Guideline Adherence After ST-Segment Elevation Versus Non-ST Segment Elevation Myocardial Infarction

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Background—Clinical guidelines recommend similar medical therapy for patients with ST-segment elevation myocardial infarction (STEMI) and non–ST-segment elevation MI (NSTEMI).

Methods and Results—Using the Get with the Guidelines–Coronary Artery Disease registry (GWTG–CAD), we analyzed data including 72,352 patients (48,966, NSTEMI; 23,386, STEMI) from 237 US sites between May 1, 2006 and March 21, 2010. Performance and quality measures were compared between NSTEMI and STEMI patients. NSTEMI patients were older and had a higher rate of medical comorbidities compared with STEMI patients, including prior coronary artery disease (38.5% versus 24.7%; P < 0.0001), heart failure (17.5% versus 6.2%; P < 0.0001), hypertension (70.8% versus 59.1%; P < 0.0001) and diabetes mellitus (34.9 versus 23.3%; P < 0.0001). Adjusting for confounding variables, STEMI patients were more likely to receive aspirin within 24 hours 98.5% versus 97.1% (adjusted odds ratio [AOR], 1.63; 95% confidence interval [CI], 1.32–2.02), be discharged on aspirin 98.5% versus 97.3% (AOR, 1.33; 95% CI, 1.19–1.49), β-blockers 98.2% versus 96.9% (AOR, 1.48; 95% CI, 1.35–1.63), or lipid-lowering medication for low-density lipoprotein level >100 mg/dL 96.8% versus 91.0% (AOR, 1.85; 95% CI, 1.61–2.13). STEMI patients were also more likely to receive β-blockers within 24 hours of hospital arrival 93.9% versus 90.8% (AOR, 1.57; 95% CI, 1.37–1.79) and the following discharge medications: angiotensin-converting enzyme inhibitors or angiotensin receptor blocking agents 85.3% versus 77.4% (AOR, 1.62; 95% CI, 1.51–1.75), clopidogrel 85.6% versus 67.0% (AOR, 2.42; 95% CI, 2.23–2.61) or lipid-lowering medications 94.8% versus 88.0% (AOR, 1.71; 95% CI, 1.56–1.86).

Conclusions—Among hospitals participating in GWTG–CAD, adherence with guideline-based medical therapy was high for patients with both STEMI and NSTEMI. Yet, there is still room for further improvement, particularly in the care of NSTEMI patients. (Circ Cardiovasc Qual Outcomes. 2012;5:00-00.)

Key Words: acute myocardial infarction ■ coronary artery disease ■ myocardial infarction ■ non-ST segment elevation acute coronary syndromes ■ ST segment elevation myocardial infarction

Although different diagnoses, the professional society guideline recommendations for the treatment of acute myocardial infarction (MI) presenting with ST-segment elevation MI (STEMI) and non–ST-segment elevation MI (NSTEMI) with medications are nearly identical. The early use of antiplatelet agents, β-blockers, angiotensin-converting enzyme (ACE) inhibitors or angiotensin receptor blocking (ARB) agents, and statin therapy are mainstays of treatment for both types of infarction. The American College of Cardiology and American Heart Association have published consensus guidelines to educate and promote increased clinician use of these evidence-based therapies. These are summarized in Table 1.1,2 The guidelines for treatment of NSTEMI and STEMI have been updated, and recommendations for performance improvement measures are nearly identical.3,4 Despite the similarity in these guidelines for treatment of STEMI and NSTEMI, both data from the United States National Registry of Myocardial Infarction (NRMI) 4 database, collected between 2000 and 2002, and from the French Observatoire sur la Prise en charge hospitalière, l’Evolution à un an et les caractéristiques de patients présentant un infarctus du myocarde avec ou sans onde Q (OPERA) registry, collected from 2002 to 2003, show adherence to guideline-based medical therapy is significantly lower in patients suffering NSTEMI than STEMI.5,6 It has also been shown that patients suffering NSTEMI have a higher rate of comorbidities, including a history of previous
MI, coronary revascularization or extra cardiac atherosclerotic vascular disease, and may contribute to an overall worse prognosis in this cohort.5–7 The presence of these factors makes initiation of guideline-based therapy even more critical. Failure to adhere to evidence-based treatments results in inferior outcomes, including increased mortality in both conditions.8

**WHAT IS KNOWN**

- Despite pathophysiologic differences between ST-segment elevation myocardial infarction and non–ST-segment myocardial infarction, the guidelines for medical treatment are nearly identical.
- Patients suffering the latter are often afflicted by more numerous medical comorbidity, however, rates of guideline adherence are lower in these patients.
- The Get With the Guidelines–Coronary Artery Disease program aims to improve compliance with guideline-based therapy in these patients.

**WHAT THIS ARTICLE ADDS**

- Rates of guideline adherence are generally high, however, a small difference remains between those suffering ST segment elevation myocardial infarction and non–ST-segment myocardial infarction.
- There may yet be room for improvement in ensuring all patients suffering acute myocardial infarction receive all appropriated guideline-based medical therapy.

