

## NATIONAL QUALITY FORUM

### Measure Submission and Evaluation Worksheet 5.0

This form contains the information submitted by measure developers/stewards, organized according to NQF's measure evaluation criteria and process. The evaluation criteria, evaluation guidance documents, and a blank online submission form are available on the [submitting standards web page](#).

<b>NQF #:</b> 2027	<b>NQF Project:</b> <a href="#">Neurology Project</a>
(for Endorsement Maintenance Review)	
<b>Original Endorsement Date:</b> <b>Most Recent Endorsement Date:</b> <b>Last Updated Date:</b> <a href="#">May 02, 2016</a>	
<b>BRIEF MEASURE INFORMATION</b>	
<b>De.1 Measure Title:</b> <a href="#">Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization</a>	
<b>Co.1.1 Measure Steward:</b> <a href="#">Centers for Medicare &amp; Medicaid Services</a>	
<b>De.2 Brief Description of Measure:</b> <a href="#">The measure estimates a hospital-level risk-standardized readmission rate (RSRR) for patients 18 and older discharged from the hospital with a principal diagnosis of acute ischemic stroke. The outcome is defined as readmission for any cause within 30 days of the date of discharge of the index stroke admission, excluding a specified set of planned readmissions.</a>	
<b>2a1.1 Numerator Statement:</b> <a href="#">The outcome for this measure is 30-day readmission. We define readmission as an inpatient admission for any cause, with the exception of certain planned readmissions, within 30 days from the date of discharge for patients 18 and older discharged from the hospital with a principal diagnosis of ischemic stroke. If a patient has one or more admissions (for any reason) within 30 days after discharge from the index admission, only one is counted as a readmission. For more details on how planned readmissions were identified and removed from the outcome, please refer to the attached report, Re-specifying the Hospital 30-Day Ischemic Stroke Readmission Measure by adding a Planned Readmission Algorithm.</a>	
<b>2a1.4 Denominator Statement:</b> <a href="#">This claims-based measure can be used in either of two patient cohorts: (1) patients aged 65 years or older or (2) patients aged 18 years or older. We have explicitly tested the measure in both age groups.</a>  <a href="#">The cohort includes admissions for patients age 65 years or older discharged from the hospital with a principal diagnosis of ischemic stroke (ICD-9-CM codes 433.x1, 434.x1, 436) and with a complete claims history for the 12 months prior to admission.</a>	
<b>2a1.8 Denominator Exclusions:</b> <a href="#">An index admission is the hospitalization considered for the readmission outcome (readmitted within 30 days of the date of discharge from the initial admission). The measure excludes admissions for patients:</a> <ul style="list-style-type: none"><li><a href="#">• with an in hospital death (because they are not eligible for readmission).</a></li><li><a href="#">• transferred to another acute care facility (because the readmission is attributed to the hospital that discharges the patient to a non-acute setting).</a></li><li><a href="#">• discharged alive and against medical advice (AMA) (because providers did not have the opportunity to deliver full care and prepare the patient for discharge).</a></li><li><a href="#">• without at least 30 days post-discharge claims data (because the 30-day readmission outcome cannot be assessed in this group).</a></li></ul> <a href="#">In addition, if a patient has more than one admission within 30 days of discharge from the index admission, only one is counted as a readmission, as we are interested in a dichotomous yes/no readmission outcome,</a>	

as opposed to the number of readmissions. No admissions within 30 days of discharge from an index admission are considered as additional index admissions, thus no hospitalization will be counted as both a readmission and an index admission. The next eligible index admission is 30 days after the discharge date of the previous index admission.

**1.1 Measure Type:** Outcome

**2a1. 25-26 Data Source:** Administrative claims

**2a1.33 Level of Analysis:** Facility

**1.2-1.4 Is this measure paired with another measure?** No

**De.3 If included in a composite, please identify the composite measure (title and NQF number if endorsed):**

This measure is not formally paired with another measure, however this measure is harmonized with a measure of hospital-level, all-cause, 30-day, risk-standardized mortality following an ischemic stroke hospitalization.

#### STAFF NOTES (issues or questions regarding any criteria)

**Comments on Conditions for Consideration:**

**Is the measure untested?** Yes ☐ No ☒ If untested, explain how it meets criteria for consideration for time-limited endorsement:

**1a. Specific national health goal/priority identified by DHHS or NPP addressed by the measure (check De.5):**

**5. Similar/related endorsed or submitted measures (check 5.1):**

**Other Criteria:**

**Staff Reviewer Name(s):**

#### 1. IMPACT, OPPORTUNITY, EVIDENCE - IMPORTANCE TO MEASURE AND REPORT

Importance to Measure and Report is a threshold criterion that must be met in order to recommend a measure for endorsement. All three subcriteria must be met to pass this criterion. See [guidance on evidence](#).

**Measures must be judged to be important to measure and report in order to be evaluated against the remaining criteria. (evaluation criteria)**

**1a. High Impact:** H ☒ M ☒ L ☐ I ☐ NA ☐

(The measure directly addresses a specific national health goal/priority identified by DHHS or NPP, or some other high impact aspect of healthcare.)

**De.4 Subject/Topic Areas (Check all the areas that apply):** Neurology, Neurology : Stroke/Transient Ischemic Attack (TIA)

**De.5 Cross Cutting Areas (Check all the areas that apply):** Care Coordination : Readmissions, Safety : Readmissions

**1a.1 Demonstrated High Impact Aspect of Healthcare:** Affects large numbers, A leading cause of morbidity/mortality, High resource use, Patient/societal consequences of poor quality, Severity of illness

**1a.2 If "Other," please describe:**

**1a.3 Summary of Evidence of High Impact (Provide epidemiologic or resource use data):**

Stroke is a leading cause of morbidity for patients. It increases patients' likelihood of dependence on the

healthcare system and is a condition that contributes greatly to the cost of healthcare in the U.S. There is good evidence of variation in readmission rates for stroke patients. For these reasons stroke is an important target for quality measurement and improvement initiatives.

Stroke is a priority area for outcomes measure development as it is a relatively common condition with potentially debilitating effects. Approximately 7 million Americans have experienced and survived a stroke (AHA, 2012). Stroke affects approximately 795,000 people each year in the US, and of these strokes, about 610,000 are first attacks and 185,000 are recurrent attacks (AHA, 2012). By 2030, it is projected that an additional 4 million people will have had a stroke, a 24.9% increase in prevalence from 2010 (AHA, 2012).

Stroke is a disease associated with high rates of preventable complications and discharge to settings with substantial requirements for ongoing care, e.g. home health or rehabilitation settings. Both of these factors provide numerous opportunities for potential readmissions, and, consequently, opportunities to reduce readmission rates with appropriate interventions and care decisions.

**1a.4 Citations for Evidence of High Impact cited in 1a.3:** American Heart Association, Heart Disease and Stroke Statistics - 2012 Update. American Heart Association, Circulation 2012, 125:e2-e220.

#### **1b. Opportunity for Improvement: H● M● L● I●**

*(There is a demonstrated performance gap - variability or overall less than optimal performance)*

##### **1b.1 Briefly explain the benefits (improvements in quality) envisioned by use of this measure:**

The goal of this measure is to improve patient outcomes by providing patients, physicians, and hospitals with information about hospital-level, risk-standardized readmission rates following hospitalization for stroke. Measurement of patient outcomes allows for a broad view of quality of care that encompasses more than what can be captured by individual process-of-care measures. Complex and critical aspects of care, such as communication between providers, prevention of, and response to, complications, patient safety and coordinated transitions to the outpatient environment, all contribute to patient outcomes but are difficult to measure by individual process measures. The goal of outcomes measurement is to risk-adjust for patients' conditions at the time of hospital admission and then evaluate patient outcomes. This readmission measure was developed to identify institutions, whose performance is better or worse than would be expected based on their patient case-mix, and therefore promote hospital quality improvement and better inform consumers about care quality.

##### **1b.2 Summary of Data Demonstrating Performance Gap** *(Variation or overall less than optimal performance across providers): [For Maintenance – Descriptive statistics for performance results for this measure - distribution of scores for measured entities by quartile/decile, mean, median, SD, min, max, etc.]*

Patients with follow-up interventions such as post-discharge home visits have been shown to have lower readmission rates than those with standard follow-up (Anderson, 2000). System level strategies have the potential to improve outcomes and reduce readmissions (Cameron, 2008). Additionally, hospitals obtaining early Joint Commission Primary Stroke Center certification have been shown to have lower post-stroke readmission rates than non-certified centers (Lichtman, 2009).

In our analysis of calendar year 2008 Medicare FFS patients, updated by applying the new planned readmission algorithm, readmission rates of a national sample of 168,511 admissions across 4,390 hospitals demonstrates that hospital readmission rates for stroke patients are generally high, at a mean of 14.3%, and that there is a large amount of variation in outcomes, with the risk-standardized readmission rates ranging from 10.2% to 19.6%.

##### **1b.3 Citations for Data on Performance Gap:** *[For Maintenance – Description of the data or sample for measure results reported in 1b.2 including number of measured entities; number of patients; dates of data;]*

*if a sample, characteristics of the entities included]*

The sample for the above analyses is a one-year cohort of Medicare FFS hospitalizations for stroke (calendar year 2008). The analyses were performed using the new planned readmission algorithm.

