

Relationship of Hospital Teaching Status With Quality of Care and Mortality for Medicare Patients With Acute MI

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ISSUES OF COST AND QUALITY HAVE increased importance in the delivery of medical care,¹ and all hospitals, especially teaching hospitals, must reassess their mission and strategy for survival.² Teaching hospitals may provide care that is of higher quality but more costly when compared with nonteaching hospitals.³⁻¹⁰ Rosenthal et al¹¹ suggest that much of the increased cost attributed to academic medical centers stems from such societal functions as providing medical education, conducting research, and caring for indigent patients. Some authors speculate that the academic medical institution as it is known today cannot survive,¹²⁻¹⁵ and academic medical centers are responding to this challenge by developing new strategies for maintaining their “core mission.”¹⁶

Comparisons of teaching hospitals and nonteaching hospitals have produced different conclusions regarding cost and quality of care for several conditions,¹⁷⁻²¹ and a few studies have specifically looked at differences in the treat-

Context Issues of cost and quality are gaining importance in the delivery of medical care, and whether quality of care is better in teaching vs nonteaching hospitals is an essential question in this current national debate.

Objective To examine the association of hospital teaching status with quality of care and mortality for fee-for-service Medicare patients with acute myocardial infarction (AMI).

Design, Setting, and Patients Analysis of Cooperative Cardiovascular Project data for 114411 Medicare patients from 4361 hospitals (22354 patients from 439 major teaching hospitals, 22493 patients from 455 minor teaching hospitals, and 69564 patients from 3467 nonteaching hospitals) who had AMI between February 1994 and July 1995.

Main Outcome Measures Administration of reperfusion therapy on admission, aspirin during hospitalization, and β -blockers and angiotensin-converting enzyme inhibitors at discharge for patients meeting strict inclusion criteria; mortality at 30, 60, and 90 days and 2 years after admission.

Results Among major teaching, minor teaching, and nonteaching hospitals, respectively, administration rates for aspirin were 91.2%, 86.4%, and 81.4% ($P < .001$); for angiotensin-converting enzyme inhibitors, 63.7%, 60.0%, and 58.0% ($P < .001$); for β -blockers, 48.8%, 40.3%, and 36.4% ($P < .001$); and for reperfusion therapy, 55.5%, 58.9%, and 55.2% ($P = .29$). Differences in unadjusted 30-day, 60-day, 90-day, and 2-year mortality among hospitals were significant at $P < .001$ for all time periods, with a gradient of increasing mortality from major teaching to minor teaching to nonteaching hospitals. Mortality differences were attenuated by adjustment for patient characteristics and were almost eliminated by additional adjustment for receipt of therapy.

Conclusions In this study of elderly patients with AMI, admission to a teaching hospital was associated with better quality of care based on 3 of 4 quality indicators and lower mortality.

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ment of acute myocardial infarction (AMI). Iezzoni et al⁷ reported higher AMI mortality rates after admission to 15 major teaching hospitals in Boston, Mass. Rosenthal et al¹¹ compared severity-adjusted mortality for 6 conditions including AMI at 5 major teaching hospitals, 6 minor teaching hospitals, and 19 nonteaching hospitals. In general, adjusted mortality was lower at major teaching hospitals than at minor or nonteaching hospitals for all 6 conditions. Using data from the 1994-1995 Coop-

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erative Cardiovascular Project (CCP), Chen et al²² found that admission to top-ranked hospitals, as defined by *US News & World Report*, was associated with greater use of aspirin and β -adrenergic receptor antagonists. Chen et al also reported that patients treated at the top-ranked hospitals had better 30-day survival. An accompanying editorial suggested that nonteaching hospitals may have lower “standards of clinical practice” than teaching hospitals.²³

We used the CCP data set, which is rich in clinical detail and breadth of patient representation, to examine quality of care and mortality for Medicare patients with AMI admitted to teaching vs nonteaching hospitals.

