An Organized Approach to Improvement in Guideline Adherence for Acute Myocardial Infarction

Results With the Get With The Guidelines Quality Improvement Program

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**Background:** Evidence-based guidelines from the American Heart Association are voluntary, and adherence is highly variable across the country. Get With The Guidelines (GWTG) is a national quality improvement program sponsored and developed by the American Heart Association. The objective of this study was to evaluate whether participation in GWTG is associated with greater adherence to guidelines for coronary artery disease (CAD).

**Methods:** Data on adherence to guidelines were obtained from Hospital Compare, grouping hospitals according to participation in the GWTG-CAD program on January 1, 2004: GWTG-CAD hospitals, n=223; non–GWTG-CAD hospitals, n=3407. The GWTG program uses a patient management tool, education, and benchmarked quality reports to improve guideline adherence. Adherence to 8 national measures, including the use of aspirin and β-blockers early and at discharge and timeline reperfusion, was analyzed. A composite score was also calculated. Multivariable logistic regression was performed for comparing composite adherence rates between groups.

**Results:** Adherence to the overall Hospital Compare composite measure was higher in GWTG-CAD hospitals than in non-GWTG-CAD hospitals (mean [SD], 89.7% [10.0%] vs 85.0 [15.0%]; absolute increase, 4.7%; \( P < .001 \)). Adherence to the GWTG-CAD performance measures (PM) composite was also higher (89.5% [11.0%] vs 83.0% [18.0%]; \( P < .001 \)). In multivariate analysis, GWTG-CAD participation was associated with a modest absolute increase in adherence to the PM composite by 2.52% (95% confidence interval [CI], 0.19%-4.85%). Larger acute myocardial infarction volume by quartile (absolute increase, 14.2%; 95% CI, 12.2%-16.3%), geographic location in the Northeast, and teaching hospital status (absolute increase, 2.87%; 95% CI, 0.43-5.32) were also associated with improved adherence to the PM composite. As a control, evaluation of unrelated quality measures for pneumonia, showed lower adherence among GWTG-CAD participating hospitals (74.8% [7.3%] vs 76.1% [9.7%]; \( P = .005 \)).

**Conclusion:** Participation in GWTG-CAD was independently associated with improvements in guideline adherence beyond that associated with public reporting.

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**Despite a significant improvement in mortality over the last several decades, cardiovascular disease remains the leading cause of death in the United States, representing 36% of all deaths.**

While American Heart Association (AHA) and American College of Cardiology (ACC) guidelines summarize evidence-based recommendations, adherence to these guidelines in clinical medicine is both incomplete and highly variable. Guideline adherence has been shown to be dependent on geographic region, teaching status, and profit status. As a result of this observation, quality improvement programs, including the ACC Guidelines in Applied Practice (GAP) program and the AHA Get With The Guidelines—Coronary Artery Disease (GWTG-CAD) program, were developed. The GWTG-CAD program is the largest hospital-based, national performance initiative, and an analysis of the first 100 hospitals found improvements over the first year of participation compared with baseline.

The objectives of this study were (1) to directly compare hospitals within GWTG-CAD with outside hospitals at a fixed period to avoid confounding of general changes over time in quality of care, (2) to summarize the variability across hospitals, and (3) to determine the major predictors of guideline adherence. We hypothesized that hospitals participating in

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the AHA GWTG-CAD program would have higher guideline adherence than hospitals not participating using publicly reported quality measures in the same time frame. This hypothesis was tested by comparing hospitals participating in GWTG-CAD with those not participating using the publicly available Centers for Medicare and Medicaid Hospital Compare (HC) database.

