
Final Report

November 2003

Christina Park, Ph.D.
ANASYS, Inc.

Submitted to:
Centers for Medicare & Medicaid Services
Center for Beneficiary Choices/
Quality Measurement and Health Assessment Group
South Bldg., S3-24-05
7500 Security Blvd.
Mail Stop S3-02-01
Baltimore, MD 21244-1850

Submitted by:
Mathematica Policy Research, Inc.
955 Massachusetts Avenue, Suite 801
Cambridge, MA 02139
Telephone: (617) 491-7900
Facsimile: (617) 491-8044

Project Officer: Lein Han
Project Director: Angela Merrill
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXECUTIVE SUMMARY</td>
<td>xiii</td>
</tr>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II. CHARACTERISTICS OF THE FFS STROKE/TIA POPULATION</td>
<td>3</td>
</tr>
<tr>
<td>III. OVERALL TRENDS IN STROKE-RELATED HOSPITAL DISCHARGES AND OUTCOMES</td>
<td>5</td>
</tr>
<tr>
<td>IV. GEOGRAPHIC VARIATION IN STROKE-RELATED HOSPITAL DISCHARGES AND OUTCOMES</td>
<td>13</td>
</tr>
<tr>
<td>V. DISPARITY IN STROKE-RELATED HOSPITAL DISCHARGES AND OUTCOMES</td>
<td>22</td>
</tr>
<tr>
<td>VI. DISCUSSION</td>
<td>30</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>31</td>
</tr>
<tr>
<td>APPENDIX A: STROKE SPECIFICATIONS</td>
<td></td>
</tr>
</tbody>
</table>
Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>II.1</td>
<td>Age Distribution of FFS Stroke/TIA Population and the FFS Medicare Population, 2001</td>
<td>3</td>
</tr>
<tr>
<td>III.1</td>
<td>Age-Sex–Adjusted Discharge Rates for Stroke Cohorts, 1992–2001</td>
<td>5</td>
</tr>
<tr>
<td>III.2</td>
<td>Age-Sex–Adjusted Beneficiary Discharge Rates for Atrial Fibrillation, 1992–2001</td>
<td>6</td>
</tr>
<tr>
<td>III.3</td>
<td>Total Medicare Payments for Stroke Cohort Hospitalizations, 1992–2001</td>
<td>7</td>
</tr>
<tr>
<td>III.4</td>
<td>Age-Sex–Adjusted Average Length of Stay for Stroke Cohort Hospitalizations, 1992–2001</td>
<td>9</td>
</tr>
<tr>
<td>III.5</td>
<td>Age-Sex–Adjusted 30-Day Stroke Readmission Rates for Stroke Cohorts, 1994–2001</td>
<td>10</td>
</tr>
<tr>
<td>III.6</td>
<td>Age-Sex–Adjusted 365-Day Stroke Readmission Rates for Stroke Cohorts, 1994–2000</td>
<td>11</td>
</tr>
<tr>
<td>III.7</td>
<td>Age-Sex–Adjusted 30-Day Mortality Rates Following Stroke/TIA or CEA Hospitalization, 1992–2001</td>
<td>12</td>
</tr>
<tr>
<td>IV.1</td>
<td>Age-Sex–Adjusted Stroke/TIA Discharge Rates, by State, 2001</td>
<td>13</td>
</tr>
<tr>
<td>IV.2</td>
<td>Age-Sex–Adjusted Atrial Fibrillation Discharge Rates, by State, 2001</td>
<td>14</td>
</tr>
<tr>
<td>IV.3</td>
<td>Age-Sex–Adjusted Carotid Endarterectomy Discharge Rates, by Census Region, 1992–2001</td>
<td>15</td>
</tr>
</tbody>
</table>
Figures

IV.4 Age-Sex–Adjusted Carotid Endarterectomy Discharge Rates, by State, 2001 ................................................................................................ 16

IV.5 Age-Sex–Adjusted Average Length of Stay for Stroke/TIA Hospitalizations, by Census Region, 1992–2001 .................................... 17

IV.6 Age-Sex–Adjusted 30-Day Stroke Readmission Rates for Beneficiaries Discharged with Stroke or TIA, by Census Region, 1994–2001 ................................................................. 18

IV.7 Age-Sex–Adjusted 30-Day Stroke Readmission Rates for Beneficiaries Discharged with Atrial Fibrillation, by Census Region, 1994 and 2001 ................................................................. 19

IV.8 Age-Sex–Adjusted 365-Day Mortality Following Admissions for Stroke or TIA, by State, 2000 ........................................................................ 20

IV.9 Age-Sex–Adjusted 365-Day Mortality Following Carotid Endarterectomy, by Census Region, 1992 and 2000 ............................... 21

V.1 Female-to-Male Ratio of Discharge Rates for Stroke Cohorts, 1992– 2001 ................................................................................................. 22


V.4 Female-to-Male Ratio of 30-Day Stroke Readmission Rates for Stroke Cohorts, 1994–2001 ................................................................. 26

V.5 Black-to-White Ratio of 30-Day Stroke Readmission Rates for Stroke Cohorts, 1994– 2001 ........................................................................ 27


Mathematica Policy Research, Inc. (MPR) prepared this report under contract GS-10F-0050L, task order CMS-02-01175, with the Centers for Medicare & Medicaid Services. MPR would like to acknowledge the contribution of RTI International, which prepared the databases, draft Appendix B tables, and draft data processing documentation. We would also like to acknowledge the direction and comments of Lein Han, Neil Gittings, and Aaron Goldfarb of CMS. Christina Park of ANASYS, Inc., and Angela Merrill, Robert Schmitz, So Sasigent Limpa-Amara, Randall Brown, Daryl Hall, and Alfreda Holmes of MPR prepared the report.

Opinions and interpretations expressed herein are not necessarily the position of CMS or any other federal agency.
ABOUT MQMS

BACKGROUND

The Medicare Quality Monitoring System (MQMS) is an ongoing system that processes, analyzes, interprets and disseminates health related data to monitor the quality of care delivered to Medicare fee-for-service beneficiaries. The MQMS was initiated to provide useful information to the CMS PROs (Peer Review Organizations, currently renamed as Quality Improvement Organizations) program and has been evolved to address growing public concerns over quality of care, patient safety, provider accountability and patient choice. It is directed by the Centers for Medicare & Medicaid Services (CMS) with assistance from its contractors. MQMS development and production involves a diverse group of CMS staff, including program managers, clinical area team leaders (clinicians), epidemiologists, statisticians, and data analysts in the central and regional offices. CMS also consulted with leading experts in other federal agencies—such as the Agency for Health Care Research and Quality, the Centers for Disease Control—and in quality improvement organizations and academia.

INTENDED USE OF THE MQMS DATA

The MQMS is designed with the intention to support data-driven decision-making regarding quality improvement and payment/coverage policymaking. Development and production of the 2003 MQMS measures and respective methodologies were primarily aiming at providing input for broad and high-level policy making and program planning within CMS.

The 2003 MQMS describes trends, patterns, and variations in health status, disease- and procedure-specific utilization, outcomes and process of care at the national and state level that are related to CMS quality improvement program and initiatives, patient safety and payment/coverage policies. Without further analysis and manipulation of the data, the 2003 MQMS data are inadequate to explain the specific causes of the trends, patterns, and variations.
In addition to CMS internal use, MQMS provides data on Medicare quality of care for the AHRQ National Healthcare Quality Report (NHQR) and National Healthcare Disparities Report (NHDR).

- Specifically the MQMS data are to be used for:
  - Identifying potential quality problems
  - Tracking program implementation
  - Suggesting project ideas for quality improvement program
  - Targeting interventions
  - Prioritizing activities & allocation of resources
  - Focusing on a particular problem
  - Raising research questions/hypothesis for further investigation

- Further well-deliberated multivariate analysis is required for the MQMS data to be meaningful and useful for:
  - Drawing conclusions on cause-effect association between the QIOs process of care measures with the MQMS outcome measures
  - Evaluating individual QIO, providers in a state or state performance
  - Evaluating directly the effectiveness of the QIO program and other CMS quality improvement initiatives and payment/coverage policies

**Population and Health Issues Examined**

The population under study consists of Medicare fee-for-service (FFS) beneficiaries. MQMS is limited to FFS beneficiaries because of the current unavailability of encounter data from Medicare managed care plans. The MQMS 2003 edition monitors the following types of quality measures:

- Mortality and readmission rates, length of stay, and cost of hospitalizations for three conditions — acute myocardial infarction (AMI), heart failure and stroke

- Process of care and progression of diseases for diabetes

- Mortality and readmission rates following cancer-related and cardiac-related high-risk surgical procedures

- Patient safety

- Preventable hospitalization

*About MQMS*
METHODS

The 2003 MQMS analysis is limited to the national and/or state level, presenting longitudinal and/or cross-sectional descriptive statistics for various demographic and geographic subgroups. The results of MQMS 2003 edition are age-sex adjusted and not risk adjusted. The age-sex adjustment eliminates state-to-state and year-to-year variations in the age and sex composition but not the comorbidities or severity of illness of the population. The age-sex adjusted data preclude interpretation alluding to state or provider performance.

