Dissociation Between Hospital Performance of the Smoking Cessation Counseling Quality Metric and Cessation Outcomes After Myocardial Infarction

Gordon R. Reeves, MD, MPT; Tracy Y. Wang, MD, MS; Kimberly J. Reid, MS; Karen P. Alexander, MD; Carole Decker, RN, PhD; Homaa Ahmad, MD; John A. Spertus, MD, MPH; Eric D. Peterson, MD, MPH

Background: Recognizing the importance of smoking cessation after acute myocardial infarction (AMI), the Centers for Medicare & Medicaid Services and the Joint Commission on Accreditation of Healthcare Organizations currently uses documentation of smoking cessation counseling (SCC) as a metric of hospitals' quality of AMI care. Yet, the association between hospitals' performance of this quality measure and subsequent tobacco cessation rates has not been established.

Methods: We analyzed 889 consecutive smokers treated for AMI at 19 hospitals in PREMIER (Prospective Registry Evaluating Myocardial Infarction: Events and Recovery) between January 1, 2003, and June 28, 2004. Patients were followed up for 1 year after hospitalization. Multivariate regression modeling was performed to determine the association between hospital-level documented SCC rates and tobacco cessation rates after discharge.

Results: On a hospital level, the median medical record–documented SCC rate was 72.0% (interquartile range, 59.6%-90.1%). At 1 year, the median smoking cessation rate was 55.6% (interquartile range, 37.5%-61.9%). Although patients with documented SCC were more likely to recall receiving SCC at 1 month (86.1% vs 70.8%, \( P < .001 \)), their rate of quitting at 1 year was lower than that of patients without documented SCC (50.1% vs 60.7%, \( P = .02 \); relative risk, 0.76; 95% confidence interval, 0.61-0.94). At the hospital level, there was no correlation between SCC documentation and successful quitting at 6 months (\( r = -0.19, P = .11 \)) or 1 year (\( r = -0.13, P = .45 \)).

Conclusions: The performance metric for SCC, as it is currently structured, does not correlate with actual smoking cessation at 6 months or 1 year. Revision of this performance measure should be considered to more effectively reflect the goal of promoting smoking cessation.

Arch Intern Med. 2008;168(19):2111-2117

S

MOKING IS THE LEADING CAUSE OF PREVENTABLE DEATH IN THE UNITED STATES.1 Smoking cessation is particularly important for patients who have had an acute myocardial infarction (AMI), where it has been associated with a 36% to 46% reduction in mortality,2,3 equaling or exceeding the benefit from other common interventions, such as aspirin, \( \beta \)-blocker, or lipid-lowering therapy after AMI.4,5 Patients who continue to smoke after an AMI also have an increased risk of recurrent nonfatal MI,6 poorer control of other cardiovascular risk factors,7 and worse functional status after percutaneous coronary intervention.8,9 Because of the importance of smoking cessation in this population, national guidelines recommend smoking cessation counseling (SCC) for all smokers after AMI.10-12

Based on the benefit of smoking cessation and the presumption that SCC at the time of hospitalization would improve quit rates, the Centers for Medicare & Medicaid Services (CMS) and the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) established SCC as a hospital performance measure of quality for patients with AMI.13,14 As such, SCC, defined as documentation that the patient received SCC instructions before hospital discharge, is 1 of 8 process measures used to publicly rate hospitals' AMI quality of care and a component of the CMS's ongoing pay-for-performance pilot projects.15,16 Despite its use as a performance measure and quality indicator, the association between hospital performance of the SCC metric and actual rates of subsequent smoking cessation is unknown.

The objectives of this study are (1) to describe the variability in hospital performance of SCC and its association with subsequent smoking cessation rates after discharge and (2) to assess the association between documentation of SCC per-
performance and patients’ recollection of having received such smoking cessation advice, a measure of successful communication and an anticipated mediator of successful quitting.

STUDY POPULATION

Patients in this study were part of PREMIER (Prospective Registry Evaluating Myocardial Infarction: Events and Recovery), the details of which have been previously described. Briefly, patients were eligible to participate in PREMIER if they were 18 years or older with biochemical evidence of myocardial necrosis within 24 hours of hospital admission and supporting evidence of AMI (>20 minutes of ischemic signs or symptoms or electrocardiographic ST changes). Patients were not eligible if they were transferred from another facility more than 24 hours after their original presentation or if they developed positive cardiac markers as a complication of an elective coronary revascularization procedure. Hospital participation in PREMIER required approval from each institutional review board, and individual patient informed consent was obtained before participation in the study.

