NATIONAL QUALITY FORUM

Memo

TO: NQF Members and Public

FR: NQF Staff

RE: Draft Technical Report Addendum: *National Voluntary Consensus Standards for Neurology, Phase I*

DA: September 12, 2012

Background

Per NQF policy, when material changes are made to a measure's specifications, an additional member/public comment period is required.

As part of measure harmonization efforts following the June 20-21, 2012 in-person meeting, developers made substantive changes to the specifications of two measures:

- **#2026**: Hospital 30-day, all-cause, risk-standardized mortality rate (RSMR) following an acute ischemic stroke hospitalization (CMS/Yale)
- **#2027**: Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization (CMS/Yale)

These changes are summarized below:

- Measure #2026
  - This measure now includes all-payer patients ages 18 and over (rather than Medicare FFS patient ages 65+ only)
- Measure #2027
  - This measure now includes all-payer patients ages 18 and over (rather than Medicare FFS patient ages 65+ only)
  - This measure now incorporates an algorithm for identifying and excluding planned readmissions from the measure
    - Originally, the measure excluded readmissions that were planned for procedures that are related to follow-up care after an ischemic stroke (e.g., carotid endarterectomy). The revised algorithm identifies commonly planned readmissions for all types of patients, not just those that are planned as follow-up post-stroke (e.g., maintenance chemotherapy, rehabilitation).
    - The new planned readmission algorithm harmonizes the stroke readmission measures with other CMS/Yale readmission measures.

Detailed reports describing the effects of these changes on the measures are available on the NQF project page.

The Steering Committee initially recommended these measures for endorsement, but several public/member comments expressed the concern that an indicator of stroke severity (particularly, the value of the NIH Stroke Scale) is not included in the risk-adjustment models for these measures. Most of these comments specifically cited a recent article by Fonarow[1] and colleagues.

Because of material changes to the measure specifications, as well as the concern regarding inclusion of stroke severity in the risk-adjustment models, the Committee agreed to re-vote on these measures following their August 27, 2012 post-comment call. To inform their decisions, the Committee considered all comments and developer responses, supplemental materials[2], revised specifications, and reports documenting the effects of the changes in specifications, which also are posted on the project webpage. Upon re-vote, the Committee:

- Could not reach consensus on measure #2026 (yes-11, no-11)
- Could not reach consensus on measure #2027 (yes-10, no-12)

NQF Process

The changes to the measure specifications were deemed by NQF to be material changes, and thus an additional 15-day public and member comment period has been initiated. This comment period will open on September 12, 2012 and conclude at **6:00pm ET on September 26, 2012.**

Next Steps

The Neurology Steering Committee will consider all comments on these measures during Day 2 of the Neurology Phase II in-person meeting, which is being held in Washington, D.C. on October 3-4, 2012. The Committee will then finalize their recommendations on these two measures. Depending on the final recommendations from the Committee after this second comment period, member voting on these two measures will be held.

[1] Fonarow, et al. (July 18, 2012). Comparison of 30-day mortality models for profiling hospital performance in acute ischemic stroke with vs without adjustment for stroke severity. *JAMA, 308(3)*, 257-264.

[2] See http://www.qualityforum.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=71740 , http://www.qualityforum.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=71817 and http://www.qualityforum.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=71815 .

NATIONAL QUALITY FORUM

Neurology Endorsement Maintenance – Phase I

DRAFT TECHNICAL REPORT ADDENDUM

September 12, 2012

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Neurology Endorsement Maintenance – Phase I

DRAFT TECHNICAL REPORT ADDENDUM

Introduction

Neurological conditions and injuries affect millions of Americans each year, taking a tremendous toll on patients, families, and caregivers, and costing billions of dollars in treatment, rehabilitation, and lost or reduced earnings. Specifically:

- Strokes were the fourth leading cause of death in the United States in 2009, as well as a leading cause of disability.[1] Each year, approximately 795,000 people suffer a stroke.[2] Health care costs for stroke-related morbidity reached $73.7 billion in 2010.[3]
- An estimated 5.4 million Americans have Alzheimer's disease, and an estimated 16 million will have Alzheimer's by 2050.[4] The disease accounts for 70 percent of the cases of dementia in the country.[5] In 2009, Alzheimer's disease was the fifth leading cause of death for adults ages 65 and over. Medicare and Medicaid spending on people with Alzheimer's disease totaled $130 billion in 2011; this could rise to $1.1 trillion by 2050.[6]
- Epilepsy affects two million Americans and is estimated to cost $15.5 billion each year in medical costs and lost or reduced earnings and production.[7]
- One million Americans have Parkinson's disease, and the combined direct and indirect costs are estimated at $25 billion per year.[8]
- Approximately 400,000 Americans have multiple sclerosis.[9]
- Traumatic brain injury (TBI) is a major health issue affecting all age groups in the United States, causing 52,000 deaths and 275,000 hospitalizations each year. An additional 1.3 million people are treated for mild TBI and released annually from emergency departments. Direct and indirect costs for treatment and lost productivity add up to an estimated $76.5 billion yearly. These numbers do not include TBI associated with serving overseas in the military.[10]

Over the past decade, NQF has endorsed a number of consensus standards to evaluate the quality of care for neurological conditions. As quality measurement has matured, better data systems have become available, electronic health records are closer to widespread adoption, and the demand for meaningful performance measures has prompted development of more sophisticated measures of healthcare processes and outcomes for neurological conditions. An evaluation of the NQF-endorsed® neurology measures and consideration of new measures will ensure the currency of NQF's portfolio of voluntary consensus standards.

Measure Evaluation

On June 20-21, 2012, the Neurology Steering Committee evaluated 6 new measures and 23 measures undergoing maintenance review against NQF's standard evaluation criteria. As discussed in the accompanying memo, substantive changes to the specifications of measures #2026 and #2027 were made after June 20-21 meeting. These changes necessitate the initiation of an additional NQF member and public comment period.

During the June 20-21 in-person meeting, two overarching issues emerged in relation to measures #2026 and #2027: risk-adjustment for outcome measures and competing measures/measure harmonization. The bulk of the Committee's discussion around these measures centered on the adequacy of the risk-adjustment model in terms of the factors included (e.g., stroke severity) and the discriminatory power of the model. Also, measures #0467 and #2026 were identified as competing measures because both address mortality among stroke patients, and measure #2027 was identified as related to #2026 because both target the same population. At the time of the June 20-21 meeting, these measures differed in the following ways:

Number and Title	**0467 Acute Stroke Mortality Rate (IQI 17) (AHRQ)**	**2026 Hospital 30-day, all-cause, risk-standardized mortality rate (RSMR) following an acute ischemic stroke hospitalization (Yale/CMS)**	**2027 Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization (Yale/CMS)**
Measure focus	In-hospital death	Death (any cause) within 30 days of index admission	Readmission (any cause) within 30 days of index discharge
Patient population	Patients 18+, principal dx=stroke	Patients 65+, 12 months FFS Medicare Part A/B, principle dx=acute ischemic stroke	Patients 65+, 12 months FFS Medicare Part A/B, principle dx=acute ischemic stroke
Denominator exclusions	Transferring to another short-term hospital, MDC 14 (pregnancy, childbirth, and puerperium), missing discharge disposition, gender, age, quarter, year or principal diagnosis	Transferred from another acute care hospital, with inconsistent or unknown mortality status or other unreliable data, discharged against medical advice (AMA), enrolled in the Medicare hospice program any time in the 12 months prior to the index hospitalization including the first day of the index admission	Within hospital death, transferred to another acute care facility, discharged against medical advice (AMA), without at least 30 days post-discharge claims data, only one 30-day readmission counted, no hospitalization counted as both a readmission and an index admission
Timeframe	In-hospital	Within 30 days	Within 30 days
Level of analysis	Facility	Facility	Facility
Data source	Administrative claims	Administrative claims, other	Administrative claims

In their discussion of measures #0467 and #2026, the Committee agreed that there is value in having two different measures of mortality. However, they encouraged the developers to harmonize the measure exclusions to the extent possible, for measure #2026 to be expanded to patients age 18 years

and older, and for measure #0467 to be stratified so that rates for the stroke subtypes can be reported and rates for patients age 65 and older can be reported. In the discussion of measures #2026 and #2027, the Committee did not identify any harmonization issues to be addressed by the developer.

The Neurology Steering Committee's discussion and ratings of the criteria following the initial comment period are summarized in the evaluation tables below. (Note that these tables include the revised specifications; the changes to the measure specifications are redlined in Appendix A.)