Whether differences in the use of guideline-recommended medications in NSTEMI and STEMI care are smaller among hospitals participating in a performance improvement program has not been well studied. To explore this topic, we have examined a large contemporary national dataset, the Get with the Guidelines–Coronary Artery Disease (GWTG–CAD) performance improvement registry, to determine whether adherence to guideline-based therapies differs between patients presenting to the hospital with STEMI versus NSTEMI.

**Methods**

**Database**

The data in this study were collected from the GWTG–CAD registry. The GWTG–CAD is a large national registry created by the American Heart Association with an aim of assisting hospitals and providers to adhere to guideline-based recommendations. The specific features and goals of the GWTG program have been described previously.5–10 Participation in the GWTG–CAD registry is on a voluntary basis and includes a large number of US hospitals. These facilities represent all regions of the country, in both urban and rural settings, and both academic and community-based medical centers. Institutions participating in the GWTG–CAD registry submit clinical information regarding the medical history, hospital care, and outcomes of consecutive patients who are hospitalized for coronary artery disease using an online, interactive case report form and Patient Management Tool (Outcome Sciences, Inc, Cambridge, MA). Outcome Sciences, Inc serves as the data collection (through their Patient Management Tool) and coordination center for GWTG. The Duke Clinical Research Institute serves as the data analysis center and has institutional board approval to analyze the aggregate deidentified data for research purposes.

**Study Population**

There were 107,879 patients from 251 fully participating sites in the GWTG–CAD registry between May 1, 2006 and March 21, 2010 that provided the data used for this analysis. Patients were excluded for an admission diagnosis of heart failure with coronary artery disease (N=9706), a non-MI (N=23,696), or an unspecified MI (N=1641). Patients were also excluded for an unknown or unspecified discharge destination (N=484). As a result, there were a total of 72,352 patients enrolled from 237 US sites whose data comprise this analysis.

**Variables and Measures**

The performance measures in the GWTG–CAD registry have been previously described.11–14 The following were included as performance measures at discharge in this analysis: aspirin therapy before hospital admission or within 24 hours, discharge medications, including aspirin, β-blockers, use of ACE inhibitors or ARB agents in patients with left ventricular systolic dysfunction, lipid-lowering therapy for those with low-density lipoprotein >100 mg/dL, and smoking cessation

<table>
<thead>
<tr>
<th>Performance Measures</th>
<th>STEMI</th>
<th>NSTEMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspirin given 24 h before or after hospital arrival</td>
<td>Class I level of evidence A</td>
<td>Class I level of evidence A</td>
</tr>
<tr>
<td>Aspirin given at discharge</td>
<td>Class I level of evidence A</td>
<td>Class I level of evidence A</td>
</tr>
<tr>
<td>Patients discharged on β-receptor blockers</td>
<td>Class I level of evidence A</td>
<td>Class I level of evidence B</td>
</tr>
<tr>
<td>Patients with LDL &gt;100 mg/dL who receive lipid-lowering drugs</td>
<td>Class I level of evidence A</td>
<td>Class I level of evidence A</td>
</tr>
<tr>
<td>Current smokers that receive smoking cessation advice</td>
<td>Class I level of evidence B</td>
<td>Class I level of evidence B</td>
</tr>
<tr>
<td>β-receptor blockers given within 24 h before or after hospital arrival</td>
<td>Class I level of evidence A</td>
<td>Class I level of evidence B</td>
</tr>
<tr>
<td>Discharged on ACE inhibitors</td>
<td>Class I level of evidence A</td>
<td>Class IIa level of evidence A Class I level of evidence A</td>
</tr>
<tr>
<td>Discharge on clopidogrel and aspirin</td>
<td>Class I level of evidence A</td>
<td>Class I level of evidence B</td>
</tr>
<tr>
<td>Patients who received statins or lipid-lowering drugs</td>
<td>Class I level of evidence A</td>
<td>Class I level of evidence A</td>
</tr>
<tr>
<td>Patients who received rehab or physical activity recommendations</td>
<td>Class I level of evidence B</td>
<td>Class I level of evidence B</td>
</tr>
<tr>
<td>Diabetes mellitus teaching</td>
<td>Class I level of evidence B</td>
<td>Class I level of evidence B</td>
</tr>
<tr>
<td>Overweight patients who receive weight management and physical activity recommendations</td>
<td>Class I level of evidence B</td>
<td>Class I level of evidence B</td>
</tr>
</tbody>
</table>

STEMI indicates ST-segment elevation myocardial infarction; NSTEMI, non–ST-segment elevation myocardial infarction; LDL, low-density lipoprotein; and ACE, angiotensin-converting enzyme.

*Patients with NSTEMI and heart failure left ventricular dysfunction.
counseling in current smokers. A composite of compliance with all performance measures was also included. Quality measures were β-blockers before hospital admission or within 24 hours, discharge medications, including ACE inhibitors or ARB agents, discharge on clopidogrel, lipid-lowering therapy at discharge, rehabilitation or physical activity recommendations, diabetes mellitus treatment and teaching, and physical activity and weight management recommendations for overweight patients. Data evaluating performance and quality measures only included patients without a contraindication or documented intolerance to the specific performance or quality measure and excluded patients who expired, left against medical advice, were discharged to hospice, and those transferred to another facility.