Between January 1, 2003, and June 28, 2004, 2498 patients with AMI were prospectively screened and enrolled at 19 US centers. Patients who died (n=17), left against medical advice (n=15), or were transferred to another facility (n=64) were excluded owing to lack of follow-up information (Figure 1). Consistent with CMS reporting criteria, patients who did not smoke in the year before AMI were excluded, yielding a final study population of 889 patients. Inpatient data, including baseline clinical characteristics, in-hospital interventions, and discharge instructions, were collected through direct patient interview or medical record review. Telephone follow-up was performed by a single center at 1, 6, and 12 months after discharge. Of the 889 identified smokers, 745 (83.8%) had 1-month follow-up, 682 (76.7%) had 6-month follow-up, and 677 (76.2%) had 1-year follow-up. Patients without 1-year follow-up included those who had died (50 [5.6%]), who were unavailable for follow-up (141 [15.9%]), or who were contacted but refused the interview (21 [2.4%]).

DATA DEFINITIONS

Smoking status was obtained during a detailed baseline interview performed within the first 24 to 72 hours of hospital admission. For the primary analysis, per CMS reporting criteria, a smoker was defined as a patient with any cigarette smoking in the past year documented in the medical record during their hospital stay. Secondary analyses were also performed with a smoker defined as a patient with any smoking in the past 30 days (“active smoker”), a definition endorsed by the Society for Research on Nicotine and Tobacco and the World Health Organization. Patients were considered to have received SCC if this was documented in their medical record before discharge. Patients were asked about their current smoking status at 1, 6, and 12 months after discharge. Patients were considered to have quit smoking if they reported not having smoked (not even a puff) for at least 30 days before the 6-month or 1-year follow-up interview. A patient who quit and then relapsed with use of cigarettes within 30 days of the interview was considered to still be smoking.

STATISTICAL ANALYSIS

We compared baseline demographic, clinical, and hospital characteristics in patients who did and did not receive SCC. Continuous variables are presented as mean (SD) and are compared using independent t tests, and categorical variables are expressed as frequencies and are compared using χ² or Fisher exact tests.

Rates of documented SCC during hospitalization and smoking cessation at 6 and 12 months were calculated overall and for each site. A site-based analysis of the relationship between hospital performance of SCC and patient-reported smoking cessation at 6 months and 1 year was performed using an unadjusted χ² analysis and a simple linear regression model weighted by the size of the sites.

To evaluate whether a different definition of the denominator for current smokers would affect the association of SCC with quitting, this analysis was repeated after restricting the population to active smokers, that is, only those with tobacco use in the past 30 days. χ² Testing was also performed to examine the association between documented SCC and patient recall of having received such advice at 1 month.

The association between documented SCC and 1-year smoking cessation was explored using multivariate hierarchical modified Poisson regression modeling. Covariates in the multivariate model included socioeconomic factors (age, sex, white race, marital status, education, insurance, and whether the patient avoided obtaining health care services because of cost), clinical factors (diabetes mellitus, congestive heart failure, previous MI, previous percutaneous coronary intervention, previous coronary artery bypass graft, lung disease, and ST-segment elevation MI), and whether the patient received medical record–documented cardiac rehabilitation instructions at discharge. Often, such analyses use logistic regression to estimate adjusted odds ratios, which are then generally interpreted as relative risks. However, because the event being modeled in this study is not rare, odds ratios are poor estimates of relative risk. To address this issue, we estimated adjusted relative risks directly using a modified Poisson regression model. Correlation of patients within site was accounted for by using a hierarchical model structure of patients within site. A propensity analysis was performed to measure possible bias attributable to patients for whom 1-year follow-up data were not available. Using predictor variables, including sociodemographic and lifestyle factors, clinical characteristics, vital signs, laboratory results, disease severity, baseline health status, medi-
cations, and treatments received during the initial acute coronary syndrome hospitalization, propensity scores were computed using nonparsimonious logistic regression to predict the likelihood of unsuccessful follow-up. The reciprocal of this probability was then used to account for those missing patients by weighting available patients' scores similar to those missing more heavily in the multivariate regression analyses to assess lost-to-follow-up bias.20

All tests for statistical significance were 2-tailed, with \( \alpha = .05 \). All analyses were conducted using SAS release 9.1 (SAS Institute Inc, Cary, North Carolina) and R version 2.1.1.21

RESULTS

Of 2498 patients with AMI enrolled in PREMIER, 889 (35.6%) had smoked in the year before their AMI hospitalization based on review of their hospital records (CMS-defined smokers). Of this group, 826 (92.9%) were active smokers who had smoked within 30 days of admission, and 63 (7.1%) were recent quitters who had smoked in the past year but not in the past 30 days.