METHODS

The Cooperative Cardiovascular Project

The CCP was a national quality improvement project sponsored by the Health Care Financing Administration (HCFA) to improve the quality of care for Medicare patients hospitalized with AMI.^{24,25} In the CCP, data were obtained by medical record review from a large random sample of Medicare patients with AMI, quality measures were computed, and the results were reported back to the admitting hospitals.²⁶

Data for our analyses were obtained from the original CCP analysis data set containing 234 754 randomly selected Medicare fee-for-service beneficiaries from all 50 states who were hospitalized with AMI from February 1994 through July 1995. Cases were identified using the hospital bills (UB-92 Claims Form Data) in the Medicare National Claims History File. Patients with an *International Classification of Diseases, 9th Revision, Clinical Modification*²⁷ principal discharge diagnosis code of 410 (AMI) were sampled from 6684 hospitals.

To derive the data set used in this study, 120 343 patients were excluded for the following reasons: AMI not confirmed by clinical criteria (n=29 885), second hospital admission for AMI (n=22 773), age younger than 65 years (n=17 591), ethnicity other than African American or white (n=9007), trans-

ferred to an index hospital (n=39 025), transferred from an index hospital within 24 hours of admission (n=42 176), or unclear hospital teaching status (n=11 855). We excluded patients who were not African American or white for 2 main reasons: race/ethnicity is an important confounding variable, and races/ethnicities other than African American or white cannot be classified with reasonable reliability from Medicare administrative data sets.^{28,29} Patients were confirmed as having AMI according to the clinical criteria listed by Marciniak et al.²⁶

As an integral part of the CCP, quality indicators for the management of AMI were developed from the guidelines issued by the American Heart Association and the American College of Cardiology.³⁰ For our analyses, we chose 4 quality indicators: (1) provision of acute reperfusion therapy (including thrombolysis or primary angioplasty) on admission, (2) administration of aspirin during hospitalization, (3) administration of angiotensin-converting enzyme (ACE) inhibitors at discharge, and (4) administration of β -blockers at discharge. These process of care indicators have been validated previously³¹ and are linked to favorable outcomes by strong clinical evidence.^{32,33}

For reperfusion therapy, aspirin, and ACE inhibitors, we identified “ideal candidates” as patients who met inclusion criteria and lacked relative and absolute contraindications to therapy. For β -blockers, we defined “eligible candidates” as patients who met inclusion criteria and lacked absolute contraindications. Candidate definitions were derived from the CCP quality indicators, as defined by Marciniak et al.²⁶ For the β -blocker at discharge and ACE inhibitor at discharge quality indicators, the CCP algorithms excluded all patients not discharged alive.

As part of the CCP, all variables needed to calculate the quality of care indicator rates and measures of risk, comorbidity, and severity of illness were abstracted by trained personnel at 2 clinical data abstraction centers. Data quality was monitored and main-

tained through the use of randomly selected records for reabstraction, and the results are reported elsewhere.²⁶

In addition, we ascertained patient mortality at 30, 60, and 90 days and 2 years after hospital admission for AMI.

Definition of Hospital Teaching Status

We determined hospital teaching status by 2 methods and analyzed the data separately for each method. First, we merged the CCP data set with HCFA data on the number of interns per bed (I/B ratio) at each hospital. Although different demarcation points have been used in other studies,^{17,19} we placed hospitals in 1 of 3 mutually exclusive categories: hospitals with an I/B ratio greater than 0.10 (the median I/B ratio of all teaching hospitals in our study data set) were classified as major teaching hospitals; those with an I/B ratio less than or equal to 0.10 but greater than 0 were classified as minor teaching hospitals; and those with an I/B ratio of 0 were considered nonteaching hospitals.

Second, we used the classification approach by Rosenthal et al and merged the CCP data set with the 1996 American Hospital Association Annual Hospital Survey.^{11,34} Hospitals that were members of the Council of Teaching Hospitals and had approval to participate in residency training by the Accreditation Council for Graduate Medical Education were classified as major teaching hospitals. Those that were not members but had accredited residency programs were classified as minor teaching hospitals, and those that met neither criterion were classified as nonteaching hospitals.

