Characteristics and Outcomes of America’s Lowest-Performing Hospitals
An Analysis of Acute Myocardial Infarction Hospital Care in the United States

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Background—Studies suggest that most hospitals now have relatively high adherence with recommended acute myocardial infarction (AMI) process measures. Little is known about hospitals with consistently poor adherence with AMI process measures and whether these hospitals also have increased patient mortality.

Methods and Results—We conducted a retrospective study of 2761 US hospitals reporting AMI process measures to the Center for Medicare and Medicaid Services Hospital Compare database during 2004 to 2006 that could be linked to 2005 Medicare Part A data. The main outcome measures were hospitals’ combined compliance with 5 AMI measures (aspirin and β-blocker on admission and discharge and angiotensin-converting enzyme inhibitor/angiotensin receptor blocker use at discharge for patients with left ventricular dysfunction) and risk-adjusted 30-day mortality for 2005. We stratified hospitals into those with low AMI adherence (ranked in the lowest decile for AMI adherence for 3 consecutive years [2004–2006, n=105]), high adherence (ranked in the top decile for 3 consecutive years [n=63]), and intermediate adherence (all others [n=2593]). Mean AMI performance varied significantly across low-, intermediate-, and high-performing hospitals (mean score, 68% versus 92% versus 99%, P<0.001). Low-performing hospitals were more likely than intermediate- and high-performing hospitals to be safety-net providers (19.2% versus 11.0% versus 6.4%; P=0.005). Low-performing hospitals had higher unadjusted 30-day mortality rates (23.6% versus 17.8% versus 14.9%; P<0.001). These differences persisted after adjustment for patient characteristics (16.3% versus 16.0% versus 15.7%; P=0.02).

Conclusion—Consistently low-performing hospitals differ substantially from other US hospitals. Targeting quality improvement efforts toward these hospitals may offer an attractive opportunity for improving AMI outcomes.

Key Words: myocardial infarction ■ hospitals ■ quality of health care

Several initiatives have been launched in recent years to collect hospital performance data and make it widely available to the public. The practice that began more than 15 years ago in New York State1 has become commonplace, as the Centers for Medicare and Medicaid Services (CMS) now publicly reports performance of hospitals nationally on their website, Hospital Compare (http://www.hospitalcompare.hhs.gov). One rationale for public reporting is that it will motivate low-performing hospitals to improve and encourage patients to select higher quality hospitals.2 Yet questions linger about how to best assess hospital quality and motivate improvement.

Uncertainty remains about whether hospital performance is best measured using adherence to evidence-based process measures or patient outcomes (eg, risk-adjusted mortality).3–11 This uncertainty stems, in part, from conflicting data as to whether hospitals with better adherence with process measures have correspondingly better patient outcomes.9–11 In addition, it is unclear whether pay-for-performance initiatives based on adherence to process measures unfairly target low-performing hospitals with limited resources for quality improvement programs (eg, safety-net hospitals).12,13

Whereas a number of prior studies have characterized hospitals’ adherence with CMS process measures4,7–11,13–17 and how adherence may be changing over time,15–18 to the best of our knowledge there are no studies specifically focusing on hospitals with consistently poor adherence. In

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particular, it is unclear how many hospitals have consistently low adherence with CMS process measures, whether these hospitals may face common challenges that were not considered in development of these performance measures, and whether patients treated in hospitals with poor adherence have higher mortality than patients treated in hospitals with better adherence. Furthermore, the identification of low-performing hospitals may offer a particularly good opportunity to target investments in quality improvement in a small group of hospitals that offer the greatest opportunity for benefit.

Thus, our primary objective is to examine the organizational characteristics of hospitals with consistently low adherence with CMS process measures for AMI, as compared to US hospitals with intermediate and high performance. Our secondary objective is to examine characteristics and risk-adjusted mortality of patients treated in low-performing hospitals, as compared to patients treated in intermediate- and high-performing hospitals.