Statistical Analysis
All statistical analyses were performed by the Duke Clinical Research (Durham, NC) using SAS version 9.2 (SAS Institute, Cary, NC). The diagnosis of NSTEMI versus STEMI was the primary independent variable of interest. Percentages and median and interquartile ranges were reported for categorical and continuous variables, respectively. Baseline characteristics were compared using Pearson χ² tests for all categorical row variables and χ² rank-based group means score statistics for all continuous row variables. Multivariable logistic regression models to determine whether diagnosis of STEMI versus NSTEMI independently influences adherence to performance and quality measures were produced using generalized estimating equations to account for the correlation of data within hospitals. The models adjusted for the potential confounders of age, sex, race (white versus nonwhite), medical history of chronic obstructive pulmonary disease or asthma, diabetes mellitus (combined insulin dependent and noninsulin dependent), hyperlipidemia, hypertension, peripheral vascular disease, stroke or transient ischemic attack, heart failure, renal insufficiency, smoking, geographic region of the United States, teaching hospital, and hospital size represented by number of beds. All variables included in the models had missing rates of <8%. Odds ratios with their corresponding 95% confidence intervals were reported for each measure. All tests were 2-sided and P values <0.05 were considered statistically significant.

Results
Of the 72,352 patients who met the entry criteria for this analysis, there were 23,386 diagnosed with STEMI and 48,966 diagnosed with NSTEMI. The baseline characteristics of the patients are displayed in Table 2. Individuals suffering NSTEMI were significantly older (median age 69 versus 61 years; P<0.0001) and were more often female (40.2% versus 30.2%; P<0.0001). NSTEMI patients had a higher rate of medical comorbidities compared with STEMI patients. NSTEMI patients had more risk factors and manifestations of vascular disease, as shown by higher rates of hyperlipidemia, prior MI, coronary artery revascularization, prior stroke or transient ischemic attack, peripheral vascular disease, as well as heart failure. Additionally, NSTEMI patients suffered higher rates of morbidity, including diabetes mellitus, kidney disease, chronic obstructive pulmonary disease, and hypertension. Atrial fibrillation and flutter were also more common in NSTEMI patients. However, patients with STEMI were more likely treated at larger hospitals than those with NSTEMI; 35.7% versus 28.4% (P<0.0001) were treated at hospitals with >500 beds. STEMI patients also were more likely to be treated in an academic medical center, 58.0% versus 54.4% (P<0.0001).

The rate of adherence to performance measures was lower in the NSTEMI group compared with STEMI patients for most measures (Table 3). Compared with NSTEMI patients, STEMI patients had a small but significantly higher compliance rate for the performance measures of receiving aspirin within 24 hours of arrival, or being discharged on aspirin or β-blockers. A more sizeable treatment difference between STEMI and NSTEMI patients was seen in NSTEMI patients with low-density lipoprotein >100 mg/dL who received lipid-lowering medications less often (91.0% versus 96.8%; P<0.0001). Of the quality measures, NSTEMI patients received β-blockers within 24 hours of hospital arrival less often, and fewer NSTEMI patients were discharged on ACE inhibitors or ARB agents, aspirin, or clopidogrel. Statin or lipid-lowering medication use was also lower in patients with NSTEMI. In addition, NSTEMI patients received fewer referrals for rehabilitation compared with STEMI patients. The composite of compliance with all applicable performance measures was higher in STEMI patients (94.3% versus 91.1%; P<0.0001).

The odds of patients in the STEMI group receiving guideline-based therapy for which they were eligible were significantly higher than in the NSTEMI group for performance measures of aspirin within 24 hours of arrival, discharge on aspirin, discharge on β-blockers, use of ACE inhibitors or ARB agents for ventricular dysfunction and lipid-lowering medications for those with low-density lipoprotein >100 mg/dL and the composite of compliance with all of these measures. This also held true for the quality measures, including treatment with β-blockers within 24 hours of arrival, discharge on ACE inhibitors, dual antiplatelet therapy, discharge on statins or lipid-lowering drugs, and physical therapy recommendations. The odds of not receiving diabetes mellitus teaching and weight management recommendations for overweight patients were also higher for NSTEMI patients (Table 4). When adjusting for confounding comorbidities, the increase in odds ratios maintained statistical significance for the above measures except for diabetes mellitus treatment and teaching and weight management recommendations (Table 4).

STEMI patients had a higher adjusted odds of in-hospital mortality than NSTEMI patients (adjusted odds ratio, 1.95; 95% confidence interval, 1.75–2.19). NSTEMI patients were more likely to be transferred to skilled nursing facilities than patients with STEMI, whereas STEMI patients had a higher likelihood of being discharged home than NSTEMI patients. NSTEMI patients were more likely to remain in the hospital for >4 days (Table 5).

