrisankaran, and Scanlon (2001) estimated a significant and relatively large effect of implicit information about quality prior to publication of health maintenance organization (HMO) report cards. These studies suggest that the effect of quality report cards on provider selection depends on the amount of "news" they deliver. If reports only confirm consumers' prior perceptions about the quality of providers, then their publication will not alter selection patterns (Mukamel and Mushlin 2001). If report cards change consumers' perceptions of relative quality, then we can expect to

Dana B. Mukamel, Ph.D., *is an associate professor in the Department of Medicine, Division of General Internal Medicine and Primary Care, and a senior fellow at the Center for Health Policy Research, University of California, Irvine.* ***David L. Weimer, Ph.D.,*** *is a professor at the LaFollette Institute of Public Affairs, University of Wisconsin, Madison.* ***Jack Zwanziger, Ph.D.,*** *is director and professor, Division of Health Policy and Administration, School of Public Health, University of Illinois at Chicago.* ***Shih-Fang Huang Gorthy, M.S.,*** *is with Quinetix, LLC.* ***Alvin I. Mushlin, M.D., Sc.M.,*** *is professor and chair, Department of Public Health, Weill Medical College, Cornell University. Address correspondence to Prof. Mukamel at Center for Health Policy Research, University of California, Irvine, 111 Academy Way, Suite 220, Irvine, CA 92697-5800. Email: dmukamel@uci.edu*

Inquiry 41: 435–446 (Winter 2004/2005).
0046-9580/04/4104–0435

see an increase in the volume of providers with better reported performance.

In addition to influencing selection directly, quality report cards can be expected to affect the role of other, implicit signals for quality. In periods in which explicit measures of quality are not available, consumers are likely to rely on implicit signals. These may include the number of years the physician has been in practice as a proxy for experience; price, with higher prices interpreted to indicate higher quality (Bagwell and Riordan 1991); and recommendations from other physicians. When explicit quality measures become available through report cards, it is likely that consumers will substitute those for the implicit measures if they believe that the explicit measures are more informative or more accurate.

The study we present here examines the effect of the New York State (NYS) Cardiac Surgery Reports on selection of cardiac surgeons by testing several hypotheses:

- ☐ Prior to publication of the NYS reports, selection of surgeons was associated with observable surgeon characteristics including:
  - — Inferred risk-adjusted mortality rate (inferred by patients from observed surgeon characteristics such as the hospital in which the surgeon practices), with lower inferred RAMR perceived as higher quality;
  - — Price charged by the surgeon, with higher prices interpreted as indicators of higher quality;
  - — Surgeon's experience (years since graduation from medical school);
  - — Recommendations of referring physician.
- ☐ Following publication of these reports, the probability of selection has been associated with the new information imparted by publicly reported quality ratings.
- ☐ Following publication of these reports, the importance of observable surgeon characteristics (listed previously) has declined in influencing the probability of selection.

Because the effect of report cards is likely to differ by patient characteristics, we examine these hypotheses for all patients, and in relation to income, education, race, and whether a patient sought a second opinion prior to the surgery.

The study is designed to compare surgeon selection in a period without report cards (1991) and a period with report cards (1992). The comparison of the two periods allows us to separately assess the impact of report cards—that is, the provision of explicit information about quality—from the impact of quality per se, which patients may infer in different ways by relying on various signals for quality with varying degrees of accuracy.

The study presented here builds on our earlier work that found that market shares of surgeons with better reported outcomes increased following publication of the reports (Mukamel and Mushlin 1998). The earlier study was limited, however, because it did not account for any potential variables that influence surgeon selection (e.g., distance) and which may have confounded the analyses. This paper presents an analysis that is grounded in a behavioral model and includes all the important confounders. It thus provides stronger evidence and better estimates of the effect of report cards. Furthermore, in this analysis we also investigate the effect of report cards among subpopulations.

The New York State Cardiac Surgery Reports

New York first published RAMRs for coronary artery bypass graft (CABG) surgery for cardiac surgeons in December 1991 (private communication, D. Doran, NYS Department of Health 1996). The reports include the number of cases, RAMR, and a designation of outlier status for each hospital and for each cardiac surgeon. The reports are available on the Web and are sent to all cardiologists with the expectation that they will be used in referral recommendations. Publication of the reports often is covered by local news media (Zinman 1991).

