Achievement of Guideline-Concordant Care and In-Hospital Outcomes in Patients With Coronary Artery Disease in Teaching and Nonteaching Hospitals

Results From the Get With The Guidelines–Coronary Artery Disease Program

Lori M. Tam, MD; Gregg C. Fonarow, MD; Deepak L. Bhatt, MD, MPH; Maria V. Grau-Sepulveda, MD, MPH; Adrian F. Hernandez, MD, MPH; Eric D. Peterson, MD, MPH; Lee H. Schwamm, MD; Robert P. Giugliano, MD, SM; on behalf of the GWTG Steering Committee and Investigators

Background—Secondary prevention therapies improve longitudinal outcomes in patients with coronary artery disease. Previous studies showed that teaching hospitals (THs) more consistently use evidence-based secondary prevention therapies than non-THs (NTHs). It is unclear whether these differences persist after initiation of a national quality improvement system.

Methods and Results—We analyzed 270,902 patients across 361 hospitals in the Get With The Guidelines–Coronary Artery Disease program from June 2000 to September 2009. The primary outcome was guideline-concordant care, defined as compliance with all Get With The Guidelines–Coronary Artery Disease quality measures: (1) aspirin within 24 hours, (2) aspirin at discharge, (3) angiotensin-converting enzyme inhibitor/angiotensin receptor blockers for systolic dysfunction, (4) β-blockers at discharge, (5) lipid therapy if low-density lipoprotein >100 mg/dL, and (6) smoking cessation. We used multivariate modeling to compare the relationship between TH and NTH status on quality measures, in-hospital mortality, and length of stay. Guideline-concordant care was higher at THs (78.4% versus 73.3%; P < 0.01). The adjusted odds ratio between 2000 and 2009 for guideline-concordant care at THs compared with NTHs was 2.78 (confidence interval, 1.28–6.06; P = 0.01). Guideline-concordant care increased from 2000 to 2009 at THs (n = 176; 65.3%–88.3%; adjusted odds ratio for year increase, 1.24 [confidence interval, 1.16–1.30; P < 0.01]) and NTHs (n = 185; 61.0%–93.9%; adjusted odds ratio for year increase, 1.35 [confidence interval, 1.26–1.45]; P < 0.01). THs had shorter length of stay (adjusted odds ratio, 0.74 for length of stay >4 days; confidence interval, 0.58–0.94) from 2000 to 2009. Lower in-hospital mortality was observed at THs (3.7% versus 4.4% at NTHs; P < 0.01), but this was not significant after adjustment.

Conclusions—Adherence to guideline-recommended therapies increased over time with participation in the Get With The Guidelines–Coronary Artery Disease program, regardless of the teaching status. Guideline-concordant care over the full decade was higher in THs; however, NTHs demonstrated greater incremental improvement over time. (Circ Cardiovasc Qual Outcomes. 2013;6:58–65.)

Key Words: acute coronary syndromes • adherence • performance measures • quality improvement • secondary prevention

Guideline-recommended therapies improve clinical outcomes in patients admitted for acute coronary syndrome. Previous studies have suggested greater adherence to guideline-recommended therapies at teaching hospitals (THs) compared with non-THs (NTHs) in the treatment of non–ST-segment–elevation acute coronary syndrome and myocardial infarction (MI). Landon et al found that THs provided higher-quality care in terms of diagnosis and treatment compared with NTHs but performed worse in the area of prevention and counseling. More variability was noted among NTHs, but the overall use of evidence-based therapies was suboptimal at both THs and NTHs.

Received February 16, 2012; accepted October 11, 2012.

From the Johns Hopkins Hospital, Baltimore, MD (L.M.T.); David Geffen School of Medicine at University of California at Los Angeles (G.C.F.); VA Boston Healthcare System, Brigham and Women’s Hospital, and Harvard Medical School, Boston, MA (D.L.B.); Duke Clinical Research Institute at Duke University School of Medicine, Durham, NC (M.V.G.-S., A.F.H., E.D.P.); Massachusetts General Hospital and Harvard Medical School, Boston (L.H.S.); and Brigham and Women’s Hospital and Harvard Medical School, Boston, MA (R.P.G.).

