Improved Quality of Stroke Care for Hospitalized Medicare Beneficiaries in Michigan

Bradley S. Jacobs, MD, MS; Patricia L. Baker, RN, MS; Canopy Roychoudhury, PhD; Rajendra H. Mehta, MD; Steven R. Levine, MD

**Background and Purpose**—We reported previously that acute ischemic stroke patients encountered delays in obtaining neuroimaging and receiving thrombolysis, and that deep venous thrombosis prophylaxis was used only in a minority of eligible patients. We investigated whether these and other measures improved after a quality improvement initiative.

**Methods**—Medicare fee-for-service ischemic stroke and transient ischemic attack discharges in 136 acute care hospitals in Michigan were identified by *International Classification of Diseases*, 9th Revision, Clinical Modification codes. Only patients with stroke symptoms persisting for >1 hour and present on arrival were included in the analysis. Seven quality indicators were abstracted from chart review at baseline (discharges between July 1, 1998, and June 30, 1999) and at remeasurement (discharges between January 1, 2001, and June 30, 2001) after an intensive quality improvement initiative throughout Michigan hospitals. Quality indicators were compared at baseline and remeasurement.

**Results**—Indicators of care were determined in 5146 patients at baseline and 4980 patients on remeasurement. Four quality-of-care indicators showed significant improvement on remeasurement: antithrombotic prescribed at discharge (81.9 baseline versus 83.7% remeasurement; *P*=0.026), avoidance of sublingual nifedipine in patients with acute ischemic stroke (97.1 versus 99.7%; *P*<0.0001), documentation of a computed tomography (CT)/MRI during hospitalization (98.0 versus 99.1%; *P*=0.024), and appropriate deep venous thrombosis prophylaxis (13.8 versus 26.9%; *P*<0.0001). Time to CT/MRI did not significantly change, but time to thrombolysis improved (113 versus 88.5 minutes; *P*=0.045).

**Conclusions**—Improvement occurred in several indicators of quality of care in Michigan Medicare beneficiaries presenting with acute stroke symptoms. (*Stroke*. 2005;36:1227-1231.)

**Key Words:** acute cerebral infarction ■ antithrombotic agents ■ deep vein thrombosis ■ emergency medical services ■ stroke ■ thrombolysis

Stroke is the third leading cause of death in the United States and the leading cause of long-term disability.² The national ischemic stroke (IS)/transient ischemic attack (TIA) project was 1 of 5 inpatient topics under the Centers for Medicare and Medicaid Services (CMS) Health Care Quality Improvement Program (HCQIP) for the Sixth Scope of Work. Through HCQIP, quality improvement organizations (QIOs) in all states and territories serving Medicare beneficiaries worked with hospitals and health care providers to improve care of Medicare patients. These projects were statewide quality improvement projects standardized to the methods of the national projects. CMS led a national expert panel that developed quality indicator measures based on stroke care guidelines³—⁹ and previous experience of the QIO community. The outcome objectives of the national and Michigan projects were to improve the functional status and decrease the mortality and morbidity for Medicare patients by improving adherence to guideline-based therapies through data feedback and quality improvement support and consultation.

We reported previously the baseline measures of these indicators in hospitals throughout Michigan¹⁰ and found delays in acute stroke patients obtaining neuroimaging and receiving thrombolysis that did not meet recommended goals for evaluation of patients with acute stroke.¹¹ Additionally, deep venous thrombosis (DVT) prophylaxis was used in only a minority of eligible acute stroke patients. Following these

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measures, an intensive quality improvement initiative throughout Michigan hospitals was initiated by the Michigan Peer Review Organization (MPRO), Michigan’s Medicare QIO, to improve these and other measures. We report the results of a remeasurement of these quality indicators after this initiative.

Methods
Medicare fee-for-service IS and TIA discharges in Michigan were identified by CMS claims, with a principal diagnosis including International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) codes 433 (occlusion and stenosis of pre- and intracranial arteries), 434 (occlusion of cerebral arteries), 436 (acute but ill-defined cerebrovascular disease), 362.34 (transient arterial occlusion), or 435 (transient cerebral ischemia), excluding 435.2 (subclavian steal syndrome). Among the patients with these ICD-9-CM codes, patients were only included in the analysis if they had stroke symptoms, including visual, speech, motor, or sensory deficit, that persisted for >1 hour and were present on arrival. Acute IS (AIS) was a subgroup defined as symptom onset <48 hours before arrival.