Discussion
This study, among hospitals participating in GWTG–CAD, compared the use of guideline-recommended medical therapies for patients with NSTEMI and STEMI. With few exceptions, NSTEMI patients were less likely to receive guideline-recommended therapies even after adjusting for demographics, comorbidities, and hospital characteristics. The use of guideline-recommended treatments in eligible patients in this study was higher than previous reported for both STEMI and NSTEMI patients. However, there is a persistent difference in treatment that is concerning as it has been previously demonstrated that use of guideline compliant care is directly associated with survival.
Although differences were observed, for many of the performance measures, the disparity between adherences to guideline-based therapy was small and may be of limited clinical significance. More meaningful was the observation of a treatment gap in the use of lipid-lowering therapy for those with low-density lipoprotein >100 mg/dL. However, the rates of compliance were >90% for both groups across all performance measures. This compares favorably with compliance rates

<table>
<thead>
<tr>
<th>Table 2. Baseline Characteristics</th>
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<tbody>
<tr>
<td>Description</td>
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<tr>
<td>Demographics</td>
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<tr>
<td>Age in years, median (IQR)</td>
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<tr>
<td>Sex</td>
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<tr>
<td>Female</td>
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<tr>
<td>Male</td>
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<tr>
<td>Missing</td>
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<tr>
<td>Race</td>
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<td>White</td>
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<td>Black</td>
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<td>Hispanic</td>
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<td>Asian</td>
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<tr>
<td>Native Hawaiian or Pacific Islander</td>
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<tr>
<td>American Indian or Alaska Native</td>
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<tr>
<td>Missing</td>
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<tr>
<td>BMI, median kg/m² (IQR)</td>
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<td>Hospital characteristics</td>
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<tr>
<td>Number of beds</td>
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<tr>
<td>&gt;500</td>
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<td>200–500</td>
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<td>&lt;200</td>
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<td>Academic</td>
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<td>Region</td>
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<td>Northeast</td>
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<td>Midwest</td>
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<td>South</td>
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<tr>
<td>West</td>
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<tr>
<td>Medical history</td>
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<tr>
<td>Hypertension</td>
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<td>Coronary artery disease</td>
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<td>Heart failure</td>
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<tr>
<td>Prior myocardial infarction</td>
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<tr>
<td>Prior stroke/TIA</td>
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<tr>
<td>Prior PCI</td>
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<tr>
<td>Prior CABG</td>
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<tr>
<td>Valvular heart disease</td>
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<tr>
<td>Atrial fibrillation</td>
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<td>Peripheral vascular disease</td>
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<tr>
<td>Hyperlipidemia</td>
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<tr>
<td>Diabetes mellitus</td>
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<tr>
<td>COPD or asthma</td>
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<tr>
<td>Renal insufficiency</td>
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<tr>
<td>Dialysis (chronic)</td>
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<tr>
<td>Depression</td>
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<tr>
<td>Smoking</td>
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</tbody>
</table>

BMI indicates body mass index; TIA, transient ischemic attack; PCI, percutaneous coronary intervention; and CABG, coronary artery bypass graft.
observed with guideline-based therapy from a prior studies from NRMI 4 and OPERA registries collected between 2000 and 2003. This higher rate of guideline adherence in our data, compared with older studies, is encouraging and may suggest that compliance with guideline-based therapy has improved significantly over the past several years across the nation. This improvement may be in part attributable to tools made available to clinicians and hospitals such as the GWTG–CAD program.

Because early initiation of medical therapy has been shown to increase long-term compliance in post-MI patients, there is potential for the GWTG–CAD program to have a substantial impact on long-term outcomes. However, further research is required to evaluate the role of programs such as the GWTG–CAD program.

The rates of compliance in quality measures, particularly the use of ACE inhibitors, clopidogrel, and statin therapies for the entire cohort, were lower than compliance with performance measures. The reasons for low rate of use of ACE inhibitors, clopidogrel, and statin therapies require further study. The rates of adherence to guideline-based therapy in our data do, however, compare favorably with long-term treatment rates noted in prior studies involving outpatients with coronary artery disease. Other studies of hospitalized NSTEMI patients have also demonstrated increasing rates of compliance in the past several years, however, a significant proportion of patients who may derive a mortality benefit from such therapies continue to be undertreated. These data can be used to bring additional attention to physicians and hospital personnel that there is underutilization of these medications in MI.

Of note, hospitals treating NSTEMI patients tended to be smaller in size and were less likely to be academic medical centers than centers treating STEMI; therefore, our data, which show that over two thirds of patients received both performance and quality measures of adherence to beneficial therapies, are encouraging. The fact that NSTEMI patients were treated in smaller hospitals may reflect some degree of acute referral bias. STEMI patients may be more likely directed, particularly by the 27% of emergency medical services systems which show that over two thirds of patients received both performance and quality measures of adherence to beneficial therapy. This may overestimate the actual compliance rate of guideline-based therapy in many communities, hospitals must maintain certification to support evidence-based care for STEMI, in particular, a door-to-balloon time of <90 minutes. Thus, hospitals treating STEMI may be better situated from a programmatic standpoint and structure to adhere to evidence-based practice than centers without continuous interventional capabilities. In addition, hospitals that participate in a program such as GWTG–CAD may tend to be more organized with regards to performance improvement and guideline-based therapy.