Andersen HE, Schultz-Larsen K, Kreiner S, Forchhammer BH, Eriksen K, Brown A. Can readmission after stroke be prevented? Results of a randomized clinical study: a postdischarge follow-up service for stroke survivors. *Stroke*. 2000 May;31(5):1038-45.

Cameron JI, Tsoi C, Marsella A. Optimizing stroke systems of care by enhancing transitions across care environments. *Stroke*. 2008 Sep;39(9):2637-43. Epub 2008 Jul 17.

Lichtman JH, Allen NB, Wang Y, Watanabe E, Jones SB, Goldstein LB. Stroke patient outcomes in US hospitals before the start of the Joint Commission Primary Stroke Center certification program. *Stroke*. 2009 Nov;40(11):3574-9.

**1b.4 Summary of Data on Disparities by Population Group:** [***For Maintenance*** –*Descriptive statistics for performance results for this measure by population group*]

Despite the documented disparity in stroke incidence and mortality across gender and racial subgroups, little work has compared rates of post-stroke readmission among these populations (Sacco, 1991).

#### Race

We used the Medicare Provider Analysis and Review (MEDPAR) File for 2007 to calculate the percentage of African-American patients at each hospital, using all patients admitted to each hospital. We examined hospital-level RSRRs with the 2006-2008 sample across hospitals which were grouped by quintile of percentage of African-American patients they cared for. There was an increase in RSRRs by quintile as well as a broader range of RSRRs as the proportion of African-American patients increased. The distributions for the RSRRs overlapped, and some hospitals caring for the highest percentage of African-American patients performed well on the measure. The median weighted RSRR for hospitals with the highest proportion of African-American patients was 15.5% compared with 14.2% for hospitals with the lowest proportion of African-American patients. In comparison to the national average (14.7%), hospitals with high proportions of African-American patients have modestly worse 30-day RSRRs.

#### SES

We determined a SES level for each hospital, by calculating the percentage of patients with dual eligibility for Medicare and Medicaid for each hospital, using all patients admitted to each hospital. We grouped hospital into quintiles using the 2006-2008 sample by percentage of dual-eligible patients and examined hospital-level RSRRs across quintiles. There were increases in RSRRs across quintiles. The distributions for the RSRRs overlapped, and many hospitals in the lowest quintile performed well on the measure. The median weighted RSRR was 14.5% for hospitals in the lowest and 15.5% for the highest quintiles. In comparison to the national average (14.7%), hospitals with higher proportions of dual-eligible patients do not have worse 30-day RSRRs.

**1b.5 Citations for Data on Disparities Cited in 1b.4:** [***For Maintenance*** – *Description of the data or sample for measure results reported in 1b.4 including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included*]

The analyses were performed using the original measure specification (without the new planned readmission algorithm).

Sacco RL, Hauser WA, Mohr JP. Hospitalized stroke in blacks and Hispanics in northern Manhattan.

Stroke. 1991 Dec;22(12):1491-6.

**1c. Evidence** (Measure focus is a health outcome OR meets the criteria for quantity, quality, consistency of the body of evidence.)

Is the measure focus a health outcome? Yes ☒ No ☐ If not a health outcome, rate the body of evidence.

Quantity: H ☒ M ☐ L ☐ I ☐ Quality: H ☒ M ☐ L ☐ I ☐ Consistency: H ☒ M ☐ L ☐ I ☐

Quantity	Quality	Consistency	Does the measure pass subcriterion 1c?
M-H	M-H	M-H	Yes <input checked="" type="radio"/>
L	M-H	M	Yes <input checked="" type="radio"/> IF additional research unlikely to change conclusion that benefits to patients outweigh harms: otherwise No <input type="radio"/>
M-H	L	M-H	Yes <input checked="" type="radio"/> IF potential benefits to patients clearly outweigh potential harms: otherwise No <input type="radio"/>
L-M-H	L-M-H	L	No <input type="radio"/>

**Health outcome** – rationale supports relationship to at least one healthcare structure, process, intervention, or service

**Does the measure pass subcriterion 1c?**  
Yes ☒ IF rationale supports relationship

**1c.1 Structure-Process-Outcome Relationship** (Briefly state the measure focus, e.g., health outcome, intermediate clinical outcome, process, structure; then identify the appropriate links, e.g., structure-process-health outcome; process-health outcome; intermediate clinical outcome-health outcome):

N/A This is an outcomes measure, not a process measure. The goal is to directly affect patient outcomes by measuring risk-standardized rates of readmission.

**1c.2-3 Type of Evidence** (Check all that apply):

Other

N/A This is an outcomes measure, not a process measure.

**1c.4 Directness of Evidence to the Specified Measure** (State the central topic, population, and outcomes addressed in the body of evidence and identify any differences from the measure focus and measure target population):

N/A This is an outcomes measure, not a process measure.

**1c.5 Quantity of Studies in the Body of Evidence** (Total number of studies, not articles): N/A This is an outcomes measure, not a process measure.

**1c.6 Quality of Body of Evidence** (Summarize the certainty or confidence in the estimates of benefits and harms to patients across studies in the body of evidence resulting from study factors. Please address: a) study design/flaws; b) directness/indirectness of the evidence to this measure (e.g., interventions, comparisons, outcomes assessed, population included in the evidence); and c) imprecision/wide confidence intervals due to few patients or events): N/A This is an outcomes measure, not a process measure.

**1c.7 Consistency of Results across Studies** (Summarize the consistency of the magnitude and direction of the effect): N/A This is an outcomes measure, not a process measure.

**1c.8 Net Benefit** (Provide estimates of effect for benefit/outcome; identify harms addressed and estimates of effect; and net benefit - benefit over harms):

N/A This is an outcomes measure, not a process measure.

**1c.9 Grading of Strength/Quality of the Body of Evidence.** Has the body of evidence been graded? **No**

**1c.10 If body of evidence graded, identify the entity that graded the evidence including balance of representation and any disclosures regarding bias:** **N/A This is an outcomes measure, not a process measure.**

**1c.11 System Used for Grading the Body of Evidence:** **Other**

**1c.12 If other, identify and describe the grading scale with definitions:** **N/A This is an outcomes measure, not a process measure.**

**1c.13 Grade Assigned to the Body of Evidence:** **N/A This is an outcomes measure, not a process measure.**

**1c.14 Summary of Controversy/Contradictory Evidence:** **N/A This is an outcomes measure, not a process measure.**

**1c.15 Citations for Evidence other than Guidelines(*Guidelines addressed below*):**  
**N/A This is an outcomes measure, not a process measure.**

**1c.16 Quote verbatim, the specific guideline recommendation (Including guideline # and/or page #):**  
**N/A This is an outcomes measure, not a process measure.**

**1c.17 Clinical Practice Guideline Citation:** **N/A This is an outcomes measure, not a process measure.**

**1c.18 National Guideline Clearinghouse or other URL:** **N/A This is an outcomes measure, not a process measure.**

**1c.19 Grading of Strength of Guideline Recommendation.** Has the recommendation been graded? **No**

**1c.20 If guideline recommendation graded, identify the entity that graded the evidence including balance of representation and any disclosures regarding bias:**

**1c.21 System Used for Grading the Strength of Guideline Recommendation:** **Other**

**1c.22 If other, identify and describe the grading scale with definitions:** **N/A This is an outcomes measure, not a process measure.**

**1c.23 Grade Assigned to the Recommendation:** **N/A This is an outcomes measure, not a process measure.**

**1c.24 Rationale for Using this Guideline Over Others:** **N/A This is an outcomes measure, not a process measure.**

**Based on the NQF descriptions for rating the evidence, what was the developer's assessment of the quantity, quality, and consistency of the body of evidence?**

**1c.25 Quantity:** **High** **1c.26 Quality:** **High** **1c.27 Consistency:** **High**

**1c.28 Attach evidence submission form:**

**1c.29 Attach appendix for supplemental materials:**

**Was the threshold criterion, *Importance to Measure and Report*, met?**  
**(1a & 1b must be rated moderate or high and 1c yes) Yes ☒ No ☐**



**Provide rationale based on specific subcriteria:**

**For a new measure if the Committee votes NO, then STOP.**

**For a measure undergoing endorsement maintenance, if the Committee votes NO because of 1b. (no opportunity for improvement), it may be considered for continued endorsement and all criteria need to be evaluated.**

## 2. RELIABILITY & VALIDITY - SCIENTIFIC ACCEPTABILITY OF MEASURE PROPERTIES

Extent to which the measure, as specified, produces consistent (reliable) and credible (valid) results about the quality of care when implemented. (**evaluation criteria**)

Measure testing must demonstrate adequate reliability and validity in order to be recommended for endorsement. Testing may be conducted for data elements and/or the computed measure score. Testing information and results should be entered in the appropriate field. Supplemental materials may be referenced or attached in item 2.1. See [guidance on measure testing](#).