New York calculates the RAMR published in the report as follows: the state average mortality rate is multiplied by the ratio of a surgeon's observed mortality rate to the surgeon's predicted rate. The predicted rate controls for the risk factors of the patients treated by the surgeon: age, gender, hemodynamic state, comorbidities, severity of the artherosclerotic process, ventricular function, and previous open-heart operations (NYS 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

New York using logistic regression models. The median RAMR reported in the first publication (December 1991) was 3.51%, with a standard deviation of 7.85%. The minimum was 0.00% and the maximum was 62.26%. The lowest decile was at 2.40% or below, and the top decile was at 9.94% and above.

The risk-adjustment methodology used to calculate the NYS measures is considered to be one of the most credible methods in use. It is based on clinical risk factors specific to CABG surgery, rather than administrative data, which are limited to patient demographics, diagnoses, and procedures. It has been studied extensively and validated (Hannan et al. 1990). It has been linked to reductions in CABG mortality in New York (Hannan et al. 1994; Peterson et al. 1998) and has been found to influence market shares of surgeons and contracting decisions by managed care organizations (Mukamel and Mushlin 1998; Mukamel et al. 2000; Mukamel et al. 2002). It therefore offers an excellent test case for the potential impact of quality report cards.

Methods

We assume that patients (possibly in conjunction with their referring physician) choose cardiac surgeons from among all surgeons practicing in their referral area. (Referring physicians are described in more detail subsequently.) An analysis of patient migration patterns indicates that most patients do not travel outside their area of residence for CABG surgery (see Mukamel et al. 2000). We model the choice of surgeon following McFadden (1973). We assume that surgeon *i* will be chosen if the patient's utility derived from this choice exceeds the utility derived from all other possible choices. Patients' utility is assumed to depend on attributes of the surgeon, such as reported or inferred quality, experience, and the distance between the patient's residence and the hospital in which the surgeon practices. Characteristics of the individual patient, such as education, income, and race, are assumed to influence the choice either by shifting preferences or by changing the constraints that patients face, particularly in terms of obtaining information about quality. (These variables are discussed in more detail later.) The empirical model (conditional logit) estimates the probability that a surgeon will be chosen conditional on his or her attributes relative to all other surgeons available in the choice set. Patient (chooser) attributes are introduced into the model through interaction with the *surgeon* characteristics.

Data

CABG Surgeries and Patients

The study includes all NYS Medicare fee-for-service (FFS) enrollees (age 65 or older) who had CABG procedures during 1991 and 1992. We include only FFS patients because they are not limited in their choice of surgeons, while those enrolled in restricted-panel managed care organizations might be. As the surgeons' RAMRs were first published on Dec. 18, 1991, all surgeries performed prior to that date are considered to be in the pre-report period.

Cardiac Surgeons

For each surgery, the "accountable" surgeon is identified as the surgeon whose billing claim did not include *Current Procedural Terminology* (CPT) modifier codes indicating assistant status. The RAMR for the accountable surgeon comes from the NYS report.

Referring Physicians

To identify the physician who may have referred the patient to the cardiac surgeon, we analyzed patterns of visits to cardiologists and primary care physicians occurring during the six months preceding the surgery. We identified the referring physician based on the following decision rules. If the patient made visits to a single cardiologist, then the cardiologist was chosen as the referring physician. If the patient made visits to more than one cardiologist, then the one with the most visits was designated as the referring physician. If the patient made equal numbers of visits to more than one cardiologist, the most recent was selected. If there were no visits to cardiologists, then the analysis was repeated for primary care physicians (internal medicine, family medicine, or general practice). We compared the percentage of surgeries that had an identified referring physician based on analyses of data for one to six months prior to the surgery in one-month increments. The majority of referring physicians (91.5%) were identified within a two-month window of the surgery. Therefore, in the final analysis we defined referring physicians based on the two months prior to surgery.

Patients' Choice Sets: Referral Regions

To determine the relevant set of surgeons from which patients could choose, we identified the referral regions for each patient. We analyzed the relationship between patients' counties of residence and the counties in which their CABG hospitals were located and assigned counties to referral regions to minimize in- and out-of-region patient migration. This resulted in nine referral regions corresponding to the major urban areas in New York state.

Analytical File

The final analytical file included multiple observations for each patient—one observation for each possible choice of surgeon. The data set included 13,078 patients and 943,567 observations based on all possible combinations of patients and surgeons within patients' choice sets.