Statistical Analyses

We used the I/B ratio method to determine hospital teaching status for all primary analyses. We compared patient baseline demographics, severity of illness, and comorbidity status across the 3 types of hospitals with the χ^2 trend statistic for dichotomous variables and analysis of variance for continuous variables.³⁵ Next, we examined the bivariate association of each process of care indicator with hospital status. We mea-

sured quality of the process of care for each therapy as the proportion of CCP-defined ideal or eligible candidates who actually received treatment.

We based much of our multivariable modeling process on the work of Krumholz et al,³⁶ who compared several mortality prediction models derived from CCP data. We considered the patient as the unit of analysis and performed logistic regression with mortality as the dependent variable.³⁷ Model 1 included terms for risk adjustment (patient demographics, comorbidity, and severity of illness). Model 2 included all variables from model 1 with the addition of hospital teaching status. We represented hospital teaching status as 2 main independent indicator variables, one for major teaching vs nonteaching and one for minor teaching vs nonteaching.

Model 3 included all terms from model 2 with the addition of covariates representing administration of therapy. Receipt of therapy was based on treatment categories derived from all possible combinations of the 4 unique treatments. For model 3, we first added individual indicator variables for receipt of each therapy with 1 model for each therapy. However, combining all therapies in a single model produced the best fit by the $-2\log$ likelihood statistic. We examined standardized coefficients to determine the relative contribution of each independent variable to the variation in mortality captured by the model.³⁸ The c statistic was used to assess model discrimination³⁹ and the Nagelkerke R^2 was used as an approximation of explanatory power.⁴⁰

All primary analyses described above were performed using the study data set, which was derived from the full CCP analysis data set by applying the exclusion criteria. To examine these primary analyses for bias introduced by our assumptions, we conducted a set of secondary analyses. We conducted separate, parallel analyses for the 2 different methods of determining hospital teaching status. To detect potential bias associated with our inclusion criteria, we compared the results of the primary analyses based on the study data set with identical analyses performed using the full CCP analysis data set. To detect bias introduced by the CCP quality indicators for ideal candidacy, we used the study data set and repeated all process of care analyses with all patients in the denominator instead of only those classified as ideal or eligible candidates. We repeated the univariate analyses using the study data set without excluding those patients of race/ethnicity other than African American or white, and we also repeated the univariate analyses after stratifying by race. We used generalized estimation equations to detect any inflation of statistical significance due to the clustering of patients within hospitals.⁴¹ The results of all these secondary analyses are not reported herein, but were not importantly different from the results presented in this article.

Table 1. Hospital Characteristics by Teaching Status*

Characteristic	Major Teaching (n = 439)	Minor Teaching (n = 455)	Nonteaching (n = 3467)	P Value
% of hospitals	10.1	10.4	79.5	...
No. of patients	22 354	22 493	69 564	...
Intern-bed ratio, mean†	0.27	0.05	0	...
Cardiac procedure capability, %				
Coronary angiography	83.6	73.3	51.9	<.001
PTCA	72.4	62.5	33.0	<.001
CABG surgery	69.7	58.8	28.6	<.001

*PTCA indicates percutaneous transluminal coronary angioplasty; CABG, coronary artery bypass graft; and ellipses, analysis does not apply. P values were determined using the Cochran-Armitage trend test for differences among hospital types.

†The intern-hospital bed ratio is explained in the "Definition of Hospital Teaching Status" section of the "Methods." This ratio was used to classify major vs minor teaching hospitals. The median ratio of all teaching hospitals in the study was 0.10.

Table 2. Patient Characteristics by Hospital Teaching Status*

Characteristic	Major Teaching (n = 22 354)	Minor Teaching (n = 22 493)	Nonteaching (n = 69 564)	P Value
Age, mean, y	76.9	76.9	77.8	<.001
Female, %	51.0	49.1	51.4	.02
African American, %	11.7	6.6	5.3	<.001
Charlson score, mean†	0.67	0.70	0.75	<.001
APACHE II score, mean‡	9.9	9.9	10.3	<.001
Comorbidities, %				
Diabetes	26.3	25.3	25.3	.009
Hypertension	41.9	38.6	36.5	<.001
Chronic renal insufficiency	6.2	5.2	5.2	<.001
Congestive heart failure	45.8	42.4	45.3	.33
Prior PTCA, %	7.8	7.6	5.7	<.001
Prior CABG surgery, %	13.6	13.4	12.3	<.001

*PTCA indicates percutaneous transluminal coronary angioplasty; CABG, coronary artery bypass graft. P values were determined using the Cochran-Armitage trend test for differences among hospital types. The intern-hospital bed ratio was used to classify major vs minor teaching hospitals (see "Methods" section).