METHODS

HC DATABASE

In January 2004, hospitals began reporting guideline adherence data to receive incentive payments. Three clinical measures were reported: (1) acute myocardial infarction (AMI) (International Classification of Diseases, Ninth Revision, code 410), (2) heart failure, and (3) pneumonia. These data were reported on the HC Web site. The measures for the treatment of AMI were aspirin within 24 hours of admission, aspirin on discharge, β-blocker within 24 hours of admission, β-blocker on discharge, angiotensin-converting enzyme (ACE) inhibitor in patients with left ventricular dysfunction, thrombolytic agent within 30 minutes of arrival, percutaneous coronary intervention within 120 minutes of arrival, and smoking cessation counseling. Data for the AMI measures were downloaded from the HC Web site on July 26, 2005, and represent measures from January through June 2004. There were 3630 hospitals reporting at least 1 parameter that were included. To be consistent with respect to sample size, outliers, and missing information, the data were independently reviewed and analyzed.

GWTG-CAD PROGRAM COMPONENTS

The GWTG-CAD quality improvement program is hospital based and relies on a multidisciplinary team consisting of nurses, physicians, quality improvement staff, administrative leaders, and other members such as pharmacists or respiratory therapists. It includes didactic sessions, best practice sharing, interactive workshops, and a Web-based patient management tool (Outcome Sciences Inc, Cambridge, Massachusetts).9 The patient management tool provides concurrent data collection, clinical decision support, and real-time feedback of hospital data to support rapid cycle improvement. All hospitals participating in GWTG-CAD on January 1, 2004, were included in the analysis.

OTHER DATABASES USED

The 2004 American Hospital Association database was used to provide data on geographic location, profit status, teaching hospital status, and number of beds. This database matched the HC database in 97.3% of cases.

DATA ANALYSIS

Percent adherence was recorded for the 8 AMI measures for each hospital. In the GWTG-CAD program, 8 measures are collected, but only 4 measures (aspirin at discharge, β-blocker at discharge, ACE inhibitor therapy, and tobacco cessation counseling) are considered performance measures (PM) that are used to guide performance achievement award selection in the GWTG-CAD program. The inclusion and exclusion criteria for these 4 measures match those of the HC database (available at: http://www.qualitynet.org/). Therefore, the 4 measures are the focus of participating hospitals, creating 2 composite scores: the HC composite, which includes all 8 measures, and the PM composite, which includes all GWTG-CAD PM. Composites were calculated by dividing the number of treated cases by the number of eligible cases for the measures combined.

Two types of analysis were performed. The first was a hospital-based analysis in which each hospital served as a single observation. Hospitals' composite adherence scores were compared between GWTG-CAD and non-GWTG-CAD participants using the Wilcoxon rank-sum test. A multivariate regression analysis was performed to examine the independent influences of GWTG-CAD participation and the volume of patients with AMI (in quartiles), geographic region, teaching status, total number of beds, and for-profit status. The second was an opportunity-based analysis in which each opportunity to adhere contributed a single observation, with a dichotomous (fulfilled/unfulfilled) outcome. For example, if a patient was eligible for 5 measures and received 3 of them, there would be 5 observations in the analysis data set, and 3 would be positive. In this opportunity-based analysis, χ² analysis was used to compare adherence rates in GWTG-CAD hospitals with those in non-GWTG-CAD hospitals. A multivariable logistic regression, including GWTG-CAD participation and other hospital characteristics, was carried out to examine hospital performance as a result of GWTG-CAD participation. The generalization estimating equations approach was used in this analysis to account for clustering within hospitals. Because each patient should receive the care for which he or she is eligible, regardless of race, sex, and conditions, the comparison was not adjusted for patient case mix. Moreover, because of the variation on adherence rates across the HC and GWTG-CAD measures, a multivariable analysis that included the quality measure indicators in the model (8 indicators in the HC composite and 4 indicators in the PM composite) was also performed to allow the comparison to adjust for the hospital's opportunity mix.