Definitions of Variables

Choice attributes: variables describing the surgeon. A surgeon's quality, as measured by the RAMR, can be decomposed into two components. The first can be inferred by patients and referring physicians based on their observations of other surgeon characteristics that serve as signals for quality. We refer to this component as "inferred RAMR." It was available to patients and physicians even before report cards were published (i.e., it was available in both periods). The second component is the new information that was revealed only when the report cards were published. We refer to this component as "hidden information" in the pre-report period, and as "new information" in the post-report period. To calculate these variables we estimated a regression of actual RAMR (unobserved by either patients or referring physicians prior to report publication) on observed surgeon characteristics (years of experience, years of experience squared, indicators for hospitals of practice, Medicare participation, and copayment rate) as follows:

$$RAMR_i = \sum_{j=1}^{5} \beta_j X_{ij} + \varepsilon_i$$

where the X_{ij} are the five observed characteristics ($j = 1 \ldots 5$) of surgeon i.

We then calculated the inferred $RAMR$ for surgeon i as $\overline{RAMR}_i = \sum_j \hat{\beta}_j X_{ij}$. The calculated residual, $\hat{\varepsilon}_i = RAMR_i - \overline{RAMR}_i$, is the component that is not observed prior to report publication (i.e., the "hidden information") and is observed once the reports are published (the "new information"). The informational value added from report cards is captured by the effect of the "new information" on surgeon selection.

It should be noted that it is possible that patients and their referring physicians have other information which is not observable to us and therefore is not included in the "inferred RAMR" variable, but which they use in inferring surgeon quality and which affects their surgeon selection. Such information would be captured by the residual, ε_i. If this were the case, then we would expect a significant relationship between the residual and surgeon selection in the pre-publication period as well.

In addition, or in lieu of forming expectations about RAMR, patients may interpret certain surgeon characteristics as proxies or signals of quality. We therefore also include three variables that can be viewed as indirect signals for quality. The first, surgeons' experience (and its square), is measured by years since graduation from medical school, with more experience (up to some level) expected to be interpreted by patients as a proxy for better quality.

The second is price, with higher prices being interpreted as indicative of higher quality. If patients interpret prices as signals for quality, then measured price elasticity of demand, which is expected to be negative, would be biased upward toward zero or may even be positive. We measured price as the copayment that Medicare FFS patients pay based on information in the physician Part B claim. To obtain values for all observations, including surgeons who were in the choice set but were not chosen by the patient and for whom we do not observe a copayment, we predicted surgeon/surgery specific copayment based on the extent of the procedure (number of grafts), whether or not it was urgent, and the year. (Note that the copayment varied by both intensity of the procedure—that is, number of grafts—and surgeon. During 1991, physicians' reimbursement was based on the usual and customary fee-for-service system, which allowed surgeons to charge their own price, within some limits. During 1992, Medicare began implementation of the physician relative value based payment system, which fixed prices across physicians.

This system was phased in gradually and in 1992 physicians were allowed to charge a blend of their prices under the previous system and the new value-based prices. We also note that some patients did not face a copayment if they had Medigap insurance. We did not have information on Medigap insurance, and therefore our estimates of the price effect are likely attenuated toward zero.)

The last variable that may have an implicit quality signal interpretation is referring physician loyalty. It is measured as the percentage of all patients treated by the referring physician (not only CABG patients) who were admitted to the hospital in which the surgeon operates. Referring physicians' advice to their patients may be an important determinant of choice.

We also include a variable measuring the straight-line distance between the centroids of a patient's residence and the zip codes of the hospitals in which surgeons practice. Distance has been shown in previous studies to be an important predictor of provider choice (Luft et al. 1990; Burns and Wholey 1992).

Chooser attributes: patient characteristics. Since the focus of this study is to understand the effect of providing information on patients' choices, several patient characteristics related to the ability to access information, understand it, and act on it may be important. We therefore interact the inferred RAMR and the residual RAMR with variables measuring education, income, race, and whether a patient sought a second opinion prior to surgery. This last variable can be viewed as reflecting patients' preferences for quality and the ability to seek it. Patients who seek second opinions can be expected to be more influenced by quality and information about quality.

Income and education conditional on race are measured for a patient's zip code of residence reported in the 1990 census. For each zip code, we obtained the median family income and the percentage of residents with a high school education. Race is defined as a dichotomous variable indicating whether the patient is black, and is based on data recorded in the patient's Medicare claim. The second-opinion variable is defined as an indicator variable: 1 if the patient saw another cardiac surgeon prior to the surgery, 0 otherwise.

Because patients who have an urgent procedure rather than a scheduled procedure are less likely to be able to choose their surgeon, the analyses were repeated for the subset of patients identified in the claims data as not having an urgent procedure (72% of patients). Because the results were similar (somewhat stronger) and since it is not clear that even urgent procedures do not present an opportunity to shop for a surgeon, we present the more conservative results for the full sample.