MQMS results are based on data from all fee-for-service beneficiaries and claims, rather than a sample of such beneficiaries and claims. This means that the rates presented in MQMS reports do not contain sampling error. MQMS rates are not presented with confidence intervals or significance testing, since these intervals and tests are based on properties of sampling error. This approach implies that the FFS population is not interpreted as a sample drawn from a super-population, such as all Medicare beneficiaries or FFS beneficiaries from another time period. The one exception is the MQMS diabetes results, which are based on a five percent sample of full-year fee-for-service Medicare beneficiaries. Thus, rates presented in the MQMS diabetes reports are subject to sampling error, and confidence intervals or significance testing are presented.

MQMS results are subject to measurement error in the CMS Denominator File and MedPAR database, as well as to modeling error resulting form the age-sex adjustment. CMS continues to investigate the magnitude of these errors.

PRODUCTS

The MQMS products are a series of reports on quality measures, a set of tables on CMS’ web site, plus the data files at the person and aggregate level used to generate the reports and documentation of the methodology and data processing. The reports are available on the CMS website; the data files and documentation reside on the CMS mainframe. To facilitate the use of the data and replication of the analysis, CMS makes available SAS programs and data processing documentation. Access to the data can be granted to CMS analysts on request. Other federal agencies and CMS contractors may obtain the data through a formal data request process.

MQMS 2003 reports include:

About MQMS

EXECUTIVE SUMMARY

This report summarizes trends and variation in the hospitalization of Medicare beneficiaries for ischemic stroke and its related conditions. The MQMS “stroke” Clinical Priority Area examines four clinical cohorts: stroke or transient ischemic attack (TIA), stroke only, atrial fibrillation, and carotid endarterectomy (CEA). “Stroke” refers to ischemic stroke only and excludes hemorrhagic stroke.

The report describes discharge rates, length of stay, cost, readmission, and mortality for the above stroke cohorts from 1992 to 2001. It tracks utilization and outcome measures for the stroke population as a whole and by demographic and geographic subgroup over the study period. Intended as one component of a surveillance effort, the report highlights recent trends and possible changes in trends in the hospital care of stroke patients. It also points to geographic and demographic differences in utilization and mortality of beneficiaries hospitalized for stroke. The report addresses four key questions:

• What are the characteristics of the Medicare beneficiaries hospitalized for stroke and how similar is this population to the general Medicare FFS population?

• What are the overall trends in stroke-related hospital outcomes over the 1992-2001 decade, i.e., discharge, readmission, and mortality rates after hospitalizations for stroke and related conditions, among the Medicare FFS population?

• How do the stroke-related hospital outcomes vary geographically and over the years?

• How do the stroke-related hospital outcomes vary by demographic characteristics?

Characteristics of the Stroke Population

• Medicare FFS beneficiaries hospitalized for stroke in 2001 were predominately age 75 and above, female, white, and living in the South.
• Compared with the distribution of the entire FFS population, stroke beneficiaries were disproportionately older, dually eligible for Medicaid, eligible for end-stage renal disease (ESRD), and living in the South.

• Compared with the general FFS population, stroke patients were similar in distribution by gender, race, and urban/rural residence.

• While the proportion of beneficiaries who are male in the general FFS population increased slightly from 1992 to 2001, it decreased slightly among the stroke population.

**Overall Trends in Stroke-Related Hospital Discharges and Outcomes**

• Age-sex–adjusted rates of discharge for stroke/TIA (and stroke only) increased slightly from 1992 to 1996 and declined by 2001 while discharge rates for atrial fibrillation steadily increased from 1992 to 2001.

• Average length of stay declined dramatically between 1992 and 2001 for stroke and related conditions. For stroke/TIA hospitalization, it decreased from 8.1 days in 1992 to 4.8 days in 2001.

• The study period saw little change in 30-day readmission rates following stroke/TIA, atrial fibrillation, or CEA hospitalization. Long-term stroke readmission rates, however, declined slightly for all stroke cohorts. Beneficiaries who had been hospitalized for stroke/TIA were more than twice as likely to be readmitted for stroke than those with atrial fibrillation or CEA hospitalizations.

• Mortality rates (from any cause) following stroke/TIA and CEA hospitalizations decreased over the study period. Thirty-day mortality following stroke/TIA declined by 14 percent and, following CEA, by 35 percent.

**Geographic Variations in Stroke-Related Hospital Discharges and Outcomes**

• Hospital discharge rates for stroke and related conditions varied by census region and by state but not by urban/rural residence. Such variations differed slightly for each stroke cohort in that discharge rates were the highest in the South for stroke/TIA; in the Northeast closely followed by the South for atrial fibrillation; and in the South and Midwest for CEA.

• Regional differences for most measures examined remained largely consistent over the years. For example, stroke/TIA discharge rates were consistently highest in the South and lowest in the West for all of the years.

• Large regional differences in average lengths of stay (LOS) for stroke/TIA hospitalizations appear to be disappearing rapidly. Rates were highest and decreased the most from 1992 to 2001 in the Northeast, dropping from 11.1 to 5.6 days.

*Executive Summary*
Average LOS was lowest and changed the least over the years in the West, from 5.9 days in 1992 to 4.3 days in 2001.

- Relatively smaller differences occurred in stroke readmission rates, than in discharge rates, by region. Readmission rates were still highest in the South.

- In contrast to the South’s highest stroke/TIA discharge rates in the nation, the West—from 1992 to 1998—exhibited the highest one-year mortality rates following stroke/TIA hospitalizations.

**Disparity in Stroke-Related Hospital Discharges and Outcomes**

- Hospital discharge rates and outcomes for stroke and related conditions exhibit notable disparities when examined by beneficiary’s demographic characteristics; these relationships changed little over the years.

- In general, older age was not only associated with higher discharge rates but also with worse outcomes, i.e., higher readmission and mortality rates.

- Women had lower hospital discharge rates than men for all stroke cohorts; blacks had higher rates than whites for stroke/TIA but lower rates for atrial fibrillation and CEA; and beneficiaries dually eligible for Medicaid had higher rates of stroke/TIA and atrial fibrillation but lower rates of CEA.

- Women who had atrial fibrillation and CEA hospitalizations had higher stroke readmission rates than men, and blacks and dual eligibles had higher rates than whites and nondual eligibles.

- On mortality following hospitalization for stroke/TIA and CEA, women had lower mortality than men, but blacks and dual eligibles continued to have higher mortality than their counterparts.

Discharge rates from stroke/TIA remained the same in 1992 and 2001 (with a slight peak in 1996), but long-term readmission rates for stroke and mortality following stroke/TIA hospitalization declined slightly over the 10-year study period. These changes occurred while the discharge rate of atrial fibrillation increased considerably and the rate of CEA remained largely stable over the same period. These findings may be a result of several factors at play as related to the prevention, treatment, and care of stroke and related conditions. Certainly, the results seem to indicate better treatment of stroke but not improved prevention. However, it may be that despite better prevention, patients with cerebrovascular or cardiovascular events are surviving more often, placing them at risk for a stroke hospitalization or an atrial fibrillation diagnosis.