†Charlson comorbidity scale had an observed range of 0-5, with higher scores indicating more comorbidity.

‡The Acute Physiology and Chronic Health Evaluation (APACHE) scale had an observed range of 5-42, with higher scores indicating more severe illness.

RESULTS

Hospital and Patient Characteristics

The study sample is based on 114 411 of the 234 754 patients and 4361 of the 6668 hospitals in the original CCP data set. For the included hospitals, 79.5% were classified as nonteaching, 10.1% as major teaching, and 10.4% as minor teaching (TABLE 1). Teaching hospitals tended to be larger: approximately half had bed sizes of at least 500. As expected, more major teaching hospitals offered invasive cardiac procedures, followed by minor teaching hospitals then nonteaching hospitals.

Major teaching hospitals had a higher proportion of African American patients compared with minor teaching

and nonteaching hospitals (TABLE 2). While most differences in other patient characteristics were relatively small, and perhaps not important, some differences were statistically significant because of the very large sample size. Patients treated at nonteaching hospitals had slightly higher mean Charlson comorbidity and APACHE II (Acute Physiology and Chronic Health Evaluation) scores, but patients treated at teaching hospitals had a slightly higher mean prevalence of diabetes, hypertension, and chronic renal insufficiency and were slightly more likely to have had prior percutaneous transluminal coronary angioplasty (PTCA) or coronary artery bypass graft surgery.

Process of Care

The numbers of ideal candidates for each therapy were 57 476 for aspirin; 13 025 for ACE inhibitors; 28 636 for β -blockers; and 14 071 for reperfusion. For aspirin, ACE inhibitors, and β -blockers, there was a “gradient” effect with the performance of minor teaching hospitals below that of major teaching hospitals, but above that of nonteaching hospitals (FIGURE 1). The mean performance of major teaching, minor teaching, and nonteaching hospitals by type of therapy is illustrated in Figure 1.

Of all patients who received reperfusion therapy, 16.3% received primary angioplasty alone, 71.0% received thrombolysis alone, and 12.7% received both. Acute reperfusion therapy was more likely to include primary PTCA at major teaching hospitals (44.8%), followed by minor teaching hospitals (40.1%), and then by nonteaching hospitals (24.5%) ($P < .001$).

Outcomes of Care

Mortality for patients treated at minor teaching hospitals was greater than for those treated at major teaching hospitals and less than that of patients treated at nonteaching hospitals (FIGURE 2). This gradient persisted from 30 days until 2 years following admission.

Mortality differences were attenuated by adjustment for patient characteristics and receipt of therapy (TABLE 3). The standardized coefficients for major and minor teaching hospitals were in general several orders of magnitude smaller than the coefficients for patient characteristics and process of care variables.

COMMENT

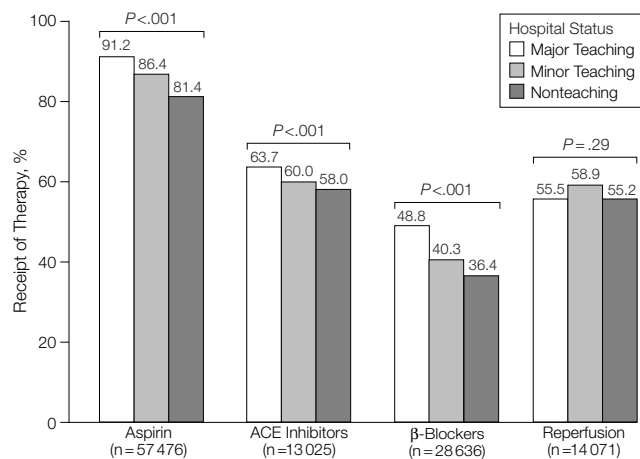
We found that teaching hospitals provided more aspirin, ACE inhibitors, and β -blockers for Medicare beneficiaries ad-