**S.1 Measure Web Page** (*In the future, NQF will require measure stewards to provide a URL link to a web page where current detailed specifications can be obtained*). Do you have a web page where current detailed specifications for this measure can be obtained? **No**

**S.2 If yes, provide web page URL:**

**2a. RELIABILITY. Precise Specifications and Reliability Testing: H● M● L● I●**

**2a1. Precise Measure Specifications.** (*The measure specifications precise and unambiguous.*)

**2a1.1 Numerator Statement** (*Brief, narrative description of the measure focus or what is being measured about the target population, e.g., cases from the target population with the target process, condition, event, or outcome*):

The outcome for this measure is 30-day readmission. We define readmission as an inpatient admission for any cause, with the exception of certain planned readmissions, within 30 days from the date of discharge for patients 18 and older discharged from the hospital with a principal diagnosis of ischemic stroke. If a patient has one or more admissions (for any reason) within 30 days after discharge from the index admission, only one is counted as a readmission. For more details on how planned readmissions were identified and removed from the outcome, please refer to the attached report, Re-specifying the Hospital 30-Day Ischemic Stroke Readmission Measure by adding a Planned Readmission Algorithm.

**2a1.2 Numerator Time Window** (*The time period in which the target process, condition, event, or outcome is eligible for inclusion*):

We define the time period for readmission as within 30 days from the date of discharge of the index stroke admission.

**2a1.3 Numerator Details** (*All information required to identify and calculate the cases from the target population with the target process, condition, event, or outcome such as definitions, codes with descriptors, and/or specific data collection items/responses*):

This outcome measure does not have a traditional numerator and denominator like a core process measure (e.g., percentage of adult patients with diabetes aged 18-75 years receiving one or more hemoglobin A1c tests per year); thus, we are using this field to define the outcome.

The measure counts readmissions to any acute care hospital for any cause within 30 days of the date of discharge of the index stroke admission, excluding planned readmissions as defined below.

**Admissions not Counted as Readmissions**

**Unplanned readmissions are acute clinical events experienced by a patient that require urgent**

rehospitalization. Higher than expected unplanned readmission rates suggest lower quality of hospital and post-discharge care and are the focus of hospital quality measurement as part of quality improvement efforts. In contrast, planned readmissions are generally not a signal of quality of care. Furthermore, there is concern that including planned readmissions in a readmission measure could create a disincentive to provide appropriate care to patients who are scheduled for elective or necessary procedures, unrelated to the quality of the prior admission, within 30 days of discharge. The originally submitted ischemic stroke readmission measure identified planned readmissions specifically for follow on care of the stroke. The following procedures were considered planned unless accompanied by an acute primary discharge diagnosis: carotid endarterectomy; carotid stenting; percutaneous carotid stenting; inter-cranial and inter-vertebral stenting; patent foramen ovale closure; ablation; aortic or mitral valve replacement; and cranioplasty.

This year, we have developed an algorithm for using claims data to identify additional “planned readmissions” that will not count as outcomes in the readmission measure. Analyzing Medicare FFS data from calendar year 2008, the revised measure increased the number of index hospitalizations for ischemic stroke that were followed by a planned readmission from 0.5% to 1.1%. After accounting for these additional planned readmissions, the crude 30-day measured readmission rate decreased from 14.8% to 14.3%.

Please see the attached report, Re-specifying the Hospital 30-Day Ischemic Stroke Readmission Measure by adding a Planned Readmission Algorithm, that details the algorithm used to identify planned readmissions.

**2a1.4 Denominator Statement** *(Brief, narrative description of the target population being measured):*

This claims-based measure can be used in either of two patient cohorts: (1) patients aged 65 years or older or (2) patients aged 18 years or older. We have explicitly tested the measure in both age groups.

The cohort includes admissions for patients age 65 years or older discharged from the hospital with a principal diagnosis of ischemic stroke (ICD-9-CM codes 433.x1, 434.x1, 436) and with a complete claims history for the 12 months prior to admission.

**2a1.5 Target Population Category** *(Check all the populations for which the measure is specified and tested if any):* Senior Care

**2a1.6 Denominator Time Window** *(The time period in which cases are eligible for inclusion):*

This measure was developed with 12 months of data.

**2a1.7 Denominator Details** *(All information required to identify and calculate the target population/denominator such as definitions, codes with descriptors, and/or specific data collection items/responses):*

Note: This outcome measure does not have a traditional numerator and denominator like a core process measure (e.g., percentage of adult patients with diabetes aged 18-75 years receiving one or more hemoglobin A1c tests per year). We therefore use this field to define the measure cohort.

The denominator includes patients 18 and over hospitalized for acute ischemic stroke. The measure was developed in a cohort of patients 65 years and older who were enrolled in Medicare FFS and admitted to non-federal hospitals. To be included in the Medicare FFS cohort the inclusion criteria required that the patient be continuously enrolled in Medicare FFS Parts A and B for the 12 months prior to the index hospitalization.

Acute ischemic stroke is defined by the following ICD-9-CM and ICD-10-CM codes:



ICD-9-CM codes used to define ischemic stroke:

- 433.01 Occlusion and stenosis of precerebral arteries, Basilar artery with cerebral infarction
- 433.11 Occlusion and stenosis of precerebral arteries, Carotid artery with cerebral infarction
- 433.21 Occlusion and stenosis of precerebral arteries, Vertebral artery with cerebral infarction
- 433.31 Occlusion and stenosis of precerebral arteries, Multiple and bilateral with cerebral infarction
- 433.81 Occlusion and stenosis of precerebral arteries, Other specified precerebral artery with cerebral infarction
- 433.91 Occlusion and stenosis of precerebral arteries, Unspecified precerebral artery with cerebral infarction, Precerebral artery NOS
- 434.01 Occlusion of cerebral arteries, Cerebral thrombosis with cerebral infarction, thrombosis of cerebral arteries
- 434.11 Occlusion of cerebral arteries, Cerebral embolism with cerebral infarction
- 434.91 Occlusion of cerebral arteries, Cerebral artery occlusion, unspecified, with cerebral infarction
- 436 Acute, but ill-defined, cerebrovascular disease

ICD-10-CM codes used to define ischemic stroke:

- I6322 Cerebral infarction due to unspecified occlusion or stenosis of basilar arteries
- I63139 Cerebral infarction due to embolism of unspecified carotid artery
- I63239 Cerebral infarction due to unspecified occlusion or stenosis of unspecified carotid arteries
- I63019 Cerebral infarction due to thrombosis of unspecified vertebral artery
- I63119 Cerebral infarction due to embolism of unspecified vertebral artery
- I63219 Cerebral infarction due to unspecified occlusion or stenosis of unspecified vertebral arteries
- I6359 Cerebral infarction due to unspecified occlusion or stenosis of other cerebral artery
- I6320 Cerebral infarction due to unspecified occlusion or stenosis of unspecified precerebral arteries
- I6330 Cerebral infarction due to thrombosis of unspecified cerebral artery
- I6340 Cerebral infarction due to embolism of unspecified cerebral artery
- I6350 Cerebral infarction due to unspecified occlusion or stenosis of unspecified cerebral artery
- I678 Other specified cerebrovascular diseases

**2a1.8 Denominator Exclusions** (*Brief narrative description of exclusions from the target population*):

An index admission is the hospitalization considered for the readmission outcome (readmitted within 30 days of the date of discharge from the initial admission).

The measure excludes admissions for patients:

- with an in hospital death (because they are not eligible for readmission).
- transferred to another acute care facility (because the readmission is attributed to the hospital that discharges the patient to a non-acute setting).
- discharged alive and against medical advice (AMA) (because providers did not have the opportunity to deliver full care and prepare the patient for discharge).
- without at least 30 days post-discharge claims data (because the 30-day readmission outcome cannot be assessed in this group).

In addition, if a patient has more than one admission within 30 days of discharge from the index admission, only one is counted as a readmission, as we are interested in a dichotomous yes/no readmission outcome, as opposed to the number of readmissions. No admissions within 30 days of discharge from an index admission are considered as additional index admissions, thus no hospitalization will be counted as both a

readmission and an index admission. The next eligible index admission is 30 days after the discharge date of the previous index admission.

**2a1.9 Denominator Exclusion Details** *(All information required to identify and calculate exclusions from the denominator such as definitions, codes with descriptors, and/or specific data collection items/responses):*

In-hospital deaths are identified using the discharge disposition vital status indicator.

Transfers to other acute care facilities are defined when a patient with an inpatient hospital admission (with at least one qualifying stroke admission) is discharged from an acute care hospital and admitted to another acute care hospital on the same day or next day.

Discharges Against Medical Advice (AMA) are identified using the discharge disposition indicator.

Lack of claims data for 30 days post-discharge is identified by patient enrollment status in the CMS' Enrollment Database (EDB) (for Medicare FFS patients only).

**2a1.10 Stratification Details/Variables** *(All information required to stratify the measure results including the stratification variables, codes with descriptors, definitions, and/or specific data collection items/responses):*

N/A

**2a1.11 Risk Adjustment Type** *(Select type. Provide specifications for risk stratification in 2a1.10 and for statistical model in 2a1.13):* Statistical risk model    **2a1.12 If "Other," please describe:**

**2a1.13 Statistical Risk Model and Variables** *(Name the statistical method - e.g., logistic regression and list all the risk factor variables. Note - risk model development should be addressed in 2b4.):*

Our approach to risk adjustment is tailored to and appropriate for a publicly reported outcome measure, as articulated in the American Heart Association (AHA) Scientific Statement, "Standards for Statistical Models Used for Public Reporting of Health Outcomes"<sup>1</sup>.