Analyses

We estimated two conditional logit models. The dependent variable indicates whether a surgeon was selected or not. The first model includes only surgeon or surgery-related variables. This model provides estimates of the effects of the RAMR for the average patient. The second model adds interaction terms with patient attributes, allowing us to examine the effect of the quality measures for subpopulations. In both models, all independent variables are interacted with a variable indicating whether the surgery occurred in the post-report period. F-tests are used to test whether the post-report effect of each variable (given by the sum of the main effect and the interaction term for the variable) is significantly different from zero.

Results

Table 1 provides means and standard deviations for all variables. Table 2 presents the estimated multivariate conditional logit models. Model 1 includes only characteristics of the surgeon. The pseudo R^2 is .19. Adding characteristics of the patient (model 2) increases the explanatory power of the model only minimally. The coefficients for these added variables, however, are significant, indicating that the effects of both the inferred RAMR and the residual RAMR vary by subpopulations.

As the interpretation of the coefficients is complicated in the presence of interaction terms, we present in tables 3 and 4 the marginal effects of the explicit quality information and the quality signals in the pre- and post-publication periods. The tables present odds ratios for a one-unit increase in the variable (e.g., RAMR of 4.65% instead of the average of 3.65%) with the exception of copayment, where the odds ratio is for an increase of $100.

Results for the Average Patient

Table 3 presents the odds ratios for the average patient, based on model 1. The inferred RAMR

Table 1. Descriptive statistics: patients' and surgeons' characteristics

	Mean	Standard deviation[a]
Patients (N = 13,078)		
Age	72	6.2
Race		
White (%)	97.3	
Black (%)	2.7	
Specialty of referring physician		
Cardiologist (%)	82.6	
Primary care physician (%)	17.4	
Urgent CABG procedures (%)	28.0	
Copayment ($)	706	201
Median annual income in patient zip code ($)	43,523	15,808
High school graduates in patient zip code (%)	77.5	9.6
Patient sought second opinion (%)	7.3	
Distance (in miles) from patient residence to CABG hospital	21.2	28.0
Referring physician loyalty to the hospital	.244	.284
Cardiac surgeons (N = 151)		
RAMR	3.65	2.48
Years since graduation from medical school	19.0	8.8

[a] Standard deviation is shown only for continuous variables.

is significantly associated with probability of selection in both periods—a higher RAMR (i.e., lower quality) lowers the surgeon's odds of being selected by about 7% to 8%. There was no significant change between the two periods, indicating that the role of inferred quality has not changed with publication of the report cards. In contrast, the effect of the residual RAMR is significant only in the post-report period. The odds ratio declines from .99 prior to publication to .94 post-publication. This suggests that, as we hypothesized, the residual RAMR is hidden—that is, unobserved by patients and their physicians—before the reports become available. The value of the report cards is thus revealed by the impact of the RAMR residual on surgeon selection in the second period, when it becomes public knowledge and provides new information.

The impact of the two other signals for quality that patients can observe—price and years of experience of the surgeon—declines once the report cards are published. Price had no effect on surgeon selection in the first period, suggesting that the negative price effect on selection one typically would expect is counter balanced by a positive effect due to the interpretation of higher prices indicative of higher quality. In the second period, when explicit information is available, the role of price as a signal for quality diminishes—post-publication, higher prices are significantly and negatively associated with the probability of surgeon selection. Similarly, while surgeon experience does increase the probability of selection, the odds ratio declines significantly in the second period (from 1.11 to 1.06), again consistent with the hypothesis that explicit information about quality replaces implicit signals.

In contrast, the effect of the variable measuring the propensity of the referring physician to admit to the hospital in which the surgeon practices—the referring physician loyalty—does not change after publication. This may be due to the fact that physicians' referral recommendations are less sensitive to the published information, either because they are more skeptical about the validity of the measures or because their referral patterns are dominated by other considerations, such as incentives to direct their patients to specific hospitals or collegial relationships that are hard to break. Indeed, in a survey of New York cardiologists only 38% indicated that the information in the reports affected their referral recommendations (Hannan et al. 1997). It is possible that physicians may need to observe consistent RAMR scores over several years to change their referral patterns. Investigating the long-term response of referring physicians is outside the scope of this study.

In summary, these findings suggest that publication of explicit information about quality influences selection of surgeons. Furthermore, it diminishes the role of surgeon characteristics that patients observe and may interpret as signals of quality in the absence of explicit information.