This manuscript was handled independently by Jack V. Tu, MD, MSc, PhD, FRCP, as Guest Editor. The Editors had no role in the evaluation of the article or the decision about its acceptance.

Correspondence to Robert P. Giugliano, MD, SM, 350 Longwood Ave, 1st Office Floor, Boston, MA 02115. E-mail rgiugliano@partners.org

© 2012 American Heart Association, Inc.

Circ Cardiovasc Qual Outcomes is available at http://circoutcomes.ahajournals.org

DOI: 10.1161/CIRCOUTCOMES.112.965525
WHAT IS KNOWN
• Participation in national quality improvement programs such as Get With The Guidelines—Coronary Artery Disease is associated with greater adherence to guideline-recommended therapies for coronary artery disease.
• Hospital teaching status has been associated with better performance in prior studies, but it is unclear whether these differences are observed among hospitals participating in national quality improvement programs.

WHAT THE STUDY ADDS
• Among Get With The Guidelines—Coronary Artery Disease—participating hospitals, guideline-concordant care in coronary artery disease was initially higher at teaching hospitals.
• There was a significant temporal improvement in guideline adherence at both teaching and nonteaching hospitals with each year of participation in the Get With The Guidelines—Coronary Artery Disease program both by program years and by calendar years.
• Participation in Get With The Guidelines—Coronary Artery Disease was associated with greater relative improvement at nonteaching hospitals such that differences by hospital teaching status in guideline-recommended care were eliminated over time.

Methods
GWTG Program Design
The GWTG-CAD is a national quality improvement initiative that aims to increase adherence to guideline recommendations for secondary prevention in patients admitted with CAD. This hospital-based program involves a trained multidisciplinary team of doctors, nurses, quality improvement personnel, and ancillary staff who participate in educational sessions and collaborative workshops on standardized quality improvement methodology and allows idea sharing and interactive learning. Participating institutions in the registry use an Internet-based patient management tool (Outcome Sciences, Inc, Cambridge, MA) to submit clinical information on the medical history, hospital care, and outcomes of consecutive patients hospitalized for CAD. Patients hospitalized with CAD were identified for inclusion on the basis of prospective clinical identification, retrospective identification with International Classification of Diseases, Ninth Revision, Clinical Modification discharge codes, or a combination. The eligibility of each CAD admission was confirmed on chart review before abstraction. GWTG-CAD also aids in real-time decision making by allowing providers to access guideline recommendations and provides on-demand hospital data feedback on key quality measures. Outcome Sciences, Inc is the data collection coordination center for the American Heart Association/American Stroke Association GWTG programs. The Duke Clinical Research Institute (Durham, NC) served as the data analysis center. THs (per the American Hospital Association database) are defined as having an Accreditation Council for Graduate Medical Education–approved residency program or being a member of the Council of Teaching Hospitals.

Patient Population
Our study population started with 274,490 patients from 377 hospitals in the United States fully participating in the GTWG-CAD program from January 2000 to September 2009. Hospitals with unknown teaching status were excluded from this analysis, leaving 270,902 patients admitted with CAD or CAD equivalents (acute ST-segment and non-ST-segment MI, CAD, heart failure with CAD, peripheral artery disease, and unstable angina) from 361 hospitals. In the analysis population, 155,414 patients were admitted to THs (n=176) and 115,488 patients were admitted to NTHs (n=185). Baseline and clinical characteristics were obtained, which included demographics, medical history, admission vital signs and laboratory values, ejection fraction, hospital characteristics, region, and years of participation in the GWTG program. Most measures exclude patients who transferred to another hospital, left against medical advice, or expired. However, measures that involve treatment in the first 24 hours do not by convention exclude patients who transferred, whereas discharge measures by convention exclude patients who transferred. Thus, these patients were not excluded from the entire study cohort, only from applicable measures.