Finally, we sought to determine whether participation in the program specifically resulted in higher adherence in GWTG-CAD hospitals or whether these hospitals were already committed to quality improvement and would have achieved these results regardless of participation. To determine if the improvement observed was specifically related to participation in the program or just due to an institutional commitment to quality, we evaluated adherence to HC pneumonia core measures stratified by participation in GWTG-CAD. A composite of the 4 pneumonia core measures (pneumococcal vaccine administration, antibiotic administration within 4 hours of arrival, oxygenation assessment, and tobacco cessation counseling) was evaluated.

The HC database does not report the volume of patients with AMI; therefore, volume calculations were estimated using the number of patients who were eligible to receive aspirin on admission. This volume was then divided into quartiles of increasing numbers of patients with AMI for analysis. Hospital volume and bed number data were reported as medians with interquartile ranges.

A P value of less than .05 was considered significant for all tests. All analyses were performed using SAS software (Version 8.2; SAS Institute, Cary, North Carolina). Because no individual patient data were reviewed, an institutional review board waiver was granted by the institutional review board of MetroHealth Medical Center, Cleveland, Ohio.

RESULTS

There were 4203 hospitals in the first 2 quarters of the 2004 HC database, 4091 of which (97.3%) were matched to the AHA database. Of these 4091 hospitals, 461 did not report any of the 8 (AMI) quality measures and were excluded. The study population consisted of 3630 hos-
HOSPITAL-BASED ANALYSIS

Overall mean ± SD HC composite adherence was 85.3% ± 15.0%. Overall mean ± SD PM composite adherence was 83.4% ± 18.0%. The adherence of GWTG-CAD hospitals to the HC composite measure was moderately higher than that of non–GWTG-CAD hospitals (89.7% ± 10.0% vs 85.0% ± 15.0%; absolute difference, 4.7%; P < .001). Comparing adherence to the GWTG-CAD quality measures (the PM score), GWTG-CAD hospitals adherence was also higher than that of non–GWTG-CAD hospitals (89.5% ± 11.0% vs 83.0 ± 18%; absolute difference, 6.5%; P < .001). In both HC and PM composite adherence, participation in the GWTG-CAD program was associated with reduced variation. Individual adherence for each of the 8 measures is listed in Table 1.

The GWTG-CAD hospitals demonstrated moderately superior adherence compared with the non–GWTG-CAD hospitals in (1) β-blocking drug administration on admission (87.7% ± 14.0% vs 82.8% ± 21.0%; P < .05), (2) β-blocker drug administration on discharge (89.7% ± 13.0% vs 83.6% ± 22.0%; P < .05), and (3) aspirin administration on discharge (92.2% ± 12.0% vs 85.9% ± 21.0%; P < .05).

A multivariate regression analysis was performed to evaluate the independent effect of the GWTG-CAD program. Variables included GWTG-CAD participation, region of the United States (South, West, Midwest, and Northeast), teaching hospital classification, total number of beds, hospital profit status, and volume of patients with AMI (quartiles). Table 2 shows the effect of the variables in the 2 models. The estimate is the absolute percentage of change resulting from the variable. In the overall HC composite, GWTG-CAD participation was not independently associated with improved adherence. In contrast, in the PM composite, GWTG-CAD independently predicted improved adherence by a modest absolute increase of 2.5% (P < .05). Other independent variables, including teaching hospital classification (P < .05), higher number of hospital beds (P < .05), large AMI volume, and location in the Northeast, predicted improved adherence in both the HC and PM composites. In multivariate analysis, GWTG-CAD was independently associated with improved adherence for the individual core measures of ACE inhibitor treatment on discharge (4.7%; P < .02) and tobacco cessation counseling or advice (3.8%; P < .05).