The measure employs a hierarchical logistic regression model to create a hospital-level 30-day RSRR. This approach to modeling appropriately accounts for the structure of the data (patients clustered within hospitals), the underlying risk due to patients' comorbidities, and sample size at a given hospital when estimating hospital readmission rates. In brief, the approach simultaneously models two levels (patient and hospital) to account for the variance in patient outcomes within and between hospitals.<sup>2</sup> At the patient level, the model adjusts the log-odds of readmission within 30 days of discharge for age and selected clinical covariates. The second level models hospital-specific intercepts as arising from a normal distribution. The hospital-specific intercepts represent the hospital contribution to the risk of readmission, after accounting for patient risk and sample size, and can be inferred as a measure of quality. The hospital-specific intercepts are given a distribution in order to account for the clustering (non-independence) of patients within the same hospital. If there were no differences among hospitals, then after adjusting for patient risk, the hospital intercepts should be identical across all hospitals.

**Candidate and Final Risk-adjustment Variables:** The measure was developed using Medicare FFS 2007 claims data. Candidate variables were patient-level risk-adjustors that were expected to be predictive of readmission, based on empirical analysis, prior literature, and clinical judgment, including age and indicators of comorbidity and disease severity. For each patient, covariates are obtained from Medicare claims extending 12 months prior to and including the index admission. The model adjusts for case mix differences based on the clinical status of patients at the time of admission. We used condition categories (CCs), which are clinically meaningful groupings of more than 15,000 ICD-9-CM diagnosis codes, and combinations of CCs as candidate variables. A file which contains a list of the ICD-9-CM codes and their

groupings into CCs is available on <http://www.qualitynet.org/dcs/ContentServer?c=Page&pagename=QnetPublic%2FPage%2FQnetTier3&cid=1182785083979>). We did not risk-adjust for CCs that were possible adverse events of care and that were only recorded in the index admission. Only comorbidities that conveyed information about the patient at that time or in the 12 months prior, and not complications that arose during the course of the hospitalization were included in the risk-adjustment.

Frequencies and odds ratios for the 2007 cohort (n=174,024 admissions) are presented below.

Final set of risk-adjustment variables:

Variable//Frequency (%)//Odds Ratio (95% confidence interval)

#### Demographic

- Age-65 (continuous)/Mean (SD)=80.12(7.83)/ OR (95% CI)=1.004(1.003 - 1.006)
- Male/Frequency =40.44/ OR (95% CI)=1.045(1.016 - 1.045)

#### Cardiovascular/Cerebrovascular

- Congestive Heart Failure (CC 80)/Frequency =25.68/ OR (95% CI)=1.221(1.182 - 1.261)
- Hypertensive heart disease (CC 90)/Frequency =6.91/ OR (95% CI)=1.100(1.047 - 1.157)
- Cerebral Hemorrhage (CC 95)/Frequency =1.81/ OR (95% CI)=1.079(0.954 - 1.182)
- Ischemic or Unspecified Stroke (CC 96)/Frequency =26.41/ OR (95% CI)=1.042(1.008 - 1.078)
- Cerebrovascular Disease (CC 97)/Frequency =23.75/ OR (95% CI)=1.045(1.010 - 1.080)
- Hemiplegia, paraplegia, paralysis, functional disability (CC 100-102)/Frequency =9.70/ OR (95% CI)=0.951(0.907 - 0.997)
- Vascular or circulatory disease (CC 104-106)/Frequency =31.09/ OR (95% CI)=1.070(1.038 - 1.103)

#### Comorbid Conditions

- Metastatic cancer and acute leukemia (CC 7)/Frequency =2.27/ OR (95% CI)=1.264(1.163 - 1.373)
- Cancer (CC 8-12)/Frequency =18.52/ OR (95% CI)=1.034(0.998 - 1.071)
- Diabetes and DM complications (CC 15-20, 119-120)/Frequency =37.84/ OR (95% CI)=1.156(1.124 - 1.364)
- Protein-calorie malnutrition (CC 21)/Frequency =4.45/ OR (95% CI)=1.288(1.216 - 1.364)
- Disorders of Fluid/Electrolyte/Acid-Base (CC 22-23)/Frequency = 23.72/ OR (95% CI)=1.142(1.104 - 1.181)
- Obesity/disorders of thyroid, cholesterol, lipids (CC 24)/Frequency = 68.03/ OR (95% CI)=0.916(0.890 - 0.943)
- Severe Hematological Disorders (CC 44)/Frequency = 1.53/ OR (95% CI)=1.266(1.153 - 1.391)
- Iron Deficiency and Other/Unspecified Anemias and Blood Disease (CC 47)/Frequency = 30.90/ OR (95% CI)=1.142(1.108 - 1.178)
- Dementia and senility (CC 49-50)/Frequency = 28.56/ OR (95% CI)=1.015(0.985 - 1.047)
- Quadriplegia, paraplegia, functional disability (CC 67-69, 177-178)/Frequency = 1.99/ OR (95% CI)=1.139(1.046 - 1.242)
- Seizure Disorders and Convulsions (CC 74)/Frequency = 7.45/ OR (95% CI)=1.161(1.107 - 1.218)
- COPD (CC 108)/Frequency =22.96/ OR (95% CI)=1.133(1.098 - 1.170)
- Other lung disorder (CC 115)/Frequency =22.04/ OR (95% CI)=1.082(1.047 - 1.117)
- End-stage renal disease or dialysis (CC 130)/Frequency =1.51/ OR (95% CI)=1.356(1.237 - 1.487)
- Renal Failure (CC 131)/Frequency =14.29/ OR (95% CI)=1.163(1.117 - 1.211)
- Other urinary tract disorders (CC 136)/Frequency =18.57/ OR (95% CI)=1.101(1.064 - 1.140)
- Decubitus ulcer or chronic skin ulcer (CC 148-149)/Frequency =6.79/ OR (95% CI)=1.079(1.026 - 1.134)
- Major Symptoms, Abnormalities (CC 166)/Frequency =61.63/ OR (95% CI)=1.098(1.063 - 1.134)

References:

1. Krumholz HM, Brindis RG, Brush JE, et al. 2006. Standards for Statistical Models Used for Public Reporting of Health Outcomes: An American Heart Association Scientific Statement From the Quality of Care and Outcomes Research Interdisciplinary Writing Group: Cosponsored by the Council on Epidemiology and Prevention and the Stroke Council Endorsed by the American College of Cardiology Foundation. *Circulation* 113: 456-462.
2. Normand S-LT, Shahian DM. 2007. Statistical and Clinical Aspects of Hospital Outcomes Profiling. *Stat Sci* 22 (2): 206-226.

**2a1.14-16 Detailed Risk Model Available at Web page URL** (or attachment). Include coefficients, equations, codes with descriptors, definitions, and/or specific data collection items/responses. Attach documents only if they are not available on a webpage and keep attached file to 5 MB or less. NQF strongly prefers you make documents available at a Web page URL. Please supply login/password if needed:

Attachment

[Stroke\\_Readmission\\_MethodologyReport9.29.10.pdf](#)

**2a1.17-18. Type of Score:** [Rate/proportion](#)

**2a1.19 Interpretation of Score** (*Classifies interpretation of score according to whether better quality is associated with a higher score, a lower score, a score falling within a defined interval, or a passing score*):  
[Better quality = Lower score](#)

**2a1.20 Calculation Algorithm/Measure Logic**(*Describe the calculation of the measure score as an ordered sequence of steps including identifying the target population; exclusions; cases meeting the target process, condition, event, or outcome; aggregating data; risk adjustment; etc.*):

The measure employs a hierarchical logistic regression model to create a hospital level 30-day RSRR. In brief, the approach simultaneously models two levels (patient and hospital) to account for the variance in patient outcomes within and between hospitals (Normand & Shahian, 2007). At the patient level, each model adjusts the log-odds of readmission within 30-days of discharge for age and selected clinical covariates. The second level models the hospital-specific intercepts as arising from a normal distribution. The hospital intercept represents the underlying risk of readmission, after accounting for patient risk. The hospital-specific intercepts are given a distribution in order to account for the clustering (non-independence) of patients within the same hospital. If there were no differences among hospitals, then after adjusting for patient risk, the hospital intercepts should be identical across all hospitals.

The RSRR is calculated as the ratio of the number of “predicted” to the number of “expected” readmissions, multiplied by the national unadjusted readmission rate. For each hospital, the numerator of the ratio (“predicted”) is the number of readmissions within 30 days predicted on the basis of the hospital’s performance with its observed case mix, and the denominator (“expected”) is the number of readmissions expected on the basis of the nation’s performance with that hospital’s case mix. This approach is analogous to a ratio of “observed” to “expected” used in other types of statistical analyses. It conceptually allows for a comparison of a particular hospital’s performance given its case-mix to an average hospital’s performance with the same case-mix. Thus, a ratio lower than one indicates lower-than-expected readmission or better quality and a ratio higher than one indicates higher-than-expected readmission or worse quality.