Definitions and End Points
The primary outcome was guideline-concordant care, defined as 100% compliance with all 6 GWTG-CAD quality measures: (1) aspirin within 24 hours in acute coronary syndrome, (2) aspirin at discharge in CAD patients, (3) angiotensin-converting enzyme inhibitors or angiotensin receptor blockers at discharge for patients with left ventricular systolic dysfunction, (4) β-blockers at discharge in CAD patients, (5) lipid-lowering medication treatment in CAD patients with low-density lipoprotein >100 mg/dL, and (6) smoking cessation counseling among current smokers. In addition to the composite end point, the achievement of additional quality measures was analyzed: (1) angiotensin-converting enzyme inhibitors for patients with an acute MI, (2) blood pressure control ≤140/90 mm Hg at discharge, (3) β-blockers within 24 hours, (4) lipid-lowering medication at discharge, and (5) cardiac rehabilitation or exercise counseling. The aspirin and β-blocker within 24-hour performance measures apply only to acute MI patients, whereas the discharge aspirin and β-blocker measures apply to all CAD patients, hence the different number of patients in the denominators. Temporal changes at both academic and nonacademic institutions were compared. Data on the rates of inpatient invasive procedures, inpatient mortality, and length of stay (LOS) were also obtained.

Statistical Methods
Wilcoxon rank-sum test and χ² test were used to compare continuous and categorical variables, respectively, among patients from academic and nonacademic hospitals. Multivariate logistic regression was used to assess the relationship between TH and NTH status on performance and quality measures, in-hospital mortality, use of invasive procedures, and LOS. To account for hospital clustering, we
used generalized estimating equation models. The following variables were included in the adjusted models: age, sex, race (whites versus nonwhites), body mass index, medical history (heart failure, chronic obstructive lung disease/asthma, diabetes mellitus on oral medications, diabetes mellitus on insulin, hyperlipidemia, hypertension, cerebrovascular accident/transient ischemic attack, peripheral vascular disease, and renal failure), years in the program, number of beds in the hospital and region of the United States, arrival during on- or off-hours, smoking, and diagnosis (CAD, unstable angina, heart failure with CAD, acute MI, cerebrovascular disease, peripheral vascular disease, other). The models of in-hospital procedures were also adjusted for hospital revascularization capability. Missing values for individual characteristics were imputed to the most common category for categorical variables (race, medical history) and with sex-specific medians for continuous variables (body mass index). Compliance rates by academic status for each year in GWTG-CAD were evaluated with \(\chi^2\) tests.

**Results**

**Baseline Characteristics**

Of the 270,902 patients admitted with CAD from 361 hospitals participating in the GWTG-CAD program during the study period, the median age was 69 years at NTHs and 67 years at THs. Of the patients treated at THs, 23.5% were nonwhite, whereas only 16% of patients at NTHs were identified as nonwhite. THs had more patients with a history of hypertension (72%) compared with 67.6% at NTHs. THs also had more patients with hyperlipidemia with a baseline demographic of 45.8% compared with 42.4% of patients at NTH. Other baseline demographics and medical history were similar among patients treated at THs and NTHs (Table 1).

**Performance and Quality Measures**

In unadjusted analyses, THs demonstrated significantly higher achievement of quality measures of care than NTHs, except for aspirin administration within the first 24 hours (Table 2). The primary end point of guideline-concordant care, defined as 100% compliance with the 6 performance measures, was significantly higher at THs (THs 78.4% versus NTHs 73.3%; unadjusted odds ratio [OR], 1.27; confidence interval [CI], 1.06–1.53; \(P=0.01\)). After adjustment for patient and other hospital characteristics, the OR for the primary end point of guideline-concordant care at THs compared with NTHs from 2000 to 2009 was 2.78 (CI, 1.28–6.06; \(P=0.01\); Figure 1).

Both THs and NTHs showed temporal improvement with each year of participation in the GTWG-CAD program both by program years and by calendar years (Figures 2 and 3). The number of patients who received guideline-concordant care increased with each year of participation in the program in both THs (65.3% at baseline → 88.3% at 6+ years; adjusted OR for year increase, 1.24 [CI, 1.16–1.30]; \(P<0.01\)) and NTHs (61.0% at baseline to 93.9% at 6+ years; adjusted OR for year increase, 1.35 [CI, 1.26–1.45]; \(P<0.01\)), with greater relative improvement in NTHs (\(P<0.01\); Figure 2). After 5 years of participation in the GWTG-CAD program, NTHs surpassed THs in the rates of achievement of guideline-concordant care (THs, 87.5% versus NTHs, 89.6%; Figure 2); however, this finding was not statistically significant after taking into account the clustering of data within hospitals (\(P=0.37\)).