The finding that racial and possibly economic disparities (reflected by poorer outcomes for beneficiaries also enrolled in Medicaid) in stroke outcomes did not diminish over the years points to a persistent health care problem. Further research is needed to
identify possible explanations and solutions to some of these stroke-related problems. At the least, research should examine differences in comorbidities, severity of illness, the availability of outpatient management for stroke, and provider characteristics across the subgroups.
MEDICARE QUALITY MONITORING SYSTEM (MQMS) REPORT:

STROKE, 1992–2001

I. INTRODUCTION

Cerebrovascular disease, or stroke, is currently the third leading cause of death in the United States as well as a leading cause of serious, long-term disability, placing an enormous burden on health care and health care costs. Approximately 700,000 new or recurrent stokes are documented annually in the United States, triggering close to 1 million hospitalizations at a total cost of $51.2 billion (American Heart Association 2002). Ischemic stroke is the predominant form of all strokes (88 percent) (American Heart Association 2002) and tends to have a better prognosis than hemorrhagic stroke (Fang and Alderman 2001). In 2001, over one-half million Medicare beneficiaries were hospitalized at least once for ischemic stroke (referred to as stroke in this report), and Medicare spent about $2.7 billion just on hospital care for stroke.

This report uses data from the Medicare Quality Monitoring System (MQMS) to study trends and variations in stroke discharges, readmissions, and mortality among Medicare fee-for-service beneficiaries from 1992 through 2001. Other MQMS reports will provide information on the other four Clinical Priority Areas in the Health Care Quality Improvement Project (HCQIP): acute myocardial infarction, heart failure, diabetes, and pneumonia. During the 1990s, CMS increased its efforts to improve the quality of care for beneficiaries hospitalized with these conditions. In 1999, CMS began evaluating the Quality Improvement Organizations (QIO) on inpatient quality indicators for each condition. CMS chose these diagnoses because (1) they are common in the Medicare population and (2) effective interventions have been shown to reduce disability and mortality. All five conditions were projects under the Sixth Scope of Work for Medicare QIOs.

As part of the HCQIP, the National Stroke Project aims to decrease the morbidity/mortality rate related to stroke by improving quality of care for patients with (ischemic) stroke/TIA, atrial fibrillation, and CEA (CMS 2002). Ischemic stroke occurs...
when a blood clot blocks a blood vessel or artery, interrupting blood flow to an area of the brain. TIA is a brief episode of stroke symptoms that does not lead to permanent brain damage, but may be a warning sign of an impending stroke. Atrial fibrillation is a form of heart arrhythmia that is considered an independent risk factor for stroke, and carotid endarterectomy is a surgical procedure performed as a preventive measure to lower the risk of ischemic stroke. The project set four stroke quality indicators to measure quality improvement: (1) proportion of discharges without contraindications who are prescribed warfarin at discharge; (2) antithrombotic prescribed at discharge; (3) avoidance of sublingual nifedipine in patients with acute stroke; and (4) stroke readmission and mortality (30 day) in patients with CEA. We examine the latter in this report.

This report will present results in four parts: (1) comparison of the characteristics of the Medicare beneficiaries hospitalized for stroke with those of the general Medicare FFS population; (2) the overall trends in stroke-related hospital outcomes, i.e., discharge, readmission, and mortality rates after hospitalizations for stroke and related conditions among the Medicare FFS population; (3) variation in stroke-related hospital outcomes by geographic region and over the years; and (4) variation in stroke-related hospital outcomes by demographic characteristics. Stroke readmission, i.e., readmission with a diagnosis of “stroke only,” is one of the main hospital outcomes examined for beneficiaries with stroke/TIA, atrial fibrillation, and CEA. Based on the ICD-9 codes, the “stroke only” diagnosis is available only from 1994 and on; therefore, “stroke only” discharge and readmission rates are measured for 1994 through 2001 while the other measures are available for 1992 through 2001 (see Appendix C).

Appendix A contains a detailed description of the data sources, case selection, and variable construction for each outcome measure used in this report. Appendix B provides supporting tables for each stroke cohort, offering greater detail than that presented in the text for demographic groups, state, and region. Appendix C lists ICD-9 codes used in defining stroke cohorts.
II. CHARACTERISTICS OF THE FFS STROKE/TIA POPULATION

Of the 31.5 million Medicare beneficiaries enrolled in FFS for the entire year (or until death) in 2001, close to one-half million beneficiaries (1.5 percent) were hospitalized for stroke or TIA. Appendix Table B.1-3 presents a comparison of the stroke/TIA population with the overall FFS population in 1992 and 2001.

Figure II.1. Age Distribution of FFS Stroke/TIA Population and the FFS Medicare Population, 2001

- Beneficiaries with stroke/TIA hospitalizations tended to be older than the entire Medicare population. In 2001, 42 percent of beneficiaries who were hospitalized for stroke/TIA were age 80 or above compared with 24 percent of all FFS beneficiaries (Figure II.1).

- Gender distributions were similar; in 2001, females represented 57.6 percent of stroke/TIA beneficiaries and 56.4 percent of FFS beneficiaries. Even smaller differences were evident in the distribution by race or by urban/rural residence between the stroke/TIA population and the entire FFS population (Appendix Table B.1-3).

- Stroke/TIA beneficiaries were disproportionately more eligible for Medicaid. In 2001, one-fifth of stroke/TIA beneficiaries were dually enrolled compared with 17 percent of the entire FFS population.

- Twice as many stroke/TIA beneficiaries (2 percent) as the FFS Medicare population (1 percent) had ESRD in 2001.
In 2001, disproportionately more stroke/TIA patients than overall FFS beneficiaries lived in the South (42 percent versus 38 percent), and slightly fewer lived in the West (12 percent versus 15 percent).
III. OVERALL TRENDS IN STROKE-RELATED HOSPITAL DISCHARGES AND OUTCOMES

This report examines discharge rates, Medicare costs, length of stay, readmission rates, and mortality rates, for all beneficiaries hospitalized for stroke/TIA, stroke only, atrial fibrillation, and CEA for the years 1992 to 2001. Hospital discharges for stroke/TIA and stroke only are based on principal diagnosis only while discharges for atrial fibrillation are based on both principal and secondary diagnoses. Discharges for CEA reflect any procedure code for CEA. If a discharge falls into two cohorts, it is included in both cohorts.

Figure III.1. Age-Sex–Adjusted Discharge Rates for Stroke Cohorts, 1992–2001

- The rates of hospital discharges for stroke/TIA, stroke only, and CEA changed little over the years from 1992 to 2001 (Figure III.1). There was a slight rise and fall in the discharge rates for stroke/TIA, peaking in 1996 at 16.6 but then dropping to 15.1 per 1,000 beneficiaries in 2001 (Appendix Table B.1-4).

- Stroke-only discharges accounted for approximately 80 percent of stroke/TIA discharges since 1995 (Appendix Tables B.1-1 for stroke/TIA and B.2-1 for stroke-only).

- The rate of hospital discharges for CEA started at two per 1,000 beneficiaries in 1992, then increased to three per 1,000 beneficiaries in 1995 and stayed stable thereafter (Appendix Table B.4-4).
• Atrial fibrillation discharge rates, which include both principal and secondary diagnoses, are presented at the beneficiary level and show a steady increase over the study period (Figure III.2). From 1992 to 2001, the rate of beneficiaries discharged with atrial fibrillation increased from 25 to 36 per 1,000 beneficiaries, a 45 percent increase (Appendix Table B.3-5).

• The pattern of increasing diagnosis and repeated hospitalization for atrial fibrillation can be seen in the mean number of atrial fibrillation discharges per beneficiary with atrial fibrillation, which rose from 1.31 in 1992 to 1.45 in 2001, an 11 percent increase (Appendix Table B.3-10). In contrast, the mean number of stroke/TIA and CEA discharges per affected beneficiary, respectively, remained virtually unchanged at slightly over 1 (Appendix Tables B.1-10 and B.4-10).

*Rates based on beneficiaries discharged with principal and secondary diagnoses.
Figure III.3. Total Medicare Payments for Stroke Cohort Hospitalizations, 1992–2001

- Following the pattern for discharge rates, total annual Medicare payments for stroke or TIA and stroke only changed little between 1992 and 2001 (Figure III.3). Payments for CEA increased by 47 percent over the period. When adjusted for inflation, costs for each cohort actually declined over the years (not shown).

- Total annual Medicare payments for stroke/TIA hospitalizations increased from $2.5 billion in 1992 to $2.9 billion in 1996, then decreased to $2.5 billion in 2000 (Appendix Table B.1-7). In constant 1992 dollars, payments fell from $2.5 billion in 1992 to $1.6 billion in 2001.

- Total annual Medicare payments for hospitalizations involving CEA increased from $500 million in 1992 to $700 million in 2001 (Appendix Table B.4-7). In constant 1992 dollars, the 2001 payments totaled $400 million.