OPPORTUNITY-BASED ANALYSIS

In opportunity-based analysis, adherence rate calculations were not based on individual hospitals but rather on individual opportunities to adhere. In this analysis, there were 928,750 opportunities to adhere to the HC composite. The aggregate adherence to the HC composite was 91.8% in GWTG-CAD hospitals and 90.5% in non–GWTG-CAD hospitals (P < .001). There were 536,635 opportunities to adhere to the PM composite. Adherence to this composite was significantly greater in GWTG-CAD hospitals than in non–GWTG-CAD hospitals (92.1% vs 90.4%; P < .001). After adjustment for other hospital characteristics, GWTG-CAD hospitals were a factor associated with improved adherence to HC composite (odds ratio [OR], 1.12; 95% confidence interval [CI], 1.00-1.24; P < .05) and to PM composite (OR, 1.26; 95% CI, 1.11-1.43; P < .001) (Table 3).

Individual adherence and the number of opportunities to adhere for each of the 8 measures are listed in Table 1. The GWTG-CAD hospitals demonstrated superior adherence compared with non–GWTG-CAD hospitals in (1) aspirin administration on discharge (OR, 1.33; 95% CI, 1.12-1.57; P = .001), (2) β-blocking drug administration on discharge (OR, 1.20; 95% CI, 1.04-1.39; P = .01), (3) ACE inhibitor therapy administration on discharge (OR, 1.19; 95% CI, 1.05-1.36; P = .008), and (4) smoking cessation counseling (OR, 1.43; 95% CI, 1.15-1.77; P = .001). An additional multivariable analysis with adjustment for opportunity mix also shows that GWTG-CAD participants have higher adherence to the HC composite (OR 1.15; 95% CI 1.03-1.29; P = .0138) and the PM composite (OR, 1.26; 95% CI, 1.10-1.44; P = .001) than do non–GWTG-CAD hospitals.
Table 2. Multivariable Analysis Comparing Hospitals’ Hospital Compare (HC) and Performance Measures (PM) Scores Between Get With The Guidelines–Coronary Artery Disease (GWTG-CAD) vs Non–GWTG-CAD Participants (Hospital-Based Analysis)

| Variable | HC Composite | | | PM Composite | | | Estimate, Absolute % Increase/Decrease (95% CI) | P Value | Estimate, Absolute % Increase/Decrease (95% CI) | P Value |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| GWTG-CAD participation | 0.86 (-1.00 to 2.72) | 0.37 | | 2.52 (0.19 to 4.85) | 0.03 | | | | | | | | | | | |
| Teaching hospital | 2.06 (0.10 to 4.02) | 0.04 | | 2.87 (0.43 to 5.32) | 0.02 | | | | | | | | | | | |
| No. of hospital beds (per 100 beds) | 0.37 (0.02 to 0.71) | 0.04 | | 0.48 (0.04 to 0.91) | 0.03 | | | | | | | | | | | |
| For-profit hospital | -0.12 (-1.36 to 1.12) | 0.85 | | 0.12 (-1.45 to 1.69) | 0.88 | | | | | | | | | | | |
| Volume by quartile | | | | | | | | | | | | | | | | |
| First vs Fourth | -13.6 (-15.2 to -12.0) | <.001 | | -14.2 (-16.3 to -12.2) | <.001 | | | | | | | | | | | |
| Second vs Fourth | -4.61 (-6.11 to -3.10) | <.001 | | -7.09 (-8.98 to -5.21) | <.001 | | | | | | | | | | | |
| Third vs Fourth | -1.02 (-2.36 to 0.33) | 0.14 | | -2.11 (-3.79 to -0.43) | 0.01 | | | | | | | | | | | |
| Region | | | | | | | | | | | | | | | | |
| West vs Northeast | -1.72 (-3.27 to -0.16) | 0.03 | | -2.32 (-4.28 to -0.36) | 0.02 | | | | | | | | | | | |
| Midwest vs Northeast | -1.33 (-2.76 to 0.10) | 0.07 | | 0.55 (-1.25 to 2.36) | 0.55 | | | | | | | | | | | |
| South vs Northeast | -5.28 (-6.65 to -3.92) | <.001 | | -4.76 (-6.48 to -3.04) | <.001 | | | | | | | | | | | |
| Other vs Northeast | -11.2 (-15.5 to -7.0) | <.001 | | -13.5 (-18.8 to -8.1) | <.001 | | | | | | | | | | | |

Abbreviation: CI, confidence interval.

