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An Analysis of Publicly Reported Outcomes in Cardiac Surgery

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During the past two decades, several public and private organizations have initiated programs to report publicly on the quality of medical care provided by specific hospitals and physicians. These programs have sparked broad debate among economists and policymakers. At issue is the question of whether, and to what extent, these "report card" programs have improved or harmed medical productivity.

Economists typically see more information as obviously beneficial. How can patients be harmed by knowing more about the quality of their medical-care providers? The key problem is the potential inaccuracy of quality data. Consider an attempt to rate the quality of surgeons performing cardiac bypass surgery, which we examine in this paper. The outcome of any bypass operation depends on physician and hospital characteristics and on the underlying health of the patient. Patients who are sicker are more likely to have poor outcomes than those who are healthier.

If the quality reporting system does not take these patient differences into account, several problems might result. First, patients and referring physicians, many of whom have prior informal data about the quality of various providers, may make decisions based on the new data without realizing the potential inaccuracies. Second, even if the patients do not rely on the new information, its existence may confuse them to the point that they ignore both sources of information. Either way, it is possible that referral patterns might change for the worse.

The situation could be even more problematic. If hospitals know that their reputations may be penalized if they treat high-risk patients, they might reduce their willingness to operate on such patients, denying them potentially needed care or forcing them to travel to other areas. As a result, health outcomes may suffer.

These possibilities are not simply theoretical. David Dranove et al. (2003) argued that quality report cards for coronary artery bypass graft (CABG) surgery in New York State and Pennsylvania hurt quality, by limiting access to surgery for high-risk patients. Similarly, Nowamagbe Omoigui et al. (1996) found that a larger percentage of high-risk bypass surgery patients were transferred out of New York State following the introduction of report cards, and Eric Schneider and Arnold Epstein (1996) found that many cardiac surgeons reported a decreased willingness to operate on severe patients after introduction of CABG report cards in Pennsylvania. But the evidence on this issue is not uniform. Edward Hannan et al. (1994) and Eric Peterson et al. (1998) found that the average in-hospital mortality rate for CABG surgery in New York declined significantly after introduction of hospital report cards.[1]

[1] This issue is also debated. William Ghali et al. (1997) find that the decline in mortality in New York from 1990 to

With few exceptions,[2] the above studies all examine the impact of report cards by considering trends at the state level. Identification of the impact of report cards thus comes from average effects within states with report cards relative to average effects in those without such programs. An alternate approach, and that which we employ, is to examine the impact of report cards on the outcomes for and allocation of patients across *individual providers* within a given state that adopted a report-card system. This allows more observations on quality as well as very complete data for risk adjustment.

We take advantage of a cross-sectional time series of different hospitals to address two fundamental questions about quality reporting. First, we examine whether report cards affect the distribution of where patients go for bypass surgery. Second, we determine whether report cards lead to improved medical quality among hospitals identified as particularly bad or good performers. Our data are from one of the longest-standing efforts to measure and report health care quality—the Cardiac Surgery Reporting System (CSRS) in New York State.

I. New York's Cardiac Surgery Reporting System

Since the late 1980's, CSRS has collected detailed information on every patient receiving bypass surgery at a hospital in New York State. In addition to identifying the surgeon and hospital involved with the procedure, CSRS collects data on clinical outcomes (specifically, whether or not the patient died in the hospital following the procedure) and incoming severity of the patient. The severity data contain information on whether a given patient has a history

FIGURE 1. DISTRIBUTION OF HOSPITAL-LEVEL RISK-ADJUSTED MORTALITY RATES IN NEW YORK, 1991–1999

Notes: The risk-adjusted mortality rates in this figure are based on a single logistic regression using isolated CABG procedures in New York State for the period from 1991 through 1999. See footnote 3 for a comparison of our procedure to that used in New York's CABG report cards.

of one or more of roughly 40 clinical conditions including diabetes, kidney failure, liver failure, or prior heart attack (for a detailed description of this clinical information, see Hannan et al. [1994]). Once every 12–18 months, the state releases these data, along with information on which hospitals were statistically significantly better or worse than the statewide average. These data are reported with a lag of several years. For example, the data on hospitals for 1999 were released in September 2002.

To adjust for underlying health risks of the patients, New York uses a logistic regression to predict the expected probability of in-hospital mortality. The covariates for the regression are drawn from the clinical variables contained in CSRS. We follow this procedure in our analysis.[3]

Figure 1 illustrates the 25th percentile, median, and 75th percentile values of risk-adjusted mortality across all hospitals performing bypass surgery in New York in a given year.

1992 was not significantly different from that in Massachusetts (which had not adopted a report card system as of 1992) over the same period.