**Use of Invasive Procedures and In-hospital Outcomes**

The unadjusted data on the use of invasive procedures and inhospital outcomes are presented in Table 3. After adjustment, coronary artery bypass grafting was more frequent in NTH hospitals, whereas the rates of coronary angiography and percutaneous intervention were similar at TH and NTH (Figure 4).

Before adjustment, there was no significant difference in LOS >4 days (OR, 1.10; CI, 0.97–1.25; \(P=0.12\)). However after adjustment, TH were less likely to have an LOS >4 days (adjusted OR, 0.74; CI, 0.58–0.94; Figure 4) from 2000 to 2009, although the LOS decreased in both TH and NTH over calendar time (adjusted OR, 0.96; CI, 0.94–0.99; \(P<0.01\) and adjusted OR, 0.95; CI, 0.93–0.97; \(P<0.01\); Table 4). There was a trend toward lower in-hospital mortality at TH (3.7% at THs versus 4.4% at NTHs; \(P<0.01\); Table 3), with an OR of 0.87 (CI, 0.72–1.06; \(P=0.17\)) and adjusted OR of 0.88 (CI, 0.73–1.07; \(P=0.21\); Figure 4) from 2000 to 2009. However, after adjustment by calendar time, there was no significant difference in in-hospital mortality in THs or NTHs. The ORs for program years and calendar years by hospital teaching status for guideline-concordant care, in-hospital mortality, and LOS >4 days are presented in Table 4.

**Discussion**

Among hospitals participating in GWTG-CAD, THs provided more guideline-concordant care in patients admitted with CAD during initial program participation and overall between 2000 and 2009. In an adjusted analysis, higher guideline-concordant care in THs was driven mainly by compliance with aspirin and \(\beta\)-blocker guidelines. Care at both THs and NTHs participating in the GWTG-CAD improved over time; however, there was greater improvement in NTHs such that after 4 years of GWTG participation, care was of higher quality in NTHs. These findings suggest that participation in GWTG-CAD was associated with the elimination of differences in guideline-recommended care between teaching and nonteaching hospitals. Previous studies have evaluated the association between hospital teaching status and quality of care. Chen et al.\(^{14}\) found that elderly patients with acute MI treated at 60 top-ranked hospitals in cardiology on the list of America’s Best Hospitals published between 1995 and 1997 by the US News and World Report were more likely to receive aspirin and \(\beta\)-blockers and had lower mortality than similarly equipped hospitals and nonsimilarly equipped hospitals. All of the 60 top-ranked hospitals were THs, whereas 56% of similarly equipped hospitals were THs and only 9% of nonsimilarly equipped hospitals were teaching institutions. That study suggests that participation in GWTG-CAD was associated with the elimination of differences in guideline-recommended care between teaching and nonteaching hospitals. However, after adjustment by calendar time, there was no significant difference in in-hospital mortality in THs or NTHs. The ORs for program years and calendar years by hospital teaching status for guideline-concordant care, in-hospital mortality, and LOS >4 days are presented in Table 4.

In a study of Medicare patients with acute MI, Allison et al.\(^{15}\) found that THs performed better in terms of the administration of aspirin, angiotensin-converting enzyme inhibitors, and \(\beta\)-blockers. Care at academic medical centers cost 44% more than other urban NTHs, and even nonacademic medical center THs are 14% more expensive than their nonteaching counterparts.\(^{16}\) In an era of healthcare reform and emphasis on
reducing healthcare costs, it would be important to determine whether the care at THs balances the additional costs with better performance.

