The Relationship Between Managed Care Insurance and Use of Lower-Mortality Hospitals for CABG Surgery

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Context Explicit information about the quality of coronary artery bypass graft (CABG) surgery has been available for nearly a decade in New York State; however, the extent to which managed care insurance plans direct enrollees to the lowest-mortality CABG surgery hospitals remains unknown.

Objective To compare the proportion of patients with managed care insurance and fee-for-service (FFS) insurance who undergo CABG surgery at lower-mortality hospitals.

Design A retrospective cohort study of CABG surgery discharges from 1993 to 1996, using New York Department of Health databases and multivariate analysis to estimate the use of lower-mortality hospitals by patients with different types of health insurance.

Setting Cardiac surgical centers in New York, of which 14 were classified as lower-mortality hospitals (mean rate, 2.1%) and 17 were classified as higher-mortality hospitals (mean rate, 3.2%).

Patients A total of 58,902 adults older than 17 years who were hospitalized for CABG surgery. Patients were excluded if their CABG surgery was combined with any valve procedure or left ventricular aneurysm resection or if they were younger than 65 years and enrolled in Medicare FFS or Medicare managed care.

Main Outcome Measure Probability of a patient receiving CABG surgery at a lower-mortality hospital.

Results Compared with patients with private FFS insurance (n=18,905), patients with private managed care insurance (n=7169) and Medicare managed care insurance (n=880) were less likely to receive CABG surgery at a lower-mortality hospital (relative risk [RR] of surgery at a lower-mortality hospital compared with patients with private FFS insurance, 0.77; 95% confidence interval [CI], 0.74-0.81; P<.001; and RR, 0.61; 95% CI, 0.54-0.70; P<.001, respectively, after controlling for multiple potential confounding factors). Patients with Medicare FFS insurance used lower-mortality hospitals at rates more similar to those with private FFS insurance (n=31,948; RR, 0.95; 95% CI, 0.91-0.98; P=.004).

Conclusions Patients in New York State with private managed care and Medicare managed care insurance were significantly less likely to use lower-mortality hospitals for CABG surgery compared with patients with private FFS insurance.
artery bypass graft (CABG) surgery, but they found no difference between these 2 types of patient groups in Florida. Data on CABG surgery mortality were not publicly available in either setting, making it unlikely that health plans explicitly considered mortality rates in their CABG surgery contracting decisions.

In contrast, New York was the first and one of the few states to provide information on CABG surgery, including risk-adjusted mortality rates, to the public, allowing health plans, at least in theory, to explicitly consider quality of care when contracting with hospitals to provide CABG surgery. To explore the relationship between insurance type and patterns of hospital use, we compared the probabilities that patients with managed care insurance and patients with fee-for-service (FFS) insurance would undergo CABG surgery at lower-mortality hospitals in New York State, where quality-of-care information is available.

**METHODS**

**Population**

We examined CABG surgery discharges in New York State for the years 1993 through 1996, using records from New York State annual hospital discharge databases. These legislatively mandated databases included patient age, race, ethnicity, insurance type, ZIP code, hospital of admission, and International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes for all patients aged 18 years or older who underwent CABG surgery in these years. We selected New York State residents who underwent CABG surgery (ICD-9-CM codes 36.1, 36.10-36.17) at 1 of 31 CABG surgery hospitals in New York State and had 1 of the following primary health insurance types: private FFS, private managed care, Medicare FFS, or Medicare managed care. Single codes represented each insurance type except private FFS, which included codes 06 (Blue Cross), 08 (commercial insurance company), and 15 (self-insured company). Private managed care was defined as code 11 (health maintenance organization); no codes existed for preferred provider organizations or other variations of private managed insurance. We excluded patients who underwent CABG surgery combined with any valve procedure or left ventricular aneurysm resection. Because they represent such a heterogeneous group, patients younger than 65 years who were enrolled in either Medicare FFS or Medicare managed care programs were also excluded.

**Designation of Lower- and Higher-Mortality Hospital Groups**

Rather than ranking hospitals separately for each year, we ranked hospitals into lower- and higher-mortality groups based on volume-weighted average adjusted mortality rates to simplify the analysis and improve interpretability of results. These rates, published by the New York Department of Health, are adjusted for multiple demographic and medical risk factors, including age, sex (for years 1995-1996 only), body surface area, hemodynamic status, medical comorbidities, severity of atherosclerotic process, measures of ventricular function, and history of open-heart surgery.