2026 Hospital 30-day, all-cause, risk-standardized mortality rate (RSMR) following an acute ischemic stroke hospitalization

Submission | **Specifications**

Status: New Submission
Description: The measure estimates a hospital-level, risk-standardized mortality rate (RSMR) for patients 18 and older discharged from the hospital with a principal diagnosis of acute ischemic stroke. Mortality is defined as death from any cause within 30 days of the index admission date for patients discharged from the hospital with a principal diagnosis of acute ischemic stroke.
Numerator Statement: The outcome for this measure is 30-day all-cause mortality. We define mortality as death from any cause within 30 days from the index admission date for patients 18 and older discharged from the index hospital with a principal diagnosis of acute ischemic stroke.
Denominator Statement: 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 acute ischemic stroke (ICD-9-CM codes 433.x1, 434.x1, 436) and with a complete claims history for the 12 months prior to admission.
Exclusions: An index admission is the hospitalization considered for mortality outcome.
The measure excludes admissions for patients:
• transferred from another acute care hospital (because the death is attributed to the hospital where the patient was initially admitted);
• with inconsistent or unknown mortality status or other unreliable data (e.g. date of death precedes admission date).
• who were discharged alive and against medical advice (AMA) (because providers did not have the opportunity to deliver full care and prepare the patient for discharge);
For Medicare FFS patients, the measure additionally excludes admissions for patients:
• enrolled in the Medicare Hospice program any time in the 12 months prior to the index hospitalization including the first day of the index admission (since it is likely these patients are continuing to seek comfort measures only). Although this exclusion currently applies to Medicare FFS patients, it could be expanded to include all-payer data if an acceptable method for identifying hospice patients outside of Medicare becomes available.
Adjustment/Stratification: Statistical risk model Our approach to risk adjustment was 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".1
The measure employs a hierarchical logistic regression model to create a hospital-level 30-day RSMR. 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 mortality within 30 days of admission 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 mortality, after accounting for patient risk. See section 2a1.20. Calculation Algorithm/Measure Logic for more detail.

2026 Hospital 30-day, all-cause, risk-standardized mortality rate (RSMR) following an acute ischemic stroke hospitalization

Candidate and Final Risk-adjustment Variables: The measure was initially developed using Medicare FFS 2007 claims data. Candidate variables were patient-level risk adjustors that were expected to be predictive of mortality, 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 www.qualitynet.org (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. Following initial model development, in response to suggestions from our working group and Technical Expert Panel (TEP) members, we evaluated the mortality rates of patients admitted for stroke after having been evaluated at a different hospital's emergency department. Our experts expressed concern that such patients may be at higher risk and that the admitting hospital would not have had the opportunity to evaluate and treat such patients at first presentation. They also felt that certain hospitals may receive substantially greater proportions of patients transferred from outside EDs. Based on our analyses, we updated the measure to include a risk factor that indicates if a patient was transferred in from an outside ED, that is, the patient was seen in a different hospital's ED prior to being admitted for the index admission. This revision was done using 2008 data.

Frequencies and odds ratios for the model are presented below (2008 Medicare FFS patients aged 65 and older; n=175,267 admissions):

Final set of risk-adjustment variables:

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

• Transfer from another ED/Frequency= 5.64/OR (95% CI)= 1.37 (1.29-1.45)

Demographic

• Age-65 (continuous)/mean (SD)=15.31 (7.93)/OR (95% CI)= 1.069 (1.067-1.07)

• Male /Frequency= 40.28/OR (95% CI)= 0.99 (0.96-1.03)

Cardiovascular/Cerebrovascular

• Congestive Heart Failure /Frequency= 26.03/OR (95% CI)= 1.38 (1.34-1.43)

• Valvular and Rheumatic Heart Disease /Frequency= 23.03/OR (95% CI)= 0.87 (0.84-0.89)

• Congenital Cardiac/Circulatory Defects /Frequency= 2.04/OR (95% CI)= 0.71 (0.64-0.8)

• Hypertensive Heart Disease /Frequency= 6.54/OR (95% CI)= 0.83 (0.78-0.88)

• Specified Heart Arrhythmias /Frequency= 29.37/OR (95% CI)= 1.59 (1.54-1.64)

• Cerebral Hemorrhage /Frequency= 1.88/OR (95% CI)= 1.16 (1.06-1.27)

• Ischemic or Unspecified Stroke /Frequency= 24.81/OR (95% CI)= 1.00 (0.96-1.03)

• Precerebral Arterial Occlusion and Transient Cerebral Ischemia /Frequency= 22.83/OR (95% CI)= 0.82 (0.8-0.85)

• Cerebral Atherosclerosis and Aneurysm /Frequency= 10.67/OR (95% CI)= 0.83 (0.80-0.87)

• Hemiplegia/Hemiparesis /Frequency= 5.60/OR (95% CI)= 1.17 (1.10-1.24)

Comorbidities

• History of Infection/Frequency= 26.72/OR (95% CI)= 1.15 (1.11-1.18)

• Metastatic Cancer and Acute Leukemia and Other Major Cancers /Frequency= 3.65/OR (95% CI)= 2.77 (2.61-2.95)

• Lymphatic, Head and Neck, Brain, Breast, Colorectal and Other Major Cancers/Frequency= 23.92/OR (95% CI)= 0.92 (0.89-0.95)

• Protein-Calorie Malnutrition /Frequency= 5.42/OR (95% CI)= 1.69 (1.61-1.77)

• Other Significant Endocrine and Metabolic Disorders /Frequency= 75.98/OR (95% CI)= 0.75 (0.72-0.77)

• Other Gastrointestinal Disorders /Frequency= 43.64/OR (95% CI)= 0.90 (0.88-0.93)

2026 Hospital 30-day, all-cause, risk-standardized mortality rate (RSMR) following an acute ischemic stroke hospitalization

• Disorders of the Vertebrae and Spinal Discs /Frequency= 17.06/OR (95% CI)= 0.89 (0.86-0.93)
• Osteoarthritis of Hip or Knee /Frequency= 10.36/OR (95% CI)= 0.82 (0.78-0.86)
• Other Musculoskeletal and Connective Tissue Disorders /Frequency= 63.50/OR (95% CI)= 0.86 (0.84-0.89)
• Iron Deficiency and Other/Unspecified Anemia and Blood Disease /Frequency= 31.86/OR (95% CI)= 1.09 (1.05-1.12)
• Dementia or senility /Frequency= 28.64/OR (95% CI)= 1.24 (1.20-1.28)
• Major Psychiatric Disorders /Frequency= 9.12/OR (95% CI)= 1.08 (1.04-1.13)
• Quadriplegia, Other Extensive Paralysis /Frequency= 1.54/OR (95% CI)= 1.39 (1.26-1.53)
• Multiple Sclerosis /Frequency= 10.27/OR (95% CI)= 0.83 (0.79-0.87)
• Seizure Disorders and Convulsions /Frequency= 6.92/OR (95% CI)= 1.27 (1.21-1.33)
• Hypertension /Frequency= 88.00/OR (95% CI)= 0.77 (0.74-0.81)
• Peripheral Vascular Disease /Frequency= 23.02/OR (95% CI)= 1.07 (1.04-1.11)
• Chronic Obstructive Pulmonary Disease /Frequency= 21.92/OR (95% CI)= 1.06 (1.03-1.10)
• Pneumonia /Frequency= 17.36/OR (95% CI)= 1.49 (1.44-1.54)
• Pleural Effusion/Pneumothorax /Frequency= 6.92/OR (95% CI)= 1.13 (1.07-1.18)
• Other Eye Disorders /Frequency= 19.34/OR (95% CI)= 0.91 (0.88-0.94)
• Other Ear, Nose, Throat, and Mouth Disorders /Frequency= 26.99/OR (95% CI)= 0.87 (0.84-0.90)
• Dialysis Status /Frequency= 1.47/OR (95% CI)= 1.38 (1.24-1.52)
• Renal Failure /Frequency= 15.45/OR (95% CI)= 1.16 (1.12-1.21)
• Urinary Tract Infection /Frequency= 21.55/OR (95% CI)= 1.14 (1.10-1.18)
• Male Genital Disorders /Frequency= 11.95/OR (95% CI)= 0.78 (0.74-0.82)
• Decubitus Ulcer of Skin /Frequency= 2.52/OR (95% CI)= 1.29 (1.20-1.39)
• Chronic Ulcer of Skin, Except Decubitus /Frequency= 5.52/OR (95% CI)= 1.16 (1.10-1.23)
• Other Dermatological Disorders /Frequency= 29.38/OR (95% CI)= 0.92 (0.89-0.95)

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. N/A

Level of Analysis: Facility
Type of Measure: Outcome
Data Source: Administrative claims, Other
Measure Steward: Centers for Medicare & Medicaid Services (CMS) **Other organizations:** MPR: Mathematica Policy Research; RTI: Research Triangle Institute

2026 Hospital 30-day, all-cause, risk-standardized mortality rate (RSMR) following an acute ischemic stroke hospitalization

STEERING COMMITTEE MEETING [June 20-21, 2012]

Importance to Measure and Report: <u>The measure meets the Importance criteria</u>

(1a. High Impact: 1b. Performance Gap, 1c. Evidence)

1a. Impact: **H-21; M-1; L-0; I-0**; 1b. Performance Gap: **H-20; M-2; L-0; I-0** 1c. Evidence: **Y-22; N-0**

<u>Rationale</u>:

- The developer noted that stroke is the fourth leading cause of death in the U.S.; they also noted the frequent sequelae of stroke, including severe and long-term disability and the associated costs and healthcare resource demands.
- The developers reported an inter-quartile range of hospital unadjusted mortality rates between 9.1 and 21.4 percent, which they note is consistent with the literature. They also reported an inter-quartile range of hospital risk-standardized mortality rates between 14.4 and 16.4 percent.
- The Committee agreed that there is a rationale linking stroke mortality to at least one healthcare structure, process, intervention, or service.