Table 3. Comparison of Clinical Performance and Quality Measures in STEMI/NSTEMI

<table>
<thead>
<tr>
<th>Description</th>
<th>Overall n=72,352 (%)</th>
<th>STEMI n=23,386 (%)</th>
<th>NSTEMI n=48,966 (%)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance measure (eligible patients only*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspirin within 24 h of arrival</td>
<td>44,854 (97.5)</td>
<td>14,806 (98.5)</td>
<td>30,048 (97.1)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Discharge on aspirin</td>
<td>56,410 (97.7)</td>
<td>19,388 (98.5)</td>
<td>37,022 (97.3)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>ACE inhibitor or ARB on discharge for LV systolic dysfunction</td>
<td>10,200 (92.5)</td>
<td>3,803 (95.0)</td>
<td>6,397 (91.1)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Discharge on β-blockers</td>
<td>55,203 (97.3)</td>
<td>18,640 (98.2)</td>
<td>36,563 (97.0)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Lipid-lowering therapy for LDL &gt;100 mg/dL</td>
<td>14,804 (93.5)</td>
<td>6,542 (96.8)</td>
<td>8,262 (91.0)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Smokers who receive smoking cessation counseling</td>
<td>19,893 (97.7)</td>
<td>8,610 (97.9)</td>
<td>11,283 (97.5)</td>
<td>0.1289</td>
</tr>
<tr>
<td>Composite performance: compliance with all applicable performance measures</td>
<td>62,214 (92.1)</td>
<td>20,638 (94.3)</td>
<td>41,576 (91.1)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Quality measure (eligible patients only*)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>β-blockers within 24 h of arrival</td>
<td>37,304 (91.8)</td>
<td>12,133 (93.9)</td>
<td>25,171 (90.8)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Discharge on ACE inhibitors or ARB</td>
<td>43,908 (80.1)</td>
<td>15,956 (85.3)</td>
<td>27,952 (77.4)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Discharge on clopidogrel</td>
<td>40,185 (73.2)</td>
<td>15,855 (85.6)</td>
<td>24,330 (67.0)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Lipid-lowering therapy at discharge</td>
<td>54,045 (90.2)</td>
<td>18,969 (94.8)</td>
<td>35,076 (88.0)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>LDL recorded</td>
<td>45,468 (73.3)</td>
<td>16,256 (79.2)</td>
<td>29,212 (70.3)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Rehabilitation or physical activity recommendations</td>
<td>51,185 (82.5)</td>
<td>17,534 (85.4)</td>
<td>33,651 (81.0)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>SBP &lt;140 mmHg and DBP &lt;90 mmHg</td>
<td>41,325 (81.9)</td>
<td>14,713 (87.8)</td>
<td>26,612 (79.0)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Diabetes mellitus treatment (data available from 2008 onward)</td>
<td>8,227 (92.8)</td>
<td>1,962 (94.2)</td>
<td>6,265 (92.4)</td>
<td>0.0046</td>
</tr>
<tr>
<td>Diabetes mellitus teaching (data available from 2008 onward)</td>
<td>2,503 (28.2)</td>
<td>621 (29.8)</td>
<td>1,882 (27.8)</td>
<td>0.0666</td>
</tr>
<tr>
<td>Overweight patients who receive weight management and physical activity recommendations</td>
<td>3,264 (88.0)</td>
<td>17,534 (85.4)</td>
<td>33,651 (81.0)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

LDL indicates low-density lipoprotein; ACE, angiotensin-converting enzyme; ARB, angiotensin receptor blocker; SBP, systolic blood pressure; DBP, diastolic blood pressure; and LV, left ventricular.

*Eligible patients are those who lack contraindications to a particular measure.
Table 4. Unadjusted and Adjusted Odds Ratios for Performance and Quality Measures in STEMI vs NSTEMI