The predicted hospital outcome (the numerator) is the sum of predicted probabilities of readmission for all patients at a particular hospital. The predicted probability of each patient in that hospital is calculated using the hospital-specific intercept and patient risk factors. The expected number of readmissions (the denominator) is the sum of expected probabilities of readmission for all patients at a hospital. The expected

probability of each patient in a hospital is calculated using a common intercept and patient risk factors.

Please see attachment for more details on the calculation algorithm.

References:

Normand S-LT, Shahian DM. 2007. Statistical and Clinical Aspects of Hospital Outcomes Profiling. Stat Sci 22 (2): 206-226.

**2a1.21-23 Calculation Algorithm/Measure Logic Diagram URL or attachment:**

Attachment

Stroke\_Readmission\_Calculation\_Algorithm.pdf

**2a1.24 Sampling (Survey) Methodology.** If measure is based on a sample (or survey), provide instructions for obtaining the sample, conducting the survey and guidance on minimum sample size (response rate):

N/A - This measure is not based on a sample or survey.

**2a1.25 Data Source** (*Check all the sources for which the measure is specified and tested*). If other, please describe:

Administrative claims

**2a1.26 Data Source/Data Collection Instrument** (*Identify the specific data source/data collection instrument, e.g. name of database, clinical registry, collection instrument, etc.*): To apply the measure to Medicare FFS patients, Medicare Part A inpatient and outpatient claims are used. To apply the measure to a non-Medicare population, inpatient claims data are used.

The Medicare data sources used to create the measure were:

1. Medicare Part A Inpatient and Outpatient and Part B outpatient claims from the Standard Analytic File, including inpatient and outpatient claims for the 12 months prior to an index admission.

2. Medicare Enrollment Database (EDB): This database contains Medicare beneficiary demographic, benefit/coverage, and vital status information. This dataset was used to obtain information on several inclusion/exclusion indicators such as Medicare status on admission as well as vital status. These data have previously been shown to accurately reflect patient vital status (Fleming Fisher et al., 1992).

The measure was subsequently tested in 2006 California Patient Discharge Data, a large, linked all-payer database of patient hospital admissions. Records are linked by a unique patient identification number, allowing us to determine patient history from previous hospitalizations as well as whether the patient was readmitted to any hospital within 30 days.

Reference:

Fleming C., Fisher ES, Chang CH, Bubolz D, Malenda J. Studying outcomes and hospital utilization in the elderly: The advantages of a merged data base for Medicare and Veterans Affairs Hospitals. Medical Care. 1992; 30(5): 377-91.

**2a1.27-29 Data Source/data Collection Instrument Reference Web Page URL or Attachment:**

Attachment

Stroke\_Cohort\_ICD9\_to\_ICD10\_Maps-634717470963767860.pdf



**2a1.30-32 Data Dictionary/Code Table Web Page URL or Attachment:**

Attachment

[Stroke\\_Readmission\\_Planned\\_Readmission\\_Report\\_8.24.12\\_toNQF.pdf](#)

**2a1.33 Level of Analysis** *(Check the levels of analysis for which the measure is specified and tested):*

Facility

**2a1.34-35 Care Setting** *(Check all the settings for which the measure is specified and tested):*

Hospital/Acute Care Facility

**2a2. Reliability Testing.** *(Reliability testing was conducted with appropriate method, scope, and adequate demonstration of reliability.)*

**2a2.1 Data/Sample** *(Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included):*

In measure development and testing, we used Medicare Part A and Part B claims data for calendar years 2006, 2007, and 2008 to test model reliability among Medicare FFS patients (without including the new planned readmission algorithm). The 2006 cohort included 182,927 admissions; the 2007 cohort included 174,024 admissions; and the 2008 cohort included 168,511 admissions.

**2a2.2 Analytic Method** *(Describe method of reliability testing & rationale):*

Data Element Reliability

In constructing the measure in Medicare FFS patients, we aim to utilize only those data elements from the claims that have both face validity and reliability. We avoid the use of fields that are thought to be coded inconsistently across hospitals or providers. Specifically, we use fields that are consequential for payment and which are audited. We identify such variables through empiric analyses and our understanding of CMS auditing and billing policies and seek to avoid variables which do not meet this standard. For example, "discharge disposition" is a variable in Medicare claims data that is not thought to be a reliable variable for identifying a transfer between two acute care facilities. Thus, we derive a variable using admission and discharge dates as a surrogate for "discharge disposition" to identify hospital admissions involving transfers. This allows us to identify these admissions using variables in the claims data which have greater reliability than the "discharge disposition" variable.

In addition, CMS has in place several hospital auditing programs used to assess overall claims code accuracy, to ensure appropriate billing, and for overpayment recoupment. CMS routinely conducts data analysis to identify potential problem areas and detect fraud, and audits important data fields used in our measures, including diagnosis and procedure codes and other elements that are consequential to payment.

Finally, we assess the reliability of the data elements by comparing model variable frequencies and odds ratios in three years of data.

Measure Result Reliability

The reliability of a measurement is the degree to which repeated measurements of the same entity agree with each other. For measures of hospital performance, the measured entity is naturally the hospital, and reliability is the extent to which repeated measurements of the same hospital give similar results.

Accordingly, our approach to assessing reliability is to consider the extent to which assessments of a hospital using different but randomly selected subsets of patients produce similar measures of hospital performance. That is, we take a "test-retest" approach in which hospital performance is measured once using a random subset of patients, then measured again using a second random subset exclusive of the first, and the agreement of the two resulting performance measures compared across hospitals.<sup>1</sup>

For test-retest reliability of the measure in Medicare FFS patients aged 65 and older, we combined index admissions from successive measurement periods into one dataset, randomly sampled half of patients within each hospital, calculated the measure for each hospital, and repeated the calculation using the second half. Thus, each hospital is measured twice, but each measurement is made using an entirely distinct set of patients. To the extent that the calculated measures of these two subsets agree, we have evidence that the measure is assessing an attribute of the hospital, not of the patients. As a metric of agreement we calculated the intra-class correlation coefficient<sup>2</sup>, and assessed the values according to conventional standards<sup>3</sup>. Specifically, we used a combined 2006-2008 sample, randomly split it into two approximately equal subsets of patients, and calculated the RSRR for each hospital for each sample. The agreement of the two RSRRs was quantified for hospitals in each sample using the intra-class correlation as defined by ICC (2,1) by Shrout and Fleiss.<sup>2</sup>

Using two independent samples provides an honest estimate of the measure's reliability, compared with using two random but potentially overlapping samples which would exaggerate the agreement. Moreover, because our final measure is derived using hierarchical logistic regression, and a known property of hierarchical logistic regression models is that smaller volume hospitals contribute less 'signal', a split sample using a single measurement period would introduce extra noise, potentially underestimating the actual test-retest reliability that would be achieved if the measure were reported using three years of data.

#### References:

1. Rousson V, Gasser T, Seifert B. "Assessing intrarater, interrater and test-retest reliability of continuous measurements," *Statistics in Medicine*, 2002, 21:3431-3446.
2. Shrout P, Fleiss J. Intraclass correlations: uses in assessing rater reliability. *Psychological Bulletin*, 1979, 86, 420-3428.
3. Landis J, Koch G, The measurement of observer agreement for categorical data, *Biometrics*, 1977;33:159-174.

### **2a2.3 Testing Results** (*Reliability statistics, assessment of adequacy in the context of norms for the test conducted*):

#### Data Element Reliability

Overall, risk factor frequencies changed very little across the three-year period, and there were no notable differences in the odds ratios across years of data.

#### Measure Result Reliability

There were 525,146 admissions in the combined three-year sample, with 262,573 in each randomly selected sample. The agreement between the two RSRRs for each hospital was 0.383, which according to the conventional interpretation is "Fair."<sup>1</sup> The intra-class correlation coefficient is based on a split sample of 3 years of data, resulting in a volume of patients in each sample equivalent to only 1.5 years of data, whereas the measure is likely to be reported with a full three years of data. Based on our experiences with similar measures using split sample, with 4 years (and volume equivalent to 2 years), the intra-class correlation coefficient would be higher and in the moderate range.

#### References:

1. Landis J, Koch G, The measurement of observer agreement for categorical data, *Biometrics*, 1977;33:159-174.

## **2b. VALIDITY. Validity, Testing, including all Threats to Validity: H M L I**

**2b1.1 Describe how the measure specifications (measure focus, target population, and exclusions) are consistent with the evidence cited in support of the measure focus (criterion 1c) and identify any differences from the evidence:**

N/A

**2b2. Validity Testing.** (*Validity testing was conducted with appropriate method, scope, and adequate demonstration of validity.*)

**2b2.1 Data/Sample** (*Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included*):

We validated the administrative model (original model specification without the new planned readmission algorithm) by comparing it to a medical record model in a matched cohort of admissions for which stroke medical record data and administrative claim data were available. The goal of the medical record validation was to determine if the output of the administrative claims-based measure was similar to that of a measure built from medical record data. To build the medical record model, we used the Medicare Health Care Quality Improvement Program's National Stroke Project (NSP) data. The NSP data is medical record-abstracted data that was collected as part of a national quality improvement project. The data comes from a representative population of patients hospitalized with stroke from all states (plus Puerto Rico and the District of Columbia) during March 1, 1998-March 31, 1999 and July 1, 2000-June 30, 2001. Based on the principal discharge diagnosis, up to 750 stroke discharges per state were identified. Two clinical abstraction centers abstracted the corresponding medical records with computerized abstraction tools, and the sample was checked for reliability of abstraction.