DEPLOYMENT OF SCC

Overall, SCC was documented in 72.3% of 889 smokers. Across hospitals, the median medical record–documented SCC rate was 72.0%, and it varied considerably across hospitals (interquartile range, 59.6%-90.1%) (Figure 2). Patient and hospital characteristics for smokers with and without documented SCC are given in the Table. Patients who had documented SCC were more likely to be younger and white, with a lower prevalence of comorbidities such as hypertension, diabetes mellitus, and previous cardiovascular disease. Patients with documented SCC started smoking at a similar age but smoked a slightly higher number of cigarettes per day compared with patients who did not have documented SCC. Patients who had documented SCC were more likely to be treated at smaller hospitals with lower AMI volumes. There were no significant differences in SCC rates when stratified by other hospital characteristics, such as volume of cardiac catheterization, university affiliation, or urban/rural location.

PATIENT RECALL OF SCC

Although SCC was documented, whether patients recall such counseling is unknown and so was assessed at the 1-month interview. Recall of SCC was modestly higher in those with documented SCC at discharge (86.1%), although a substantial proportion of patients without SCC documentation also reported being instructed to quit smoking (70.8%, \( P < .001 \)). Most smokers (56.8%) who did not recall SCC had SCC documented at discharge, suggesting a substantial discordance between documentation and successful communication to patients.

ASSOCIATION BETWEEN SCC DOCUMENTATION AND ACTUAL SMOKING CESSION

Smoking cessation rates at 6 months and 1 year were 52.6% and 52.8%, respectively. There were no significant differences in the mean number of cigarettes smoked daily (18.9 vs 21.2, \( P = .07 \)) and the mean age at which the patient started smoking regularly (18.2 vs 17.4 years, \( P = .14 \)) between patients who did and did not successfully quit smoking at 1 year. Paradoxically, patients who had documented SCC had lower actual 1-year cessation rates (50.1% vs 60.7%, \( P = .02 \)). After multivariate adjustment, documentation of SCC was still associated with a small, but statistically significant, lower rate of quitting at 1 year (relative risk, 0.76; 95% confidence interval, 0.61-0.94).

Across hospitals, there was significant variation in median smoking cessation rates: 50.0% (interquartile range,
37.5%-62.7%) at 6 months and 55.6% (interquartile range, 37.5%-61.9%) at 1 year. There was, however, no correlation between hospital performance of the SCC metric and rates of patient-reported smoking cessation at 6 months ($r = -0.19, P = .11$) or 1 year ($r = -0.13, P = .45$) (Figure 3). Similarly, changing the denominator to include only those who had smoked in the past 30 days did not affect the association between site-based SCC performance and quit rates at 6 months ($r = -0.06, P = .86$) or 1 year ($r = -0.03, P = .96$).

**Table. Baseline Sociodemographic, Clinical, and Hospital Characteristics of Patients With and Without Documented Smoking Cessation Counseling**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Documented Smoking Cessation Counseling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No (n = 246)</td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>56.3 (11.4)</td>
</tr>
<tr>
<td>Women, %</td>
<td>34.6</td>
</tr>
<tr>
<td>Race, %</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>57.0</td>
</tr>
<tr>
<td>Black</td>
<td>37.3</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2.9</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>0.4</td>
</tr>
<tr>
<td>American Indian/Alaskan native</td>
<td>1.2</td>
</tr>
<tr>
<td>Other</td>
<td>1.2</td>
</tr>
<tr>
<td>Married, %</td>
<td>48.3</td>
</tr>
<tr>
<td>High school education or less, %</td>
<td>61.4</td>
</tr>
<tr>
<td>No insurance, %</td>
<td>18.3</td>
</tr>
<tr>
<td>Clinical history, %</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>62.2</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>44.3</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>20.0</td>
</tr>
<tr>
<td>Previous MI</td>
<td>24.0</td>
</tr>
<tr>
<td>Previous CABG</td>
<td>11.0</td>
</tr>
<tr>
<td>Previous stroke</td>
<td>6.1</td>
</tr>
<tr>
<td>Heart failure</td>
<td>19.1</td>
</tr>
<tr>
<td>Smoking history</td>
<td></td>
</tr>
<tr>
<td>Cigarettes smoked daily in past 30 d, mean (SD), No.</td>
<td>17.0 (13.6)</td>
</tr>
<tr>
<td>Age started smoking regularly, mean (SD), y</td>
<td>17.3 (5.1)</td>
</tr>
<tr>
<td>Hospital characteristics</td>
<td></td>
</tr>
<tr>
<td>University-affiliated hospital, %</td>
<td>98.8</td>
</tr>
<tr>
<td>Urban hospital, %</td>
<td>73.2</td>
</tr>
<tr>
<td>Total beds, mean (SD), No.</td>
<td>790 (199)</td>
</tr>
<tr>
<td>AMI volume (2001), mean (SD), No.</td>
<td>818 (421)</td>
</tr>
<tr>
<td>Cardiac catheterization volume (2001), mean (SD), No.</td>
<td>3102 (1785)</td>
</tr>
</tbody>
</table>