**WHAT IS KNOWN**

- A number of recent studies have characterized hospitals’ adherence with CMS process measures, and how adherence may be changing over time. Data suggest that, while overall quality has improved over time, some hospitals seem to lag significantly behind. Yet little is known about the characteristics and outcomes of these hospitals.
- Identification of low-performing hospitals may offer a particularly good opportunity to target investments in quality improvement in a small group of hospitals that offer the greatest opportunity for benefit.

**WHAT THE STUDY ADDS**

- Analyses provide evidence that low-performing hospitals differ substantially from better-performing US hospitals. Low-performing hospitals have different organizational characteristics, including lower bed numbers, lower staffing ratios and lower volumes, and are less likely to provide specialty services such as coronary revascularization. Low-performing hospitals have a more likely to be safety nets for vulnerable populations and appear to have somewhat worse mortality than other US hospitals.
- Thus, the study suggests that, by targeting policy and quality improvement efforts at low-performing hospitals, there is a unique opportunity for improving patient outcomes and reducing disparities in health care.

**Hospital-Level Data**

We first identified all hospitals reporting performance on AMI process measures during 2004 to 2006 through the Hospital Compare website (www.hospitalcompare.hhs.gov; n=3802). The Hospital Compare website provides performance information for most acute care nonfederal hospitals in the United States, including each hospital’s adherence with 5 core AMI process measures: (1) use of aspirin within 24 hours of arrival; (2) use of aspirin at discharge; (3) use of β-blockers within 24 hours of arrival; (4) use of β-blockers at discharge; (5) the use of an angiotensin-converting-enzyme (ACE) inhibitor or angiotensin receptor blocker (ARB) for left ventricular systolic dysfunction. Although participation in Hospital Compare is voluntary, because CMS has created financial incentives for reporting most measures, participation is nearly universal. There are 3 additional AMI process measures (time-to-reperfusion with either thrombolitics or percutaneous coronary intervention [PCI], and smoking cessation counseling) that were not linked to financial incentives for reporting during the study period and fewer hospitals reported data for these measures; thus our analyses focused on adherence with the 5 core measures. For each hospital and each measure, the Hospital Compare database provides the number of patients eligible for each therapy and the number of eligible patients receiving that specific therapy; hospital performance is assessed as the proportion of eligible patients receiving each recommended therapy. We downloaded these publicly available data from the Hospital Compare web site.

We excluded all hospitals at which the total number of patients eligible for each of the 5 therapies was less than 25 (n=965) in accordance with similar methodology employed by CMS and other investigators.7,14 because such hospitals are considered to have too few cases to allow for a statistically reliable assessment of performance. The remaining 2837 hospitals were linked to the 2005 AHA Annual Survey using each hospital’s unique provider number. The AHA survey provided data on hospitals’ structural and operational characteristics including teaching status, for-profit status, and bed size. We excluded 21 hospitals (<1% of the final sample) that were unable to link to the AHA data.

Our analyses used a number of additional hospital characteristics that we derived from the data sources described above. We identified each hospital’s location as urban or rural based on each hospital’s zip code using rural-urban commuting area codes (http://www.ers.usda.gov/data/ruralurbancommutingareacodes). We categorized hospitals as safety-net providers if the hospital’s Medicaid caseload for 2005 exceeded the mean for all US hospitals by 2 standard deviations of the overall distribution for the study hospitals (mean, 16.4%; SD, 9.6%), thus adapting a method that has been previously used in research.12,13 Finally, we calculated nurse staffing ratios for each hospital as nurse full-time equivalents (FTEs) divided by adjusted patient days.20

**Patient-Level Data**

The study used 2 sources of patient-level data: (1) 2005 MedPAR data for characteristics and outcomes of AMI patients admitted to study hospitals; and (2) the US Census 2000 Summatory File (publicly available at http://factfinder.census.gov) for zip code level SES measures for study patients.

We used the 2005 MedPAR data to identify all patients admitted to the study hospitals with AMI (International Classification of Diseases, Ninth revision, Clinical Modification [ICD-9-CM code 410.X]) during 2005; hospitals identified in the HQA data that could not be linked to the MedPAR data (n=76) were excluded. The MedPAR files contain patient-level data on all hospitalizations of fee-for-service Medicare enrollees including patient demographics, primary and secondary diagnoses; procedures; and discharge disposition. Patients in the MedPAR files are linked to the Medicare Denominator files to ascertain deaths occurring after hospital discharge. Deaths occurring after transfer were attributed to the initial admitting hospital rather than the receiving hospital.