- Average Medicare payment per stroke/TIA discharge increased by only 5 percent, from $5,073 in 1992 to $5,350 in 2001 (Appendix Table B.1-8). Average payment for CEA saw a similar change, an increase of 5 percent, from $7,459 in 1992 to $7,805 in 2001 (Appendix Table B.4-8).

1 Dollars are adjusted by using the Bureau of Economic Analysis’s personal consumption expenditure index for medical services.
• The small changes in payments per stroke/TIA or CEA discharge contrast sharply with increases in payment for Medicare hospital discharges in general. The average payment for all acute-care Medicare hospital stays increased by 21 percent between 1993 and 1998 (Health Care Financing Review 1995; 2000, Table 26), compared to 3 percent for stroke/TIA and CEA (calculated from Appendix Tables B.1-8 and B.4-8).

• Total beneficiary payments—in the form of coinsurance and deductibles—for stroke/TIA hospitalizations increased by 15 percent over the period, from about $278 million in 1992 to $320 million in 2001 (Appendix Table B.1-9). On the other hand, total beneficiary payments for CEA hospitalizations increased considerably (73 percent), from about $33 million in 1992 to $58 million in 2001 (Appendix Table B.4-9).
Average length of stay declined substantially between 1992 and 2001 for stroke and related conditions (Figure III.4). The largest decline occurred for CEA hospitalizations, a 50 percent drop from 7.4 days in 1992 to 3.7 days in 2001 (Appendix Table B.4-6).

Among the stroke cohorts, average length of stay was highest for atrial fibrillation, at 9.4 days in 1992. It fell to 7.2 days in 1997 and has stayed stable since then.

The reduction in length of stay for stroke/TIA was comparable to the decline in length of stay for overall Medicare hospital stays. From 1993 and 1998, the average length of a Medicare acute-care stay fell by 27 percent from eight to six days (Medicare Statistical Supplement 1995; 2000). During those years, the average stroke/TIA length of stay fell by 33 percent (calculated from Appendix Table B.1-6).
Thirty-day rates of readmission for stroke among beneficiaries who had an index hospitalization (i.e., first hospitalization for stroke/TIA, atrial fibrillation, or CEA in a year) changed little over the study period (Figure III.5). Approximately 25 per 1,000 beneficiaries (or 2.5 percent) discharged for stroke/TIA were readmitted for stroke within one month (Appendix Table B.1-13). For beneficiaries who had been hospitalized with atrial fibrillation, the 30-day stroke readmission rate declined from 8 per 1,000 in 1994 to 7 per 1,000 in 2001 (Appendix Table B.3-13), and for those with CEA, the rates decreased from 11.1 to 10.4 per 1,000 (Appendix Table B.4-13).

Beneficiaries who had been hospitalized for stroke/TIA were more than twice as likely to be readmitted for stroke as those with atrial fibrillation or CEA hospitalizations. Throughout the study period, 30-day stroke readmission rates for stroke/TIA beneficiaries were around 25 per 1,000; for atrial fibrillation and CEA, the rates were around 10 per 1,000 or below.
Figure III.6. Age-Sex-Adjusted 365-Day Stroke Readmission Rates for Stroke Cohorts, 1994–2000

*Hospital discharges based on principal and secondary diagnoses.

- Long-term (180, 365, and 730 days) stroke readmission rates declined somewhat for all stroke cohorts from 1994 to 2000 (Figure III.6). For stroke/TIA beneficiaries, one-year stroke readmission rates declined from 117 to 107 per 1,000 (Appendix Table B.1-13).

- Beneficiaries with atrial fibrillation and CEA had virtually the same one-year stroke readmission rates over the same period, declining from 51 in 1994 to approximately 45 in 2000 (Appendix Tables B.3-13 and B.4-13). Two-year stroke readmission rates fell even further, especially for CEA (Appendix Table B.4-13).
Mortality rates (from any cause) following stroke/TIA and CEA hospitalizations decreased at all window lengths over the period. For example, 30-day mortality rates decreased from 81 to 70 per 1,000 stroke/TIA patient (Figure III.7), and one-year mortality rates fell from 214 to 189 per 1,000 stroke/TIA patient in 2000 (Appendix Table B.1-16).

Mortality rates from CEA hospitalization were also much lower than those of stroke/TIA hospitalization (Figure III.7). Thirty-day mortality rates from CEA decreased from 23 per 1,000 in 1992 to 15 per 1,000 per CEA patient in 2001, and one-year mortality rates fell from 90 per 1,000 in 1992 to 76 per 1,000 CEA patients in 2000 (Appendix Table B.4-16).

Mortality rates increased sharply with age after age 65. For example, in 2001, 30-day Stroke/TIA mortality rates ranged from 41 per 1,000 stroke/TIA patients aged 65-69 to 273 per 1,000 patients aged 95 or above (Appendix Table B.1-16).
IV. GEOGRAPHIC VARIATION IN STROKE-RELATED HOSPITAL DISCHARGES AND OUTCOMES

Hospital discharge rates and outcomes of stroke and related conditions varied by census region and by state but not by urban/rural residence. Geographic variation for a given measure of a specific stroke cohort remained largely consistent throughout the study period; for example, stroke discharge rates were consistently highest in the South and lowest in the West for all of the years.

Figure IV.1. Age-Sex-Adjusted Stroke/TIA Discharge Rates, by State, 2001

- For all of the years between 1992 and 2001, stroke/TIA discharge rates remained highest in the South and lowest in the West (Appendix Table B.1-4). Figure IV.1 illustrates this pattern. Furthermore, while stroke/TIA discharge rates stayed stable or declined in the Northeast, Midwest, and West, the South accounted for a slight increase (Appendix Table B.1-4).

- Both the level and change in stroke/TIA discharge rates varied widely by state. State discharge rates in 2001 ranged from 10 to 21 per 1,000 beneficiaries (Appendix Table B.1-4).
For atrial fibrillation, almost all states in the West fell in the bottom tercile of discharge rates, and some states in the South and Northeast fell in the top tercile (Figure IV.2). State discharge rates in 2001 ranged from 32 to 66 per 1,000 beneficiaries (Appendix Table B.3-4).

The rates increased for all census regions over the period. In each year, the discharge rates were highest in the Northeast, followed closely by the South and Midwest while the rates in the West were much lower (Appendix Table B.3-4).
CEA discharge rates increased from 1992 to 1995 and have stayed generally stable since then in all regions (Figure IV.3). Such a pattern has been reported elsewhere and has been attributed to the success of the operation in clinical trials conducted in the early 1990s (Adams, Hachinski, and Norris 2001, p. 374).
The CEA discharge rates were higher in the South and Midwest and lowest in the West (Figure IV.4). State discharge rates in 2001 ranged from 0.8 to 4.1 per 1,000 beneficiaries (Appendix Table B.4-4).
Average lengths of stay for stroke/TIA hospitalizations were highest and decreased the most in the Northeast, dropping from 11.1 days in 1992 to 5.6 days in 2001. Average lengths of stay were lowest and changed the least over the years in the West, from 5.9 days in 1992 to 4.3 days in 2001.

The same regional pattern held for stroke only (Appendix Table B.2-6), atrial fibrillation (Appendix Table B.3-6), and CEA (Appendix Table B.4-6).
Relatively small differences seem to exist in stroke readmission rates by region for all follow-up window periods. Thirty-day stroke readmission rates for stroke/TIA patients were consistently highest in the South for the study period (Figure IV.6), with the same holding true for long-term readmission rates (Appendix Table B.1-13).

The states showed some variation in 30-day stroke readmission rates for stroke/TIA patients. For example, rates in 2001 ranged from 20 to 35 per 1,000 beneficiaries. However, the variation in 1-year stroke readmission rates was wider, from 76 to 132 per 1,000 beneficiaries (Appendix Table B.1-13).
• All regions saw a steady decline in stroke readmission rates for patients with atrial fibrillation in all follow-up window periods (Appendix Table B.3-13). However, the South recorded the highest rates and saw the least decline in rates between 1994 and 2001 (Figure IV.7).

• In 2000, state variation in one-year stroke readmission rates for atrial fibrillation patients was reflected in rates that ranged from 34 to 68 per 1,000 beneficiaries (Appendix Table B.3-13).