Abbreviations: AMI, acute myocardial infarction; CABG, coronary artery bypass grafting; MI, myocardial infarction.

**Figure 3.** Correlation between hospital performance of smoking cessation counseling and rate of actual smoking cessation at 6 months (A) and 1 year (B). Each point represents 1 hospital weighted by the number of smokers at that site.

Documentation of SCC in smokers is a performance metric used by the CMS and the JCAHO to measure the qual-
ity of AMI care, and the proportion of smokers who have documented counseling is publicly reported and used in pay-for-performance programs. However, this study shows that this metric, as it is currently structured, does not correlate with the key clinical outcome of smoking cessation and, as such, may not be an appropriate quality measure to ensure better outcomes for smokers after AMI.

Although improvement in hospital performance of several of the CMS process measures for AMI has been associated with better outcomes, this has not been clearly established for the smoking cessation process measure. Although 2 observational studies have shown SCC to be associated with reduced long-term mortality in patients hospitalized with AMI, neither study measured post-discharge smoking cessation rates, and it is unclear whether the difference in mortality was actually attributable to SCC. In one study, Houston et al found that increased hospital SCC rates also improved mortality in nonsmokers, suggesting that the influence on long-term outcomes may result from an unmeasured hospital-level effect for which documented SCC may be an indirect marker. Such conclusions are supported by the present findings that those with documented SCC tended to be younger and healthier than those who did not receive such advice.

Overall, SCC rates in this study were relatively high (72%) compared with historical rates of approximately 40% but were lower than the most recent SCC rates reported by national JCAHO data (88%). This rapid rise in rates of SCC is likely to be, at least partly, in response to SCC becoming a performance metric. Yet, it is unclear whether this increase actually reflects an improvement in quality of care because SCC documentation had only a modest association with patient’s recall of having received such advice and was not associated with actual quit rates at 6 or 12 months after discharge. The lack of correlation between SCC documentation and actual cessation rates was consistent whether the CMS definition of a smoker (tobacco use within 1 year) or the World Health Organization definition of an active smoker (tobacco use within 30 days) was used. Despite improvement in the rate of documented SCC, we found that the actual 6-month quit rate (53%) was similar to those in studies predating the SCC performance metric (49%).

More important, at the hospital level, we found no correlation between performance of the SCC metric and actual patient quit rates at 6 months or 1 year. These findings raise significant concerns about the adequacy of the CMS smoking cessation performance metric in reflecting substantive differences in the quality of care delivered to patients with AMI.

One explanation for this lack of association may be related to the variable intensities of SCC delivered to satisfy this performance metric. Although simple medical record documentation of SCC delivery would satisfy the performance metric, counseling activities can range from a very brief counseling effort or a generic statement in the discharge instructions to an individualized smoking cessation assessment with possible referral to a formal smoking cessation program. Although brief advice from a physician has been shown to significantly improve smoking cessation rates, this finding is supported almost exclusively by studies in the outpatient setting. The efficacy of brief smoking cessation interventions isolated to the inpatient setting has not been supported by previous studies. Moreover, the effectiveness of SCC has been shown to be dose dependent. Intensive inpatient counseling, combined with outpatient follow-up, has been associated with improved cessation and mortality rates.

There may also be a disconnect between what actually occurs during SCC at the patient’s bedside and what is documented in the medical record. Specifically, hospitals, through the efforts of physicians, nurses, and trained counselors, may do a reasonably good job of counseling patients yet not as complete a job of documenting this. The data from the 1-month interview support this conclusion because there were relatively high rates of recall of having received SCC in patients who did and did not have documented SCC. The correlation between in-hospital SCC and later recall of SCC may be further confounded in habituated smokers who have had other opportunities for SCC either preceding or following the AMI event.