<table>
<thead>
<tr>
<th>Description</th>
<th>n*</th>
<th>Unadjusted OR (95% CI) STEMI vs NSTEMI</th>
<th>P Value Unadjusted</th>
<th>Adjusted OR (95% CI) STEMI vs NSTEMI†</th>
<th>P Value Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance measure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspirin within 24 h of arrival</td>
<td>45988</td>
<td>1.80 (1.39–2.32)</td>
<td>&lt;0.001</td>
<td>1.63 (1.32–2.02)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Discharge on aspirin</td>
<td>57731</td>
<td>1.47 (1.35–1.59)</td>
<td>&lt;0.001</td>
<td>1.33 (1.19–1.49)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>ACE inhibitor or ARB on discharge for LV systolic dysfunction</td>
<td>11301</td>
<td>1.57 (1.36–1.79)</td>
<td>&lt;0.001</td>
<td>1.38 (1.17–1.63)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Discharge on β-blockers within 24 h of arrival</td>
<td>56743</td>
<td>1.46 (1.36–1.56)</td>
<td>&lt;0.001</td>
<td>1.48 (1.35–1.63)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Lipid-lowering therapy for LDL &gt;100 mg/dL</td>
<td>15839</td>
<td>2.10 (1.88–2.35)</td>
<td>&lt;0.001</td>
<td>1.85 (1.61–2.13)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Smokers who receive smoking cessation counseling</td>
<td>20368</td>
<td>1.13 (0.94–1.36)</td>
<td>0.182</td>
<td>1.02 (0.81–1.28)</td>
<td>0.893</td>
</tr>
<tr>
<td>Composite performance: compliance with all performance measures</td>
<td>67537</td>
<td>1.44 (1.35–1.54)</td>
<td>&lt;0.001</td>
<td>1.39 (1.30–1.48)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Quality measure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>β-blockers within 24 h of arrival</td>
<td>40660</td>
<td>1.42 (1.26–1.60)</td>
<td>&lt;0.001</td>
<td>1.57 (1.37–1.79)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Discharge on ACE inhibitors or ARB</td>
<td>54829</td>
<td>1.52 (1.42–1.62)</td>
<td>&lt;0.001</td>
<td>1.62 (1.51–1.75)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Discharge on clopidogrel</td>
<td>54870</td>
<td>2.33 (2.16–2.52)</td>
<td>&lt;0.001</td>
<td>2.42 (2.23–2.61)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Lipid-lowering therapy at discharge</td>
<td>59889</td>
<td>1.72 (1.60–1.86)</td>
<td>&lt;0.001</td>
<td>1.71 (1.56–1.86)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LDL recorded</td>
<td>62069</td>
<td>1.45 (1.36–1.54)</td>
<td>&lt;0.001</td>
<td>1.27 (1.19–1.37)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Rehabilitation or physical activity recommendations</td>
<td>62069</td>
<td>1.22 (1.14–1.30)</td>
<td>&lt;0.001</td>
<td>1.29 (1.14–1.46)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>SBP &lt;140 mm Hg and DBP &lt;90 mm Hg</td>
<td>50431</td>
<td>1.84 (1.74–1.95)</td>
<td>&lt;0.001</td>
<td>1.55 (1.46–1.65)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diabetes mellitus treatment at discharge (data available from 2008 onward)</td>
<td>8862</td>
<td>1.18 (0.97–1.44)</td>
<td>0.099</td>
<td>1.11 (0.88–1.40)</td>
<td>0.366</td>
</tr>
<tr>
<td>Diabetes mellitus teaching at discharge (data available from 2008 onward)</td>
<td>8862</td>
<td>1.24 (1.13–1.36)</td>
<td>&lt;0.001</td>
<td>1.05 (0.94–1.19)</td>
<td>0.380</td>
</tr>
<tr>
<td>Overweight patients who receive weight management and physical activity recommendations</td>
<td>37113</td>
<td>1.11 (1.03–1.19)</td>
<td>0.006</td>
<td>1.05 (0.98–1.13)</td>
<td>0.156</td>
</tr>
</tbody>
</table>

STEMI indicates ST-segment elevation myocardial infarction; NSTEMI, non–ST-segment elevation myocardial infarction; LDL, low-density lipoprotein; ACE, angiotensin-converting enzyme; PVD, peripheral vascular disease; CI, confidence interval; and TIA, transient ischemic attack.

* n represents the sample size of the model, which excludes patients for which sex and hospital characteristics (region, teaching hospital, and number of beds) are missing.

† Odds Ratios adjusted for age, sex, white race (vs other), chronic obstructive pulmonary disease or asthma, diabetes mellitus (combined), hyperlipidemia, hypertension, PVD, Stroke/TIA, heart failure, renal insufficiency, smoking, region, teaching hospital, and number of beds.

Quality measure

Across the country, our study was not designed to evaluate such differences.

Although our data demonstrated statistically lower compliance for NSTEMI patients, STEMI patients still had higher overall adjusted in-hospital mortality risk. This difference most likely arises from the differing natural history of the disease entities rather than response to guideline-based therapy. Mortality in STEMI is more likely to occur early during the hospitalization, whereas mortality in NSTEMI tends to surpass that of STEMI in the months following initial presentation.20 This study is limited by lack of longer term follow-up and further research is required to determine whether the disparity in compliance with evidence-based therapy leads to an increase in adverse events or out-of-hospital mortality in NSTEMI patients. Longer term follow-up regarding compliance with medications and lifestyle changes for patients after discharge is also important for achieving durable favorable outcomes after MI.