• For CEA, short-term readmission rates by census region fluctuated widely over the years as a consequence of the small numbers of cases. For one-year and two-year follow-up periods, however, the stroke readmission rates steadily declined from 1994 to 2000 (Appendix Table B.4-13).
While the South had the highest stroke/TIA discharges rates in the nation (Figure IV.1), the West as a whole—from 1992 to 1998—exhibited the highest one-year mortality rates following stroke/TIA hospitalizations (Appendix Table B.1-16). In 2000, half the states in the West as well as several Southern states fell in top tercile of one-year mortality rates (Figure IV.8).

In 2000, states’ one-year mortality rates following stroke/TIA hospitalizations varied from 203 to 269 per 1,000 patients (Appendix Table B.1-16).
• The decline in mortality rates following CEA between 1992 and 2000 occurred in all regions but most markedly in the South (Figure IV.9). The rates in 2000 were similar in all four regions, ranging from 73 to 77 per 1,000 patients.

• Even though regional mortality rates were similar, state rates showed wide variation. One-year mortality rates following CEA varied from 44 to 101 per 1,000 patients among 38 states with at least 25 deaths (Appendix Table B.4-16).
V. DISPARITY IN STROKE-RELATED HOSPITAL DISCHARGES AND OUTCOMES

Hospital outcomes for stroke and related conditions exhibit notable disparities when examined by beneficiary’s demographic characteristics. In general, older age is associated with worse outcomes, i.e., higher readmission and mortality rates. The following discussion places emphasis on disparities by gender, race, and dual Medicaid eligibility status. The accompanying figures present disparity ratios, computed as the ratio of a rate for one subgroup to that of the comparison subgroup. The disparity ratios changed little for most outcomes from 1992 to 2001.

Figure V.1. Female-to-Male Ratio of Discharge Rates for Stroke Cohorts, 1992–2001*

- Women registered lower discharge rates than men for stroke and related conditions as demonstrated by female-to-male ratios of less than 1 (Figure V.1).
- For stroke/TIA, the ratios were approaching 1 in more recent years as men’s stroke/TIA discharge rates decreased at 3 percent over the years while women’s stroke/TIA discharge rates increased at 3 percent (Appendix Table B.1-4).
- The biggest disparity observed was for CEA, in that women had the procedure at a rate of 60 percent below that of men’s. This discrepancy is reported elsewhere and is thought to reflect the younger age of men who develop atherosclerotic disease at the internal carotid artery (Adams, Hachinski and Norris 2001, p.374), suggesting that severity of disease at a given age is more severe among men.

*Hospital discharges based on principal and secondary diagnoses.

MQMS: Stroke
The CEA discharge rate for men was 3.8 per 1,000 and for women was 2.2 per 1,000 in 2001 (Appendix Table B.4-4).
The discharge rates for stroke cohorts revealed notable differences by race. Blacks were more likely than whites to have stroke/TIA discharges but less likely to have atrial fibrillation and CEA discharges (Figure V.2). In 2001, 3 in 1,000 white beneficiaries underwent CEA while 1 in 1,000 black beneficiaries took advantage of the procedure (Appendix Table B.4-4).
• Stroke/TIA and atrial fibrillation discharge rates among dual eligibles were much higher than among nondual eligibles while CEA discharge rates were lower among dual eligibles (Figure V.3). However, the disparity ratios for CEA were approaching 1 in more recent years as the rate of CEA among dual eligibles was increasing at a faster rate (53 percent) than among nondual eligibles (42 percent) (Appendix Table B.4-4).

*Hospital discharges based on principal and secondary diagnoses.
Gender differences in short-term stroke readmission rates among stroke/TIA patients were small as evidenced by the disparity ratios of around 1 (Figure V.4), but women accounted for more long-term readmissions than men (Appendix Table B.1-13).

Female atrial fibrillation and CEA patients were readmitted for stroke at substantially higher rates than male patients (Figure V.4) for all follow-up window periods (Appendix Tables B.3-13 and B.4-13).
Black beneficiaries (and beneficiaries of other race as well) with stroke/TIA, atrial fibrillation, and CEA were all readmitted for stroke at higher rates than their white counterparts (Figure V.5) for all follow-up window periods (Appendix Tables B.1-13, B.3-13, and B.4-13) and for all of the years from 1994 to 2001.

A similar pattern held for Medicaid eligibility status. Beneficiaries who were dually eligible were consistently more likely to be readmitted for stroke than nondual eligibles for all three conditions/procedures over the years and for all follow-up periods (Appendix Tables B.1-13, B.3-13, and B.4-13).

*Hospital discharges based on principal and secondary diagnoses.
• For mortality (from any cause) following stroke/TIA or CEA, women fared slightly better than men. In 2001, one-year mortality among stroke/TIA male patients was 195 per 1,000 male patients and 184 per 1,000 among female patients. Following CEA, the mortality rates were 81 and 72 per 1,000 patients, respectively, among men and women.
As with readmission rates, black beneficiaries (and beneficiaries of other races as well) had higher mortality rates than white beneficiaries following stroke/TIA or CEA (Figure V.7) for all follow-up window periods (Appendix Tables B.1-16, B.3-16, and B.4-16) and for all of the years from 1992 to 2001.

A similar pattern held for Medicaid eligibility status but at higher disparity ratios, which continued to increase in more recent years. Beneficiaries who were dually eligible had higher mortality rates than nondual eligibles—30 percent higher for stroke/TIA and 50 percent higher for CEA in 2001.
VI. DISCUSSION

Discharge rates from stroke/TIA were the same in 1992 and 2001 (after a slight peak in 1996), but long-term readmission rates for stroke, and mortality following stroke/TIA hospitalization declined slightly over the 10-year period of study while the average length of stay declined by more than three days (about 40 percent). These results are similar to the findings from a study that analyzed a national hospital discharge database covering multiple years up to 1997 (Fang and Alderman 2001). Discharge rates for atrial fibrillation (based on both principal and secondary diagnoses) increased considerably over the study years, and the rate of CEA jumped between 1994 and 1995 and remained generally stable thereafter. Despite rapid decreases in length of stay, there appeared to be improved outcomes in terms of readmission and mortality.

The results for stroke/TIA seem to indicate a somewhat better treatment of stroke over time but not improved prevention. On the other hand, it may be that despite better prevention, patients with cerebrovascular or cardiovascular events are surviving longer, placing them at risk for a stroke hospitalization or an atrial fibrillation diagnosis. At any rate, results showing no or little reduction in stroke discharges are discouraging and puzzling when medical communities have launched huge efforts to fight stroke and previously succeeded in making advances in its treatment.

Discharge rates for stroke were consistently high in the South, as has been well documented. The large differences across states in readmissions and deaths suggests that stroke patients in some states appear to be at substantially higher risk of poor outcomes than are beneficiaries in other states. Higher mortality following stroke/TIA in the South as well as in several Western states is supported by a recently published atlas of stroke mortality, which is based on death certificate data (Casper et al. 2003).

The findings of racial and possibly economic disparities (represented by dually eligible for Medicaid) in stroke outcomes suggest that the disparities did not diminish at all over the years and thus point to a persistent health care problem for the nation, even among Medicare beneficiaries (who all have the same basic coverage).

The health outcome measures presented in this report are adjusted for age and sex differences between groups. However, age-sex adjustment is not considered sufficient to interpret the findings on trends over time, across geographic region, and between demographic subgroups as evidence of differences in the quality of care received. Risk adjustment of the outcome measures would provide more interpretable results but would present an enormous challenge given that the current MQMS database is based solely on claims data.