The Impact of Patient Sociodemographics: Income, Education and Race

Tables 4, 5, and 6 present odds ratios for the effect of the inferred RAMR and the new information on surgeon selection for patients of different education, income, and race, and by whether they sought a second opinion.

Table 4 shows that higher inferred RAMR is associated with a lower selection probability in the pre-publication period only for whites of high and mean education and of high income (ranging from .94 to .88). This suggests that patients of

Table 2. Estimated regression models

Variable	Model 1: Choice (surgeon attributes only)	Model 2: Choice and chooser (surgeon and patient attributes)
Referring physician loyalty	.079***	.079***
Referring physician loyalty*year 2	.001	.000
Distance from patient residence to hospital	−.028***	−.028***
Distance from patient residence to hospital*year 2	−.001	−.002
Patient copayment	.000	.000
Patient copayment*year 2	−.001***	−.001***
Surgeon's years out of medical school	.104***	.104***
Surgeon's years out of medical school*year 2	−.045***	−.043***
Square of surgeon's years out of medical school	−.002***	−.002***
Square of surgeon's years out of medical school*year 2	.001***	.001***
Inferred RAMR	−.069***	.026[a]
Inferred RAMR*year 2	−.018	.164[a]
Residual RAMR	−.008	.010[a]
Residual RAMR*year 2	−.054***	.085[a]
High school*inferred RAMR		.018
High school*inferred RAMR*year 2		−.568**
High school*residual RAMR		−.189
High school*residual RAMR*year 2		.002
Income*inferred RAMR		−.003**
Income*inferred RAMR*year 2		.006***
Income*residual RAMR		.000
Income*RAMR residual*year 2		−.000
Black*inferred RAMR		.112[b]
Black*inferred RAMR*year 2		.006[b]
Black*RAMR residual		−.049[b]
Black*RAMR residual*year 2		.052[b]
Second opinion*inferred RAMR		−.036[c]
Second opinion*inferred RAMR*year 2		−.019[c]
Second opinion*RAMR residual		.016[c]
Second opinion*RAMR residual*year 2		−.032[c]
Sample size		
Number of choice sets (patients)	13,078	13,078
Number of choices (patient/surgeon)	943,567	943,567
LR χ^2	18,360	18,412
(P value)	(0.000)	(0.000)
Pseudo R^2	.1909	.1917

[a] Test for the joint significance of these variables: $P = .000$.
[b] Test for the joint significance of these variables: $P = .081$.
[c] Test for the joint significance of these variables: $P = .047$.
*** $P < .01$.
** $.01 < P < .05$.
* $.05 < P < .01$.

low education of all races and blacks of all education and income levels have much more limited access to implicit information about surgeon quality. In the post-publication period (Table 5), this relationship is significant for whites in the high and mean education levels irrespective of income. For blacks the relationship continues to be nonsignificant for the most part. Furthermore, patients of low education, particularly if they are black, are more likely to select surgeons of lower quality—that is, those with higher RAMR. Odds ratios exceeding 1 (ranging from 1.12 to 1.30) suggest a crowding-out effect: these patients may be turned away by the better surgeons whose schedules may fill up with patients who make use of the information in the report cards. It should be noted that this may be only a short-term response, when capacity is fixed.

Table 3. Odds ratios of selecting a surgeon for a one-unit increase in variable: results for the average patient (based on Table 2, model 1)

	Pre-report publication	Post-report publication	Change
Inferred RAMR	.933***	.917***	−.016
Residual RAMR			−.052***
Hidden information	.992		
New information		.940***	
Copayment[a]	1.000	.896***	−.104***
Surgeon's years post-graduation	1.110***	1.061***	−.049***
Square of surgeon's years post-graduation	.998***	.999***	.001***
Referring physician loyalty	1.082***	1.083***	−.001

[a] Odds ratio calculated for an increase of $100 in copayment.
*** $P < .01$.
** $.01 < P < .05$.
* $.05 < P < .01$.

With time, the capacity of the better surgeons may increase or the performance of other surgeons may improve, so that a broader sociodemographic range of patients can be accommodated by surgeons of higher quality.

Table 6 shows that the new information is significantly associated with surgeon selection for patients of high and mean education of both races: a higher residual RAMR is associated with a lower probability of selecting a surgeon once the reports are published (the residual RAMR is not significantly associated with selection in the pre-publication period for any subpopulation). Furthermore, the effect is very similar in magnitude for blacks and whites, ranging from .86 to .92. The new information is not associated with selection probability for patients of low education for any income levels and either race. These findings suggest that the report cards level the playing field somewhat for blacks, allowing them similar access to information about surgeons' quality as whites have.