2. Scientific Acceptability of Measure Properties: <u>The measure meets the Scientific Acceptability criteria</u>

(2a. Reliability – precise specifications, testing; 2b. Validity – testing, threats to validity)

2a. Reliability: **H-3; M-18; L-1; I-0** 2b. Validity**: H-3; M-13; L-5; I-1**

<u>Rationale:</u>

- To demonstrate reliability of the measure score, developers randomly split 3 years of Medicare Fee-For-Service data, computed the RSMR, and then computed an intra-class correlation coefficient of 0.4 from the two samples. The Committee interpreted this statistic to reflect a moderate level of agreement.
- The Committee asked for additional information regarding the comparisons of the hospital ratings based on this measure with those based on chart-abstracted data. Developers stated that they created a risk-adjustment model based on the medical record data, computed hospital-specific risk-standardized mortality rates, and then correlated those with the rates found based on administrative data. The reported correlation from this analysis was 0.8. One Committee member noted, however, that the high correlation would be less meaningful if both models have poor predictive ability.
- One Committee member expressed concern that indicators of stroke severity did not seem to be included in the risk-adjustment model (*c* statistic=0.732). The developers noted that the NIH Stroke Scale score is not available on claims data. They also noted their use of the condition grouper that includes diagnoses that are potentially related to stroke severity (e.g., coma).
- Developers clarified their approach to excluding complications of care in the risk-adjustment model, noting that they first developed a list of potential complications and included those in the risk model only if they appear in the claims data in the 12-months prior to the index admission.
- Several Committee members raised concerns about co-morbid medical conditions that appear to be paradoxically protective for mortality (e.g., hypertension) in the risk-adjustment model. The developers offered their interpretation of this result by suggesting that such diagnoses from the historical ambulatory care claims data are indicators of patients who are less severely sick because of coding practices. However, Committee members expressed some skepticism about this interpretation. The developers noted that for at least some of these questionable conditions, the confidence intervals include one and are thus not statistically significant in the model.
- One Committee member questioned the validity of using administrative billing data for this measure, noting particularly a concern that additional clinical information (e.g., coma) may not be included on the claims data. Other Committee members noted that while this concern may not be applicable for the diagnoses included on the facility-level claim, it might be for the historical physician-level data.
- One Committee member noted a concern that the risk-adjustment model does not take into account how a patient entered a facility (e.g., Life Flight) or where a patient was discharged to (e.g., home versus a nursing facility). Developers explained that they purposely did not risk-adjust for discharge location

because this may reflect the quality of care that was provided. They also noted that while they cannot adjust for Life Flight status, they do include in the risk-adjustment model an indicator of whether the patient came into a facility from an outside Emergency Department.

3. Usability: H-4; M-18; L-0; I-0
(*Meaningful, understandable, and useful to the intended audiences for 3a. Public Reporting/Accountability and 3b. Quality Improvement)*
Rationale:

- The developers stated that this measure is not currently used in public reporting or quality improvement efforts.
- One Committee member expressed concern about the potential use of this measure for pay-for-performance applications. NQF staff clarified that NQF endorsement implies that the measure is acceptable for a wide range of accountability applications, including accreditation, public reporting, and payment.

4. Feasibility: H-14; M-8; L-0; I-0
(4a. Clinical data generated during care delivery; 4b. Electronic sources; 4c.Susceptibility to inaccuracies/ unintended consequences identified 4d. Data collection strategy can be implemented)
Rationale:

- Committee members noted that the measure is computed from administrative data, although there was some question about whether mortality data are routinely gathered. The developers stated that researchers have validated that Medicare is very good at collecting mortality data.

5. Related and Competing Measures

- This measure directly competes with #0467 [Acute Stroke Mortality Rate (IQI 17)] because both address mortality among stroke patients. The main differences between the measures are that measure #0467 includes patients 18 and older with any type of stroke and assesses in-hospital mortality, while measure #2026 includes patients 65 years and older with ischemic stroke and assesses mortality within 30 days of the stroke admission.
  - The Committee agreed that there is value in having measures of both in-hospital mortality as well as 30-day mortality.
  - The Committee has asked AHRQ if they can stratify their measure to obtain rates for ischemic stroke, intracerebral hemorrhage, and subarachnoid hemorrhage and also stratify for ages 65 and older.
  - ***AHRQ response***: We agree that in addition to the ability to calculate the measure with the present denominator, we will create the capability for the user to stratify within the measure by ischemic stroke, intracerebral hemorrhage, and subarachnoid hemorrhage. In regard to age, users already have the functionality to stratify by age. So that capacity – as with other AHRQ QIs – would of course be maintained going forward. The Committee has encouraged CMS to extend the measure to ages 18 and older.
    CMS/Yale response: We have re-specified this measure to include both non-FFS Medicare patients aged 65+ years and all-payer patients aged 18-64 years.
  - The Committee has asked the developers to respond regarding the possibility of harmonization of the measure exclusions.
    Joint AHRQ/CMS response: AHRQ's measure excludes cases:
    • Transferring to another short-term hospital
    • MDC 14 (pregnancy, childbirth, and puerperium)
    • With missing discharge disposition, gender, age, quarter, year or principal diagnosis

CMS's measure excludes admissions for patients:
• transferred from another acute care hospital
• with inconsistent or unknown mortality status or other unreliable data (e.g. date of death precedes admission date)
• who were discharged alive and against medical advice (AMA)
• enrolled in the Medicare Hospice program at any time in the 12 months prior to the index hospitalization including the first day of the index admission

Harmonized Exclusions
The measure developers view the following exclusions as consistent and harmonized between the two measures:
• Exclusion of pregnancy-related admissions: the current CMS measure includes only patients 65 years and older. YNHHSC/CORE/CMS plans to exclude pregnancy-related admissions in all-payer specified measure.
• Exclusion of admissions with missing or unreliable data: the measures have slightly different approaches to handling missing or unreliable data but both address the issue of missing or unreliable data. Given the difference in data source we do not see a need to further harmonize.

Plans for Exclusions not Currently Harmonized
For the exclusions that are not harmonized between the measures, we provide rationales and adjustments (when appropriate) below.

- The AHRQ measure excludes cases *transferred to* another acute care facility, while CMS's measure excludes admissions for patients *transferred from* another acute care facility. This is a necessary difference given the scope of the respective measures. Since AHRQ's measure is an in-hospital mortality measure, transfers to another acute care facility are excluded because the outcome of interest is not observed. CMS's 30-day mortality measure attributes death to the hospital where the patient was initially admitted, thereby excluding admissions that are transferred from another acute care facility. These exclusions will remain unharmonized as they are specific to the outcome being assessed by each measure.
- CMS excludes admissions for patients who are discharged against medical advice (AMA) as providers were not given the opportunity to deliver full care and prepare the patient for discharge. Given that AHRQ's measure focuses on in-patient mortality, patients with the status of AMA are irrelevant to the assessment of in-hospital mortality. As such, this exclusion will remain the same.
- CMS excludes admissions for patients enrolled in Medicare Hospice since it is likely these patients continued to seek comfort measures only. Given the AHRQ measure is computed using inpatient data, the AHRQ QI is not able to employ exclusions based on other data sets, which in this case would involve hospice claims prior to the inpatient admission.
- In regard to inpatient administrative data that we have historically had access to, CMS and AHRQ are in agreement that the V66.7 palliative care code is not sufficient to use as an exclusion for it does not specify that the decision to only provide palliative care occurred at admission. However, additional data has recently become available regarding hospice care that AHRQ is exploring as whether inpatient mortality measures would benefit from using the data as either an exclusion or a covariate. The data element is: Point of origin code for admitted from hospice (value of "F"). At the present time, this data element is being analyzed for potential use in the AHRQ QIs. At the time the analysis is complete, results will be discussed between CMS and AHRQ in regard to the potential to benefit either or both measures. One possible outcome could be that the point of origin code for admitted from hospice is used as a reasonable proxy to the CMS exclusion.