[2] Dana Mukamel and Alvin Mushlin (1998) find that hospitals and surgeons with better reported outcomes experienced higher rates of growth in the market shares following the reports, though they do not consider how the outcomes for or severity of future patients seen by these providers is affected. Stanley Dziuban et al. (1994) consider the impact of the New York report cards on one hospital that was cited as having significantly poorer than average outcomes. This case study provides some insight into steps that one hospital took in response to the reports.
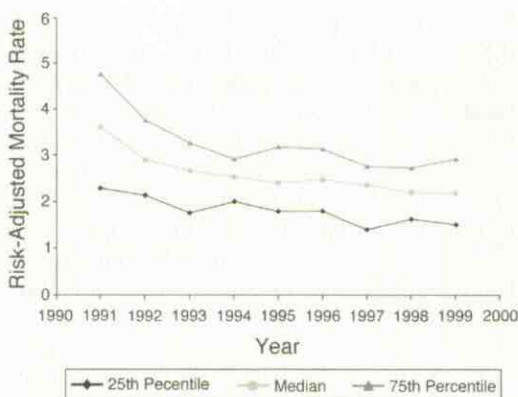
[3] One difference in our analysis is that we keep the set of covariates constant over time, while New York State varies them each year based on a stepwise regression procedure. In our risk-adjustment model, we include any covariate that (i) was used in the New York models for all data from 1991 through 1999 and (ii) was reliably collected for all nine years in our sample. A detailed list of the covariates included in this regression is available from the authors upon request.

Risk-adjusted mortality fell significantly across the state during the first decade of the report-card program. Further, the range between the hospitals at the 25th and 75th percentiles narrows during the early years of the reporting program, suggesting improved performance among initial poor performers. Although these results do not compare New York to other states without report-card programs, they are consistent with prior findings that suggest an improvement in outcomes in New York during the initial years of the reporting.

To examine the impact of report cards on the allocation of patients across hospitals, we use the total number of CABG cases for each hospital-month as the dependent variable in regressions that include hospital and year fixed effects. Our basic equation is of the following form:

$$(1) \quad \text{Cases}_{imt} = \beta_1(\text{High}_{imt}) + \beta_2(\text{Low}_{imt})$$

$$+ \delta_i + \lambda_t + \varepsilon_{it}$$

where i denotes hospital, m denotes month of hospital admission (for years 1991 through 1996) or discharge (for years 1997 through 1999), and t denotes year of admission or discharge. The vectors δ and λ include fixed effects for hospital and year, respectively. The key independent variables are indicators for whether the hospital previously has received a high-mortality flag (High_{imt}) or low-mortality flag (Low_{imt}). Given lags in the release of the report cards, the flags assigned to hospitals in period t are typically based on performance data for year $t - 2$ or $t - 3$. Each of these indicators is interacted with indicators for the number of months since a hospital received its first flag (e.g., 1–12 months, 13–24 months, 25–36 months, and more than 36 months) to estimate the persistence of any effects on volume.[4]

The first column of Table 1 shows the results of this regression. Being identified as a high-mortality hospital is associated with a decline of approximately 4.9 bypass-surgery patients per

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[4] While there is a small set of hospitals that received multiple high- or low-mortality flags during the nine-year period, we use only the first occurrence of either type of flag in determining when the high- or low-mortality indicator shifts from 0 to 1.

TABLE 1—REGRESSIONS OF CABG CASES AND RISK-ADJUSTED MORTALITY ON PUBLICLY REPORTED PERFORMANCE

Independent variable	CABG cases			Risk-adjusted mortality rate
	All patients	Low severity	High severity	All patients
Months since initial high-mortality flag				
1–12	−4.9*	−5.4**	0.6	−1.2**
	(2.4)	(2.0)	(0.9)	(0.4)
13–24	−3.1	−3.7†	0.7	−1.3†
	(2.6)	(2.1)	(1.0)	(0.7)
25–36	−3.7	−4.0	0.4	−1.3**
	(3.7)	(2.8)	(1.4)	(0.5)
More than 36	−7.1	−5.9	−1.2	−0.6
	(4.9)	(3.8)	(1.5)	(0.6)
Months since initial low-mortality flag				
1–12	3.0	1.5	1.5	0.2
	(6.6)	(4.5)	(2.4)	(0.3)
13–24	−0.8	−0.3	−0.6	0.3
	(6.8)	(4.2)	(3.1)	(0.2)
25–36	−1.8	−1.9	0.0	0.3*
	(5.9)	(4.1)	(2.5)	(0.2)
More than 36	−7.1	−3.2	−4.0	0.2
	(8.8)	(6.3)	(2.8)	(0.2)
Hospital fixed effects?	yes	yes	yes	yes
Year fixed effects?	yes	yes	yes	yes
Average value of dependent variable	47.49	35.63	12.13	2.55
Number of observations:	3,406	3,404	3,337	3,406
Adjusted R^2:	0.862	0.838	0.706	0.073

Notes: The level of observation is the hospital-month. Standard errors (in parentheses) are heteroscedasticity-robust and clustered by hospital. In regression with risk-adjusted mortality as the dependent variable, observations are weighted by the total number of cases for the relevant hospital-month.