We identified AMI location using ICD-9-CM diagnostic codes and comorbid illnesses following algorithms developed by Elixhauser et al.21 We also calculated each hospital’s Medicare AMI, PCI, and

**Methods**

The current study relied on 4 primary hospital- and patient-level data sources: (1) the CMS Hospital Compare for hospital performance on AMI process measures; (2) the American Hospital Association (AHA) Annual Survey for hospital characteristics; (3) Medicare Part A (MedPAR) data for AMI patient characteristics and outcomes; and (4) US Census data for patient socioeconomic status (SES) measures.
coronary artery bypass grafting (CABG) surgery volumes by summing the number of patients admitted to each hospital for each procedure in the MedPar data. We assessed whether each hospital had full revascularization capability, defined as the performance of at least 2 PCI and 2 CABG procedures on Medicare enrollees during 2005.

We linked each patient’s zip code of residence in the MedPar files to 2000 US Census data to obtain socioeconomic measures (eg, mean household income) of patients admitted to the study hospitals. Zip code–based centroids were also used to calculate distances between patients’ residences and admitting hospitals, and between admitting hospitals without revascularization and closest hospitals providing full revascularization services. The final sample included 2761 hospitals admitting 186,700 AMI patients.

Identification of Low-, Intermediate-, and High-Performing Hospitals

We assessed hospital compliance with AMI process measures by calculating a composite AMI score for each hospital and each year reflecting overall compliance with the 5 AMI measures described previously. Using the methodology adopted by Williams et al,17 the scores were computed as the ratio of the number of patients in a given hospital who received each treatment divided by the number of patients in that hospital who were eligible for each treatment for all 5 measures in aggregate. Hospitals were then stratified into deciles based on their composite AMI score for each year (ie, 2004, 2005, and 2006). We defined low-performing hospitals as all hospitals ranking in the bottom decile on the AMI composite measure for each of the 3 years (n=105); we defined high-performing hospitals as hospitals ranking in the top decile during each of the 3 years (n=63). All other hospitals (n=2593) were defined as intermediate-performing hospitals.

Analyses

First, we compared the AMI composite performance scores and hospital characteristics (urban location, safety-net status, teaching status, bed size, nurse staffing ratios, and Medicare AMI volumes) of low-, intermediate-, and high-performing hospitals. These analyses used analyses of variance with Bonferroni adjustment for multiple comparisons for continuous variables and the Cochran-Armitage test for trend for comparisons of proportions across the 3 hospital categories. Second, we compared the characteristics of AMI patients (eg, demographics, rates of comorbid illness, and SES measures) treated in low-, intermediate-, and high-performing hospitals, and rates of patient transfers and revascularization for patients admitted at low-, intermediate-, and high-performing hospitals, using similar statistical methods. Rates of revascularization were calculated for 30 days after the initial admission, and included procedures performed during the index admission, transfer to other acute care hospitals, and subsequent hospitalizations for coronary revascularization. Because we only had MedPar admission data through December 31, 2005, we calculated transfer and revascularization rates through November 30, 2005.

Lastly, we compared crude and adjusted 30-day mortality rates for AMI patients hospitalized in low-, intermediate-, and high-performing hospitals. Crude mortality rates were compared using the Cochran Armitage test for trend. Risk-adjusted 30-day mortality rates were constructed as the ratio of predicted to expected mortality at each hospital, multiplied by the mean overall 30-day mortality rate for this population (ie, hospital-specific risk-standardized mortality rates5). Predicted and expected 30-day mortality were estimated using multivariable mixed models that controlled for patient socioeconomic characteristics and comorbidity using fixed coefficients, and individual hospital effects using random hospital coefficients. Thus, expected mortality at a given hospital reflects the expected probability of death based on patient characteristics and is independent of hospital, whereas predicted mortality reflects the mortality for patients with the same characteristics at the specific hospital. Potential patient risk factors associated with mortality were identified in bivariate analyses (P<0.01) or from previous studies.