mitted with AMI. The gradient effect of increasing quality of care from nonteaching to minor teaching to major teaching hospitals was accompanied by a corresponding survival gradient, suggesting a dose-response effect. Our multivariate analyses indicated that the process of care measures we used were strongly related to the observed mortality advantage of teaching hospitals.

Our study demonstrated no significant difference in the receipt of acute reperfusion by hospital type. As acknowledged by Chen et al, CCP reperfusion analyses are limited by the relatively small number of ideal patients.²² However, the teaching hospital is apt to have a more complex organizational structure,⁴²⁻⁴⁴ which may delay administration of time-sensitive treatment such as reperfusion beyond the period of patient eligibility. Additional potential explanations for the absence of better teaching hospital performance on the reperfusion measure may include, for example, competing technologies and research protocols.

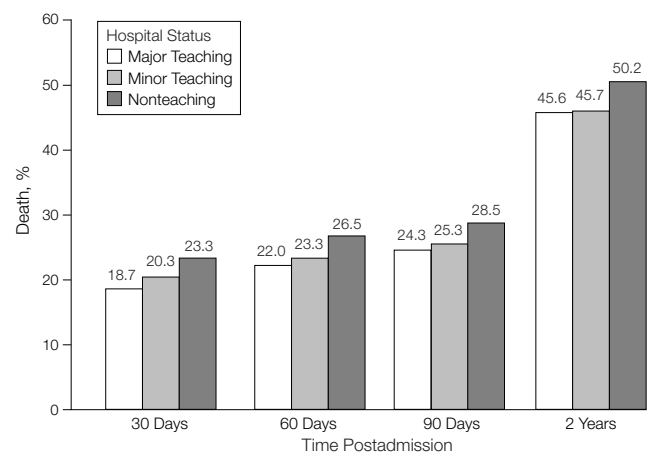
In addition to differences in process of care indicators, we also found significant mortality differences. The bivariate analysis revealed that patients admitted to teaching hospitals had a significant mortality advantage at 30 days follow-

Figure 1. Receipt of Therapy for “Ideal Candidates”



P values were determined using the Cochran-Armitage test for comparison within therapy. Reperfusion includes primary percutaneous transluminal coronary angioplasty or thrombolysis. See the “Methods” for the definition of ideal candidates.

Figure 2. Mortality by Hospital Teaching Status



All comparisons were significant at $P < .001$ (Cochran-Armitage test for comparison within time interval). Hospital teaching status is defined in the “Definition of Hospital Teaching Status” section of the “Methods.”

ing discharge. This unadjusted survival advantage of approximately 4% to 5% for teaching compared with nonteaching hospitals remained remarkably constant for each time interval (30, 60, and 90 days, and 2 years). This is consistent with the concept that treatment administered early during hospitalization or at time of discharge manifests an immediate and lasting benefit.

Adjustment for patient characteristics and receipt of therapy greatly attenuated the apparent mortality difference between teaching and nonteaching hospitals. Examination of the standardized coefficients from the multivariate models suggests that mortality was most strongly affected by receipt of therapy and less so by patient and hospital characteristics.³⁸ Therefore, the posthospital survival advantage of patients admitted to teaching hospitals may be due to better processes of care.

Although Chen et al^{22,45} reported similar findings using the CCP data set, they did not directly compare the per-

formance of teaching hospitals with nonteaching hospitals. Their main comparison groups were top-ranked hospitals as determined by the *US News & World Report* vs peer hospitals. The top-ranked hospitals, which provided better quality of care and had lower postdischarge mortality when compared to similarly equipped and nonsimilarly equipped hospitals not in the top 60 list, included only a small fraction of the major teaching hospitals in the CCP data set. In addition, all comparison groups included teaching hospitals. More specifically, Chen et al placed 60 teaching hospitals in the top-ranked category, 426 teaching hospitals in the similarly equipped category, and 357 teaching hospitals in the nonsimilarly equipped category. They did subdivide teaching hospitals into major and minor categories but did not report any subgroup analyses. Also, they only reported mortality at 30 days.