Future MQMS reports on stroke will include an analysis of variations in the duration from discharge to either readmission or death, helping to identify more precisely state variation in adverse outcomes. Considerations for future analytic improvement include correlating the MQMS trends with process-of-care trends and linking with post-discharge ambulatory care, which has implications for readmissions and mortality.
Further research is needed to identify possible explanations and solutions to some of these stroke-related problems. At the least, the research should examine differences in comorbidities, severity of illness, the availability of outpatient management for stroke, and provider characteristics across subgroups of interest. As one medical commentator put it, “the clinical and research communities need to continue their aggressive fight against the scourge of stroke” and “to continue to monitor both the successes and failures, as the battle against stroke continues” (Tu 2001).
REFERENCES


______. *1995 Statistical Supplement.*

Tu, J.V. “Are We Winning the Battle Against Stroke?” Editorial Comment. *Stroke*, vol. 32, p. 2226.
APPENDIX A

STROKE SPECIFICATIONS
# A. STROKE DISCHARGE RATES, LENGTH OF STAY, AND COST (M4)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Rate of discharges from short-stay hospitals for the following stroke cohorts:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1) A principal diagnosis of stroke/TIA;</td>
</tr>
<tr>
<td></td>
<td>2) A principal diagnosis of stroke;</td>
</tr>
<tr>
<td></td>
<td>3) A principal or secondary diagnosis of atrial fibrillation; and</td>
</tr>
<tr>
<td></td>
<td>4) Any procedure code indicating carotid endarterectomy (CEA)</td>
</tr>
</tbody>
</table>

| Case Definition | Stroke-cohort discharges are defined as claims with diagnosis or procedure codes as specified in Appendix C. Claims that reflect transfers (within one day) from acute-care, short-stay hospitals to other acute-care, short-stay hospitals were combined with the claim for the original hospital admission, using the diagnosis codes from the later admission. |

| Population | Beneficiaries eligible for Medicare in January of each calendar year, enrolled in Part A for the full year, and not enrolled in Medicare managed care at any point in the year. Beneficiaries who died during the calendar year but who would have qualified otherwise are included. |

| Computation | Numerator:  

- **Discharge level**: Number of stroke-cohort discharges  
- **Beneficiary level**: Number of beneficiaries with at least one stroke-cohort discharge  

Denominator: Number of beneficiaries in the population  
Rates are expressed in thousands. |

| Rationale | Description of utilization for stroke |

| Data Sources | MedPAR File  
Denominator File  
CMS Cross-Reference File |

| Exclusions | Missing or invalid values for state, sex, race, Medicare status  
Discharges from all hospitals other than short-stay hospitals  
Duplicate records  
Discharges from stand-alone emergency rooms |
<table>
<thead>
<tr>
<th><strong>Discharges with invalid procedure codes</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharges for Medicare beneficiaries whose Health Insurance Claim Number (HICNO) does not have a match in CMS’s Cross-Reference File</td>
</tr>
<tr>
<td>Overlapping beneficiary acute-care, short-stay hospital claims</td>
</tr>
<tr>
<td><strong>Adjustment</strong></td>
</tr>
<tr>
<td>Rates are age-sex–adjusted by using the Medicare Part A FFS population as of July 1, 1999, as the standard population.</td>
</tr>
<tr>
<td>National results are standardized with 18 age/sex groups using direct standardization. State results are standardized using indirect standardization due to smaller sample sizes. Both methods are described in Anderson et al. (1998). The direct standardization method computes the weighted sum of the mean outcomes across the age-sex cells, using the proportion of the standard population in each cell as the weights. The indirect method, which is necessary when some age-sex cells are empty, is a ratio estimate in which the mean for the group of interest is estimated by multiplying the standard population mean by the ratio of the observed outcome for the population of interest to the expected outcome. The expected outcome is the weighted sum of outcomes for the standard population across the age-sex cells, using the distribution of the population of interest as the weights. Given the use of two standardization methods, state results are not directly comparable to national results.</td>
</tr>
<tr>
<td><strong>Period</strong></td>
</tr>
<tr>
<td>1992–2001</td>
</tr>
<tr>
<td><strong>Stratifiers</strong></td>
</tr>
<tr>
<td>Age (0–54, 55–64, 65–69, 70–74, 75–79, 80–84, 85–89, 90–94, 95+) on July 1 of the reference year</td>
</tr>
<tr>
<td>Race (white, black, other)</td>
</tr>
<tr>
<td>Sex</td>
</tr>
<tr>
<td><strong>Reason for Medicare eligibility</strong> (aged without end-state renal disease [ESRD], disabled without ESRD, ESRD)</td>
</tr>
<tr>
<td><strong>Dual enrollment</strong> defined as enrolled in Medicare Part A and with Medicaid buy-in at least one month during the calendar year.*</td>
</tr>
<tr>
<td><strong>Urban/rural</strong> based on the metropolitan statistical area (MSA) and Bureau of Economic Analysis (BEA) State and County Crosswalk File developed for the CMS Prospective Payment System. All counties in an MSA are designated as urban; all other counties are considered rural.</td>
</tr>
<tr>
<td><strong>Census region</strong> of the beneficiary’s residence on March 31 of</td>
</tr>
</tbody>
</table>

*Appendix A: Stroke Specifications*
the year following the reference year

**State** of the beneficiary’s residence on March 31 of the year following the reference year

* The Medicare data do not record true dual-enrollment status but only whether a state Medicaid program pays the beneficiary’s Medicare premiums, copayments, and deductibles. The payment of these Medicare expenses by Medicaid does not always translate into full Medicaid coverage. Nevertheless, the buy-in indicator in the Medicare data is a reasonably accurate indicator of beneficiary poverty.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Average length of stay per stroke-cohort discharge in short-stay hospitals, measured in days</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Case Definition</strong></td>
<td>Stroke-cohort discharges are defined as claims with diagnosis or procedure codes as specified in Appendix C. Claims that reflect transfers (within one day) from acute-care, short-stay hospitals to other acute-care, short-stay hospitals were combined with the claim for the original hospital admission, using the diagnosis codes from the later admission.</td>
</tr>
<tr>
<td><strong>Population</strong></td>
<td>Beneficiaries eligible for Medicare in January of each calendar year, enrolled in Part A for the full year, and not enrolled in Medicare managed care at any point in the year and who had at least one stroke-cohort discharge. Beneficiaries who died during the calendar year but who would have otherwise qualified are included.</td>
</tr>
<tr>
<td><strong>Computation</strong></td>
<td>Numerator: Sum of days for stroke-cohort hospitalization, based on admission and discharge date, with a maximum of 90 days Denominator: Number of stroke-cohort discharges in the population</td>
</tr>
<tr>
<td><strong>Rationale</strong></td>
<td>Description of stroke utilization</td>
</tr>
<tr>
<td><strong>Data Sources</strong></td>
<td>MedPAR File Denominator File CMS Cross-Reference File</td>
</tr>
<tr>
<td><strong>Exclusions</strong></td>
<td>Missing or invalid values for state, sex, race, Medicare status Discharges from all hospitals other than short-stay hospitals Duplicate records</td>
</tr>
</tbody>
</table>

*Appendix A: Stroke Specifications*
| Discharges from stand-alone emergency rooms |
| Discharges with invalid procedure codes |
| Discharges for Medicare beneficiaries whose Health Insurance Claim Number (HICNO) does not have a match in CMS’s Cross-Reference File |
| Overlapping beneficiary acute-care, short-stay hospital claims |

**Adjustment**

Length of stay is age-sex–adjusted using the Medicare Part A FFS population as of July 1, 1999, as the standard population.

National results are standardized with 18 age/sex groups using direct standardization. State results are standardized using indirect standardization due to smaller sample sizes. Both methods are described in Anderson et al. (1998). The direct standardization method computes the weighted sum of the mean outcomes across the age-sex cells, using the proportion of the standard population in each cell as the weights. The indirect method, which is necessary when some age-sex cells are empty, is a ratio estimate in which the mean for the group of interest is estimated by multiplying the standard population mean by the ratio of the observed outcome for the population of interest to the expected outcome. The expected outcome is the weighted sum of outcomes for the standard population across the age-sex cells, using the distribution of the population of interest as the weights. Given the use of two standardization methods, state results are not directly comparable to national results.

**Period**

1992–2001

**Stratifiers**

- **Age** (0–54, 55–64, 65–69, 70–74, 75–79, 80–84, 85–89, 90–94, 95+) on July 1 of the reference year
- **Race** (white, black, other)
- **Sex**
- **Reason for Medicare eligibility** (aged without ESRD, disabled without ESRD, ESRD)
- **Dual enrollment** defined as enrolled in Medicare Part A and with Medicaid buy-in at least one month during the calendar year.*
- **Urban/rural** based on the metropolitan statistical area (MSA) and Bureau of Economic Analysis (BEA) State and County Crosswalk File developed for the CMS Prospective Payment System. All counties in an MSA are designated as
urban; all other counties are considered rural.