Based on these averages, we divided hospitals into lower- and higher-mortality groups using a mortality rate cut point that allocated about half of the patients to each group. The lower-mortality hospital group included 14 hospitals, constituting 49.8% of the total number of patients, with a mean adjusted mortality rate of 2.1% (range, 1.2%-2.5%) and a mean annual case volume of 561 (range, 189-1528). The higher-mortality hospital group included 17 hospitals, with a mean adjusted mortality rate of 3.2% (range, 2.5%-5.1%) and a mean annual case volume of 466 (range, 63-1019).

This method of ranking hospitals appeared to be fairly stable from year to year. The published hospital adjusted mortality rates averaged for the first 2 years of the study correlated highly with those for the last 2 years (Pearson \( r = 0.53; \ P = .002 \)). Rankings derived from these rates correlated significantly as well (Spearman \( r = 0.37; \ P = .04 \)). Thus, at least in theory, insurers could use this type of rating to predict hospital mortality rates in future years.

**Analysis of Use of Lower-Mortality Centers**

The outcome of interest was the probability that a patient underwent a CABG operation at 1 of the lower-mortality hospitals. The independent variable of interest was insurance type. In addition, models controlled for age, sex, urgent/emergent admission, and the presence of medical comorbidities, including diabetes, chronic renal failure, congestive heart failure, systemic hypertension, and chronic obstructive pulmonary disease. Age was represented as a categorical variable with 4 values: younger than 55 years, 55 to 64 years, 65 to 75 years, and older than 75 years. Other independent variables, determined using the 1990 US census, were median family income for the patient’s ZIP code of residence and designation of the patient’s residential area as urban. Median family income for ZIP code was represented as a categorical variable in quartiles.

Because the location of a patient’s residence may be correlated with both insurance status and the choice of hospital, our analysis also used 2 factors to account for the impact of distance on the use of lower-mortality centers. These factors were the distance to the nearest lower-mortality center and the distance to the nearest higher-mortality center. Both were based on the distances from the geographic centroids of the hospital and patient residential ZIP codes because street addresses were not included in the available data. Such “straightline” methods of estimating geographic accessibility through geographic longitude and latitude data have been shown to correlate closely with estimated travel times using actual driving routes. These distance factors were log-transformed prior to analysis based
on the observation in our data set and in other similar studies\textsuperscript{19} that such
transformation resulted in a closer fit
to the relationship between distance and
use of a lower-mortality hospital than
did actual distance and several other
transformations investigated.

We identified univariate predictors
of use of lower-mortality centers using
\( 2 \times 2 \chi^2 \) tests for categorical vari-
ables. In the case of categorical vari-
ables with more than 2 possible values,
each value was compared with a refer-
ence value (eg, the youngest age group).
The Wilcoxon rank sum test was used
to determine differences among insur-
ance types for all continuous vari-
ables, none of which were normally dis-
tributed.

We then used a stepwise logistic re-
gression model to estimate the multi-
variate-adjusted odds of use of lower-
mortality centers, considering each of
the independent variables listed herein,
including the 2 distance factors. Be-
cause the rate of the outcome ( propor-
tion of patients in lower-mortality hos-
pitals) exceeded 10%, we transformed
odds ratios (ORs) to approximate rela-
tive risks (RRs) according to the method
described by Zhang and Yu.\textsuperscript{19}

Two hospitals did not report patient
race or ethnicity for the study period, so
these variables were not entered into
the models. However, we did investigate
the relationships among insurance type, hos-
pital used, and race/ethnicity by repeat-
ing the analysis separately for patients
coded as non-Hispanic white and those
coded as nonwhite or Hispanic. We also
performed supplementary analyses by
stratifying patients according to age, ur-
gency of admission, and residence in
New York City and by varying the
threshold for inclusion in the lower-
mortality hospital group. In addition, we
examined the distribution of patients
among individual hospitals in 4 delim-
ited regions of the state, including Buf-
falo, Rochester, Long Island, and New
York City.

### RESULTS

Among 58,902 adults admitted for
CABG surgery between 1993 and 1996,
most patients were male (71%), non-
Hispanic white (87%), and Medicare
FFS beneficiaries (54%). Total inpa-
tient mortality was 2.8%. Hyperten-
sion (52%) and diabetes (27%) were the
most commonly coded comorbidities.
Urgent/emergent admissions consti-
tuted 51% of all cases. TABLE 1 sum-
marizes the demographic characteris-
tics according to insurance group.