Table 3. Opportunity-Based Adherence Rates on Composite and Individual Measures Between Get With The Guidelines–Coronary Artery Disease (GWTG-CAD) and Non–GWTG-CAD Participants

| Variable | GWTG-CAD Composite (Opportunities to Adhere) | Non–GWTG-CAD Composite (Opportunities to Adhere) | Multivariate Analysisa | OR (95% CI) | P Value |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Hospital Compare composite | 91.8 (100 363) | 90.5 (828 387) | 1.12 (1.00-1.24) | 0.04 | | | | | |
| GWTG-CAD composite (performance measures) | 92.1 (62 252) | 90.4 (474 383) | 1.26 (1.11-1.43) | 0.001 | | | | | |
| Aspirin on admission | 95.0 (19 900) | 94.0 (185 954) | 1.06 (0.92-1.21) | 0.40 | | | | | |
| Aspirin on discharge | 95.2 (26 410) | 93.7 (199 459) | 1.33 (1.12-1.57) | 0.001 | | | | | |
| β-Blocker on admission | 89.4 (17 446) | 88.3 (163 683) | 1.03 (0.91-1.17) | 0.63 | | | | | |
| β-Blocker on discharge | 92.4 (26 289) | 91.0 (200 448) | 1.20 (1.04-1.39) | 0.01 | | | | | |
| ACE inhibitor on discharge | 80.9 (5989) | 77.9 (48 066) | 1.19 (1.05-1.36) | 0.008 | | | | | |
| Tobacco cessation counseling | 86.0 (3584) | 83.4 (26 410) | 1.43 (1.15-1.77) | 0.001 | | | | | |
| Thrombolytic agent in 30 min | 33.3 (120) | 39.5 (1205) | 0.73 (0.48-1.10) | 0.13 | | | | | |
| PCI within 120 min | 38.6 (645) | 38.4 (3162) | 0.99 (0.74-1.33) | >.99 | | | | | |

Abbreviations: ACE, angiotensin-converting enzyme; CI, confidence interval; OR, odds ratio; PCI, percutaneous coronary intervention.

aOther variables in the model include hospital volume, number of beds, teaching status, profit status, and regions.

Table 4 summarizes the results of the multivariate analysis. Other than participation in GWTG-CAD, predictors of improved adherence in the HC composite included higher hospital AMI volume, teaching hospital classification (OR, 1.40; 95% CI, 1.25-1.55; P < .001), number of hospital beds (OR, 1.03; 95% CI, 1.01-1.05; P < .02), and location in the northeast. Other variables predicting improved adherence in the PM composite were higher hospital volume, teaching hospital classification (OR, 1.48; 95% CI, 1.31-1.67; P < .001), higher number of hospital beds (OR, 1.04; 95% CI, 1.01-1.06; P < .005), and location in the Northeast.

Compared with the average adherence rates in the hospital-based analysis, the higher adherence levels and smaller margins in the opportunity-based analysis reflect the higher adherence in larger-volume hospitals. Therefore, while overall national adherence rates are relatively high, the greatest burden of adherence is carried by larger hospitals, and substantial opportunities for improvement exist in smaller-volume hospitals. Guideline adherence was higher in GWTG-CAD hospitals regardless of the region of the United States for the HC composite (Figure 1) and the PM composite (Figure 2).