Committee response: In response to a comment concerning harmonization for another group of

measures, the Committee recommended continued and aggressive efforts for harmonization when possible, and requested an update on progress on harmonization at the time of annual review.

- This measure is also related to #2027 [Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization] because both have the same target population.
  - The developer stated that the measures are completely harmonized and the Committee did not identify any other harmonization issues with this measure.

Steering Committee Recommendation for Endorsement: Y-18; N-4

Public & Member Comment

Comments included**:**

- A concern that administrative data rather than clinical data is used for the measure.
  Developer response: There are a number of things that contribute to the success of administrative models for risk-adjustment of hospital outcomes measures. Although a few covariates may appear counterintuitive, most are clinically coherent. What is most important to note is that the stroke measure has been validated against a chart measure in our development process with high degree of correlation between the two models (0.8). We have demonstrated, through our validation, the effectiveness of claims data for risk-adjustment by showing that the measure produces similar results as a medical record model. Moreover, it does not carry the burden for hospitals of collecting chart abstracted data.
- A concern that the most severely disabled stroke patients are re-directed to referral stroke centers, which may result in excess mortality at those sites.
  Developer response: During the development process we examined the performance of referral stroke centers, both looking at teaching hospitals and at stroke centers, but we do not find any evidence that these hospitals are shown to have excess mortality on this measure. Teaching centers, stroke centers have been shown to have overall similar distribution of performance as other hospitals.
- A concern that hospitals may "cherry pick" stroke patients with mild or moderate strokes and may not want to accept more severely ill patients.
  Developer response: We have aimed to develop a measure that will not have any such incentives. If the patient is admitted to one hospital and then transferred, the first admitting hospital is accountable for the mortality outcome. Additionally, if a patient is transferred from an outside Emergency Department, this is accounted for in the risk-adjustment of the measure.
- A concern that the measures are not well validated.
  Developer response: The measure development process has been fully transparent. We had a public call to convene members for a Technical Expert Panel and the summary of this panel's discussion on the measure specifications was publicly available. The measure also went through a public comment period during development. We have aimed for full transparency in the process of developing and validating the measure.
- Several commenters expressed the concern that an indicator of stroke severity (particularly, the value of the NIH Stroke Scale) is not included in the risk-adjustment models for stroke mortality; most specifically cited a recent JAMA article (*308(3)*, 257-264) by Fonarow and colleagues.
  Developer response: Although the paper shows, not surprisingly, that that model discrimination is improved with the inclusion of NIHSS, there are a number of concerns about this paper which limit it applicability to our measure. The paper uses a model that differs in meaningful ways from the measure we have put forth. Although presented as being modeled on our measure it includes both ischemic and hemorrhagic stroke patients, fails to account for transfers from outside EDs (which likely account in part for stroke severity), and includes a large number of covariates. The paper is also dependent on the NIHSS, which is present in fewer than half the patients; this both limits interpretation of paper's results

and speaks to the hurdles to producing a measure that could be used nationally for public reporting that included NIHSS. Finally, the paper suggests changes in hospital ranking (based on intercept terms not full risk-standardized rates) but does not indicate whether the shifts across categories are due to relatively small changes in the risk-standardized rates that move the hospitals across the boundaries of the categories or more significant changes in hospital scores change between the two measures. Further, the analysis of the outliers was done solely by comparing the random intercepts to the average hospital intercepts which does not take into account the case-mix of each hospital. For all of these reasons we do not feel the paper should change the Steering Committee's assessment of our measure.

Committee response:
The Committee discussed at length the concern regarding inclusion of stroke severity in the risk-adjustment model. Points of discussion included the need for adjustment for stroke severity, the success (or not) in adjustment for severity using only administrative data, the potential timing and feasibility of collecting the NIH stroke scale value, the findings from the Fonarow paper that inclusion of the NIH stroke score resulted in changes in hospital rankings, the potential discriminatory ability of the CMS/Yale model if the NIH stroke scale also was included, the concern that the measure unfairly categorizes tertiary care facilities that accept many transfer patients (e.g., stroke centers/safety net hospitals), and the trade-offs between a possibly imperfect measure against having no measure of readmissions at all.

Regarding the change in hospital rankings in the Fonarow study, the developer noted that most hospitals did not change classifications and suggested that, rather than focus on reclassifications based on arbitrary cut-points, it would have been more informative to know how much agreement there was in the actual risk-adjusted rates. Regarding the potential discriminatory ability of the CMS/Yale model if the NIH stroke scale also was included, the developer stated that addition of an extra variable in a model will always result in improved predictive performance (i.e., a higher R^2 value). The developer also noted that in the mortality model they developed from clinical data (*c* statistic = 0.80), they used a stroke severity scale that performs similarly to the NIH stroke scale. The developer also noted that less than half of the patients in the Fonarow study had an NIH stroke scale value (and thus more than half of the stroke patients were excluded from the study) and that the percentage of patients without the NIHSS value was not uniform across all hospitals.

Measure Changes:
As part of their measure harmonization efforts, the developer made a material change to the measure after the in-person meeting. Specifically, the measure now includes all-payer patients ages 18 and over (rather than Medicare FFS patient ages 65+ only). The developer provided a detailed report describing the effects of this change on the measure.

Due to the material change made to the measure, as well as the concern regarding inclusion of stroke severity in the risk-adjustment model, the Committee was asked to re-vote on the measure. Committee members we instructed to consider the revised specifications in their decision. Also, in addition to the abridged developer responses noted above (full responses are included in the Comment table posted to the public website), additional materials were made available to the Committee, as follows:

- Yale-New Haven Hospital Comment Letter
- Yale Follow-up to Steering Committee Meeting on August 27, 2012 (PDF)
- GWTG Supplementary Response After 27 Call (PDF)

These materials are posted on the project page on NQF's public website.

Vote Following Consideration of Public and Member Comments:

2026 Hospital 30-day, all-cause, risk-standardized mortality rate (RSMR) following an acute ischemic stroke hospitalization

1. Importance to Measure and Report *(based on decision logic):* **Yes**
1a. Impact: **H-16; M-4; L-1; I-1 1b.** Performance Gap: **H-11; M-9; L-1; I-1 1c.** Evidence: **Y-18; N-4; I-0**
2. Scientific Acceptability of Measure Properties *(based on decision logic):* **Yes**
2a. Reliability: **H-6; M-10; L-3; I-3 2b.** Validity: **H-3; M-9; L-5; I-5**
Usability: H-4; M-10; L-4; I-4
Feasibility: H-9; M-8; L-3; I-2
Recommendation for Endorsement: Y-11; N-11

Steering Committee Recommendation for Endorsement: Consensus Not Reached

2027 Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization

Submission | Specifications

Status: New Submission
Description: The measure estimates a hospital-level risk-standardized readmission rate (RSRR) for patients discharged from the hospital with a principal diagnosis of acute ischemic stroke. We define this as readmission for any cause within 30 days from the date of discharge of the index stroke admission.
Numerator Statement: The outcome for this measure is 30-day all-cause readmission. We define all-cause readmission as readmission for any cause within 30 days from the date of discharge of the index stroke for patients 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.
Denominator Statement:
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.
Exclusions: 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.

Adjustment/Stratification: Statistical risk model 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"1.

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.2 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. N/A

Level of Analysis: Facility
Type of Measure: Outcome
Data Source: Administrative claims
Measure Steward: Centers for Medicare & Medicaid Services (CMS) **Other organizations:** MPR: Mathematica Policy Research; RTI: Research Triangle Institute

2027 Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization

STEERING COMMITTEE MEETING [June 20-21, 2012]

Importance to Measure and Report: <u>The measure meets the Importance criteria</u>

(1a. High Impact: 1b. Performance Gap, 1c. Evidence)

1a. Impact: **H-17; M-3; L-0; I-0**; 1b. Performance Gap: **H-15; M-7; L-0; I-0** 1c. Evidence: **Y-19; N-2**

<u>Rationale</u>:

- Data submitted by the developer noted that stroke is a leading cause of morbidity and is associated with high rates of preventable complications and discharge to settings with substantial requirements for ongoing care, thus providing numerous opportunities for potential readmissions, and, consequently, opportunities to reduce readmission rates with appropriate interventions and care decisions.
- Data submitted by the developer reported that in their analysis of Medicare Fee-For-Service patients, non-adjusted readmission rates for stroke patients are generally high (median=14.0%), with large variations between facilities (25th percentile =10.0; 75th percentile =18.9%).
- The Committee agreed that the developers demonstrated a link between structures/processes of care and hospital readmissions. For example, the developer cited one study that found that patients with follow-up interventions such as post-discharge home visits had lower readmission rates than those with standard follow-up and another study that found that system-level strategies have the potential to improve outcomes and reduce readmissions.