There are several important distinctions between our article and that of

Chen et al.²² We categorized hospitals exclusively by teaching status, included an analysis of the administration of ACE inhibitors, and extended mortality analyses to 2 years. Chen et al used 3 comparison groups with teaching hospitals distributed among all groups, which limits direct inferences about teaching status. Unlike Chen et al, we reported a gradient according to hospital teaching status for both process and outcome of care. With multivariate analyses, we also investigated the relative contribution of teaching status and process of care to mortality.

Our study has several limitations. First, many important questions remain to be answered, especially regarding the relationship of hospital characteristics other than teaching status to quality of care and mortality. Second, data were collected from retrospective chart review and administrative files, and both sources have recognized limitations.⁴⁶⁻⁴⁸ Third, adjustment for patient socioeconomic factors was not per-

Table 3. Model Parameters and Results for 30-Day Postdischarge Mortality Models*

Covariates	Model 1: Risk Adjustment		Model 2: Risk Adjustment + Teaching Status		Model 3: Risk Adjustment + Teaching Status + Therapy	
	OR (95% CI)	SC	OR (95% CI)	SC	OR (95% CI)	SC
Major teaching (vs nonteaching)	...	...	0.80 (0.77-0.84)	-0.0489	0.91 (0.87-0.96)	-0.0199
Minor teaching (vs nonteaching)	...	...	0.91 (0.84-0.95)	-0.0201	0.96 (0.92-1.01)	-0.0080
African American (vs white)	0.79 (0.74-0.85)	-0.0329	0.81 (0.76-0.87)	-0.0299	0.79 (0.73-0.85)	-0.0325
Male (vs female)	0.81 (0.78-0.84)	-0.0592	0.81 (0.78-0.84)	-0.0592	0.84 (0.81-0.87)	-0.0489
Age (1-year increment)	1.05 (1.05-1.05)	0.1925	1.05 (1.05-1.05)	0.1905	1.04 (1.04-1.05)	0.1815
Cardiac arrest during hospitalization (yes/no)	9.96 (9.41-10.54)	0.3242	9.92 (9.38-10.50)	0.3236	8.08 (7.61-8.58)	0.2947
Congestive heart failure (yes/no)	1.34 (1.30-1.39)	0.0804	1.34 (1.30-1.39)	0.0811	1.46 (1.41-1.52)	0.1045
Admission systolic blood pressure	0.98 (0.98-0.98)	-0.2951	0.98 (0.98-0.98)	-0.2920	0.99 (0.99-0.99)	-0.2548
Serum creatinine	2.06 (1.99-2.12)	0.1970	2.06 (1.99-2.12)	0.1969	1.82 (1.76-1.89)	0.1643
White blood cell count	1.05 (1.05-1.06)	0.1476	1.05 (1.05-1.06)	0.1479	1.05 (1.05-1.05)	0.1322
Anterior or lateral AMI location (yes/no)	1.57 (1.52-1.63)	0.1121	1.56 (1.51-1.62)	0.1107	1.47 (1.41-1.52)	0.0952
Receipt of therapy dummy variables†						
Category 1	...	...	...	...	0.05 (0.05-0.06)	-0.4202
Category 2	...	...	...	...	0.23 (0.22-0.24)	-0.4002
Category 3	...	...	...	...	1.39 (1.23-1.57)	0.0209
Category 4	...	...	...	...	0.26 (0.24-0.27)	-0.2838
c statistic		0.798		0.799		0.832
Nagelkerke R ²		0.297		0.298		0.376
-2 Log likelihood statistic		93 009		92 903		85 642

*Prediction models adapted from Krumholz et al.³⁶ Models are described in the "Statistical Analysis" section. The intern-hospital bed ratio was used to classify teaching hospital status (see "Methods" section). OR indicates odds ratio; CI, confidence interval; SC, standardized coefficient; and ellipses, analysis not applicable.