**2b2.2 Analytic Method** (*Describe method of validity testing and rationale; if face validity, describe systematic assessment*):

**Medical Record Validation**

We sought to validate our administrative stroke model against the medical record model in the same cohort of patients for which stroke medical record data were available. We developed a medical record measure to compare with the administrative measure. We developed a measure cohort with the medical record data using the inclusion/exclusion criteria and risk-adjustment strategy that was consistent with the claims-based administrative measure but using chart-based risk adjusters, such as speech and motor deficits present at admission, not available in the claims data. To select variables for the model, a team of clinicians and health services researchers reviewed the list of potential candidate variables in the NSP dataset. Based on clinical sensibility, knowledge from the medical literature review, and consensus amongst the team, we selected potentially important predictors of readmission. We also identified clinically important variables that should be retained in the model regardless of statistical significance. Next we used a backwards step-wise approach to select the final variables for the model. This selection resulted in a final stroke readmission medical record risk-adjusted model that included 24 variables.

We then matched a sample of the same patients in the administrative data for comparison. The suitability of the state-level comparison is supported by the fact that there is notable variation in quality and outcomes for stroke among states, as documented in prior research and our findings.<sup>1-4</sup> We estimated state-level RSRRs using the corresponding administrative and medical record models for the matched cohort. We then examined the linear relationship between the two sets of estimates using regression techniques and weighting by the total number of cases in each state. We compared the output of the two measures, that is the state performance results, in the same group of patients.

**ICD-9 to ICD-10 Conversion**

**Statement of Intent**

☒ [X] Convert measure to the new code set, but there are no changes to the measure.

☐ [ ] Take advantage of new specific code set for the measure with changes.

☐ [ ] The intent of the measure has changed.

## Process of Conversion

We enlisted the help of clinicians with expertise in relevant areas to select and evaluate which ICD-10 codes map to the ICD-9 codes currently in use for this measure. The conversion of ICD-9 to ICD-10 is currently ongoing and the codes we have selected cannot yet be finalized since we lack sufficient ICD-10 data to evaluate the accuracy of coding/prevalence of ICD-10 codes. Once ICD-10 codes are officially in place and more data is available we will be able to provide a more accurate crosswalk.

### References:

1. Jencks SF, Huff ED, Cuerdon T. Change in the Quality of Care Delivered to Medicare Beneficiaries, 1998-1999 to 2000-2001. The Journal of the American Medical Association 2003;289:305-12.
2. Bravata DM, Ho SY, Meehan TP, Brass LM, Concato J. Readmission and death after hospitalization for acute ischemic stroke: 5-year follow-up in the Medicare population. Stroke 2007;38:1899-904.
3. Glymour MM, Avendano M. Can Self-Reported Strokes Be Used to Study Stroke Incidence and Risk Factors?: Evidence From the Health and Retirement Study. Journal of the American Heart Association 2009:873-9.
4. Lichtman, J.H., Naert, L., Allen, N.B., Watanabe, E., Jones, S.B., Barry, L.C., Bravata, D.M., & Goldstein, L.B. (2011). Use of antithrombotic medications among elderly ischemic stroke patients. Circulation: Cardiovascular Quality & Outcomes, 4(1):30-8.

### **2b2.3 Testing Results** *(Statistical results, assessment of adequacy in the context of norms for the test conducted; if face validity, describe results of systematic assessment):*

The matched sample included 35,209. We compared the output of the medical record model with that of the administrative model.

The performance of the administrative and medical record models is similar. The areas under the ROC curve are 0.59 and 0.58, respectively, for the two models. In addition, they are similar with respect to predictive ability. For the administrative model, the predicted readmission rate ranges from 8.39% in the lowest predicted decile to 21.70% in the highest predicted decile, a range of 13.31%. For the medical record model, the corresponding range is 8.21% to 18.94%, a range of 10.73%. The correlation coefficient was 0.99.

### **POTENTIAL THREATS TO VALIDITY.** *(All potential threats to validity were appropriately tested with adequate results.)*

### **2b3. Measure Exclusions.** *(Exclusions were supported by the clinical evidence in 1c or appropriately tested with results demonstrating the need to specify them.)*

**2b3.1 Data/Sample for analysis of exclusions** *(Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included):*  
In measure development, we used all stroke admissions in 2007 Medicare fee-for service data (initial cohort included 195,498 admissions) for patients age 65 and over. We initially included 36,982 stroke admissions in the 2006 all-payer California data for the 18 and over model.

### **2b3.2 Analytic Method** *(Describe type of analysis and rationale for examining exclusions, including exclusion related to patient preference):*

All exclusions (detailed in section 2a1.8. "Denominator Exclusions") were determined by careful clinical review and have been used based on clinically relevant decisions. These exclusions are consistent with similar NQF-endorsed readmission measures.

**2b3.3 Results** *(Provide statistical results for analysis of exclusions, e.g., frequency, variability, sensitivity analyses):*

We examined overall frequencies and proportions of the admissions excluded for each exclusion criterion in all stroke admissions in 2007 Medicare fee-for-service data. The initial cohort included 195,498 admissions; the final cohort, after exclusions, included 174,024 admissions. Categories are not mutually exclusive.

- 1) In-hospital deaths (n=12,077, 6.18%)
- 3) Transfer-out patients (n=4,124, 2.11%)
- 4) Without at least 30 days post-discharge or claim end date information (n=1,415, 0.72%)
- 5) Patients who leave hospital against medical advice (AMA) (n=481, 0.25%)
- 6) Additional admission for stroke within 30 days of prior index admission (n=3,436, 1.76%)

For the 18 and over model, we examined overall frequencies and proportions of admissions excluded for each exclusion criterion in all stroke admissions in 2006 California Patient Discharge Data. The initial cohort included 36,982 admissions. The final cohort, after exclusion, included 32,241 admissions. The exclusion categories are not mutually exclusive.

- 1) California Patient Discharge Data for All-payer In-hospital death (n=2,196, 5.90%)
- 2) Transferred out (n=1,667, 4.50%)
- 3) Discharges against medical advice (AMA) (n=299, 0.80%)
- 4) Hospitalizations not selected (n=612, 1.86%)

**2b4. Risk Adjustment Strategy.** *(For outcome measures, adjustment for differences in case mix (severity) across measured entities was appropriately tested with adequate results.)*

**2b4.1 Data/Sample** *(Description of the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included):*

Measure Development and Validation in Medicare FFS:

For development (original model specification without the planned readmission algorithm), we randomly divided the 2007 Medicare cohort derived above into measure development cohort (N=87,041 admissions from 4,242 hospitals) and measure validation cohort (N=86,983 admissions from 4,260 hospitals).

**Assessment of Temporal Trends in Risk Factors and Model Performance (2006-2008)**

To assess temporal trends, we used Medicare cohorts from 2006 through 2008. The 2006 cohort included 182,927 admissions; the 2007 cohort included 174,024 admissions; and the 2008 cohort included 168,511 admissions.

**Limiting Risk-adjustment data to Inpatient Claims:**

In testing other administrative claims-data measures developed in Medicare FFS data, including mortality and readmission measures for acute myocardial infarction (AMI), heart failure, pneumonia and chronic obstructive pulmonary disease (COPD), we have validated both the accuracy of the CPD Data in capturing Medicare claims as well as the use of only inpatient data for risk adjustment. For all measures, the c-statistic was qualitatively similar between the two approaches. Moreover, when comparing the models using full history data with a model using only inpatient claims data, hospital-level risk-standardized rates were highly correlated. Based on this reassuring data across measures, we did not repeat these analyses for the stroke mortality and readmission measures, but rather assumed that inpatient claims data would provide adequate risk adjustment information for application of the measures in all-payer data.

**Applying the measure to Patients Aged 18 and Older:**

To test the model in all-payer data, we used 32,241 cases aged 18 and older in the 2006 California Patient



Discharge Data (original model specification without the planned readmission algorithm).

**2b4.2 Analytic Method** (*Describe methods and rationale for development and testing of risk model or risk stratification including selection of factors/variables*):

Measure Development and Validation in Medicare FFS:

This measure is fully risk-adjusted using a hierarchical logistic regression model to calculate hospital RSRRs accounting for differences in hospital case-mix. (See section 2a1.13. "Statistical risk model and variables" for additional details.)

Approach to Assessing Model Performance:

During measure development using Medicare data for FFS patients 65 and older, we computed four summary statistics for assessing model performance (Harrell and Shih, 2001) for the development and validation cohorts:

- (1) predictive ability
- (2) area under the receiver operating characteristic (ROC) curve
- (3) distribution of residuals
- (4) model chi-square (a test of statistical significance usually employed for categorical data to determine whether there is a good fit between the observed data and expected values; i.e., whether the differences between observed and expected values are attributable to true differences in characteristics or instead the result of chance variation).