Some limitations are important to note. The participating centers included in the analysis were voluntarily participating in a national quality improvement program. As such these findings may not apply to patients and hospitals which differ significantly from those participating in GWTG–CAD. All clinical information was abstracted from medical records and depends

Table 5. Unadjusted and Adjusted Odds Ratios for Outcomes in STEMI vs NSTEMI*

<table>
<thead>
<tr>
<th>Description</th>
<th>n</th>
<th>Unadjusted OR (95% CI) STEMI vs NSTEMI</th>
<th>P Value Unadjusted</th>
<th>Adjusted OR (95% CI) STEMI vs NSTEMI*</th>
<th>P Value Adjusted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of stay &gt;4 d</td>
<td>46663</td>
<td>0.59 (0.56–0.63)</td>
<td>&lt;0.001</td>
<td>0.78 (0.74–0.83)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>In-hospital mortality</td>
<td>67066</td>
<td>1.30 (1.20–1.42)</td>
<td>&lt;0.001</td>
<td>1.95 (1.75–2.19)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Discharge home</td>
<td>68519</td>
<td>1.41 (1.33–1.49)</td>
<td>&lt;0.001</td>
<td>1.15 (1.09–1.21)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Discharge to skilled nursing facility (SNF)</td>
<td>68519</td>
<td>0.46 (0.41–0.52)</td>
<td>&lt;0.001</td>
<td>0.82 (0.75–0.90)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Transfer to acute care facility</td>
<td>68519</td>
<td>1.01 (0.97–1.06)</td>
<td>0.601</td>
<td>0.84 (0.76–0.92)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

STEMI indicates ST-segment elevation myocardial infarction; NSTEMI, non–ST-segment elevation myocardial infarction; OR, odds ratio; CI, confidence interval; PVD, peripheral vascular disease; and TIA, transient ischemic attack.

* Odds ratios adjusted for age, sex, white race (vs nonwhite), chronic obstructive pulmonary disease or asthma, diabetes mellitus (combined), hyperlipidemia, hypertension, PVD, Stroke/TIA, heart failure, renal insufficiency, smoking, region, teaching hospital, and number of beds.
upon the accuracy of documentation in each hospital, which may not be homogeneous. A proportion of patients reported to be eligible for treatment who did not receive recommended treatments may have had contraindications or intolerance to specific interventions that were present but not documented. Our findings of lower compliance in NSTEMI patients may also be influenced by the greater difficulty in certainty of diagnosis in these patients. There may be residual measured and unmeasured confounding variables which account for some or all of this findings. Because GWTG does not collect data on postdischarge outcomes, the full implications of these differences in performance and quality measure rates for NSTEMI and STEMI patient could not be directly explored.

Conclusion
Contemporary data in a large population of both NSTEMI and STEMI patients treated in diverse hospital settings across the United States indicate a high level of compliance with both performance and quality measures recommended by consensus guidelines. These data demonstrate increased utilization of recommended therapies over historical studies. Differences in compliance are present between NSTEMI and STEMI patients, with STEMI patients meeting guideline-recommended medical therapy.

Disclosures
Dr Bhatt receives research grants from Amarin, AstraZeneca, Bristol-Myers Squibb, Eisai, Ethicon, Medtronic, Sanofi-aventis, and The Medicines Company. Dr Saxon receives institutional grant support and or institutional fellowship support from Boston Scientific Corp, St. Jude Medical and Medtronic, Inc, and consultant fees from Boston Scientific Corp and St Jude Medical. Dr Fonarow received research grants from the National Heart, Lung, and Blood Institute and Agency for Healthcare Research and Quality, consultant fees from Novartis and Pfizer, and honorarium from Medtronic. Dr Cannon receives research grants from Accuteometrics, AstraZeneca, Glaxo Smith Kline, Intekrin Therapeutics, Merck, and Takada and received honorarium for development of educational independent symposia from Pfizer and AstraZeneca. Dr Cannon serves on the advisory board for Bristol-Meyers Squibb/Sanofi, Novartis, Aymlyam and donates these funds to charity. He also serves as clinical advisor and holds equity in Automedics Medical Systems. Dr Hernandez reported receiving research support from Johnson & Johnson, Proventys, and Amylin; and honoraria from Amgen and Corthera. Dr Peterson serves as the principal investigator for the American Heart Association (AHA) Get with the Guidelines (GWTG) data analytic center at Duke Clinical Research Institute. He also receives research funding from Bristol-Meyers Squibb, Sanofi-Aventis, Eli Lilly, and Ortho McNeil Pharmaceuticals. Dr Schwamm serves as chair for the AHA GWTG steering committee, and is a consultant to Medtronic. Dr Peacock serves on the advisory board of Abbot, Alere, Lilly, and the Medicines Co, receives a research grant from Alere, Brigham, Electrocore, Novartis, and the Medicines Co, is on the Speakers Bureau of Abbot, Alere, and EKR. Dr Peacock has Ownership Interest in Research Associates, Emergencies in Medicine, and the Medicines Co. Dr Peacock has no conflicts.