2. Scientific Acceptability of Measure Properties: <u>The measure meets the Scientific Acceptability criteria</u>

(2a. Reliability – precise specifications, testing; 2b. Validity – testing, threats to validity)

2a. Reliability: **H-10; M-12; L-0; I-0** 2b. Validity**: H-0; M-12; L-4; I-6**

<u>Rationale:</u>

- The Committee questioned why admissions unrelated to stroke are not excluded. The developer noted that while planned readmissions are excluded, it is very difficult to differentiate related from non-related readmissions and also emphasized that any readmission is important to the patient. The developer stated that they are not suggesting that the readmission rate should be zero, and also noted that while some readmissions (e.g., car crash injuries) may be completely unrelated, they assume that such random events are both unlikely and evenly distributed across hospitals.
- The Committee questioned how planned readmissions are accounted for in the measure. The developer explained that they had identified certain follow-up procedures that physicians often perform as a continuation of treatment after the discharge from the index admission (e.g., carotid endarterectomy). Admissions where these procedures are documented (but where acute stroke is not listed as a principal discharge diagnosis) are excluded from the measure.
- The Committee also questioned the *c* statistic value (0.6) from the risk-adjustment model, noting that such a low value indicates that the model does not have high discriminatory power. The developer noted that the risk-adjustment model includes only patient-level factors that are present at the start of care, which is consistent with NQF criteria (i.e., risk models do not include other types of explanatory variables such as hospital characteristics or care processes that relate to quality of care). They also stated that other studies have shown that patient characteristics often do not have good explanatory power for readmissions. The developers noted that hospital-level factors (e.g., care transitions, follow-up, communication) influence readmission rates—but these are the care practices for which improvement is needed and are therefore not included in the risk-adjustment model.
- The Committee questioned whether anyone had modeled hospital readmission rates so as to better understand the relative contributions of patient and hospital factors. They developers stated that they had not done those analyses, although other researchers have done similar types of analyses in other care settings. However, the developer also noted that many influential hospital-level factors are very difficult to measure. Some Committee members noted a lack of data to support the assumption that hospital-based factors can influence readmission rates.

2027 Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization

- Committee members also questioned whether anyone had modeled hospital readmission rates when accounting for community-based or post-discharge risk factors, or other factors such as state law and family choice decisions. The developer acknowledged the multi-factorial causal pathway to readmissions but noted the difficulties in trying to conduct this type of analysis. The developer noted that while their risk-model may not be comprehensive, it does level the playing field as best as possible.
- The Committee questioned the assumption by the developers that hospital practices actually can influence readmission rates. The developer responded that they are starting to see evidence in the published literature showing that effective interventions by hospitals can lower readmission rates. Other Committee members, as well as the measure developer, provided evidence that hospital practices can affect readmission rates (e.g., sending patients to a better rehab facility rather than just the one that will accept the patient the soonest). Several Committee members agreed that the utility of this measure is to drive the discovery of interventions that would influence their readmission rates.
- The Committee also noted that while hospital practices may affect readmission rates, hospitals cannot control patient behaviors once the patient leaves the hospital. Although the developer agreed that hospitals do not have full control over readmissions, they stated that there are many factors that the hospitals can influence that might affect readmission rates (e.g., medication reconciliation, clear discharge instructions, better post-discharge support).
- The Committee also asked whether similar readmission models that include stroke severity have been conducted. The developer stated that they had done this but stroke severity wasn't consistently found to be an important predictor.
- One Committee member asked whether patients admitted under observation status are excluded from the measure. The developer clarified that those patients would be excluded.

3. Usability: H-7; M-11; L-4; I-0

(*Meaningful, understandable, and useful to the intended audiences for 3a. Public Reporting/Accountability and 3b. Quality Improvement)*

Rationale:

- The Committee agreed that a high readmission rate should prompt hospitals to conduct their own investigations to determine what interventions should be implemented to reduce readmissions.
- One Committee member voiced a concern about the interpretability of hospital rankings based on this measure. The developer noted that the measure has typically been used to identify poor-performing outliers.

4. Feasibility: H-11; M-10; L-1; I-0

(4a. Clinical data generated during care delivery; 4b. Electronic sources; 4c.Susceptibility to inaccuracies/ unintended consequences identified 4d. Data collection strategy can be implemented)

Rationale:

- The Committee did not express any concerns about the feasibility of the measure.

5. Related and Competing Measures

- This measure is related to #2026 [Hospital 30-day, all-cause, risk-standardized mortality rate (RSMR) following an acute ischemic stroke hospitalization] because both have the same target population.
  - The developer stated that the measures are completely harmonized and the Committee did not identify any other harmonization issues with this measure.

Steering Committee Recommendation for Endorsement: Y-13; **N-9**

Public & Member Comment

Comments included**:**

- A concern that hospitals may not be able to influence readmission rates.

Developer response: We would like to clarify that the measure is a relative measure meant to identify hospitals whose readmission rate is higher than would be expected based on the performance of an average hospital caring for similar patients. We do not assume all readmissions are preventable. The measure is not intended to drive hospitals to a zero readmission rate, but rather is designed to encourage hospitals to identify opportunities to reduce readmission risks in their environment. Careful discharge planning and instructions, communication with outpatient providers, attention to patient safety and prevention of infections, are all important for reducing readmissions and there is increasing evidence in the peer review literature to show that hospital interventions can lower readmission rates.

- A concern that the risk-adjustment model does not have a high discriminatory power (*c* statistic=0.6).
  Developer response: We would like to clarify the important difference between predictive models intended for patient-level risk-stratification versus models used to profile hospital performance. In the first, a patient-level predictive model the objective is to best predict patient outcomes and the risk-adjustment variables are a means to better predict of these outcomes. As an example, a patient who has a serious complication of care may be at higher risk of mortality and readmission and therefore complications might be useful to include in a model used for patient-level prediction.
  By contrast, the role of risk-adjustment in hospital profiling models is to level the playing field for hospitals in measures that assess hospitals on their relative performance – that is, on how well they are doing compared to hospitals with similar patients. The risk adjustment variables should be only those that are inherent to the patient and present at the start of the time period. Although risk-adjusting for complications of care could increase the statistical power of a profiling model, it would not make sense to risk adjust for complications since it could lead hospitals with high rates of complications to appear to be performing better than hospitals that admitted similar patients even though the quality of care is worse.
- Several commenters expressed the concern that an indicator of stroke severity is not included in the risk-adjustment model.
  Developer response: Our published systematic review of papers examining readmission after stroke demonstrated found limited evidence for stroke severity as a predictor of readmission. Not all papers considered stroke severity as a predictor. Those that did, measured it in a variety of ways and in some cases found it was not predictive of readmission. (Lichtman et al, Stroke, November 2010). The Kansagra et al., article in JAMA (Oct 19, 2011) highlights that few models of readmission have high c-statistics. It also suggests, consistent with our beliefs, that it is likely that factors such as the quality of hospital and post-discharge care may play a larger role in readmission outcomes than patient factors, thus accounting for the lower c-statistics of these models.

Committee response:
The Committee discussed at length the concern regarding inclusion of stroke severity in the risk-adjustment model. Points of discussion included the need for adjustment for stroke severity, the success (or not) in adjustment for severity using only administrative data, the potential timing and feasibility of collecting the NIH stroke scale value, the face validity of the risk-adjustment model, given that some covariates seem to be paradoxically protective against readmission, the concern that the measure unfairly categorizes tertiary care facilities that accept many transfer patients (e.g., stroke centers/safety net hospitals), and the trade-offs between a possibly imperfect measure against having no measure of readmissions at all.

The developer noted that the concern that the measure potentially could unfairly categorize tertiary care facilities was an underlying reason that they created the transfer-from-emergency-department variable. Further, regarding the concern about the face validity of their risk-adjustment model, the developer noted that they are careful not to adjust for things that happen to the patient after hospital arrival and that one consequence of this is a lower *c* statistic. They also voiced a belief that if a model based on administrative claims correlates well with a model based on clinical data (as presented in the reports initially submitted by the developer), then the behavior of the

individual model covariates is less important.