† Statistically significant at the 10-percent level.
* Statistically significant at the 5-percent level.
** Statistically significant at the 1-percent level.

month during the 12 months following that designation. This decline is significant at the 5-percent level. The decline is reasonably large. The average hospital performs about 50 bypass-surgery operations per month, so the change in volume is about 10 percent. While this negative impact on volume remains in the estimates be-

yond one year after the initial report, these effects are not significant at conventional levels.

In contrast to their impact on low-quality hospitals, the reports do not seem to increase future volume for those facilities receiving low-mortality flags. The estimated coefficient is positive in the first year following a report and becomes negative in subsequent years. It is always imprecisely estimated. With only data from New York State, we cannot tell whether the patients moving out of low-quality hospitals are not receiving surgery at all or are simply being spread over all non-low-quality hospitals.

We can understand more about what is happening by considering the type of patients who are not receiving bypass surgery at high-mortality hospitals. A reduction in relatively healthy patients is more indicative that patients (or their referring doctors) are choosing not to go to low-quality providers. A reduction in sicker patients, who often receive more immediate surgery, would suggest that low-quality hospitals (or the surgeons who work at those facilities) are choosing to operate less frequently.

The next two columns of Table 1 repeat our regressions separately for low- and high-severity subsamples of the patient population.[5] The decline in volume for hospitals receiving high-mortality flags is driven by reductions in the number of low-severity cases. The number of such cases declines by roughly 15 percent and 10 percent relative to the sample average in the first and second years, respectively. There is no change in the number of high-severity patients. Thus, it appears that patients and referring cardiologists are choosing to reduce operations at low-quality institutions.

These volume effects notwithstanding, we recall that the stated goal of cardiac-surgery reporting is to improve the quality of medical care. To examine the impact of reporting on outcomes, we repeat these regressions using the risk-adjusted mortality rate as the dependent variable. We form values of risk-adjusted mortality for each hospital-month by dividing aver-

age observed mortality by average predicted mortality for a given hospital-month and multiplying that ratio by the statewide average mortality rate for the entire nine-year period. To account for heterogeneity based on sample size and to mitigate the effect of small numbers of observations, we weight the observations by the total number of bypass-surgery cases for a given hospital-year.

The last column of Table 1 shows the results for mortality. Identification as a high-mortality hospital is associated with improved future performance. Hospitals that are publicly identified as being of low quality experience a decline of 1.2 percentage points (significant at the 1-percent level) during the first 12 months after an initial report. This decrease remains for the three years following the report, though the significance is only at the 10-percent level for months 13 through 24. The average risk-adjusted mortality rate is 2.55 percent for the entire sample. For those hospitals receiving a high-mortality flag, the average risk-adjusted mortality rate prior to receiving that flag is 3.82 percent. Relative to either of these baselines, the change we identify represents a significant improvement in performance.

Those hospitals receiving a low-mortality flag show little evidence of mortality changes. The coefficients are slightly positive, but only statistically significant in the third year after the report.

II. Discussion

The evidence from the first decade of New York's bypass-surgery reporting program suggests that the public release of quality information has had an impact on both the volume of cases and future quality at hospitals identified as poor performers. With respect to procedural volume, low-performing hospitals have lost relatively healthy patients to competing facilities. This change may be the result of demand-side factors, such as the possibility that healthier patients are more able to search for higher-quality providers, although several studies have suggested that similar reports have not been used by cardiologists (Schneider and Epstein, 1996) or managed-care insurers (Mukamel et al., 2000) in affecting referral or contracting patterns.

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[5] We divide bypass-surgery patients into low and high severity based on whether the predicted mortality determined by our patient-level logistic regression is below or above the mean predicted mortality for the state of New York in a given year.

Another possibility is that supply-side factors within the affected hospitals are generating this result. For example, surgeons at poorly performing hospitals may simply be choosing to do fewer procedures or may be encouraged to do fewer procedures by hospital administrators. In the extreme, some surgeons may be exiting the market entirely. To the extent that those surgeons leaving the market were previously doing relatively routine cases, this reduction might be concentrated among relatively healthy patients. Regardless of the importance of demand- and supply-side factors in affecting procedural volumes, our results do suggest that the largest reductions for poor-performing hospitals are among low- rather than high-severity patients. Whatever efforts physicians may be making to reduce surgery to high-risk patients are not reducing their volumes of those patients in equilibrium.

Our findings with respect to quality improvement might also be explained by multiple factors. First, to the extent that hospitals flagged as poor performers lose surgical volume, they may work harder to replace that volume, particularly given the high marginal profitability associated with cardiac procedures. Alternatively, hospitals and surgeons may make efforts to improve their future quality for reasons that are motivated not by financial concerns, but by concern for patient health and their reputations as providers of high-quality medical care. Stanley Dziuban et al. (1994) argue that this is why one hospital improved its performance after quality reporting.

While New York's experience with bypass-surgery report cards has provided clear evidence of market changes associated with the public release of quality information, the exact mechanisms underlying these changes represents an area for future research. Identifying such mechanisms will provide a better understanding of the impact of public quality reports on medical productivity.

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