References


Guideline Adherence After ST-Segment Elevation Versus Non-ST Segment Elevation Myocardial Infarction
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### SUPPLEMENTAL MATERIAL

**Supplementary Table 1** - Baseline clinical characteristics stratified by LVEF assessment, excluding patients with a history of heart failure

<table>
<thead>
<tr>
<th></th>
<th>STEMI</th>
<th></th>
<th>NSTEMI</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LVEF</td>
<td>LVEF assessed</td>
<td>P-value</td>
<td>LVEF</td>
</tr>
<tr>
<td></td>
<td>not assessed</td>
<td>(N=46,276)</td>
<td></td>
<td>not assessed</td>
</tr>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>61 [52,72]</td>
<td>59 [51,69]</td>
<td>&lt;0.0001</td>
<td>71 [58,82]</td>
</tr>
<tr>
<td></td>
<td>62.0 (13.8)</td>
<td>60.3 (13.1)</td>
<td></td>
<td>69.8 (15.0)</td>
</tr>
<tr>
<td>Female</td>
<td>28.5</td>
<td>28.3</td>
<td>0.83</td>
<td>38.0</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>84.0 [73.0,98.0]</td>
<td>84.9 [73.0,98.3]</td>
<td>0.24</td>
<td>81.0 [68.0,96.0]</td>
</tr>
<tr>
<td></td>
<td>86.7 (21.9)</td>
<td>86.8 (20.3)</td>
<td></td>
<td>83.4 (23.4)</td>
</tr>
<tr>
<td>White Race</td>
<td>82.9</td>
<td>85.3</td>
<td>0.0009</td>
<td>83.4</td>
</tr>
<tr>
<td>Insurance status</td>
<td>0.002</td>
<td></td>
<td>&lt;0.0001</td>
<td></td>
</tr>
<tr>
<td>HMO/private</td>
<td>56.1</td>
<td>58.1</td>
<td>52.8</td>
<td>57.4</td>
</tr>
<tr>
<td>Government*</td>
<td>30.1</td>
<td>26.9</td>
<td>40.1</td>
<td>33.4</td>
</tr>
<tr>
<td>Self/none/International</td>
<td>13.6</td>
<td>14.8</td>
<td>6.8</td>
<td>8.9</td>
</tr>
<tr>
<td><strong>Clinical Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>63.6</td>
<td>59.5</td>
<td>&lt;0.0001</td>
<td>78.1</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>52.1</td>
<td>49.8</td>
<td>0.04</td>
<td>62.3</td>
</tr>
</tbody>
</table>
## Presenting Features

<table>
<thead>
<tr>
<th></th>
<th>STEMI</th>
<th></th>
<th>NSTEMI</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LVEF not assessed</td>
<td>LVEF assessed</td>
<td>P-value</td>
<td>LVEF not assessed</td>
</tr>
<tr>
<td>(N=2,295)</td>
<td>(N=46,276)</td>
<td>(N=4,872)</td>
<td></td>
<td>(N=60,969)</td>
</tr>
<tr>
<td>Currently on dialysis</td>
<td>1.3</td>
<td>0.6</td>
<td>0.0002</td>
<td>2.9</td>
</tr>
<tr>
<td>Chronic lung disease</td>
<td>8.1%</td>
<td>8.8</td>
<td>0.49</td>
<td>15.2</td>
</tr>
<tr>
<td>Diabetes</td>
<td>25.2</td>
<td>20.7</td>
<td>&lt;0.0001</td>
<td>35.5</td>
</tr>
<tr>
<td>Prior MI</td>
<td>23.6</td>
<td>17.3</td>
<td>&lt;0.0001</td>
<td>33.6</td>
</tr>
<tr>
<td>Prior revascularization</td>
<td>31.0%</td>
<td>21.6</td>
<td>&lt;0.0001</td>
<td>44.6</td>
</tr>
<tr>
<td>Prior stroke</td>
<td>5.8</td>
<td>3.9</td>
<td>&lt;0.0001</td>
<td>10.6</td>
</tr>
<tr>
<td>PAD</td>
<td>6.3</td>
<td>4.6</td>
<td>0.0002</td>
<td>13.7</td>
</tr>
<tr>
<td>Heart failure or shock</td>
<td>11.0</td>
<td>9.8</td>
<td>0.07</td>
<td>13.4</td>
</tr>
<tr>
<td>Initial creatinine (mg/dL)†</td>
<td>1.1 [0.9,1.3]</td>
<td>1.0 [0.9,1.2]</td>
<td>&lt;0.0001</td>
<td>1.1 [0.9,1.5]</td>
</tr>
<tr>
<td></td>
<td>1.2 (0.6)</td>
<td>1.1 (0.5)</td>
<td>1.3 (0.7)</td>
<td>1.2 (0.6)</td>
</tr>
<tr>
<td>Initial troponin (xULN)</td>
<td>1.0 [0.3,8.8]</td>
<td>1.0 [0.2,9.9]</td>
<td>0.79</td>
<td>1.9 [0.5,8.7]</td>
</tr>
<tr>
<td></td>
<td>53.8 (261)</td>
<td>74.1 (421.3)</td>
<td>18.8 (75.6)</td>
<td>28.6 (339.2)</td>
</tr>
</tbody>
</table>

Continuous variables expressed as medians with 25th and 75th percentiles with mean (standard deviation) beneath.

* Government insurance denotes Medicare, Medicaid, Veterans Administration Medical Care, Indian Health Service, and State Sponsored Insurance Plans.
†— Excludes dialysis patients

Abbreviations: HMO=health maintenance organization, MI=myocardial infarction, PAD=peripheral arterial disease, ULN=upper limit of normal for assay.