Unadjusted analyses (TABLE 2) re-
vealed that patients with private man-
aged care, Medicare FFS, and Medi-
care managed care insurance were less
likely than patients with private FFS in-
surance to undergo CABG surgery at
lower-mortality centers. Other factors
associated with less frequent use of
lower-mortality centers included fe-
male sex, nonwhite race/ethnicity, lower
median family income for ZIP
code, urgent/emergent admission, dia-
betes, and chronic renal failure. In con-
trast, patients with congestive heart
failure, hypertension, and chronic ob-
structive pulmonary disease were more
likely to use lower-mortality hos-
pitals. On average, patients undergoing
surgery at a lower-mortality hospital
lived closer to a lower-mortality cen-
ter (15.4 vs 24.6 miles; \( P < .001 \)) and pa-
tients undergoing surgery at a higher-
mortality hospital lived closer to a
higher-mortality center (38.9 vs 13.9
miles; \( P < .001 \)).

Table 2 also shows coefficients and
95% confidence intervals (CIs) for cat-
egorical covariates in the final multi-
variate model. Also included in the fi-
nal model were the 2 distance variables,
discussed herein. Compared with pa-
tients with private FFS insurance,
patients with private managed care insurance were less likely to undergo CABG surgery at a lower-mortality hospital (RR, 0.77; 95% CI, 0.74-0.81; *P* < .001), as were patients with Medicare managed care insurance (RR, 0.61; 95% CI, 0.54-0.70; *P* < .001). After controlling for other factors, patients with Medicare FFS insurance used lower-mortality hospitals at a rate similar to those with private FFS insurance (RR, 0.95; 95% CI, 0.91-0.98; *P* = .004). As in the univariate analysis, patients who were female, lived in lower ZIP code median family income groups, were admitted urgently or emergently, or had a code recorded for either diabetes or chronic renal failure were less likely to be admitted to a lower-mortality center, although the magnitude of the difference was small in some cases. In contrast, those older than 75 years and those who had a code recorded for heart failure, hypertension, or chronic obstructive pulmonary disease had a greater probability of admission to a lower-mortality center. Increasing distance from the nearest lower-mortality center reduced the odds of admission to a lower-mortality hospital (for a 0.1-log increase in distance, OR, 1.45; 95% CI, 1.38-1.52). Increasing distance to the nearest higher-mortality hospital increased the odds of admission to a lower-mortality center (for a 0.1-log increase in distance, OR, 1.44; 95% CI, 1.41-1.47; *P* < .001).

When we restricted the sample to patients living within 25 miles of both a lower-mortality and higher-mortality hospital, the results were similar. Compared with patients with private FFS insurance, patients with private managed care insurance were less likely to undergo CABG surgery at a lower-mortality hospital (RR, 0.62; 95% CI, 0.58-0.66; *P* < .001), as were patients with Medicare managed care insurance (RR, 0.57; 95% CI, 0.48-0.66; *P* < .001) and, to a smaller degree, Medicare FFS insurance (RR, 0.92; 95% CI, 0.88-0.96; *P* < .001).

Table 3 shows the sensitivity of these results to changes in the cut point for inclusion in the lower-mortality group at between 38% and 68%, which was as close as the data would allow to division at the upper and lower tertiles. Regardless of the threshold, patients with private managed care or Medicare managed care insurance were significantly less likely than patients with private FFS insurance to use a lower-mortality center. Medicare FFS estimates of use were slightly lower than those for private FFS at all cut points as well.

In subgroups stratified by region (New York City vs upstate New York and Long Island), admission type (nonurgent vs urgent or emergent), age, and race/ethnicity, patients with private managed care and Medicare managed care insurance were significantly less likely to use lower-mortality centers than patients with private FFS insurance (Table 3). Patients with Medicare FFS insurance had rates of use much closer to those with private FFS insurance, with nonsignificant differences in several patient subgroups (New York City, nonurgent admissions, and non-Hispanic white race/ethnicity).

When we examined 4 delimited areas (Buffalo, Rochester, New York City, and Long Island), patients with private managed care and, particularly, Medicare managed care insurance were virtually excluded from many of the hospitals in a given area (Table 4). For example, of 3 hospitals in the Buffalo area, 99% of patients in Medicare managed care plans were admitted to a single (higher-mortality) hospital that...