Lewis et al demonstrated that hospitals participating in the GWTG-CAD program had improved guideline adherence compared with non–GWTG-CAD hospitals. TH status was an independent predictor of compliance with guidelines; however, THs made up only 7.7% of the hospitals studied, and temporal improvement in guideline adherence with participation in the GWTG-CAD program was not evaluated. In CRUSADE, there was a trend toward more evidence-based care at larger THs; however, multivariate analysis only demonstrated the presence of cardiac revascularization facilities and treatment by a cardiologist as significant predictors of greater guideline adherence.

We studied a comprehensive population of >270 000 patients who were cared for at both THs and NTHs from all regions...
Table 2.  Adherence to GWTG-CAD Quality Measures (Percentage) by Hospital Teaching Status

<table>
<thead>
<tr>
<th>GWTG-CAD quality measures</th>
<th>Nonteaching Hospitals (Patients, n=115 488; Sites, n=185)</th>
<th>Teaching Hospitals (Patients, n=155 414; Sites, n=176)</th>
<th>Unadjusted OR (CI)</th>
<th>P</th>
<th>Adjusted OR (CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACEI/ARB for LVSD (n=45 479)</td>
<td>78</td>
<td>81</td>
<td>1.20 (1.01–1.43)</td>
<td>0.04</td>
<td>1.08 (0.87–1.34)</td>
<td>0.48</td>
</tr>
<tr>
<td>CAD patients with β-blockers at discharge (n=214 213)</td>
<td>86</td>
<td>91</td>
<td>1.50 (1.20–1.87)</td>
<td>&lt;0.01</td>
<td>1.69 (1.23–2.31)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>LDL &gt;100 mg/dL and lipid-lowering medication (n=51 201)</td>
<td>81</td>
<td>85</td>
<td>1.39 (1.09–1.77)</td>
<td>&lt;0.01</td>
<td>1.08 (0.82–1.44)</td>
<td>0.58</td>
</tr>
<tr>
<td>Smoking cessation (n=63 248)</td>
<td>87</td>
<td>90</td>
<td>1.15 (0.88–1.49)</td>
<td>0.31</td>
<td>1.18 (0.77–1.80)</td>
<td>0.45</td>
</tr>
<tr>
<td>Aspirin at discharge (n=218 248)</td>
<td>89</td>
<td>93</td>
<td>1.47 (1.14–1.89)</td>
<td>&lt;0.01</td>
<td>1.59 (1.04–2.42)</td>
<td>0.03</td>
</tr>
<tr>
<td>Aspirin within 24 h (n=115 112)</td>
<td>93</td>
<td>93</td>
<td>1.00 (0.71–1.44)</td>
<td>0.99</td>
<td>1.66 (0.72–3.83)</td>
<td>0.24</td>
</tr>
<tr>
<td>Composite quality measure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composite quality measure for 100% compliance (guideline-concordant care; n=248 843)</td>
<td>73.3</td>
<td>78.4</td>
<td>1.27 (1.06–1.53)</td>
<td>0.01</td>
<td>2.78 (1.28–6.06)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Other quality measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACEI for AMI (n=111 690)</td>
<td>70</td>
<td>73</td>
<td>1.25 (1.09–1.44)</td>
<td>&lt;0.01</td>
<td>1.10 (0.94–1.28)</td>
<td>0.24</td>
</tr>
<tr>
<td>Blood pressure (n=211 760)</td>
<td>78</td>
<td>79</td>
<td>1.01 (0.91–1.11)</td>
<td>0.90</td>
<td>1.03 (0.92–1.15)</td>
<td>0.62</td>
</tr>
<tr>
<td>β-blockers within 24 h (n=105 490)</td>
<td>86</td>
<td>87</td>
<td>1.09 (0.67–1.76)</td>
<td>0.73</td>
<td>0.90 (0.50–1.60)</td>
<td>0.71</td>
</tr>
<tr>
<td>Lipid-lowering medications at discharge (n=230 581)</td>
<td>73</td>
<td>81</td>
<td>1.54 (1.27–1.86)</td>
<td>&lt;0.01</td>
<td>1.11 (0.88–1.42)</td>
<td>0.38</td>
</tr>
<tr>
<td>Rehabilitation/activity recommendations (n=235 647)</td>
<td>77</td>
<td>81</td>
<td>1.29 (0.88–1.89)</td>
<td>0.19</td>
<td>1.09 (0.72–1.67)</td>
<td>0.68</td>
</tr>
</tbody>
</table>