**Census region** of the provider state, based on the MedPAR provider ID

**State** of the provider state, based on the MedPAR provider ID

* The Medicare data do not record true dual-enrollment status but only whether a state Medicaid program pays the beneficiary’s Medicare premiums, copayments, and deductibles. The payment of these Medicare expenses by Medicaid does not always translate into full Medicaid coverage. Nevertheless, the buy-in indicator in the Medicare data is a reasonably accurate indicator of beneficiary poverty.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Medicare and beneficiary payments for stroke-cohort discharges</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Case Definition</strong></td>
<td>Stroke-cohort discharges are defined as claims with diagnosis or procedure codes as specified in Appendix C. Claims that reflect transfers (within one day) from acute-care, short-stay hospitals to other acute-care, short-stay hospitals were combined with the claim for the original hospital admission, using the diagnosis codes from the later admission.</td>
</tr>
<tr>
<td><strong>Population</strong></td>
<td>Beneficiaries eligible for Medicare in January of each calendar year, enrolled in Part A for the full year, and not enrolled in Medicare managed care at any point in the year and who had a stroke-cohort discharge. Beneficiaries who died during the calendar year but who would have qualified otherwise are included.</td>
</tr>
<tr>
<td><strong>Computation</strong></td>
<td>Total Medicare payments: Sum of Medicare program payments for all stroke discharges in the population Total beneficiary payments: Sum of beneficiary coinsurance and deductible payments for all stroke discharges in the population Average Medicare payments per discharge: Numerator: Sum of Medicare payments for stroke-cohort discharges in the population Denominator: Number of stroke-cohort discharges in the population Note: In cases of hospital transfers, only payments from the second hospitalization are included in totals.</td>
</tr>
</tbody>
</table>
## Appendix A: Stroke Specifications

<table>
<thead>
<tr>
<th>Rationale</th>
<th>Description of stroke utilization</th>
</tr>
</thead>
</table>
| **Data Sources** | MedPAR File  
Denominator File  
CMS Cross-Reference File |
| **Exclusions** | Missing or invalid values for state, sex, race, Medicare status  
Discharges from all hospitals other than short-stay hospitals  
Duplicate records  
Discharges from stand-alone emergency rooms  
Discharges with invalid procedure codes  
Discharges for Medicare beneficiaries whose Health Insurance Claim Number (HICNO) does not have a match in CMS’s Cross-Reference File  
Overlapping beneficiary acute-care, short-stay hospital claims |
| **Adjustment** | None |
| **Period** | 1992–2001 |
| **Stratifiers** | **Age** (0–54, 55–64, 65–69, 70–74, 75–79, 80–84, 85–89, 90–94, 95+) on July 1 of the reference year  
**Race** (white, black, other)  
**Sex**  
**Reason for Medicare eligibility** (aged without ESRD, disabled without ESRD, ESRD)  
**Dual enrollment** defined as enrolled in Medicare Part A and with Medicaid buy-in at least one month during the calendar year.*  
**Urban/rural** based on the metropolitan statistical area (MSA) and Bureau of Economic Analysis (BEA) State and County Crosswalk File developed for the CMS Prospective Payment System. All counties in an MSA are designated as urban; all other counties are considered rural.  
**Census region** of the provider state, based on the MedPAR provider ID, for Medicare Payments, and of the beneficiary state, as of March 31 of the year following the reference year, for beneficiary payments  
**State** of the provider state, based on the MedPAR provider ID, for Medicare Payments, and of the beneficiary state, as of March 31 of the year following the reference year, for beneficiary payments |
March 31 of the year following the reference year, for Beneficiary Payments

* The Medicare data do not record true dual-enrollment status but only whether a state Medicaid program pays the beneficiary’s Medicare premiums, copayments, and deductibles. The payment of these Medicare expenses by Medicaid does not always translate into full Medicaid coverage. Nevertheless, the buy-in indicator in the Medicare data is a reasonably accurate indicator of beneficiary poverty.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Average number of discharges (all-cause and stroke-cohort–specific) among beneficiaries with at least one stroke-cohort discharge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case Definition</td>
<td>Stroke-cohort discharges are defined as claims with diagnosis or procedure codes as specified in Appendix C. Claims that reflect transfers (within one day) from acute-care, short-stay hospitals to other acute-care, short-stay hospitals were combined with the claim for the original hospital admission, using the diagnosis codes from the later admission.</td>
</tr>
<tr>
<td>Population</td>
<td>Beneficiaries eligible for Medicare in January of each calendar year, enrolled in Part A for the full year, and not enrolled in Medicare managed care at any point in the year and who had a stroke-cohort discharge. Beneficiaries who died during the calendar year but who would have qualified otherwise are included.</td>
</tr>
</tbody>
</table>
| Computation | Numerator:

Stroke cohort: Number of stroke-cohort (i.e., stroke/TIA, atrial fibrillation, and CEA as separate cohorts) discharges in reference year

All-cause: Number of all discharges in reference year

Denominator: Number of stroke-cohort beneficiaries in the population |
| Rationale | Description of stroke utilization |
| Data Sources | MedPAR File  
Denominator File  
CMS Cross-Reference File |
| Exclusions | Missing or invalid values for state, sex, race, Medicare status  
Discharges from all hospitals other than short-stay hospitals |

Appendix A: Stroke Specifications
## Appendix A: Stroke Specifications

| **Adjustment** | None |
| **Period**     | 1992–2001 |
| **Stratifiers** | **Age** (0–54, 55–64, 65–69, 70–74, 75–79, 80–84, 85–89, 90–94, 95+) on July 1 of the reference year  
**Race** (white, black, other)  
**Sex**  
**Reason for Medicare eligibility** (aged without ESRD, disabled without ESRD, ESRD)  
**Dual enrollment** defined as enrolled in Medicare Part A and with Medicaid buy-in at least one month during the calendar year.*  
**Urban/rural** based on the metropolitan statistical area (MSA) and Bureau of Economic Analysis (BEA) State and County Crosswalk File developed for the CMS Prospective Payment System. All counties in an MSA are designated as urban; all other counties are considered rural.  
**Census region** of the beneficiary residence, as of March 31 of the year following the reference year  
**State** of the beneficiary residence, as of March 31 of the year following the reference year  
* The Medicare data do not record true dual-enrollment status but only whether a state Medicaid program pays the beneficiary’s Medicare premiums, copayments, and deductibles. The payment of these Medicare expenses by Medicaid does not always translate into full Medicaid coverage. Nevertheless, the buy-in indicator in the Medicare data is a reasonably accurate indicator of beneficiary poverty. |

---

*The Medicare data do not record true dual-enrollment status but only whether a state Medicaid program pays the beneficiary’s Medicare premiums, copayments, and deductibles. The payment of these Medicare expenses by Medicaid does not always translate into full Medicaid coverage. Nevertheless, the buy-in indicator in the Medicare data is a reasonably accurate indicator of beneficiary poverty.*
## B. SPECIFICATIONS FOR READMISSION RATES (M5)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Beneficiary and discharge-level readmission rates following discharges for stroke/TIA, atrial fibrillation, and CEA, by type of readmission (stroke or all-cause) and by days from discharge (2, 7, 30, 180, 365, and 730)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case Definition</td>
<td>Stroke-cohort discharges are defined as claims with diagnosis or procedure codes as specified in Appendix C. Claims that reflect transfers (within one day) from acute-care, short-stay hospitals to other acute-care, short-stay hospitals were combined with the claim for the original hospital admission, using the diagnosis codes from the later admission.</td>
</tr>
<tr>
<td>Population</td>
<td>Medicare beneficiaries eligible for Medicare in January of each calendar year and enrolled in Part A and FFS for the full calendar year and who had a stroke-cohort discharge. Beneficiaries who died during the calendar year but who would have qualified otherwise are included.</td>
</tr>
</tbody>
</table>
| Computation | **Beneficiary:**

  Numerator: Number of beneficiaries hospitalized for all causes/for stroke only within 2, 7, 30, 180, 365, or 730 days of first stroke-cohort discharge in the reference year

  Denominator: Number of beneficiaries with at least one stroke-cohort discharge

**Discharge:**

  Numerator: Number of beneficiaries hospitalized for all causes/for stroke only within 2, 7, 30, 180, 365, or 730 days of each index stroke-cohort discharge in the reference year

  Denominator: Number of stroke-cohort discharges in the reference year

  All-cause readmission rates are computed only for stroke/TIA while stroke only readmission rates are computed for stroke/TIA, atrial fibrillation, and CEA.

  Readmission windows for CEA are measured from the day of surgery, not discharge.

  Rates are expressed in thousands. Rates with numerators of 25 or less are suppressed in tables.

  Beneficiary rates use the first stroke-cohort admission as the index admission; discharge rates use each stroke-cohort admission.
admission as an index admission.