Comparison of the odds ratios for patients of the same sociodemographic stratum who did or did not seek a second opinion shows that, in general, those who sought a second opinion had lower odds ratios—that is, the impact of quality on surgeon selection was stronger. The differences,

Table 4. Odds ratios of selecting a surgeon for a one-percentage-point increase in RAMR: inferred information, pre-report publication

Percentage high school graduates in zip code	Median income in zip code[a]	All races	Sought 2nd opinion		Did not seek 2nd opinion	
			White	Black	White	Black
Max = 100%	M + SD	.892**	.883**	.988	.917*	1.025
	Median	.944	.936	1.047	.971	1.086
	M − SD	1.000	.992	1.109	1.029	1.150
Mean = 77.8%	M + SD	.879***	.863***	.965	.895***	1.000
	Median	.930***	.914***	1.022	.948*	1.060
	M − SD	.984	.968	1.083	1.004	1.123
Min = 37.6%	M + SD	.855	.826	.924	.857	.958
	Median	.905	.875	.979	.908	1.015
	M − SD	.958	.927	1.037	.961	1.075

Note: Results for subpopulations (based on Table 2, model 2).
[a] M = median; SD = standard deviation.
*** $P < .01$.
** $.01 < P < .05$.
* $.05 < P < .01$.

Table 5. Odds ratios of selecting a surgeon for a one-percentage-point increase in RAMR: inferred information, post-report publication

Percentage high school graduates in zip code	Median income in zip code[a]	All races	Sought 2nd opinion		Did not seek 2nd opinion	
			White	Black	White	Black
Max = 100%	M + SD	.835***	.822***	.924	.869***	.967
	Median	.807***	.795***	.894*	.840***	.945
	M − SD	.780***	.768***	.864**	.812***	.913
Mean = 77.8%	M + SD	.939***	.910***	1.023	.962*	1.082
	Median	.907***	.880***	.990	.930***	1.046
	M − SD	.876***	.851***	.957	.900***	1.011
Min = 37.6%	M + SD	1.159*	1.095	1.231**	1.157*	1.301***
	Median	1.120*	1.059	1.190**	1.119*	1.258***
	M − SD	1.082	1.024	1.151**	1.082	1.217***

Note: Results for subpopulations (based on Table 2, model 2).
[a] M = median; SD = standard deviation.
*** $P < .01$.
** $.01 < P < .05$.
* $.05 < P < .01$.

however, were small with respect to the new information and larger with respect to the inferred information. This is consistent with the hypothesis that those who seek a second opinion are also more likely to invest in seeking information about quality, a task that is more difficult and costly when report cards are not available.

Discussion

Understanding the impact of quality report cards on provider selection is important for further development of these reports and for the success of efforts to improve the functioning of health care markets. If report cards are not effective, as earlier studies suggest (Vladeck et al. 1988; Mukamel and Mushlin 2001), then policymakers should consider alternative methods for informing consumer choices. The study we present here offers, however, evidence to indicate that report cards do have an impact on surgeon selection. We find that published quality rankings have both a direct effect and an indirect effect, substituting at least partially for implicit signals for quality.

Table 6. Odds ratios of selecting a surgeon for a one-percentage-point increase in RAMR: new information, residual RAMR post-report publication

Percentage high school graduates in zip code	Median income in zip code[a]	All races	Sought 2nd opinion		Did not seek 2nd opinion	
			White	Black	White	Black
Max = 100%	M + SD	.872**	.863**	.866**	.877**	.880*
	Median	.875***	.867***	.869**	.881**	.883**
	M − SD	.878***	.870***	.873**	.884***	.887**
Mean = 77.8%	M + SD	.910	.900*	.902	.914	.917
	Median	.913**	.904**	.906*	.918*	.921*
	M − SD	.917***	.907***	.910**	.922***	.924*
Min = 37.6%	M + SD	.983	.970	.973	.986	.988
	Median	.986	.974	.977	.990	.992
	M − SD	.990	.978	.981	.994	.996

Note: Results for subpopulations (based on Table 2, model 2). Odds ratios in the pre-report period were not significantly different from 1 for all subpopulations. Results not shown.
[a] M = median; SD = standard deviation.
*** $P < .01$.
** $.01 < P < .05$.
* $.05 < P < .01$.