CAD indicates coronary artery disease; OR, odds ratio; ACEI, angiotensin-converting enzyme inhibitors; ARB, angiotensin receptor blockers; LDL, low-density lipoprotein; AMI, acute myocardial infarction; LVSD, left ventricular systolic dysfunction; CI, confidence interval; and GWTG, Get With The Guidelines.

Our study also illustrates a substantial opportunity for further improvement in increasing guideline-concordant care in CAD in the United States as non–guideline-concordant care exceeded 20% at both THs and NTHs overall. Although guideline-concordant care was significantly higher at THs over the course of the study, our analysis found that each year of participation in this quality improvement initiative resulted in increased guideline adherence and greater...
achievement of quality measures in patients admitted with CAD at both teaching and nonteaching institutions. In fact, NTHs demonstrated more incremental improvement over time than THs. The greater temporal improvement in NTH may possibly be attributed to the lower initial adherence rate at NTHs because they may have had more potential for improvement. At baseline, the opportunities for medical education and dissemination of practice guidelines may be greater at THs, but the implementation of this quality improvement program minimizes these differences and allows NTH to achieve a level of guideline compliance that is comparable with the care at TH.

The differences in the measures between THs and NTHs are modest and would not be expected to translate into differences in in-hospital mortality; as has been shown in prior studies, these measures together explain only 6% of the variation in 30-day mortality risk. Secondary prevention therapies are more likely to affect longitudinal end points at a later time point, which are not evaluated in the GWTG database.

A limitation of our study is the lack of postdischarge outcomes in the GWTG registry. We also could not evaluate other clinical end points such as hospital readmission and recurrent MI/ischemia. There is also the potential for possible sampling bias because hospitals included in this study were voluntary participants. This may have selected for hospitals of higher quality with a greater focus on improving the delivery of care or the corollary, ie, poorer-performing hospitals that had greater room for improvement. The quality measures included in GWTG-CAD are only a subset of all guideline-recommended therapies in acute coronary syndrome and quality, and comprehensive care of CAD includes other indicators that were not measured. The GWTG-CAD program only includes hospitals in the United States and thus results may not necessarily be generalized to include other countries. The findings from our analysis apply to common issues in CAD but may not pertain to other disease states or subspecialties. Furthermore, it is important to note that there are many inherent differences in the structures and characteristics of THs and NTHs. Hospitals that elect to participate in GWTG may be more motivated to improve performance and have the capabilities to participate, which could be different from those hospitals that decide not to participate in the GWTG program. The improvements in care over time may reflect more than GWTG-CAD participation,

Figure 2. Guideline-concordant care by hospital teaching status by years in program. $P<0.01$ for unadjusted generalized estimating equation odds ratio for change over time for both teaching hospitals and nonteaching hospitals. CAD indicates coronary artery disease.

Figure 3. Guideline-concordant care by hospital teaching status over calendar years. $P<0.01$ for unadjusted generalized estimating equation odds ratio for change over time for both teaching hospitals and nonteaching hospitals. CAD indicates coronary artery disease.
including national secular trends, additional local and national improvement efforts, public reporting of acute MI measures, or other factors. Although we adjusted for all pertinent confounders that were collected, it is not possible to adjust for all elements. Residual measured and unmeasured confounding variables may account for some of our findings.

Conclusions
We found that among hospitals engaged in a national quality monitoring and improvement system, evidence-based care for CAD has improved over time for all patients in both THs and NTHs. Furthermore, the present study suggests that participation in GWTG-CAD was associated with initial differences by hospital teaching status in guideline-recommended care being eliminated after ≥5 years in the program; NTHs reached a high level of guideline concordance, which was comparable to that of THs. The majority of medical care in the United States is provided at NTHs, and greater standardization of quality measures through quality improvement initiatives will advance care at both teaching and nonteaching institutions and significantly improve compliance with evidence-based recommendations and therapies.