Readmissions include same-day readmissions to the same facility. Maryland readmission rates may not be comparable to those in other states. Maryland is the only state with a waiver from the CMS's prospective payment system. Due to Maryland's all-payer system, transfers may have been counted as readmissions, inflating readmission rates, especially short-term rates.

Rates do not include beneficiaries who entered managed care or died within the window follow-up period.

Readmissions are classified by the state of the index admission provider state, regardless of where the readmission occurs.

<table>
<thead>
<tr>
<th>Rationale</th>
<th>Description of stroke outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Sources</td>
<td>MedPAR File</td>
</tr>
<tr>
<td></td>
<td>Denominator File</td>
</tr>
<tr>
<td></td>
<td>CMS Cross-Reference File</td>
</tr>
<tr>
<td>Exclusions</td>
<td>Missing or invalid values for state, sex, race, Medicare status</td>
</tr>
<tr>
<td></td>
<td>Discharges from all hospitals other than short-stay hospitals</td>
</tr>
<tr>
<td></td>
<td>Duplicate records</td>
</tr>
<tr>
<td></td>
<td>Discharges from stand-alone emergency rooms</td>
</tr>
<tr>
<td></td>
<td>Discharges with invalid procedure codes</td>
</tr>
<tr>
<td></td>
<td>Discharges for Medicare beneficiaries whose Health Insurance Claim Number (HICNO) does not have a match in CMS’s Cross-Reference File</td>
</tr>
<tr>
<td></td>
<td>Overlapping beneficiary acute-care, short-stay hospital claims</td>
</tr>
<tr>
<td>Adjustment</td>
<td>Rates are age-sex-adjusted using the Medicare Part A FFS population as of July 1, 1999, as the standard population.</td>
</tr>
<tr>
<td></td>
<td>National results are standardized with 18 age/sex groups using direct standardization. State results are standardized using indirect standardization due to smaller sample sizes. Both methods are described in Anderson et al. (1998). The direct standardization method computes the weighted sum of the mean outcomes across the age-sex cells, using the proportion of the standard population in each cell as the weights. The indirect method, which is necessary when some age-sex cells are empty, is a ratio estimate in which the mean for the group of interest is estimated by multiplying the standard population mean by the ratio of the observed</td>
</tr>
</tbody>
</table>
outcome for the population of interest to the expected outcome. The expected outcome is the weighted sum of outcomes for the standard population across the age-sex cells, using the distribution of the population of interest as the weights. Given the use of two standardization methods, state results are not directly comparable to national results.

| Period | 1992-2001 for all-cause readmission  
1994–2001 for stroke only readmission due to coding inconsistencies for stroke-only prior to 1994. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stratifiers Age</td>
<td>0-54, 55–64, 65–69, 70–74, 75–79, 80–84, 85–89, 90–94, 95+) on July 1 of the reference year</td>
</tr>
<tr>
<td>Race</td>
<td>(white, black, other)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Reason for Medicare eligibility</td>
<td>(aged without ESRD, disabled without ESRD, ESRD)</td>
</tr>
<tr>
<td>Dual enrollment</td>
<td>defined as enrolled in Medicare Part A and with Medicaid buy-in at least one month during the calendar year.*</td>
</tr>
<tr>
<td>Urban/rural</td>
<td>based on the metropolitan statistical area (MSA) and Bureau of Economic Analysis (BEA) State and County Crosswalk File developed for the CMS Prospective Payment System. All counties in an MSA are designated as urban; all other counties are considered rural.</td>
</tr>
<tr>
<td>Census region</td>
<td>of the provider state, based on the MedPAR provider ID</td>
</tr>
<tr>
<td>State</td>
<td>of the provider state, based on the MedPAR provider ID</td>
</tr>
</tbody>
</table>

* The Medicare data do not record true dual-enrollment status but only whether a state Medicaid program pays the beneficiary’s Medicare premiums, copayments, and deductibles. The payment of these Medicare expenses by Medicaid does not always translate into full Medicaid coverage. Nevertheless, the buy-in indicator in the Medicare data is a reasonably accurate indicator of beneficiary poverty.

Appendix A: Stroke Specifications
C. SPECIFICATIONS FOR MORTALITY RATES (M6)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Mortality rates among beneficiaries with a hospitalization for stroke/TIA and CEA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Case Definition</strong></td>
<td>Stroke-cohort discharges are defined as claims with diagnosis or procedure codes as specified in Appendix C. Claims that reflect transfers (within one day) from acute-care, short-stay hospitals to other acute-care, short-stay hospitals were combined with the claim for the original hospital admission, using the diagnosis codes from the later admission.</td>
</tr>
<tr>
<td><strong>Population</strong></td>
<td>Medicare beneficiaries eligible for Medicare in January of each calendar year and enrolled in Part A and FFS for the full calendar year and who had a stroke-cohort hospitalization. Beneficiaries who died during the calendar year but who would have qualified otherwise are included.</td>
</tr>
<tr>
<td><strong>Computation</strong></td>
<td>Numerator: Number of beneficiaries who died within 2, 30, 180, 365, or 730 days from the day of the first (index) admission for stroke (and CEA) in the year Denominator: Number of beneficiaries with stroke/TIA (and CEA) discharges in the reference year Mortality windows for CEA are measured from the day of surgery, not admission. Rates are expressed in thousands. Rates with numerators of 25 or less are suppressed in tables. Rates do not include beneficiaries who switched to managed care within the window follow-up period.</td>
</tr>
<tr>
<td><strong>Rationale</strong></td>
<td>Description of stroke outcomes</td>
</tr>
<tr>
<td><strong>Data Sources</strong></td>
<td>MedPAR File Denominator File CMS Cross-Reference File</td>
</tr>
<tr>
<td><strong>Exclusions</strong></td>
<td>Missing or invalid values for state, sex, race, Medicare status Discharges from all hospitals other than short-stay hospitals Duplicate records Discharges from stand-alone emergency rooms Discharges with invalid procedure codes Discharges for Medicare beneficiaries whose Health Insurance Claim Number (HICNO) does not have a match in CMS’s Cross-Reference File</td>
</tr>
<tr>
<td><strong>Adjustment</strong></td>
<td>Rates are age-sex-adjusted using the Medicare Part A FFS population as of July 1, 1999, as the standard population. National results are standardized with 18 age/sex groups using direct standardization. State results are standardized using indirect standardization due to smaller sample sizes. Both methods are described in Anderson et al. (1998). The direct standardization method computes the weighted sum of the mean outcomes across the age-sex cells, using the proportion of the standard population in each cell as the weights. The indirect method, which is necessary when some age-sex cells are empty, is a ratio estimate in which the mean for the group of interest is estimated by multiplying the standard population mean by the ratio of the observed outcome for the population of interest to the expected outcome. The expected outcome is the weighted sum of outcomes for the standard population across the age-sex cells, using the distribution of the population of interest as the weights. Given the use of two standardization methods, state results are not directly comparable to national results.</td>
</tr>
<tr>
<td><strong>Period</strong></td>
<td>1992–2001</td>
</tr>
<tr>
<td><strong>Stratifiers</strong></td>
<td><strong>Age</strong> (0–54, 55–64, 65–69, 70–74, 75–79, 80–84, 85–89, 90–94, 95+) on July 1 of the reference year  <strong>Race</strong> (white, black, other)  <strong>Sex</strong>  <strong>Reason for Medicare eligibility</strong> (aged without ESRD, disabled without ESRD, ESRD)  <strong>Dual enrollment</strong> defined as enrolled in Medicare Part A and with Medicaid buy-in at least one month during the calendar year.*  <strong>Urban/rural</strong> based on the metropolitan statistical area (MSA) and Bureau of Economic Analysis (BEA) State and County Crosswalk File developed for the CMS Prospective Payment System. All counties in an MSA are designated as urban; all other counties are considered rural.  <strong>Census region</strong> of the provider state, based on the MedPAR provider ID  <strong>State</strong> of the provider state, based on the MedPAR provider ID</td>
</tr>
</tbody>
</table>

* The Medicare data do not record true dual-enrollment status but only whether a state Medicaid program pays the
beneficiary’s Medicare premiums, copayments, and deductibles. The payment of these Medicare expenses by Medicaid does not always translate into full Medicaid coverage. Nevertheless, the buy-in indicator in the Medicare data is a reasonably accurate indicator of beneficiary poverty.