Measure Changes:
As part of their measure harmonization efforts, the developer made two material changes to the measure after the in-person meeting, as follows:

- This measure now includes all-payer patients ages 18 and over (rather than Medicare FFS patient ages 65+ only)
- This measure now incorporates an algorithm for identifying and excluding planned readmissions from the measure
    - Originally, the measure excluded readmissions that were planned for procedures that are related to follow-up care after an ischemic stroke (e.g., carotid endarterectomy). The revised algorithm identifies commonly planned readmissions for all types of patients, not just those that are planned as follow-up post-stroke (e.g., maintenance chemotherapy, rehabilitation).
    - The new planned readmission algorithm harmonizes the stroke readmission measures with other CMS/Yale readmission measures.

The developer provided detailed reports describing the effects of the changes on the measure.

Due to the material changes made to the measure, as well as the concern regarding inclusion of stroke severity in the risk-adjustment model, the Committee was asked to re-vote on the measure. Committee members we instructed to consider the revised specifications in their decision. Also, in addition to the abridged developer responses noted above (full responses are included in the Comment table posted to the public website), additional materials were made available to the Committee, as follows:

- Yale-New Haven Hospital Comment Letter
- Yale Follow-up to Steering Committee Meeting on August 27, 2012 (PDF)
- GWTG Supplementary Response After 27 Call (PDF)

These materials are posted on NQF's public website.

Vote Following Consideration of Public and Member Comments:
1. Importance to Measure and Report *(based on decision logic):* **Yes**
1a. Impact: **H-16; M-4; L-1; I-1 1b.** Performance Gap: **H-11; M-9; L-1; I-1 1c.** Evidence: **Y-17; N-5; I-0**
2. Scientific Acceptability of Measure Properties *(based on decision logic):* **Yes**
2a. Reliability: **H-5; M-10; L-3; I-4 2b.** Validity: **H-4; M-7; L-6; I-5**
Usability: H-3; M-11; L-4; I-4
Feasibility: H-8; M-10; L-2; I-2
Steering Committee Recommendation on Overall Suitability for Endorsement: Y-10-; N-12
Steering Committee Recommendation for Endorsement: Consensus Not Reached

Appendix A: Measure Specifications

	2026 Hospital 30-day, all-cause, risk-standardized mortality rate (RSMR) following an acute ischemic stroke hospitalization
Steward	Centers for Medicare & Medicaid Services (CMS)
Description	The measure estimates a hospital-level, risk-standardized mortality rate (RSMR) for patients 18 and older discharged from the hospital with a principal diagnosis of acute ischemic stroke. Mortality is defined as death from any cause within 30 days of the index admission date for patients discharged from the hospital with a principal diagnosis of acute ischemic stroke.
Type	Outcome
Data Source	Administrative claims, Other The Medicare data sources used to create the measure were: 1. Medicare Part A inpatient and Part B outpatient claims: This database contains claims data for fee-for service inpatient and outpatient services including: Medicare inpatient hospital care, outpatient hospital services, skilled nursing facility care, some home health agency services, and hospice care, as well as 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 et al., 1992). Fleming C, Fisher ES, Chang CH, Bubolz TA, Malenda DJ. 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): 377-391. Attachment Stroke_Cohort_ICD9_to_ICD10_Maps.pdf
Level	Facility
Setting	Hospital/Acute Care Facility
Numerator Statement	The outcome for this measure is 30-day all-cause mortality. We define mortality as death from any cause within 30 days from the index admission date for patients 18 and older discharged from the index hospital with a principal diagnosis of acute ischemic stroke.
Numerator Details	**Time Window:** 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 ar 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. Measure includes deaths from any cause within 30 days from admission date of the index hospitalization. Identifying deaths in the FFS measure We identify deaths for FFS Medicare patients 65 years and older in the Medicare Enrollment Database. Identifying deaths in the all-payer measure For the purposes of development deaths were identified using the California vital statistics data file. Nationally, post-discharge deaths can be identified using an external source of vital status, such as the Social Security Administration's Death Master File (DMF) or the C 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. Measure includes deaths from any cause within 30 days from admission date of the index hospitalization. Identifying deaths in the FFS measure We identify deaths for FFS Medicare patients 65 years and older in the Medicare Enrollment Database. Identifying deaths in the all-payer measure For the purposes of development deaths were identified using the California vital statistics data file.

	2026 Hospital 30-day, all-cause, risk-standardized mortality rate (RSMR) following an acute ischemic stroke hospitalization
	Nationally, post-discharge deaths can be identified using an external source of vital status, such as the Social Security Administration's Death Master File (DMF) or the Centers for Disease Control and Prevention's National Death Index (NDI).enters for Disease Control and Prevention's National Death Index (NDI).e using this field to define the outcome. Measure includes deaths from any cause within 30 days from admission date of the index hospitalization. Identifying deaths in the FFS measure We identify deaths for FFS Medicare patients 65 years and older in the Medicare Enrollment Database. Identifying deaths in the all-payer measure For the purposes of development deaths were identified using the California vital statistics data file. Nationally, post-discharge deaths can be identified using an external source of vital status, such as the Social Security Administration's Death Master File (DMF) or the Centers for Disease Control and Prevention's National Death Index (NDI). ~~We define this as death from any cause within 30 days from the admission date for the index acute ischemic stroke hospitalization.~~ ~~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.~~ ~~Measure includes deaths from any cause within 30 days from admission date of the index hospitalization. We identify deaths for FFS Medicare patients 65 years and older in the Medicare Enrollment Database.~~
Denominator Statement	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 acute ischemic stroke (ICD-9-CM codes 433.x1, 434.x1, 436) and with a complete claims history for the 12 months prior to admission.
Denominator Details	**Time Window:** This measure was developed with 12 months of data. 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. ~~The denominator includes patients 65 years and older who were admitted to non-federal acute care hospitals for an ischemic stroke as defined by the following ICD-9-CM and ICD-10-CM codes and with a complete claims history for the 12 months prior to admission:~~ 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
Exclusions	An index admission is the hospitalization considered for mortality outcome. The measure excludes admissions for patients: • transferred from another acute care hospital (because the death is attributed to the hospital where the patient was initially admitted); • with inconsistent or unknown mortality status or other unreliable data (e.g. date of death precedes admission date). • who were discharged alive and against medical advice (AMA) (because providers did not have the opportunity to deliver full care and prepare the patient for discharge); For Medicare FFS patients, the measure additionally excludes admissions for patients: • enrolled in the Medicare Hospice program any time in the 12 months prior to the index hospitalization including the first day of the index admission (since it is likely these patients are continuing to seek comfort measures only). Although this exclusion currently applies to Medicare FFS patients, it could be expanded to include all-payer data if an acceptable method for identifying hospice patients outside of Medicare becomes available.
Exclusion Details	Transfers from other acute care facilities are identified in the claims when a patient with a qualifying admission is discharged from an acute care hospital and admitted to another acute care hospital on the same day or next day; Inconsistent vital status or unreliable data are identified if any of the following conditions are met 1) the patient's age is greater than 115 years: 2) if the discharge date for a hospitalization is before the admission date; 3) if the patient has a sex other than 'male' or 'female'. Discharges Against Medical Advice (AMA) are identified using the discharge disposition indicator. Hospice enrollment in the 12 months prior to or on the index admission is identified using hospice data and the Inpatient standard analytic file (SAF)
Risk Adjustment	Statistical risk model Our approach to risk adjustment was 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".1 The measure employs a hierarchical logistic regression model to create a hospital-level 30-day RSMR. 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 mortality within 30 days of admission 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 mortality, after accounting for patient risk. See section 2a1.20. Calculation Algorithm/Measure Logic for more detail.

Candidate and Final Risk-adjustment Variables: The measure was initially developed using Medicare FFS 2007 claims data. Candidate variables were patient-level risk adjustors that were expected to be predictive of mortality, 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 www.qualitynet.org (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.

Following initial model development, in response to suggestions from our working group and Technical Expert Panel (TEP) members, we evaluated the mortality rates of patients admitted for stroke after having been evaluated at a different hospital's emergency department. Our experts expressed concern that such patients may be at higher risk and that the admitting hospital would not have had the opportunity to evaluate and treat such patients at first presentation. They also felt that certain hospitals may receive substantially greater proportions of patients transferred from outside EDs. Based on our analyses, we updated the measure to include a risk factor that indicates if a patient was transferred in from an outside ED, that is, the patient was seen in a different hospital's ED prior to being admitted for the index admission. This revision was done using 2008 data.