Candidate predictors included socio-demographic characteristics (age, gender, race, and median household income) co-morbid conditions (as defined by Elixhauser et al), and location of myocardial infarction (categorized into 4 groups defined by ICD-9-CM codes, indicating anterior or lateral, inferior or posterior, subendocardial, or other unspecified locations). We then introduced variables significantly associated with mortality into a stepwise multivariate logistic model. For our risk-adjustment models, we retained all variables independently (P<0.01) related to mortality, with the exception of variables for which the observed relationships were not consistent with previously demonstrated clinical effects (eg, lower risk of death for a comorbidity known to increase the risk of death). Covariates included in the final model are displayed in supplemental Table I. Hospital-level risk-standardized mortality rates were compared across the 3 hospital performance categories using analysis of variance.

To examine the robustness of our findings, we performed several sensitivity analyses. We repeated the analyses using alternative thresholds for defining low- and high-performing hospitals as the bottom, respectively, top 15%, 20%, and 25% hospitals based on their composite performance score. We also repeated our analyses after excluding all patients initially admitted with AMI and subsequently transferred to another acute care facility because such patients may differ systematically from patients who do not require transfer.

Probability values were 2-sided. Statistical significance was defined using a conservative criterion of P<0.01. All analyses were performed using SAS statistical software version 9.1. This project was approved by the University of Iowa Institutional Review Board.

Results

Mean composite AMI process adherence ranged from 68% among low-performing hospitals to 99% among high-performing hospitals (Figure 1). Low-performing hospitals differed significantly from intermediate- and high-performing hospitals with respect to most hospital characteristics (Table 1). In particular, low-performing hospitals were more likely to be for-profit and were more likely to be defined as safety-net providers; interestingly, only 5 low-performing hospitals were both for-profit and safety-net providers.

Hospitals with low AMI performance were much less likely to offer full revascularization services (PCI and CABG) as compared to intermediate- and high-performance hospitals (6.7% [n=6] versus 51.4% [n=1052] versus 77.8% [n=49]; P<0.001). Low-performing hospitals without revascularization services were located further away from the nearest hospital with full revascularization services as compared with intermediate- and high-performing hospitals with-
Table 1. Characteristics of Hospitals With Low, Intermediate, and High Compliance With AMI Process Measures During 2005

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Low (n = 105)</th>
<th>Intermediate (n = 2593)</th>
<th>High (n = 63)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban location, n (%)*</td>
<td>32 (30.5)</td>
<td>1710 (67.0)</td>
<td>56 (88.9)</td>
</tr>
<tr>
<td>Safety net status, n (%)†</td>
<td>20 (19.2)</td>
<td>282 (11.0)</td>
<td>4 (6.4)</td>
</tr>
<tr>
<td>Teaching status, n (%)*</td>
<td>0 (0)</td>
<td>252 (9.8)</td>
<td>17 (27.0)</td>
</tr>
<tr>
<td>Nurse staffing ratio, mean (SD)</td>
<td>2.5 (1.1)</td>
<td>2.9 (1.0)</td>
<td>3.2 (1.2)</td>
</tr>
<tr>
<td>Bed size, median (IQR)</td>
<td>83 (57)</td>
<td>182 (205)</td>
<td>233 (198)</td>
</tr>
<tr>
<td>For profit ownership, n (%)*</td>
<td>31 (29.8)</td>
<td>425 (16.5)</td>
<td>7 (11.1)</td>
</tr>
<tr>
<td>Medicare AMI volume, median (IQR)</td>
<td>23 (17)</td>
<td>70 (106)</td>
<td>114 (172)</td>
</tr>
</tbody>
</table>

*P value for trend < 0.001.  
†P value for overall and pair-wise comparisons < 0.001.  
P values represent P for trend across the 3 ordinal categories (low, intermediate, and high performance). For continuous variables (age, income, and distance), P values represent P for overall as well as pairwise comparisons (patients admitted to low versus intermediate, and low versus high compliance hospitals). P values were adjusted for 3 comparisons within each variable using Bonferroni adjustments.