All 136 acute care hospitals in the state of Michigan were included in the project. Baseline data collection (discharges between July 1, 1998, and June 30, 1999) consisted of a 30% sample and a 5% oversample of the total IS/TIA discharges selected randomly from each hospital, with a maximum of 85 cases from each. Remeasurement data collection (discharges between January 1, 2000, and June 30, 2001) was a 50% sample and a 5% oversample selected randomly from each hospital, with a maximum of 85 cases. If the sample size was <20 cases for any hospital, all cases were studied for that hospital.

The CMS clinical data abstraction center reviewed medical records to abstract the information needed to calculate the quality indicators. Data elements abstracted by trained nurses were compared against a random sample of reabstracted cases. The overall accuracy rate was 95.5% for baseline measures and 96.6% for the remeasurement sample.

Seven quality indicators were abstracted. (1) “Antithrombotic prescribed at discharge” was defined as the percentage of patients prescribed antithrombotic at discharge among those without a contraindication or refusal to take antithrombotics; (2) “Avoidance of sublingual nifedipine in AIS patients” was defined as the percentage of patients with a blood pressure >180 mm Hg systolic or 100 mm Hg diastolic who did not receive sublingual nifedipine within 24 hours of arrival. (3) “Documentation of time of symptom onset (or interval)” was the percentage of cases with physician documentation of time interval since symptom onset, specific time of symptom onset, or specific time of symptom onset. (4) “CT or MRI during hospitalization” was the percentage of patients who had had computed tomography (CT) or MRI (CT/MRI) within 1 day before arrival or during their hospitalization among AIS who did not arrive from another acute care facility or were not receiving terminal care. (5) “Deep venous thrombosis prophylaxis initiated by the second hospital day” was the percentage of patients who had DVT prophylaxis (intermittent pneumatic compression [IPC] devices or anticoagulation with warfarin, low-dose heparin, full-dose unfractionated heparin, or low–molecular weight heparin) initiated by the second hospital day among AIS patients who were nonambulatory (bed rest, only on bathroom privileges, or only up in a chair) on the second hospital day. Patients receiving terminal care and patients on heparin before admission were excluded. (6) “Time to initial head CT/MRI” was defined in AIS patients who received head CT/MRI 1 day before arrival or during stay and had documentation of date and time of arrival and performance of CT/MRI. Patients arriving from another acute care facility or receiving terminal care were excluded. The median time to CT/MRI was defined as “zero.” (7) “The time to thrombolytic administration” was determined in AIS patients with documentation of date and time of admission and thrombolysis.

Quality Improvement Strategies
MPRO worked with hospitals and various stakeholders to improve care for Medicare beneficiaries throughout the state. MPRO systematically promoted the measures using voluntary, collaborative, and nonpunitive quality improvement and educational strategies. Strategies included providing each hospital with their baseline, hospital peer group (average performance of similar hospitals), statewide and Achievable Benchmark of Care data (calculated to serve as a target performance level based on the hospital-specific baseline sample), a self-assessment tool for identifying key quality improvement strategies; a toolkit with information on stroke care and the indicators, data collection tools, performance monitoring, sample interventions, and references: site visits; regional meetings; and phone consultation. MPRO encouraged hospitals to review the baseline data and to examine opportunities for improvement that were in concert with their organizational goals.

Furthermore, MPRO worked actively with key stakeholders in Michigan to improve awareness, early recognition and transport, emergency department triage and care, and consumer and provider education. MPRO collaborated with the Michigan Stroke Initiative sponsored by the Michigan Department of Community Health, which is a statewide effort to improve stroke care. Additionally, MPRO and other stakeholders contributed to the work of the Michigan Association of Health Plans, patient and provider education efforts entitled “Taking on Stroke in Michigan,” and the American Heart Association (AHA) efforts in “Operation Stoke” and “The Acute Stroke Treatment Program.” Together, these stakeholders held several conferences with national experts on stroke care; workshops targeting emergency medical technicians, hospital and emergency department personnel, physicians, physical medicine and rehabilitation centers; and community-based educational programs.