### Table 2. Categorical Covariate Predictors of Utilization of Lower-Mortality Hospitals*

<table>
<thead>
<tr>
<th>Categorical Covariates</th>
<th>Using Lower-Mortality Hospitals, %</th>
<th>RR</th>
<th>Multivariate Effects, RR (95% CI)†</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insurance type</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private FFS</td>
<td>56.3</td>
<td>1.00</td>
<td>1.00 (Referent)</td>
</tr>
<tr>
<td>Private managed care</td>
<td>40.8</td>
<td>0.76‡</td>
<td>0.77 (0.74-0.81)‡</td>
</tr>
<tr>
<td>Medicare FFS</td>
<td>51.0</td>
<td>0.91‡</td>
<td>0.95 (0.91-0.98)§</td>
</tr>
<tr>
<td>Medicare managed care</td>
<td>35.9</td>
<td>0.70‡</td>
<td>0.61 (0.54-0.70)‡</td>
</tr>
<tr>
<td><strong>Age, y</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;55</td>
<td>48.5</td>
<td>1.00</td>
<td>1.00 (Referent)</td>
</tr>
<tr>
<td>55-64</td>
<td>49.0</td>
<td>1.02</td>
<td>0.98 (0.94-1.02)</td>
</tr>
<tr>
<td>65-75</td>
<td>50.7</td>
<td>1.03§</td>
<td>1.05 (1.01-1.10)†</td>
</tr>
<tr>
<td>&gt;75</td>
<td>49.9</td>
<td>1.01</td>
<td>1.10 (1.04-1.15)†</td>
</tr>
<tr>
<td><strong>Sex, male</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex, female</td>
<td>51.0</td>
<td>1.08‡</td>
<td>1.05 (1.02-1.07)‡</td>
</tr>
<tr>
<td>Non-Hispanic white</td>
<td>52.4</td>
<td>1.38‡</td>
<td>...</td>
</tr>
<tr>
<td><strong>Median family income</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for ZIP code, quartile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>38.1</td>
<td>0.59‡</td>
<td>0.83 (0.81-0.86)‡</td>
</tr>
<tr>
<td>2</td>
<td>43.5</td>
<td>0.64‡</td>
<td>0.91 (0.88-0.93)‡</td>
</tr>
<tr>
<td>3</td>
<td>53.8</td>
<td>0.77‡</td>
<td>1.02 (0.99-1.04)</td>
</tr>
<tr>
<td>4</td>
<td>64.2</td>
<td>1.00</td>
<td>1.00 (Referent)</td>
</tr>
<tr>
<td><strong>Urgent admission</strong></td>
<td>44.8</td>
<td>0.81‡</td>
<td>0.85 (0.83-0.87)‡</td>
</tr>
<tr>
<td><strong>Comorbidity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>48.6</td>
<td>0.97§</td>
<td>0.97 (0.95-0.99)§</td>
</tr>
<tr>
<td>Chronic renal failure</td>
<td>44.8</td>
<td>0.90§</td>
<td>0.89 (0.82-0.96)§</td>
</tr>
<tr>
<td>Heart failure</td>
<td>52.1</td>
<td>1.07‡</td>
<td>1.10 (1.07-1.13)‡</td>
</tr>
<tr>
<td>Hypertension</td>
<td>51.7</td>
<td>1.07‡</td>
<td>1.10 (1.07-1.12)‡</td>
</tr>
<tr>
<td>COPD</td>
<td>57.4</td>
<td>1.17‡</td>
<td>1.11 (1.08-1.15)‡</td>
</tr>
<tr>
<td>Urban residence</td>
<td>48.9</td>
<td>0.99</td>
<td>1.35 (1.33-1.38)‡</td>
</tr>
</tbody>
</table>

*RR indicates relative risk; CI, confidence interval; FFS, fee-for-service; and COPD, chronic obstructive pulmonary disease.

†Data are given as odds ratios corrected to approximate RRs, with 95% CIs (see “Methods” section of text for details).

§*P* < .01.

¶Data are given as odds ratios corrected to approximate RRs, with 95% CIs (see “Methods” section of text for details).

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otherwise accounted for only 59% of that region’s caseload. Those admitted to hospitals in Long Island were restricted to the 3 hospitals with the highest adjusted mortality rates among 5 hospitals. Medicare managed care patients admitted to hospitals in New York City were admitted to 8 of 14 hospitals, and 46% were admitted to a single higher-mortality hospital that otherwise accounted for only 11% of the region’s caseload.

In all, 4 (13%) of 31 hospitals admitted no CABG surgery patients with private managed care insurance. Fourteen (45%) admitted no patients with Medicare managed care plans. Restricting the sample to patients admitted to the 17 hospitals that admitted at least 1 patient with Medicare managed care insurance did not significantly change the results of multivariate analysis. Compared with patients with private FFS insurance, those with private managed care insurance were less likely to use a lower-mortality center (RR, 0.69; 95% CI, 0.65-0.73; P<.001), as were patients with Medicare managed care (RR, 0.49; 95% CI, 0.40-0.58; P<.001) and Medicare FFS (RR, 0.75; 95% CI, 0.69-0.80; P<.001) insurance.