Table 2. Characteristics of Medicare Patients Admitted to High, Intermediate, and Low AMI Process Compliance During 2005

<table>
<thead>
<tr>
<th>Patient Characteristic</th>
<th>Low (n = 2134)</th>
<th>Intermediate (n = 216 946)</th>
<th>High (n = 7783)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>80.4 (8.4)</td>
<td>79.3 (8.1)</td>
<td>79.3 (8.0)</td>
</tr>
<tr>
<td>Race black, n (%)</td>
<td>197 (8.9)</td>
<td>13 932 (7.8)</td>
<td>250 (4.3)</td>
</tr>
<tr>
<td>Female gender, n (%)</td>
<td>1239 (55.9)</td>
<td>91 177 (51.0)</td>
<td>2888 (50.2)</td>
</tr>
<tr>
<td>Zip code median income, $ mean (SD)</td>
<td>33 730 (11 710)</td>
<td>43 150 (16 098)</td>
<td>47 502 (16 153)</td>
</tr>
<tr>
<td>Distance from home to nearest hospital with revascularization, median (IQR)</td>
<td>18.7 (25.2)</td>
<td>5.5 (14.3)</td>
<td>4.7 (11.2)</td>
</tr>
</tbody>
</table>

Comorbidities

- Heart failure, n (%): 1093 (49.3) vs 76 438 (42.8) vs 2254 (39.2) < 0.001
- Arrhythmia, n (%): 650 (29.3) vs 57 121 (32.0) vs 1772 (30.8) 0.06
- Chronic obstructive lung disease, n (%): 621 (28.0) vs 42 375 (23.7) vs 1221 (21.2) < 0.001
- Fluid and electrolyte disorders, n (%): 513 (23.1) vs 35 947 (20.1) vs 1 027 (17.9) < 0.001
- Renal failure, n (%): 249 (11.2) vs 19 948 (11.2) vs 618 (10.7) 0.37
- Neurological disease, n (%): 132 (6.0) vs 9557 (5.4) vs 280 (4.9) 0.04
- Paralysis: 15 (0.7) vs 866 (0.5) vs 26 (0.5) 0.40
- Liver disease: 16 (0.7) vs 958 (0.5) vs 30 (0.5) 0.49
- Lymphoma: 8 (0.4) vs 1243 (0.7) vs 42 (0.7) 0.16
- Metastatic cancer, n (%): 27 (1.2) vs 2180 (1.2) vs 56 (1.0) 0.15
- Weight loss, n (%): 55 (2.5) vs 3164 (1.8) vs 89 (1.5) 0.015
- Dementia, n (%): 138 (6.2) vs 7325 (4.1) vs 181 (3.2) < 0.001
- Coagulopathy, n (%): 39 (1.8) vs 6233 (3.5) vs 202 (3.5) 0.013

AMI location

- Anterior and lateral, n (%): 236 (10.7) vs 22 741 (12.7) vs 748 (13.0) < 0.001
- Inferior and posterior, n (%): 229 (10.3) vs 24 503 (13.7) vs 799 (13.9) < 0.001
- Subendocardial, n (%): 1171 (52.8) vs 111 404 (62.3) vs 3634 (62.2) < 0.001
- Other site, n (%): 581 (26.2) vs 20 082 (11.2) vs 572 (9.9) < 0.001

IQR indicates interquartile range.

*For categorical variables (proportions), P values represent P for trend across the 3 ordinal categories (low, intermediate, and high performance). For continuous variables (age, income, and distance), P values represent P for overall as well as pairwise comparisons (patients admitted to low versus intermediate, and low versus high compliance hospitals). P values were adjusted for 3 comparisons within each variable using Bonferroni adjustments.