†Because of significant interactions between receipt of acute reperfusion and aspirin, we created 5 mutually exclusive groups of patients: therapy category 0, those who received no therapy (reference group); therapy category 1, those who received no aspirin and no reperfusion but did receive angiotensin-converting enzyme (ACE) inhibitors and/or β-blockers; therapy category 2, those who received no reperfusion but did receive aspirin and/or ACE inhibitors and/or β-blockers; therapy category 3, those who received no aspirin but did receive reperfusion and/or ACE inhibitors and/or β-blockers; and therapy category 4, those who received aspirin and reperfusion and/or ACE inhibitors and/or β-blockers.

formed; however, because Medicare patients with lower socioeconomic status are more often treated at teaching hospitals but receive poorer quality of care,⁴⁹ lack of adjustment for socioeconomic status is likely to underestimate the benefit of teaching hospital status. Fourth, we considered overall mortality alone and did not examine cardiovascular deaths separately. Fifth, we did not consider factors that could influence the probability of death after discharge. Sixth, part of the apparent residual mortality difference may be a consequence of inadequate risk adjustment. For example, simple adjustment for case mix may be improved by the addition of measures of patient functional level,⁵⁰ and different risk adjustment methods may give different results.⁵¹

Three specific sources of bias in our study must be considered. First, excluding patients transferred from another acute care facility may introduce referral bias. The relationship of case mix and interhospital transfer is complex, with several studies pointing to differences in severity of illness, comorbidity, and adverse outcomes.⁵²⁻⁵⁸ However, it is not logical to attribute processes of care incurred at the initial hospital to a subsequent receiving hospital. Therefore, our main analysis focused on the set of patients not received in transfer.

Second, indicator bias may occur because the CCP indicators identified a subset of patients with strong indications for therapy and did not include many patients with weaker indications. As a result, many patients for whom a specific therapy might be reasonable were not selected as ideal or eligible candidates. Thus, the CCP quality indicators may select a subset of patients different in critical aspects other than candidacy for therapy, leading to biased estimates. However, when we performed all analyses using simple receipt of therapy for all patients instead of receipt of therapy for only ideal or eligible candidates, we obtained similar results. Also, the 4 indicators we chose for this study do not completely capture quality of care for patients with AMI, and comparisons based on other

quality indicators might have shown different results.⁵⁹

Third, we excluded patients younger than 65 years, and this Medicare population has a high proportion of dialysis patients.⁶⁰ However, we found no evidence of "exclusion bias" when we performed all analyses without the exclusion criteria and obtained similar results. Many patients, such as those enrolled in Medicare managed care organizations, were excluded by necessity because they were not in the original data set.

Our study also has several strengths. For example, we used a national data set that provided adequate power to determine overall differences of care. We placed our analysis in the classic quality improvement context of structure, process, and outcome.⁶¹ We used a database rich in clinical variables, which allowed determination of ideal status for receipt of therapy and adjustment for important factors such as severity of illness, comorbidity, and refusal of therapy.

CONCLUSION

In this study, we found that teaching hospitals provided more aspirin, β -blockers, and ACE inhibitors to Medicare patients hospitalized with AMI and that there was a gradient of increasing performance from nonteaching to minor teaching to major teaching hospitals. We found no difference in the use of acute reperfusion therapy. We also observed a corresponding teaching hospital survival advantage with a gradient of increasing mortality from major teaching to minor teaching to nonteaching hospitals. Mortality differences were attenuated by adjustment for patient characteristics and process of care. In the multivariable analysis, process of care had the strongest association with survival, suggesting that unadjusted mortality is lower in teaching hospitals because they offer better care.

It is important to emphasize that there is substantial room for improvement by all hospitals. However, the emerging trend in the quality improvement com-

munity of implementing change in an organizational context rather than in the context of an individual health care professional offers new hope for improvement.^{62,63} Hospital characteristics such as teaching status warrant serious consideration in the formulation of national policies and programs to improve health care quality.

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