Frequencies and odds ratios for the model are presented below (2008 Medicare FFS patients aged 65 and older; n=175,267 admissions):

Final set of risk-adjustment variables:

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

• Transfer from another ED/Frequency= 5.64/OR (95% CI)= 1.37 (1.29-1.45)

Demographic

• Age-65 (continuous)/mean (SD)=15.31 (7.93)/OR (95% CI)= 1.069 (1.067-1.07)
• Male /Frequency= 40.28/OR (95% CI)= 0.99 (0.96-1.03)

Cardiovascular/Cerebrovascular

• Congestive Heart Failure /Frequency= 26.03/OR (95% CI)= 1.38 (1.34-1.43)
• Valvular and Rheumatic Heart Disease /Frequency= 23.03/OR (95% CI)= 0.87 (0.84-0.89)
• Congenital Cardiac/Circulatory Defects /Frequency= 2.04/OR (95% CI)= 0.71 (0.64-0.8)
• Hypertensive Heart Disease /Frequency= 6.54/OR (95% CI)= 0.83 (0.78-0.88)
• Specified Heart Arrhythmias /Frequency= 29.37/OR (95% CI)= 1.59 (1.54-1.64)
• Cerebral Hemorrhage /Frequency= 1.88/OR (95% CI)= 1.16 (1.06-1.27)
• Ischemic or Unspecified Stroke /Frequency= 24.81/OR (95% CI)= 1.00 (0.96-1.03)
• Precerebral Arterial Occlusion and Transient Cerebral Ischemia /Frequency= 22.83/OR (95% CI)= 0.82 (0.8-0.85)
• Cerebral Atherosclerosis and Aneurysm /Frequency= 10.67/OR (95% CI)= 0.83 (0.80-0.87)
• Hemiplegia/Hemiparesis /Frequency= 5.60/OR (95% CI)= 1.17 (1.10-1.24)

Comorbidities

• History of Infection/Frequency= 26.72/OR (95% CI)= 1.15 (1.11-1.18)
• Metastatic Cancer and Acute Leukemia and Other Major Cancers /Frequency= 3.65/OR (95% CI)= 2.77 (2.61-

	2026 Hospital 30-day, all-cause, risk-standardized mortality rate (RSMR) following an acute ischemic stroke hospitalization
	2.95) • Lymphatic, Head and Neck, Brain, Breast, Colorectal and Other Major Cancers/Frequency= 23.92/OR (95% CI)= 0.92 (0.89-0.95) • Protein-Calorie Malnutrition /Frequency= 5.42/OR (95% CI)= 1.69 (1.61-1.77) • Other Significant Endocrine and Metabolic Disorders /Frequency= 75.98/OR (95% CI)= 0.75 (0.72-0.77) • Other Gastrointestinal Disorders /Frequency= 43.64/OR (95% CI)= 0.90 (0.88-0.93) • Disorders of the Vertebrae and Spinal Discs /Frequency= 17.06/OR (95% CI)= 0.89 (0.86-0.93) • Osteoarthritis of Hip or Knee /Frequency= 10.36/OR (95% CI)= 0.82 (0.78-0.86) • Other Musculoskeletal and Connective Tissue Disorders /Frequency= 63.50/OR (95% CI)= 0.86 (0.84-0.89) • Iron Deficiency and Other/Unspecified Anemia and Blood Disease /Frequency= 31.86/OR (95% CI)= 1.09 (1.05-1.12) • Dementia or senility /Frequency= 28.64/OR (95% CI)= 1.24 (1.20-1.28) • Major Psychiatric Disorders /Frequency= 9.12/OR (95% CI)= 1.08 (1.04-1.13) • Quadriplegia, Other Extensive Paralysis /Frequency= 1.54/OR (95% CI)= 1.39 (1.26-1.53) • Multiple Sclerosis /Frequency= 10.27/OR (95% CI)= 0.83 (0.79-0.87) • Seizure Disorders and Convulsions /Frequency= 6.92/OR (95% CI)= 1.27 (1.21-1.33) • Hypertension /Frequency= 88.00/OR (95% CI)= 0.77 (0.74-0.81) • Peripheral Vascular Disease /Frequency= 23.02/OR (95% CI)= 1.07 (1.04-1.11) • Chronic Obstructive Pulmonary Disease /Frequency= 21.92/OR (95% CI)= 1.06 (1.03-1.10) • Pneumonia /Frequency= 17.36/OR (95% CI)= 1.49 (1.44-1.54) • Pleural Effusion/Pneumothorax /Frequency= 6.92/OR (95% CI)= 1.13 (1.07-1.18) • Other Eye Disorders /Frequency= 19.34/OR (95% CI)= 0.91 (0.88-0.94) • Other Ear, Nose, Throat, and Mouth Disorders /Frequency= 26.99/OR (95% CI)= 0.87 (0.84-0.90) • Dialysis Status /Frequency= 1.47/OR (95% CI)= 1.38 (1.24-1.52) • Renal Failure /Frequency= 15.45/OR (95% CI)= 1.16 (1.12-1.21) • Urinary Tract Infection /Frequency= 21.55/OR (95% CI)= 1.14 (1.10-1.18) • Male Genital Disorders /Frequency= 11.95/OR (95% CI)= 0.78 (0.74-0.82) • Decubitus Ulcer of Skin /Frequency= 2.52/OR (95% CI)= 1.29 (1.20-1.39) • Chronic Ulcer of Skin, Except Decubitus /Frequency= 5.52/OR (95% CI)= 1.16 (1.10-1.23) • Other Dermatological Disorders /Frequency= 29.38/OR (95% CI)= 0.92 (0.89-0.95) 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. Attachment Stroke_MortalityMethodologyReport_9.29.10.pdf
Stratification	N/A
Type Score	Rate/proportion better quality = lower score
Algorithm	The proposed measure employs a hierarchical logistic regression model to create a hospital level 30-day RSMR. 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 mortality within 30 days of admission 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 mortality, 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 RSMR is calculated as the ratio of the number of "predicted" to the number of "expected" deaths, multiplied by the national unadjusted mortality rate. For each hospital, the numerator of the ratio ("predicted") is the number of deaths 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 deaths 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 mortality or better quality and a ratio higher than one indicates higher-than-expected mortality or worse quality. The predicted hospital outcome (the numerator) is the sum of predicted probabilities of death 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 deaths (the denominator) is the sum of expected probabilities of death 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. Attachment Stroke_Mortality_Calculation_Algorithm.pdf
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	2027 Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization
Steward	Centers for Medicare & Medicaid Services (CMS)
Description	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. We define this as readmission for any cause within 30 days from the date of discharge of the index stroke admission, excluding a specified set of planned readmissions.
Type	Outcome
Data Source	Administrative claims 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). 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. Attachment Stroke_Cohort_ICD9_to_ICD10_Maps-634717470963767860.pdf Attachment Stroke_Planned_Readmission_ICD-9_to_ICD-10_Map.pdf
Level	Facility
Setting	Hospital/Acute Care Facility
Numerator Statement	The outcome for this measure is 30-day ~~all-cause~~ readmission. We define ~~all-cause~~ readmission as an inpatient readmission for any cause, with the exception of certain planned readmissions, within 30 days from the date of discharge of the index stroke 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.
Numerator Details	**Time Window:** We define the time period for readmission as within 30 days from the date of discharge of the index stroke admission.~~We define this as readmission for any cause within 30 days from the date of discharge of the index stroke admission.~~ 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.

~~Measure includes unplanned readmissions to any acute care hospital for any cause within 30 days from the date of discharge of the index admission.~~

~~Planned Readmissions: Some stroke patients have a scheduled readmission to the hospital after they are discharged for further treatment related to their stroke. We identified these as planned readmissions and they do NOT count as readmissions in the measure. If a patient returns to the hospital within 30 days of their index stroke admission for one of the procedures listed below, the readmission will not count unless the readmission is for a recurrent ischemic stroke (primary ICD-9-CM discharge diagnosis of 433.x1, 434.x1, and 436 for the readmission):~~

- ~~Carotid Endarterectomy~~
- ~~Carotid Stenting~~
- ~~Percutaneous Carotid Stenting~~
- ~~Intracranial and Inter-vertebral Stenting~~
- ~~Patent Foramen Ovale Closure~~
- ~~Ablation~~
- ~~Aortic or Mitral Valve Replacement~~
- ~~Cranioplasty~~