Table 3. Transfer and Revascularization Rates at 30 Days for Patients Admitted to High, Intermediate, and Low AMI Process Compliance During January to November 2005

<table>
<thead>
<tr>
<th>Transfer to another hospital, n (%)</th>
<th>Low (n = 2001)</th>
<th>Intermediate (n = 163 736)</th>
<th>High (n = 5263)</th>
<th>P Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCI, n (%)</td>
<td>290 (14.5)</td>
<td>46 201 (28.2)</td>
<td>1737 (33.0)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>CABG, n (%)</td>
<td>162 (8.1)</td>
<td>17 051 (10.4)</td>
<td>546 (10.4)</td>
<td>0.003</td>
</tr>
<tr>
<td>Total, n (%)</td>
<td>452 (22.6)</td>
<td>63 252 (38.6)</td>
<td>2283 (43.4)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
Compliance for All Patients and After Excluding Patients Transferred Out

Table 4. Rates of Unadjusted and Adjusted 30-Day Mortality for Hospitals With Low, Intermediate, and High AMI Process Compliance for All Patients and After Excluding Patients Transferred Out

<table>
<thead>
<tr>
<th>30-day Hospital-Specific Mortality Rates (%)</th>
<th>Low (n=105)</th>
<th>Intermediate (n=2,593)</th>
<th>High (n=63)</th>
<th>Overall P Value</th>
<th>P Value* Low vs Intermediate</th>
<th>P Value* Low vs High</th>
</tr>
</thead>
<tbody>
<tr>
<td>All patients</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>23.6</td>
<td>17.8</td>
<td>14.9</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Adjusted for patient characteristics</td>
<td>16.3</td>
<td>16.0</td>
<td>15.7</td>
<td>0.04</td>
<td>0.15</td>
<td>0.02</td>
</tr>
<tr>
<td>Transferred patients excluded</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>30.5</td>
<td>21.6</td>
<td>16.6</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Adjusted for patient characteristics</td>
<td>16.6</td>
<td>16.0</td>
<td>15.6</td>
<td>&lt;0.001</td>
<td>0.003</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

*P values were adjusted for 3 comparisons within each variable using Bonferroni adjustments.

Low-performing hospitals had significantly higher unadjusted 30-day mortality rates as compared to intermediate- and high-performing hospitals (Figure 2 and Table 4). After adjustment for patient characteristics, the risk of mortality in low-performing hospitals remained higher than intermediate- and high-performing hospitals, but differences were modest. Results were similar when patients transferred out of the hospital were excluded from the analyses (Table 4). Sensitivity analyses using alternative definitions of low-, intermediate-, and high-performing hospitals did not significantly change our findings.

Discussion

Using linked data from Hospital Compare and Medicare, we found that hospitals with consistently low adherence to AMI process measures differ substantially from intermediate- and high-performing hospitals in a number of ways including hospital location, for-profit status, safety-net status, and availability of revascularization services. In addition, low performing hospitals serve a patient population that is older, more often black, and has more comorbid illness than higher performing hospitals. We found that hospitals with consistently low adherence with AMI process measures had higher mortality rates than better performing hospitals and that the higher mortality persisted after adjustment for patient risk factors, although differences across categories were more modest.

A number of our findings are important and merit further mention. First, our finding that low-performing hospitals appear organizationally different from higher-performing hospitals is important. Our data suggest that the category of low-performing hospitals are actually composed of 2 distinct subgroups. Many of the low-performing hospitals were small, rural, safety-net hospitals. At the same time, a substantial proportion of low-performing hospitals (n=31) were actually for-profit hospitals. This finding raises the question of why both safety-net and for-profit hospitals are over-represented among low-performing hospitals; it is likely that different mechanisms apply to each group.

It is well recognized that safety-net hospitals face significant financial constraints that have worsened in recent years. Moreover, a recent study by Laschober et al found evidence that smaller rural hospitals were less likely to have implemented formal quality improvement programs. Thus, it seems possible that safety-net hospitals lack the resources to engage in important quality improvement activities. The cause for poor performance of for-profit hospitals found in this study is somewhat less clear. Whereas some prior studies have found a negative association between hospital quality of care and for-profit ownership status, other studies have found outcomes in for-profit and not-for-profit hospitals to be quite similar. It is possible that for-profit hospitals might choose to distribute discretionary funds to their investors rather than invest in quality improvement, though such a strategy would seem risky if poor performance resulted in negative publicity and loss of market share. Alternatively, the finding could be explained by geographic variations in practice patterns, as most of the low-performing for-profit hospitals are located in the South (65%) and West (30%).