The NYS Cardiac Surgery Reports, which are the subject of the analysis presented here, offer the most favorable test case for measuring the influence of report cards for two important reasons. The risk-adjustment methodology, which is based on clinical risk factors specifically chosen to predict CABG mortality, is considered more valid and reliable than most other reported measures that often rely on administrative data (Hannan et al. 1997; Mukamel and Mushlin 2001). Second, unlike report cards such as the Health Plan Employer Data and Information Set (HEDIS), which offer information about quality in many dimensions and are complex and difficult for consumers to understand and use (Jewett and Hibbard 1996), the NYS report cards provide information about just one outcome that is of major importance to patients and that can be easily understood. The publication of these reports thus offers the best test case for the hypothesis that report cards influence patient referrals. While this represents a strength of this study when the objective is to reject the null hypothesis that report cards have no impact, it is a limitation in terms of generalizing to other report cards. The evidence provided here does not imply that other report cards with more controversial and cognitively complex measures are as successful in influencing provider selection. It only confirms that patients and their physicians, when presented with important new information that they can understand, do indeed rely on it. Therefore, efforts to identify better ways to communicate information about quality should continue so consumers can be informed in other areas of medical care where quality assessment may be more complex and cannot be distilled into one simple statistic (Mukamel and Spector 2003).

Another potential limitation of the study is due to the fact that selection of a surgeon may be done by the patient, by the referring physician, or jointly by the two. Our data do not include information on who was the actual decision maker, and therefore this study cannot speak to this question.

Quality report cards are only as good as the measures they include. The controversy about the adequacy of current technology for quality measurement (Mukamel, Dick, and Spector 2000), and hence the potential adverse incentives of report cards (Dranove et al. 2002), is ongoing. The evidence we present here that report cards do influence provider selection emphasizes the importance of developing valid and reliable measures of quality that would not give rise to adverse consequences.

Racial disparities in access to high-quality cardiac surgeons in New York have been shown to exist. Analyses of 1996 data for all NYS CABG patients found that nonwhites were more likely to receive surgery from higher RAMR surgeons (Mukamel, Murthy, and Weimer 2000; Rothenberg et al. 2004). Indeed, we find no association between inferred RAMR and surgeon selection for blacks in the high and mean education strata. However, we find that once the reports were published, selection of surgeons for black patients was associated with the new information and the odds ratios were similar to those for white patients. Thus, while the NYS report card obviously has not eliminated disparities in access to high-quality CABG surgeons, it has contributed to some leveling of the playing field and improving the ability of racial minorities to access the best surgeons. It is particularly revealing that the effect of the explicit information about quality—the new information—is almost the same for whites and blacks, while the effect of the implicit information—inferred RAMR—is stronger for whites even after publication. This suggests that report cards may have a very important role to play in addressing racial disparities in access to high-quality providers.

It is also noteworthy that the effect of the reports on choice of surgeons depends on education and income. Our results suggest that patients residing in more affluent and more educated neighborhoods have gained from the publication of the reports, as they were more likely to be treated by low RAMR surgeons in the post-report period. This shift in surgeon selection seems, however, to crowd out patients from lower socioeconomic zip codes, who in the post-report period were more likely to be treated by high RAMR surgeons. This is a likely result if the system has fixed capacity, and hence shifts in the choices of one group—those patients who are capable of accessing and using the information—occurs at the expense of those who are not. This may be only a short-term phenomenon, however, which may disappear as capacity adjusts and all surgeons improve their performance. Further studies of more recent data could shed light on this issue. If this phenomenon persists it should be considered in future efforts to develop and disseminate report cards, possibly devising interventions to assure that individuals of low educational and socioeconomic strata also have access to the information, and hence to high-quality providers.

The authors gratefully acknowledge financial support from the Agency for Healthcare Research and Quality (grant #HS09803); from the Commonwealth Fund, a New York City based private, independent foundation; from the National Institute on Aging; and the National Center for Minority Health and Health Disparities (grant #AG020644). This paper was presented at the 2002 meeting of the Academy for Health Services Research and Policy. The views presented here are those of the authors and not necessarily those of the Commonwealth Fund, its directors, officers, or staff.

References

Bagwell, K., and M.H. Riordan. 1991. High and Declining Prices Signal Product Quality. *American Economic Review* 81:224–239.

Burns, L.R., and D.R. Wholey. 1992. The Impact of Physician Characteristics in Conditional Choice Models for Hospital Care. *Journal of Health Economics* 11:43–62.

Chernew, M., G. Gowrisankaran, and D. Scanlon. 2001. Learning and the Value of Information: The Case of Health Plan Report Cards. National Bureau of Economic Research (NBER) working paper 8589. Boston: NBER.