Statistical Analysis
Analysis was performed using SAS software, version 8.2, (SAS Institute). Demographics of the baseline and remeasurement groups were compared using chi-square testing. The frequencies and percentages of cases meeting the criteria for the first 5 indicators and the median and interquartile range for the 2 time indicators were determined. Comparisons between the baseline and remeasurement rates were made using the 2-tailed binomial z tests for the first 5 indicators and a nonparametric rank-sum test for the 2 time indicators.

Results
Patient demographics were similar in baseline and remeasurement groups (Table 1), with no significant difference in any of the characteristics between the 2 timeframes. Four quality-of-care indicators showed significant improvement on remeasurement: antithrombotic prescribed at discharge, avoidance of sublingual nifedipine in patients with acute stroke, documentation of a CT/MRI during hospitalization, and appropriate DVT prophylaxis (Table 2). Twenty-four patients received sublingual nifedipine or had the medication prescribed at baseline and only 2 at remeasurement. Documentation of time of symptom onset (or time interval from symptom onset) did not improve. Time to CT/MRI did not improve, but time to thrombolysis improved significantly (Table 3).

Discussion
This quality improvement initiative was part of a CMS goal to improve quality of care delivered to Medicare beneficiaries. The focus was on processes of care rather than outcomes because these measures do not require risk adjustment and are beneficial for hospital efforts to improve critical processes of care.
Antithrombotic Prescribed at Discharge

Antiplatelet agents are typically the treatment of choice for prevention of future stroke in patients who have experienced a TIA of presumed atherothrombotic origin, as well as preventing IS in patients with previous stroke.2,13–15 The proportion of cases prescribed antithrombotics at discharge in Michigan was high at baseline (81.9%) and improved significantly \((P=0.026)\) to 83.7%, yet falls short of 100% compliance with guidelines. Some of this difference may be attributable to failure to document “over-the-counter” medications such as aspirin in the discharge notations. Providing standard discharge forms or protocols with common over-the-counter medications listed may facilitate documentation and promote continuity of care among healthcare providers, patients, and caregivers.

Avoidance of Sublingual Nifedipine

The 1994 AHA guidelines for management of AIS warns against the sublingual use of a calcium antagonist because of its rapid absorption and the possibility of a secondary

### TABLE 1. Demographics of Medicare Beneficiaries Discharged With IS/TIA at Baseline (1998 to 1999) and Remeasurement (2001)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Baseline No. (%)</th>
<th>Remeasurement No. (%)</th>
<th>(P) Value of (\chi^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICD-9 code diagnosis</td>
<td>IS 3925 (76.3%)</td>
<td>3732 (74.9%)</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>TIA 1221 (23.7%)</td>
<td>1248 (25.1%)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Men 2256 (43.8%)</td>
<td>2150 (43.2%)</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>Women 2890 (56.2)</td>
<td>2833 (56.8%)</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td>White 4552 (88.6)</td>
<td>4339 (87.2%)</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>Black 554 (10.8)</td>
<td>609 (12.2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other 32 (0.6)</td>
<td>31 (0.6)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UTD or missing</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Age (years)</td>
<td>&lt;65 244 (4.8)</td>
<td>284 (5.7)</td>
<td>0.32</td>
</tr>
<tr>
<td></td>
<td>65–74 1759 (34.2)</td>
<td>1515 (30.4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>75–84 2124 (41.3)</td>
<td>2128 (42.8)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>≥85 1015 (19.7)</td>
<td>1051 (21.1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UTD or missing</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Admission source</td>
<td>Home 4141 (82.1)</td>
<td>3890 (82.7)</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>Outpatient facility 282 (5.6)</td>
<td>231 (4.9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other healthcare facility 190 (3.8)</td>
<td>145 (3.1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extended care facility 317 (6.3)</td>
<td>312 (6.6)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other setting 114 (2.3)</td>
<td>128 (2.7)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UTD or missing</td>
<td>102</td>
<td>274</td>
</tr>
<tr>
<td>Discharge disposition</td>
<td>Home 3181 (66.5)</td>
<td>3011 (66.3)</td>
<td>0.18</td>
</tr>
<tr>
<td></td>
<td>Other health care facility 681 (14.2)</td>
<td>603 (13.3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extended care facility 844 (17.7)</td>
<td>880 (19.4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other setting 76 (1.6)</td>
<td>51 (1.1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UTD or missing</td>
<td>124</td>
<td>222</td>
</tr>
</tbody>
</table>