Our finding that low-performing hospitals had higher mortality rates than intermediate- and high-performing hospitals is also important. It is possible that low use of the evidence-based therapies captured by the process measures (eg, aspirin for AMI) is directly responsible for the higher mortality rates. Alternatively, it is possible that poor adherence to AMI process measures is the proverbial “canary in the coal mine,” identifying hospitals that are having difficulty in
many dimensions of quality including but not limited to use of the evidence-based therapies assessed in the CMS performance measures.

Our finding should be considered in light of a number of recent publications examining the effect of hospital adherence with process measures on hospital outcomes. Both Jha et al29 and Bradley et al30 have reported a strong correlation between hospital compliance with AMI process measures and improved patient outcomes. Alternatively, Werner et al31 found a far weaker correlation between hospital compliance and patient outcomes.

The policy implications of these data are important. In many ways the small group of low-performing hospitals offer an unique opportunity to improve patient outcomes by targeting quality improvement interventions on a discrete group of hospitals that generally serve a large number of vulnerable patients. Such interventions could include designing pay-for-performance programs to funnel payments to hospitals with the largest improvement rather than incentivizing hospitals based on their actual performance. In fact, the CMS Premier Hospital Quality Incentive Demonstration (HQID) pay-for-performance project is being revised to reward both top performance as well as improvement, which should provide strong incentive for low-performing hospitals.30 Second, disproportionate share hospital (DSH) payments might be updated to incentivize safety-net hospitals to invest in quality improvement activities.31 Additionally, because less than one fifth of these low-performing hospitals would be categorized as “safety-net” under current definitions, important research and policy questions arise as to how to better identify safety-net activities to allocate federal and local resources (eg, the Federal Medicaid DSH payments, and state-level uncompensated care pools) more judiciously.32

Alternatively, one could make an argument that hospitals with consistently low performance merit more punitive action rather than remediation; taking such a tact would be politically challenging, but not unprecedented.33 Future research should thus focus on understanding specific organizational issues related to poor performance, as well as on treatment choices for patients in markets with these low-performing hospitals.

The study has several limitations that need to be acknowledged. First, the analysis was limited to 1 year of Medicare data, and hospitals reporting at least 25 AMI cases for the combined measures per year, representing only 63% of US hospitals treating AMI patients. Second, adherence to process measures are self-reported by hospitals and not subjected to independent external validation; recent articles have voiced concern over whether hospitals might be manipulating their results to enhance their apparent quality. Third, one could argue that our definitions of low-, intermediate-, and high-performing hospitals were based on somewhat arbitrary thresholds of AMI process measure compliance. Although this is technically correct, we conducted extensive sensitivity analyses using alternative definitions with similar results. Finally, mortality predictions are based on Medicare patients only and on the limited number of variables available within administrative data sets.

In summary, the current study provides evidence that hospitals with consistently low adherence with CMS AMI process measures differ substantially from better-performing US hospitals in terms of both hospital organizational characteristics and patient outcomes. Targeting quality improvement efforts at low-performing hospitals offers a unique opportunity for improving patient outcomes and reducing disparities in health care.

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**Disclosures**

None.

**References**


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Correction

In the article by Popescu et al, which appeared in the May 2009 issue of the journal (Circulation: Cardiovascular Quality and Outcomes. 2009;2:221–227), there was an error with a reference in the text. On page 226, in the second paragraph, the text that read, “Both Jha et al\(^29\) and Bradley et al\(^9\) have reported a strong correlation . . .” should have read, “Both Jha et al\(^29\) and Peterson et al\(^10\) have reported a strong correlation . . .”

This correction has been made to the current online version of the article, which is available at: http://circoutcomes.ahajournals.org/content/2/3/221.full?sid=16f979d0-cd87-4fd5-9177-d4a4c1e21158.

The authors regret the error.

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