Dranove, D., D. Kessler, M. McClellan, and M. Satterthwaite. 2002. Is More Information Better? The Effects of “Report Cards” on Health Care Providers. National Bureau of Economic Research working paper 8697. Boston: NBER.

Gormley, W.T., and D.L. Weimer. 1999. *Organizational Report Cards.* Cambridge, Mass.: Harvard University Press.

Hannan, E.L., J.F. O’Donnell, G. Lukacik, and E.S. Shields. 1990. Adult Open Heart Surgery in New York State: An Analysis of Risk Factors and Hospital Mortality Rates. *Journal of the American Medical Association* 264:2768–2774.

Hannan, E.L., H. Kilburn, Jr., M. Racz, E. Shields, and M.R. Chassin. 1994. Improving the Outcomes of Coronary Artery Bypass Surgery in New York State. *Journal of the American Medical Association* 271:761–766.

Hannan, E.L., C.C. Stone, T.L. Biddle, and B.A. DeBuono. 1997. Public Release of Cardiac Surgery Outcomes Data in New York: What Do New York State Cardiologists Think of It? *American Heart Journal* 134:55–61.

Jewett, J.J., and J.H. Hibbard. 1996. Comprehension of Quality Care Indicators: Differences Among Privately Insured, Publicly Insured and Uninsured. *Health Care Financing Review* 18:75–94.

Luft. H.S., D.W. Garnick, D.H. Mark, and D.J. Peltzman. 1990. Does Quality Influence Choice of Hospital? *Journal of the American Medical Association* 263:2899–2906.

Marshall, M.N., P.G. Shekelle, S. Leatherman, and R.H. Brook. 2000. The Public Release of Performance Data: What Do We Expect to Gain? A Review of the Evidence. *Journal of the American Medical Association* 283:1866–1874.

McFadden, D. 1973. Conditional Logit Analysis of Quantitative Response Models. In *Frontiers in Econometrics,* P. Zarembka, ed. New York: Academic Press.

Mukamel, D.B., and A.I. Mushlin. 1998. Quality of Care Information Makes a Difference: An Analysis of Market Share and Price Changes Following Publication of the New York State Cardiac Surgery Report Card. *Medical Care* 36:945–954.

———. 2001. The Impact of Quality Report Cards on Choice of Physicians, Hospitals and HMOs—A Midcourse Evaluation. *Joint Commission Journal on Quality Improvement* 27:20–27.

Mukamel, D.B., A.I. Mushlin, D.L. Weimer, J. Zwanziger, T. Parker, and I. Indridason. 2000. Do Quality Report Cards Play a Role in HMOs’ Contracting Practices? Evidence From New York State. *Health Services Research* 35:319–332.

Mukamel, D.B., A.S. Murthy, and D.L. Weimer. 2000. Racial Differences in Access to High Quality Cardiac Surgeons. *American Journal of Public Health* 90:1774–1777.

Mukamel, D.B., D.L. Weimer, J. Zwanziger, and A.I. Mushlin. 2002. Quality of Cardiac Surgeons and Managed Care Contracting Practices. *Health Services Research* 37:1129–1144.

Mukamel, D.B., and W.D. Spector. 2003. Quality Report Cards and Nursing Home Quality. *The Gerontologist* 43(special issue 2):58–66.

Mukamel, D.B., A. Dick, and W.D. Spector. 2000. Specification Issues in Measurement of Quality of Medical Care Using Risk Adjusted Outcomes. *Journal of Economic and Social Measurement* 26:267–281.

New York State Department of Health. 1997. *New York State Cardiac Surgery Reports.* Albany, N.Y.: New York State Department of Health.

Peterson, E.D., E.R. DeLong, J.G. Jollis, L.H. Muhlbaier, and D.B. Mark. 1998. The Effects of New York’s Bypass Surgery Provider Profiling on Access to Care and Patient Outcomes in the

Elderly. *Journal of the American College of Cardiology* 32:993–999.
Rothenberg, B., T. Pearson, J. Zwanziger, and D.B. Mukamel. 2004. Explaining Disparities in Access to High Quality Cardiac Surgeons. *Annals of Thoracic Surgery* 78:18–24.
Vladeck, B.C., E.J. Goodwin, L.P. Myers, and M. Sinisi. 1998. Consumers and Hospital Use: The HCFA "Death List." *Health Affairs* (Spring): 122–125.
Zinman, D. 1991. Heart Surgeons Rated. *Newsday* (Dec. 18):3,35,37.