Sources of Funding
The Get With the Guidelines-Coronary Artery Disease (GWTG-CAD) program was provided by the American Heart Association. The GWTG-CAD program was supported in part by the American Heart Association Pharmaceutical Roundtable and an unrestricted educational grant from Merck.

Table 3. Rates of Inpatient Invasive Procedures, Inpatient Mortality, and Length of Stay Among Teaching and Nonteaching Hospitals by Hospital Teaching Status

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Unadjusted OR (CI)</th>
<th>Unadjusted OR (CI)</th>
<th>P</th>
<th>Adjusted OR (CI)</th>
<th>Adjusted OR (CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronary artery bypass graft, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronary angiography, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percutaneous coronary intervention, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-hospital mortality and length of stay</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-hospital mortality, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of stay &gt;7 d, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of stay &gt;4, d, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OR indicates odds ratio; and CI, confidence interval.

Figure 4. Adjusted odds ratio for in-hospital cardiac procedures, length of stay, and mortality among teaching and nonteaching hospitals. The symbol size for the point estimate is proportional to the number of patients. Adjusted for the following baseline characteristics: age, sex, race (white versus nonwhite), body mass index, medical history, number of beds in hospital, region, years in the program, arrival during on or off hours, smoking, hospital revascularization capability, and diagnosis (see Figure 1, legend for list).
Table 4. Unadjusted and Adjusted Odds Ratio for Guideline-Concordant Care, Length of Stay >4 Days, and In-hospital Mortality by Years in Program and Calendar Time, Stratified by Hospital Teaching Status

<table>
<thead>
<tr>
<th>Hospital Teaching Status</th>
<th>Outcomes</th>
<th>Time Trend, y</th>
<th>Unadjusted OR</th>
<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
<th>P</th>
<th>Adjusted OR</th>
<th>Lower 95% CI</th>
<th>Upper 95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonteaching</td>
<td>Compliance with achievement measures</td>
<td>Program time</td>
<td>1.43</td>
<td>1.32</td>
<td>1.55</td>
<td>&lt;0.01</td>
<td>1.35</td>
<td>1.26</td>
<td>1.45</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Nonteaching</td>
<td>In-hospital mortality</td>
<td>Program time</td>
<td>1.04</td>
<td>0.99</td>
<td>1.09</td>
<td>0.13</td>
<td>0.99</td>
<td>0.95</td>
<td>1.03</td>
<td>0.59</td>
</tr>
<tr>
<td>Nonteaching</td>
<td>Length of stay</td>
<td>Program time</td>
<td>0.98</td>
<td>0.95</td>
<td>1.02</td>
<td>0.42</td>
<td>0.96</td>
<td>0.94</td>
<td>0.99</td>
<td>0.01</td>
</tr>
<tr>
<td>Teaching</td>
<td>Compliance with achievement measures</td>
<td>Program time</td>
<td>1.27</td>
<td>1.21</td>
<td>1.33</td>
<td>&lt;0.01</td>
<td>1.24</td>
<td>1.19</td>
<td>1.30</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Teaching</td>
<td>In-hospital mortality</td>
<td>Program time</td>
<td>1.03</td>
<td>1.00</td>
<td>1.07</td>
<td>0.05</td>
<td>1.02</td>
<td>0.99</td>
<td>1.05</td>
<td>0.19</td>
</tr>
<tr>
<td>Teaching</td>
<td>Length of stay</td>
<td>Program time</td>
<td>1.01</td>
<td>0.97</td>
<td>1.06</td>
<td>0.51</td>
<td>1.00</td>
<td>0.96</td>
<td>1.04</td>
<td>0.96</td>
</tr>
<tr>
<td>Nonteaching</td>
<td>Compliance with achievement measures</td>
<td>Admittance</td>
<td>1.41</td>
<td>1.32</td>
<td>1.52</td>
<td>&lt;0.01</td>
<td>1.37</td>
<td>1.28</td>
<td>1.46</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Nonteaching</td>
<td>In-hospital mortality</td>
<td>Admittance</td>
<td>1.04</td>
<td>0.99</td>
<td>1.09</td>
<td>0.16</td>
<td>0.98</td>
<td>0.94</td>
<td>1.02</td>
<td>0.30</td>
</tr>
<tr>
<td>Nonteaching</td>
<td>Length of stay</td>
<td>Admittance</td>
<td>0.99</td>
<td>0.95</td>
<td>1.02</td>
<td>0.47</td>
<td>0.96</td>
<td>0.94</td>
<td>0.99</td>
<td>0.01</td>
</tr>
<tr>
<td>Teaching</td>
<td>Compliance with achievement measures</td>
<td>Admittance</td>
<td>1.26</td>
<td>1.21</td>
<td>1.31</td>
<td>&lt;0.01</td>
<td>1.25</td>
<td>1.20</td>
<td>1.29</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Teaching</td>
<td>In-hospital mortality</td>
<td>Admittance</td>
<td>1.03</td>
<td>1.00</td>
<td>1.06</td>
<td>0.06</td>
<td>1.03</td>
<td>1.00</td>
<td>1.06</td>
<td>0.05</td>
</tr>
<tr>
<td>Teaching</td>
<td>Length of stay</td>
<td>Admittance</td>
<td>0.98</td>
<td>0.94</td>
<td>1.02</td>
<td>0.36</td>
<td>0.98</td>
<td>0.95</td>
<td>1.01</td>
<td>0.14</td>
</tr>
</tbody>
</table>