Assessment of Temporal Trends in Risk Factors and Model Performance (2006-2008):

Across years, we examined consistency in parameter estimates for risk-adjustment variables and model performance (C statistic).

Applying the Measure to Patients Aged 18 and Older:

To help determine whether the measure could be applied to a population of patients aged 18+ (i.e., including younger patients aged 18-64), we examined the interaction terms between age (18-64 vs. 65+) and each of the other risk factors in 2006 California Patient Discharge Data. Specifically, we fit the model in all patients 18+ with and without interaction terms and (a) conducted a reclassification analysis to compare risk prediction at the patient level; (b) compared the C statistic; and (c) compared hospital-level risk-standardized rates (scatterplot, ICC) to assess whether the model with interactions is different from the current model in profiling hospital rates.

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Reference: Harrell FE, Shih YCT. Using full probability models to compute probabilities of actual interest to decision makers. *Int J Technol Assess Health Care*. 2001;17:17-26.

**2b4.3 Testing Results** (*Statistical risk model: Provide quantitative assessment of relative contribution of model risk factors; risk model performance metrics including cross-validation discrimination and calibration statistics, calibration curve and risk decile plot, and assessment of adequacy in the context of norms for risk models. Risk stratification: Provide quantitative assessment of relationship of risk factors to the outcome and differences in outcomes among the strata*):

Measure Development and Validation in Medicare FFS:

Performance Metrics in Development Cohort: The development cohort consisted of 87,041 patient stays at 4,242 hospitals (randomly selected half of 2007 cohort), with a risk-adjusted mean readmission rate of 14.8%. Results are summarized below:

Residuals lack of fit: <-2 = 0.00%; [-2, 0) = 85.23%; [0, 2) = 2.88%; [2+ = 11.89%  
Model Chi-square [# of covariates]: 1501 [27]

Predictive ability (lowest decile %, highest decile %): (9.10, 24.30)

Area under the ROC curve = 0.60

The discrimination and the explained variation of the model are consistent with those of models currently used to publicly report condition specific rates of both mortality and readmission.

Model Validation Using Validation Cohort (using other half of 2007 cohort and years 2006 and 2008): We compared the model performance in the development sample with its performance in the remaining half that was not selected for the 2007 development set, representing 86,983 cases discharged from 4,260 hospitals. This validation sample had a risk-adjusted mean readmission rate of 14.8%. The performance was not substantively different in this validation sample (ROC=0.60), as compared to the development sample (ROC=0.60).

The model variables were then tested among ischemic stroke admissions in 2006 and 2008. The model performance using the 2006 data (ROC=0.60) and 2008 data (ROC=0.59) were consistent with model performance using the 2007 development and validation half-samples.

Assessment of Temporal Trends in Risk Factors and Model Performance (2006-2008): Parameter estimates for risk-adjustment variables were consistent across years. In addition, model performance was also consistent across years of data; the C statistic was approximately 0.60 across all three years.

Applying the Measure to Patients Aged 18 and Older:

When the model was applied to all patients aged 18+ in 2006 California Patient Discharge Data, overall discrimination was good (C statistic=0.623). In addition, there was good discrimination and predictive ability in both those aged 18-64 and those aged 65+. Moreover, the distribution of Pearson residuals was comparable across the patient subgroups. When comparing the model with and without the interaction terms, (a) the reclassification analysis demonstrated that nearly all patients were found to be in a similar risk category; (b) the C statistic was nearly identical (0.627 vs. 0.623); and (c) hospital-level risk-standardized rates were highly correlated (ICC= 0.998). Thus, the inclusion of the interactions did not substantively affect either patient-level model performance or hospital-level results.

Therefore, the measure can be applied to all payer patients 18 and older.

**2b4.4 If outcome or resource use measure is not risk adjusted, provide rationale and analyses to justify lack of adjustment:** The measure is risk-adjusted.

**2b5. Identification of Meaningful Differences in Performance.** *(The performance measure scores were appropriately analyzed and discriminated meaningful differences in quality.)*

**2b5.1 Data/Sample** *(Describe the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included):*

We used Medicare claims data (2008) and the development sample included 168,511 admissions from 4,390 hospitals (applying the new planned readmission algorithm).

(See denominator and numerator details for sample description.)

**2b5.2 Analytic Method** *(Describe methods and rationale to identify statistically significant and practically/meaningfully differences in performance):*

The method for discriminating hospital performance has not been determined. For three publicly reported readmission measures of hospital outcomes developed with similar methodology, CMS currently estimates an interval estimate for each risk-standardized rate to characterize the amount of uncertainty associated

NQF #2027 Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization, Last Updated Date: May 02, 2016

with the rate, compares the interval estimate to the national crude rate for the outcome, and categorizes hospitals as “better than,” “worse than,” or “no different than” the US national rate. However, the decision to publicly report this measure and the approach to discriminating performance has not been determined.

See Calculation Algorithm attachment for description of analytic method.

**2b5.3 Results** (Provide measure performance results/scores, e.g., distribution by quartile, mean, median, SD, etc.; identification of statistically significant and meaningful differences in performance):

Using the 2008 data, the results of the RSRRs showed meaningful difference even after risk-adjustments: 13.8% to 14.7% (25th-75th percentile respectively) with a range from 10.18%-19.63%.

**2b6. Comparability of Multiple Data Sources/Methods.** (If specified for more than one data source, the various approaches result in comparable scores.)

**2b6.1 Data/Sample** (Describe the data or sample including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities included):

The measure performs well in both Medicare FFS data and all-payer data.

**2b6.2 Analytic Method** (Describe methods and rationale for testing comparability of scores produced by the different data sources specified in the measure):

See above.

**2b6.3 Testing Results** (Provide statistical results, e.g., correlation statistics, comparison of rankings; assessment of adequacy in the context of norms for the test conducted):

See above.

**2c. Disparities in Care: H M L I NA** (If applicable, the measure specifications allow identification of disparities.)

**2c.1 If measure is stratified for disparities, provide stratified results** (Scores by stratified categories/cohorts): Measure is not stratified for disparities.

**2c.2 If disparities have been reported/identified (e.g., in 1b), but measure is not specified to detect disparities, please explain:**

Consistent with NQF guidelines, we did not adjust for socioeconomic status, gender, race, or ethnicity because hospitals should not be held to different standards of care based on the demographics of their patients.

**2.1-2.3 Supplemental Testing Methodology Information:**

Attachment

Stroke\_All-payer\_Data\_Report\_8-24-12\_for\_NQF-634826619420616774.pdf

**Steering Committee: Overall, was the criterion, Scientific Acceptability of Measure Properties, met? (Reliability and Validity must be rated moderate or high) Yes No**

Provide rationale based on specific subcriteria:

**If the Committee votes No, STOP**

### 3. USABILITY

Extent to which intended audiences (e.g., consumers, purchasers, providers, policy makers) can understand the results of the measure and are likely to find them useful for decision making. (**evaluation criteria**)

**C.1 Intended Actual/Planned Use** (Check all the planned uses for which the measure is intended): [Public Reporting, Quality Improvement with Benchmarking](#) (external benchmarking to multiple organizations)

**3.1 Current Use** (Check all that apply; for any that are checked, provide the specific program information in the following questions): [Not in use](#)

**3a. Usefulness for Public Reporting: H● M● L● I●**

(The measure is meaningful, understandable and useful for public reporting.)

**3a.1. Use in Public Reporting - disclosure of performance results to the public at large** (If used in a public reporting program, provide name of program(s), locations, Web page URL(s)). If not publicly reported in a national or community program, state the reason AND plans to achieve public reporting, potential reporting programs or commitments, and timeline, e.g., within 3 years of endorsement: **[For Maintenance** – If not publicly reported, describe progress made toward achieving disclosure of performance results to the public at large and expected date for public reporting; provide rationale why continued endorsement should be considered.]

[This recently-developed measure is designed for use in public reporting but is not yet in use.](#)

**3a.2. Provide a rationale for why the measure performance results are meaningful, understandable, and useful for public reporting.** If usefulness was demonstrated (e.g., focus group, cognitive testing), describe the data, method, and results: [During the measure development process, developers received critical input from an advisory working group comprised of physicians and health services researchers with expertise in neurology, measure methodology, and quality improvement. We also received feedback from a Technical Expert Panel. Meetings were held throughout the development process and we received input and feedback on key methodological and clinical decisions to ensure the measure is meaningful and useful. In addition, similar measures for acute myocardial infarction \(AMI\) and heart failure underwent consumer testing prior to being publicly report and were found to be useful for publicly reporting outcomes.](#)

**3.2 Use for other Accountability Functions (payment, certification, accreditation).** If used in a public accountability program, provide name of program(s), locations, Web page URL(s): [This measure is not currently used in a public accountability program.](#)

**3b. Usefulness for Quality Improvement: H● M● L● I●**

(The measure is meaningful, understandable and useful for quality improvement.)