UTD indicates unable to determine; outpatient facility, postambulatory surgery, outpatient setting; other healthcare facility, acute care hospital, transfer from another emergency department, rehabilitation hospital, psychiatric hospital, or transitional or step-down care; other setting, noninstitutional setting, secured facility, homeless shelter.


<table>
<thead>
<tr>
<th>Quality Indicators</th>
<th>Baseline No. (%)</th>
<th>Remeasurement No. (%)</th>
<th>Percent Change Between Baseline and Remeasurement (95% CI)</th>
<th>(P) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthrombotic on discharge</td>
<td>3086 (81.9)</td>
<td>2288 (83.7)</td>
<td>1.8 (0.1–3.6)</td>
<td>0.026</td>
</tr>
<tr>
<td>Avoidance of sublingual nifedipine</td>
<td>810 (97.1)</td>
<td>770 (99.7)</td>
<td>2.6 (1.4–3.8)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Documentation of symptom onset or interval to thrombolysis</td>
<td>2010 (95.6)</td>
<td>1742 (96.1)</td>
<td>0.5 (–0.5–1.7)</td>
<td>0.875</td>
</tr>
<tr>
<td>CT/MRI performed</td>
<td>1579 (98.0)</td>
<td>1130 (99.1)</td>
<td>1.1 (0.5–1.9)</td>
<td>0.024</td>
</tr>
<tr>
<td>DVT prophylaxis</td>
<td>47 (13.8)</td>
<td>90 (26.9)</td>
<td>13.1 (11.1–19.1)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>
precipitous drop in blood pressure, which could cause further ischemic tissue damage. The use of nifedipine for hypertensive emergencies should be abandoned on the basis of reports of cerebrovascular ischemia and stroke and numerous instances of severe hypotension, acute myocardial infarction, conduction disturbances, and death. Michigan compliance was high at baseline (97.1%) and showed significant improvement in the avoidance of sublingual nifedipine, with a remeasurement rate of 99.7%.

**Time of Symptom Onset or Interval**
Identification of time of stroke symptom onset is essential to triage patients who may be candidates for thrombolytic therapy. No significant change occurred in documentation of “time of symptom onset or interval” between baseline (95.6%) and remeasurement (96.1%). Further improvement may be made by adding an appropriate history field on the emergency department medical record that notes the onset or duration of symptoms.

**CT/MRI During Hospitalization**
In 1997, the AHA Stroke Council updated its guidelines for the use of brain imaging studies in acute stroke patients. All patients with IS should receive neuroimaging by either CT or MRI. Statewide performance was excellent at baseline, and remeasurement demonstrated improvement, with 99.1% of patients receiving one of these tests.

**Time to Initial CT/MRI**
The standard of care for AIS patients requires brain imaging, particularly before the use of thrombolysis. The goal is 25 minutes from arrival at the hospital to imaging, which requires an efficient, coordinated effort between emergency medical services (EMS) in the community, the hospital triage, the emergency department physician, and the radiology department. The Brain Attack Coalition states that these imaging capabilities must be available 24 hours every day, and physicians experienced in interpreting CT and MRI studies must be available to read these scans within 20 minutes of their completion.