SPECIFICITY ANALYSIS

Specificity analysis was performed to determine if hospitals committed to quality participated in GWTG-CAD and would have demonstrated improved adherence regardless of that participation. Hospitals committed to quality improvement should demonstrate better adherence to pneumonia as well as to AMI guidelines. The GWTG-CAD hospitals did not demonstrate increased adherence to the pneumonia composite compared with the non–GWTG-CAD hospitals and, in fact, were worse (74.8% ± 7.3% vs 76.1% ± 9.7%; P = .005). Even when tobacco cessation counseling, a measure that is identical to the GWTG-CAD measure, was compared in the 2 types of hospitals, GWTG-CAD hospitals fared no better (59.5% ± 28.5% vs 60.7% ± 32.4%; P = .29). Therefore, the
higher guideline adherence observed in patients with AMI in GWTG-CAD hospitals appears to be specific for participation in the program. Interdepartmental variation within a given hospital resulting in higher adherence in cardiac patients compared with pneumonia patients cannot be excluded, but is unlikely.

Many therapies for AMI have been shown to lower mortality. After careful review, the AHA and ACC compiles those therapies into published guidelines. Despite the wide availability of these guidelines, the Institute of Medicine, in the book Crossing the Quality Chasm: A New Health System for the 21st Century, indicated that apparently there was universally low compliance with evidence-based therapies. Despite this history of poor performance, recent evidence indicates that adherence to guidelines is beginning to improve; however, there is considerable variation, even among “top hospitals.”

A variety of methods for increasing adherence to guidelines have been initiated. These methods use 3 different approaches. The first approach has been to increase the reporting of data. The Centers for Medicare and Medicaid Services began publically reporting data on guideline adherence in 2004. The second approach has been to provide hospitals and physicians with the tools and infrastructure that are necessary to improve guideline adherence. Programs such as the ACC GAP program and the AHA GWTG program are examples of quality improvement programs that are designed to improve guideline adherence through tools and system redesign strategies. The third approach is to provide incentives to improve guideline adherence. Therefore, a hospital’s financial success may be dependent on improved guideline adherence. Lindenauer et al. showed that financial incentives in a Medicare “pay-for-performance” demonstration project can increase guideline adherence.

In the present study, a number of hospital characteristics were associated with improved adherence to published guidelines. Centers with higher volume of AMI,
academic medical centers, and centers in the northeastern United States all demonstrated a significantly higher adherence. These findings are consistent with those of Bradley et al,14 who also demonstrated that higher-volume centers adhere better to the AMI guidelines.

However, because there are many factors that play a role in treating patients with AMI, it would be inaccurate to imply that volume alone leads to better adherence. In fact, the findings of our study are consistent with those of other studies that demonstrated that variables such as teaching status and region (Northeast) can predict higher guideline adherence.6,14 This variation emphasizes the complexity and team approach to AMI care. The complexity of guideline adherence was emphasized in a study by Pearson et al15 that showed that 95% of physicians questioned knew the National Cholesterol Education Program guidelines; however, only 18% of high-risk patients were treated according to the guidelines. Excellent guideline adherence requires a systematic, coordinated program involving the entire medical team using tools such as care pathways and preprinted order sets.

Our study suggests that the GWTG-CAD program was able to encompass all these needs and was associated with improved guideline adherence. It is one of the first studies to demonstrate that a quality improvement program is independently associated with increased adherence using an external, concurrent national database. The small absolute differences in quality observed in this study may be attributable to many factors. National adherence to quality measures is increasing owing to public reporting, pay-for-performance projects, and participation in other quality improvement programs. As certain measures were at levels above 90% in HC, a “ceiling effect” may exist, making further improvements in adherence more difficult. It is possible that a study limited to poor-performing hospitals would show much more dramatic improvements. Although the improvements in adherence observed in our study were small in absolute terms, with more than 1 million patients hospitalized with AMI each year, these differences in performance would still translate to tens of thousands of more patients treated with recommended therapies each year if all US hospitals provided the same level of performance as those of GWTG-CAD hospitals.