**3b.1. Use in QI.** If used in quality improvement program, provide name of program(s), locations, Web page URL(s):

**[For Maintenance** – If not used for QI, indicate the reasons and describe progress toward using performance results for improvement].

[Measure is not currently used in a QI program.](#)

**3b.2. Provide rationale for why the measure performance results are meaningful, understandable, and useful for quality improvement.** If usefulness was demonstrated (e.g., QI initiative), describe the data, method and results:

[A hospital-level, 30-day readmission measure for stroke patients may encourage hospitals to improve the quality of care for this high-risk population in order to reduce the risk of / prevent readmission. Stroke patients are at increased risk for readmission due to the ongoing care and treatment needs post discharge. Improvements in transitional care for this condition are likely to reduce costly readmissions and improve quality of care.](#)

**Overall, to what extent was the criterion, Usability, met? H● M● L● I●**

**Provide rationale based on specific subcriteria:**

#### 4. FEASIBILITY

Extent to which the required data are readily available, retrievable without undue burden, and can be implemented for performance measurement. (**evaluation criteria**)

##### 4a. Data Generated as a Byproduct of Care Processes: H● M● L● I●

**4a.1-2 How are the data elements needed to compute measure scores generated?** (*Check all that apply*).

Data used in the measure are:

Coded by someone other than person obtaining original information (e.g., DRG, ICD-9 codes on claims)

##### 4b. Electronic Sources: H● M● L● I●

**4b.1 Are the data elements needed for the measure as specified available electronically** (*Elements that are needed to compute measure scores are in defined, computer-readable fields*): ALL data elements in electronic claims

**4b.2 If ALL data elements are not from electronic sources, specify a credible, near-term path to electronic capture, OR provide a rationale for using other than electronic sources:**

##### 4c. Susceptibility to Inaccuracies, Errors, or Unintended Consequences: H● M● L● I●

**4c.1 Identify susceptibility to inaccuracies, errors, or unintended consequences of the measurement identified during testing and/or operational use and strategies to prevent, minimize, or detect. If audited, provide results:**

All-cause Readmission

This measure calculates a 30-day all-cause readmission rate. CMS measures all-cause readmission rather than readmission due to certain conditions (e.g. heart failure readmissions) for a number of reasons. First, a narrow focus on specific causes of readmission may simply provide an incentive to shift patients away from those codes. Second, within the chain of events that lead to a patient being readmitted to the hospital there is often some aspect of care that could be improved, thereby reducing the risk of readmission. This is not to suggest that all readmissions are preventable, but the goal of the measure is to encourage broad approaches to quality improvement which will thereby lower all patients' risk of readmission. More narrowly defining readmission measures to those that are disease specific may incentivize a limited focus on improvements in care as opposed to thinking comprehensively about the patient's full medical and social needs at discharge. Factors which may influence readmission rates include medication reconciliation, patient education, follow-up care and communication between inpatient and outpatient providers. The goal is not to reduce the readmission rate to zero but to reduce overall readmission rates to what is achievable by the best hospitals.

##### 4d. Data Collection Strategy/Implementation: H● M● L● I●

**A.2 Please check if either of the following apply** (*regarding proprietary measures*):

**4d.1 Describe what you have learned/modified as a result of testing and/or operational use of the measure regarding data collection, availability of data, missing data, timing and frequency of data collection, sampling, patient confidentiality, time and cost of data collection, other feasibility/implementation issues** (e.g., fees for use of proprietary measures):

The measure is not in operational use

**Overall, to what extent was the criterion, *Feasibility*, met?** H● M● L● I●

Provide rationale based on specific subcriteria:

#### OVERALL SUITABILITY FOR ENDORSEMENT



Does the measure meet all the NQF criteria for endorsement? Yes ☒ No ☐

Rationale:

If the Committee votes No, STOP.

If the Committee votes Yes, the final recommendation is contingent on comparison to related and competing measures.

## 5. COMPARISON TO RELATED AND COMPETING MEASURES

If a measure meets the above criteria and there are endorsed or new related measures (either the same measure focus or the same target population) or competing measures (both the same measure focus and the same target population), the measures are compared to address harmonization and/or selection of the best measure before a final recommendation is made.

**5.1 If there are related measures (either same measure focus or target population) or competing measures (both the same measure focus and same target population), list the NQF # and title of all related and/or competing measures:**

0330 : Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following heart failure (HF) hospitalization

0505 : Hospital 30-day all-cause risk-standardized readmission rate (RSRR) following acute myocardial infarction (AMI) hospitalization.

0506 : Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following pneumonia hospitalization

### 5a. Harmonization

**5a.1 If this measure has EITHER the same measure focus OR the same target population as [NQF-endorsed measure\(s\)](#): Are the measure specifications completely harmonized?** Yes

**5a.2 If the measure specifications are not completely harmonized, identify the differences, rationale, and impact on interpretability and data collection burden:**

### 5b. Competing Measure(s)

**5b.1 If this measure has both the same measure focus and the same target population as NQF-endorsed measure(s):**

**Describe why this measure is superior to competing measures (e.g., a more valid or efficient way to measure quality); OR provide a rationale for the additive value of endorsing an additional measure. (Provide analyses when possible):**

N/A

## CONTACT INFORMATION

**Co.1 Measure Steward (Intellectual Property Owner):** Centers for Medicare & Medicaid Services, 7500 Security Boulevard, Baltimore, Maryland, 21244

**Co.2 Point of Contact:** Helen, Dollar-Maples, [Helen.Dollar-Maples@cms.hhs.gov](mailto:Helen.Dollar-Maples@cms.hhs.gov), 410-786-7214-

**Co.3 Measure Developer if different from Measure Steward:** Yale New Haven Health Services Corporation/Center for Outcomes Research and Evaluation (YNHHSC/CORE), 1 Church Street, 2nd Floor, Suite #200, New Haven, Connecticut, 06510

**Co.4 Point of Contact:** Susannah, Bernheim, M.D., M.H.S., [susannah.bernheim@yale.edu](mailto:susannah.bernheim@yale.edu), 203-786-

7231-

**Co.5 Submitter:** Susannah, Bernheim, M.D., M.H.S., [susannah.bernheim@yale.edu](mailto:susannah.bernheim@yale.edu), 203-786-7231-, Yale New Haven Health Services Corporation/Center for Outcomes Research and Evaluation (YNHHSC/CORE)

**Co.6 Additional organizations that sponsored/participated in measure development:**

MPR: Mathematica Policy Research; RTI: Research Triangle Institute

**Co.7 Public Contact:** Susannah, Bernheim, M.D., M.H.S., [susannah.bernheim@yale.edu](mailto:susannah.bernheim@yale.edu), 203-786-7231-, Yale New Haven Health Services Corporation/Center for Outcomes Research and Evaluation (YNHHSC/CORE)

## ADDITIONAL INFORMATION

### Workgroup/Expert Panel involved in measure development

**Ad.1 Provide a list of sponsoring organizations and workgroup/panel members' names and organizations. Describe the members' role in measure development.**

Technical Expert Panel Members:

Joseph V. Agostini, M.D. Aetna

Mark J. Alberts, M.D. Northwestern University Feinburg School of Medicine

William Bloom N/A - Stroke Survivor

Mary George, M.D., M.S.P.H. Centers for Disease Control and Prevention

Robert Holloway, M.D., M.P.H. University of Rochester Medical Center

Irene Katzan, M.D., M.S. Cleveland Clinic

Dawn Kleindorfer, M.D. University of Cincinnati

Elaine Miller, Ph.D., R.N. Association of Rehabilitation Nurses

Mathew Reeves, Ph.D. Michigan State University

Joseph Schindler, M.D. Yale New Haven Stroke Center

Kevin Tabb, M.D. Stanford Hospital and Clinic

Linda Williams, M.D. Roudebush VAMC, Indiana University School of Medicine

Working Group Panel Members:

Dawn Bravata, MD Indiana University School of Medicine; VA Stroke Quality Enhancement Research Initiative (QUERI)

Pierre Fayad, MD The Nebraska Medical Center

Larry Goldstein, MD Duke University Medical Center

Ralph Sacco, MD Miller School of Medicine, University of Miami; American Heart Association; Jackson Memorial Hospital

Lee Schwamm, MD Harvard Medical School; Massachusetts General Hospital

**Ad.2 If adapted, provide title of original measure, NQF # if endorsed, and measure steward. Briefly describe the reasons for adapting the original measure and any work with the original measure steward:**

### Measure Developer/Steward Updates and Ongoing Maintenance

**Ad.3 Year the measure was first released:**

**Ad.4 Month and Year of most recent revision:**

**Ad.5 What is your frequency for review/update of this measure?**

**Ad.6 When is the next scheduled review/update for this measure?**

**Ad.7 Copyright statement:** N/A

**Ad.8 Disclaimers:**

**Ad.9 Additional Information/Comments:** Technical Report, calculation algorithm, ICD-9 to ICD-10 maps,

NQF #2027 Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization, Last Updated Date: May 02, 2016

[all-payer testing report, and planned readmission algorithm report attached.](#)

**Date of Submission (MM/DD/YY):** [05/04/2012](#)