The “time to initial head CT/MRI” indicator required that the time of arrival and the time of the imaging scan be documented on the medical record. The number of cases eligible for this indicator is small because of a lack of chart documentation of timing. The baseline aggregate median time was 89.5 minutes for 144 cases. The remeasurement median time rose to 100 minutes for 335 cases. Studies investigating patients who have received tissue plasminogen activator have found mean times from door to CT varying from 30 to 56 minutes, whereas a study of a more general acute stroke population, likely more similar to our study population, had a time of 114 minutes. Given the recommendation of 25 minutes from hospital door to neuroimaging, accelerating patients’ triage to radiology should be assigned high priority. This will require implementation of processes that better integrate radiology with EMS and perhaps improved availability of technicians for performance of these emergent studies. Improved documentation of timing for these important indicators will assist in quality improvement efforts.

**Time to Thrombolytic Administration**
This indicator required documentation of the time of arrival and time of thrombolytic administration. Because of missing chart documentation of timing and infrequency of thrombolytic use, the number of cases eligible for this number is small. Statewide baseline performance for “median time to thrombolytic administration” was 113 minutes for the 23 patients (range 64 to 130 minutes). For remeasurement, the median time decreased to 88.5 minutes for 26 cases (range 41.5 to 105.0 minutes). However, with such small sample sizes, caution is warranted in the interpretation of the significance of this improvement. Increased emphasis on documenting procedure times would facilitate analysis for quality improvement purposes.

Both of these median times are above the recommended goal of 60-minute “door-to-needle” time. Our findings are similar to other studies that had mean times of door-to-intravenous thrombolysis from 48 to 127 minutes. This quality indicator is of particular importance because reduction of time to thrombolytic administration will likely improve efficacy of the treatment.

**DVT Prophylaxis Initiated by Second Hospital Day**
DVT and thromboembolism in patients with a paralytic or paralyzed leg and resulting immobility occur in 55% of patients, with as many as 5% of early stroke deaths attributed to pulmonary embolism. Pooled results from randomized trials have shown a 56% to 82% relative risk reduction with prophylaxis.

This quality indicator provided a large opportunity for improvement, with a statewide baseline rate of 13.8%. Although the compliance rate nearly doubled and showed significant improvement to 26.9%, the rate is still far <100% compliance. Multiple factors might contribute to this low compliance rate. Some institutions might not have IPC devices available, or physicians may assume that elastic stockings are sufficient. Physicians might be reluctant to prescribe anticoagulants because of the risk of hemorrhage, cost, and inconvenience. Poor documentation of a patient’s actual level of activity or use of IPC devices might have

### Table 3. Time-Dependent Quality Care Indicators at Baseline (1998 to 1999) Compared With Remeasurement (2001) After Quality Improvement Strategy

<table>
<thead>
<tr>
<th>Quality Indicators</th>
<th>Baseline (n=5146)</th>
<th>Remeasurement (n=4980)</th>
<th>Test P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to CT/MRI</td>
<td>No. of Patients</td>
<td>Median Time</td>
<td>No. of Patients</td>
</tr>
<tr>
<td>Time to CT/MRI</td>
<td>144</td>
<td>89.5</td>
<td>335</td>
</tr>
<tr>
<td>Time to thrombolysis</td>
<td>23</td>
<td>113.0</td>
<td>26</td>
</tr>
</tbody>
</table>
underestimated the rate for DVT prophylaxis. Physicians may need to be convinced that the risk of an adverse event such as a DVT is high enough to warrant prophylactic treatment. Preprinted orders for IPC devices or anticoagulant for all nonambulatory patients may help prevent DVT.

A limitation of this study is the cross-sectional nature of the data collected and lack of a control group for comparison. Although it is likely that the quality improvement initiative had a positive impact on these measured indicators, forces other than this intervention may have resulted in some of the changes noted in the remeasurement. The percentage improvement of some quality indicators (excluding DVT prophylaxis) appears small, but the relative increase in the absolute numbers of patients with improved care is clinically significant. A prospective controlled trial of hospitals randomly assigned to a quality improvement initiative with measurements of quality indicators before and after is needed to determine whether such initiatives are truly worthwhile. Although some improvement in these quality indicators was accomplished over this short time period, much more is required. Quality improvement is a continual process. Michigan hospitals will need to use this information and continue their efforts to improve care for their patients with IS and TIA.

Acknowledgments

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