A somewhat paradoxical finding is that documented SCC at the patient level was associated with significantly lower rates of subsequent cessation in multivariate models. One potential explanation for these results is that more recalcitrant smokers may be more likely to have their SCC documented. These habituated patients would also be less likely to quit at 1 year. The current SCC metric is not adjusted for the chronicity or severity of tobacco dependence.

**POLICY IMPLICATIONS**

These findings should not be interpreted to suggest discontinuation of SCC. In fact, smoking cessation is of unquestioned importance in the secondary prevention of heart disease, improving morbidity and mortality. In addition, as many as 79% of hospitalized smokers express a desire to quit. Rather, the CMS hospital performance metric, as it is currently structured, neither seems to be an adequate surrogate for observed quit rates nor ensures improved outcomes for smokers after an AMI.

One suggested improvement may be to mandate an objective measure, such as a medication prescription, direct patient counseling, or referral to outpatient programs, to document performance of the SCC metric. However, these would still be only surrogate process measures when the true outcome of interest is actual smoking cessation. A potentially superior alternative would be to base the performance metric on patient outcomes directly, namely, cessation rates at 6 or 12 months after hospitalization for AMI. This would not only ensure that higher performance on the metric correlates with better care for patients, it could also serve to promote the implementation of smoking cessation strategies already shown to be effective and stimulate the development of new and innovative smoking cessation strategies. One potential argument is that systematic collection of follow-up data is impractical outside of the research setting. However,
STUDY LIMITATIONS
There are several limitations to this study. First, the relatively small number of sites limits the power of this hospital-based analysis. However, the sites were diverse, in terms of geography and patient demographics, and overall performance of SCC was similar to contemporary rates and variability seen nationally. Second, smoking cessation was based solely on patient reporting without biochemical (eg, exhaled carbon monoxide) confirmation. Biochemical confirmation is particularly important in studies of tobacco cessation interventions; however, this is likely impractical for a widespread performance metric. Patient-reported tobacco cessation is a more realistic outcome for such a measure. Third, confounding out-patient factors, such as ongoing SCC provided by primary care physicians and participation in smoking cessation programs, were not quantified but may affect smoking cessation outcomes. Finally, although rates of patient follow-up were reasonable for community-based studies, outcomes were missing in a portion of patients. A propensity analysis, however, was performed to help adjust for patients unavailable for follow-up and found no observable bias in these analyses.

CONCLUSIONS
Improved hospital performance of the current CMS/JCAHO SCC quality measure is not associated with higher cessation rates at either the patient or the hospital level, raising concerns about its adequacy as a performance metric. Future efforts should be directed at revising the current SCC performance metric to use a patient-centric measure, such as actual smoking cessation rates.

Accepted for Publication: February 13, 2008.
Correspondence: Eric D. Peterson, MD, MPH, Duke Clinical Research Institute, 2400 Pratt St, Durham, NC 27705 (peter016@mc.duke.edu).

Author Contributions: Dr Reeves had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Reeves, Wang, Alexander, Ahmad, Spertus, and Peterson. Acquisition of data: Reid, Alexander, Decker, and Peterson. Analysis and interpretation of data: Reeves, Wang, Reid, Alexander, Spertus, and Peterson. Drafting of the manuscript: Reeves, Wang, Reid, Alexander, Decker, Ahmad, and Peterson. Critical revision of the manuscript for important intellectual content: Reeves, Wang, Alexander, Spertus, and Peterson. Statistical analysis: Reid and Peterson. Obtained funding: Spertus and Peterson. Administrative, technical, and material support: Alexander, Decker, and Spertus. Study supervision: Wang, Alexander, and Peterson.

Financial Disclosure: None reported.

Previous Presentation: This study was presented at the American Heart Association Quality of Care and Outcomes Research Conference; May 11, 2007; Washington, DC.

Additional Contributions: The PREMIER quality improvement registry was organized by CV Outcomes Inc, a nonprofit 501(c)(3) organization dedicated to the advancement of outcomes research and the improvement of cardiovascular health care quality, and is funded by CV Therapeutics Inc. More information on PREMIER can be found at http://www.cvoutcomes.org.

REFERENCES
16. Ground breaking Medicare payment demonstration results in substantial im-