LaBresh et al8 demonstrated that the GWTG-CAD program was associated with increased adherence to smoking cessation counseling, lipid treatment, and β-blocker, aspirin, and ACE inhibitor therapy as well as cardiac rehabilitation enrollment. The GWTG-CAD program uses an infrastructure of data collection and rapid improvement cycles. Therefore, data and individual hospital improvement systems are revised periodically using a “plan, do, study, act” approach, as described by Deming.16

Similar quality improvement programs have demonstrated improved guideline adherence over time on a smaller scale. The Cardiac Hospitalization Arteriosclerosis Management Program of UCLA Medical Center, Los Angeles, California, reported increased adherence in aspirin, β-blocker, ACE inhibitor, and statin treatment adherence when the preimplementation (1992-1993) and the postimplementation (1994-1995) years were compared.17 Similarly, the ACC GAP program showed improvement in aspirin and ACE inhibitor use on discharge and in tobacco cessation counseling.7 Both of these programs were limited to a small number of hospitals. The present study has demonstrated that a quality improvement program can be successfully implemented in a large number of hospitals on a national basis.

Guidelines are based on therapies that have been proved to reduce mortality. The present study did not evaluate whether improvement in guideline adherence was associated with improved mortality, as previous studies have already demonstrated this association. The Cardiac Hospitalization Arteriosclerosis Management Program was associated with improved reinfarction rates and a 2.7% reduction in 1-year mortality.17 In multivariate analysis, the GAP program was associated with a 26% reduction in 30-day mortality and a 22% reduction in 1-year mortality.18 Further study is necessary to determine if the GWTG-CAD program results in improved outcomes.

Despite the increase in technology and treatments that are available to patients, cardiovascular disease remains the leading cause of death in the United States. The AHA has set a goal to reduce death due to cardiovascular disease by 25% by 2010.1 Adherence to evidence-based guidelines remains a critical component in achieving this goal. In fact, the AHA/ACC guidelines for secondary prevention in patients with CAD recommends participation in a quality improvement program, such as GAP or GWTG.3

There are several limitations to this study. The AMI volume was estimated by using the number of cases that were eligible for aspirin therapy on admission. The estimation is likely accurate because this parameter represented the largest category of eligible patients. It is possible that contraindications to aspirin use could have reduced the number of patients in the eligible category, resulting in an underestimation of AMI volume. We were unable to evaluate other important quality-of-care metrics, including use of lipid-lowering therapy and referral to cardiac rehabilitation, as this information is not collected in the HC database. Reperfusion measures were optional at the time these data were analyzed. They may have been selectively reported, which could have influenced the findings. Also, in 2004, the HC measure for percutaneous coronary intervention to occur was within 120 minutes. The GWTG-CAD standard was 90 minutes. While this measure is not identical in both groups, higher-quality hospitals would be expected to have better adherence at both 90 and 120 minutes. Our study did not control for the patient case mix; however, given the broad nature of the GWTG-CAD program, it is unlikely that significant differences in the types of patients occurred. Based on these data, it is not clear whether participation in the GWTG-CAD program resulted in improved adherence or whether higher-quality hospitals participate in GWTG-CAD. This concern is mitigated by the observation that improved adherence occurred in HC core measures for CAD but not for pneumonia care in GWTG-CAD hospitals. The HC data relied on self-reporting by hospitals as opposed to abstraction from medical records by independent operators; however, random sample charts were independently validated by the Centers for Medicare and Medicaid. This study was not a randomized clinical trial, and the improvements in quality measures may have been influenced by factors other than GWTG-CAD participation. Despite mul-
tivariable adjustment, we cannot exclude the possibility that residual measured and unmeasured confounding might account for these observations.

In conclusion, GWTG–CAD is the largest hospital-based program dedicated to quality-of-care improvement for patients hospitalized with CAD in the United States. Hospitals participating in GWTG–CAD demonstrated improved adherence to national guideline-recommended therapies compared with other US hospitals that were publicly reporting data at the same time. The results of this study and other health care improvement programs suggest that the quality of care provided to patients with cardiovascular disease can be further enhanced by using Web-based patient data submission and performance feedback as well as collaborative care models and by concentrating on those processes of care that have proved to improve outcomes.

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