OR indicates odds ratio; LOS, length of stay; and CI, confidence interval.

Disclosures
Dr Bhatt receives research grants from Amarin, AstraZeneca, Bristol-Myers Squibb, Eisai, Ethicon, Medtronic, Sanofi Aventis and The Medicines Company. Advisory Board for: Medscape Cardiology; Board of Directors: Boston VA Research Institute, Society of Chest Pain Centers; Chair: American Heart Association Get With The Guidelines Science Subcommittee; Honoraria: American College of Cardiology (Editor, Clinical Trials, Cardiosource), Senior Associate Editor, Journal of Invasive Cardiology, Duke Clinical Research Institute (clinical trial steering committees), Slack Publications (Chief Medical Editor, Cardiology Today Intervention), WebMD (continuing medical education steering committees). Unfunded Research: FlowCo, PLX Pharma, Takeda. Dr Hernandez receives research grants from Johnson & Johnson, Amylin, Portola and honorarium from AstraZeneca, Corthera, and Sanofi. Dr Peterson receives research grants from Lilly and Johnson & Johnson. Dr Schwamm is Chair of the GWTG steering committee (unpaid).

Dr Giugliano’s research group receives research grants related to clinical trials he participates in from Amgen, Daiichi-Sankyo, and Merck. Dr Giugliano receives honoraria for CME lectures or is a consultant for Amgen, Daiichi-Sankyo, Merck, Regeneron, Sanofi-Aventis and Janssen. The other authors report no conflicts.

References
Achievement of Guideline-Concordant Care and In-Hospital Outcomes in Patients With Coronary Artery Disease in Teaching and Nonteaching Hospitals: Results From the Get With The Guidelines–Coronary Artery Disease Program

Lori M. Tam, Gregg C. Fonarow, Deepak L. Bhatt, Maria V. Grau-Sepulveda, Adrian F. Hernandez, Eric D. Peterson, Lee H. Schwamm and Robert P. Giugliano on behalf of the GWTG Steering Committee and Investigators

Circ Cardiovasc Qual Outcomes. 2013;6:58-65; originally published online December 11, 2012; doi: 10.1161/CIRCOUTCOMES.112.965525

Circulation: Cardiovascular Quality and Outcomes is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2012 American Heart Association, Inc. All rights reserved.
Print ISSN: 1941-7705. Online ISSN: 1941-7713

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circoutcomes.ahajournals.org/content/6/1/58

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation: Cardiovascular Quality and Outcomes can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at: http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation: Cardiovascular Quality and Outcomes is online at: http://circoutcomes.ahajournals.org//subscriptions/