**COMMENT**

Over the period of the present study, patients in New York State with managed care insurance were significantly less likely to undergo CABG surgery at a hospital with lower CABG mortality compared with patients with FFS insurance. This finding remained significant within categories of age, race, urgency, and region. The findings were not sensitive to the threshold used to define lower-mortality hospitals, nor did they appear to be a manifestation of a differential lag time in the recognition of changing hospital outcomes.

Some insight into the mechanisms of these differences in hospital use patterns can be gained by examining insurance-specific use on a hospital-by-hospital basis. Patients with managed care insurance and, particularly, managed Medicare insurance were often excluded from many lower-mortality hospitals entirely, implicating relatively powerful disincentives, such as use restrictions set by insurance companies, rather than differences in patient or referring physician preferences. Such restrictions could include removing a hospital from a plan’s preferred provider list or requiring a significant patient co-payment for the use of that hospital.

How do we reconcile our finding that New York State managed health plans appeared to ignore risk-adjusted mortality rates in contracting decisions with the finding that patients in California health plans appeared more likely to use lower-mortality hospitals?1 The absence of public data on risk-adjusted mortality in California makes it unlikely that mortality rates played a significant, if any, role in health plans’ decision making. In a commentary to the study by Escarce et al, Hannan20 suggests that another reason for the difference between California and Florida may be that, because California has no certificate-of-need system, numerous low-volume hospitals with high mortality rates perform CABG surgery. Because low volumes make contracting unattractive, managed care plans in California avoid sending their patients to the highest-mortality hospitals. This indirect effect of CABG surgical volume would not be present in New York, where the certificate-of-need program

<table>
<thead>
<tr>
<th>Table 3. Supplementary Multivariate Analyses*</th>
<th>Relative Risk (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics</td>
<td>Private Managed Care</td>
</tr>
<tr>
<td>Size of lower-mortality group, %</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>0.75 (0.72-0.78)†</td>
</tr>
<tr>
<td>50</td>
<td>0.77 (0.74-0.81)†</td>
</tr>
<tr>
<td>68</td>
<td>0.88 (0.86-0.91)†</td>
</tr>
<tr>
<td>Region</td>
<td></td>
</tr>
<tr>
<td>Upstate New York and Long Island (n = 59,143)</td>
<td>0.69 (0.64-0.73)†</td>
</tr>
<tr>
<td>New York City (n = 24,006)</td>
<td>0.84 (0.79-0.90)†</td>
</tr>
<tr>
<td>Admission type</td>
<td></td>
</tr>
<tr>
<td>Urgent (n = 32,333)</td>
<td>0.74 (0.69-0.79)†</td>
</tr>
<tr>
<td>Nonurgent (n = 30,818)</td>
<td>0.81 (0.77-0.85)†</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
</tr>
<tr>
<td>&lt;65 (n = 24,807)</td>
<td>0.79 (0.76-0.83)†</td>
</tr>
<tr>
<td>≥75 (n = 38,344)</td>
<td>0.65 (0.58-0.73)†</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic white (n = 49,226)</td>
<td>0.79 (0.76-0.83)†</td>
</tr>
<tr>
<td>NonWhite/Hispanic (n = 87,355)</td>
<td>0.68 (0.59-0.77)†</td>
</tr>
</tbody>
</table>

*Private fee-for-service insurance is the comparison for all other groups.
†P<.001.
‡P<.01.
§P<.05.
Ellipses indicate patients younger than 65 years with Medicare insurance were excluded from the analyses (see “Methods” section of text for details).
It must be noted that the results of the present study may not generalize beyond New York State. Because the nature of managed care, the availability of hospital quality information, and the types of hospitals performing CABG surgery vary substantially from state to state, these relationships could differ in other parts of the country.

Despite these limitations, our findings suggest that explicit monitoring of the process and outcomes of care could play an important role in identifying problems with the quality of care for managed care enrollees. The role of managed care organizations in the reduced use of lower-mortality centers among their beneficiaries is likely to be complex and multifactorial. Plans may enter into relationships with hospitals largely on the basis of anticipated costs and may create incentives for primary care providers and patients to use lower-cost centers as well. It is also possible that lower-mortality centers may themselves be unwilling to contract with managed care organizations, if they expect better remuneration from other payers. Meanwhile, by limiting patient choices, managed care organizations may prevent patients and their advocates from taking full advantage of available information about hospital quality. This could inadvertently stifle incentives for hospitals to compete on the quality of care. Additional studies on the impact of quality information on health plans’ contracting decisions will be important as price competition among health plans becomes more intense.

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Thinking, willing and judging are the three basic fundamental activities. They cannot be derived from each other and although they have certain common characteristics, they cannot be reduced to a common denominator.
—Hannah Arendt (1906-1975)