~~The ICD-9-CM codes used to identify these procedures are as follows:~~

~~38.12 Endarterectomy, other vessels of head and neck~~
~~00.63 Percutaneous insertion of carotid artery stent(s)~~
~~00.61 Percutaneous angioplasty or atherectomy of precerebral (extracranial) vessel(s)~~
~~00.64 Percutaneous insertion of other precerebral (extracranial) artery stent(s)~~
~~35.51 Repair of atrial septal defect with prosthesis, open technique~~
~~37.33 Excision or destruction of other lesion or tissue of heart, open approach~~
~~35.21 Replacement of aortic valve with tissue graft~~
~~02.01 Opening of cranial suture~~
~~00.65 Percutaneous insertion of intracranial vascular stent(s)~~
~~35.52 Repair of atrial septal defect with prosthesis, closed technique~~
~~35.61 Repair of atrial septal defect with tissue graft~~
~~35.71 Other and unspecified repair of atrial septal defect~~
~~37.34 Excision or destruction of other lesion or tissue of heart, endovascular approach~~
~~35.22 Other replacement of aortic valve~~
~~35.23 Replacement of mitral valve with tissue graft~~
~~35.24 Other replacement of mitral valve~~
~~02.02 Elevation of skull fracture fragments~~
~~02.03 Formation of cranial bone flap~~
~~02.04 Bone graft to skull~~
~~02.05 Insertion of skull plate~~
~~02.06 Other cranial osteoplasty~~
~~02.07 Removal of skull plate~~

	2027 Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization
	~~The ICD-10 codes identifying these procedures are as follows:~~ ~~02560ZZ Destruction of Right Atrium, Open Approach~~ ~~02563ZZ Destruction of Right Atrium, Percutaneous Approach~~ ~~02570ZZ Destruction of Left Atrium, Open Approach~~ ~~02573ZZ Destruction of Left Atrium, Percutaneous Approach~~ ~~025K0ZZ Destruction of Right Ventricle, Open Approach~~ ~~025K3ZZ Destruction of Right Ventricle, Percutaneous Approach~~ ~~025L0ZZ Destruction of Left Ventricle, Open Approach~~ ~~025L3ZZ Destruction of Left Ventricle, Percutaneous Approach~~ ~~02B60ZZ Excision of Right Atrium, Open Approach~~ ~~02B63ZZ Excision of Right Atrium, Percutaneous Approach~~ ~~02B70ZZ Excision of Left Atrium, Open Approach~~ ~~02B73ZZ Excision of Left Atrium, Percutaneous Approach~~ ~~02BK0ZZ Excision of Right Ventricle, Open Approach~~ ~~02BK3ZZ Excision of Right Ventricle, Percutaneous Approach~~ ~~02BL0ZZ Excision of Left Ventricle, Open Approach~~ ~~02BL3ZZ Excision of Left Ventricle, Percutaneous Approach~~ ~~02Q50ZZ Repair Atrial Septum, Open Approach~~ ~~02Q53ZZ Repair Atrial Septum, Percutaneous Approach~~ ~~02Q54ZZ Repair Atrial Septum, Percutaneous Endoscopic Approach~~ ~~02RF07Z Replacement of Aortic Valve with Autologous Tissue Substitute, Open Approach~~ ~~02RF08Z Replacement of Aortic Valve with Zooplastic Tissue, Open Approach~~ ~~02RF0JZ Replacement of Aortic Valve with Synthetic Substitute, Open Approach~~ ~~02RF0KZ Replacement of Aortic Valve with Nonautologous Tissue Substitute, Open Approach~~ ~~02RF37Z Replacement of Aortic Valve with Autologous Tissue Substitute, Percutaneous Approach~~ ~~02RF38Z Replacement of Aortic Valve with Zooplastic Tissue, Percutaneous Approach~~ ~~02RF3JZ Replacement of Aortic Valve with Synthetic Substitute, Percutaneous Approach~~ ~~02RF3KZ Replacement of Aortic Valve with Nonautologous Tissue Substitute, Percutaneous Approach~~ ~~02RF47Z Replacement of Aortic Valve with Autologous Tissue Substitute, Percutaneous Endoscopic Approach~~ ~~02RF48Z Replacement of Aortic Valve with Zooplastic Tissue, Percutaneous Endoscopic Approach~~ ~~02RF4JZ Replacement of Aortic Valve with Synthetic Substitute, Percutaneous Endoscopic Approach~~ ~~02RF4KZ Replacement of Aortic Valve with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach~~ ~~02RG07Z Replacement of Mitral Valve with Autologous Tissue Substitute, Open Approach~~ ~~02RG08Z Replacement of Mitral Valve with Zooplastic Tissue, Open Approach~~ ~~02RG0JZ Replacement of Mitral Valve with Synthetic Substitute, Open Approach~~ ~~02RG0KZ Replacement of Mitral Valve with Nonautologous Tissue Substitute, Open Approach~~ ~~02RG37Z Replacement of Mitral Valve with Autologous Tissue Substitute, Percutaneous Approach~~ ~~02RG38Z Replacement of Mitral Valve with Zooplastic Tissue, Percutaneous Approach~~ ~~02RG3JZ Replacement of Mitral Valve with Synthetic Substitute, Percutaneous Approach~~ ~~02RG3KZ Replacement of Mitral Valve with Nonautologous Tissue Substitute, Percutaneous Approach~~ ~~02RG47Z Replacement of Mitral Valve with Autologous Tissue Substitute, Percutaneous Endoscopic Approach~~ ~~02RG48Z Replacement of Mitral Valve with Zooplastic Tissue, Percutaneous Endoscopic Approach~~ ~~02RG4JZ Replacement of Mitral Valve with Synthetic Substitute, Percutaneous Endoscopic Approach~~ ~~02RG4KZ Replacement of Mitral Valve with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach~~ ~~02T80ZZ Resection of Conduction Mechanism, Open Approach~~ ~~02U507Z Supplement Atrial Septum with Autologous Tissue Substitute, Open Approach~~

	2027 Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization
	~~02U508Z Supplement Atrial Septum with Zooplastic Tissue, Open Approach~~ ~~02U50JZ Supplement Atrial Septum with Synthetic Substitute, Open Approach~~ ~~02U50KZ Supplement Atrial Septum with Nonautologous Tissue Substitute, Open Approach~~ ~~02U537Z Supplement Atrial Septum with Autologous Tissue Substitute, Percutaneous Approach~~ ~~02U538Z Supplement Atrial Septum with Zooplastic Tissue, Percutaneous Approach~~ ~~02U53JZ Supplement Atrial Septum with Synthetic Substitute, Percutaneous Approach~~ ~~02U53KZ Supplement Atrial Septum with Nonautologous Tissue Substitute, Percutaneous Approach~~ ~~02U547Z Supplement Atrial Septum with Autologous Tissue Substitute, Percutaneous Endoscopic Approach~~ ~~02U548Z Supplement Atrial Septum with Zooplastic Tissue, Percutaneous Endoscopic Approach~~ ~~02U54JZ Supplement Atrial Septum with Synthetic Substitute, Percutaneous Endoscopic Approach~~ ~~02U54KZ Supplement Atrial Septum with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach~~ ~~037H34Z Dilation of Right Common Carotid Artery with Drug-eluting Intraluminal Device, Percutaneous App~~ ~~037H3DZ Dilation of Right Common Carotid Artery with Intraluminal Device, Percutaneous Approach~~ ~~037H3ZZ Dilation of Right Common Carotid Artery, Percutaneous Approach~~ ~~037H44Z Dilation of Right Common Carotid Artery with Drug-eluting Intraluminal Device, Percutaneous End~~ ~~037H4DZ Dilation of Right Common Carotid Artery with Intraluminal Device, Percutaneous Endoscopic Approach~~ ~~037H4ZZ Dilation of Right Common Carotid Artery, Percutaneous Endoscopic Approach~~ ~~037J34Z Dilation of Left Common Carotid Artery with Drug-eluting Intraluminal Device, Percutaneous Appr~~ ~~037J3DZ Dilation of Left Common Carotid Artery with Intraluminal Device, Percutaneous Approach~~ ~~037J3ZZ Dilation of Left Common Carotid Artery, Percutaneous Approach~~ ~~037J44Z Dilation of Left Common Carotid Artery with Drug-eluting Intraluminal Device, Percutaneous Endo~~ ~~037J4DZ Dilation of Left Common Carotid Artery with Intraluminal Device, Percutaneous Endoscopic Approach~~ ~~037J4ZZ Dilation of Left Common Carotid Artery, Percutaneous Endoscopic Approach~~ ~~037K34Z Dilation of Right Internal Carotid Artery with Drug-eluting Intraluminal Device, Percutaneous A~~ ~~037K3DZ Dilation of Right Internal Carotid Artery with Intraluminal Device, Percutaneous Approach~~ ~~037K3ZZ Dilation of Right Internal Carotid Artery, Percutaneous Approach~~ ~~037K44Z Dilation of Right Internal Carotid Artery with Drug-eluting Intraluminal Device, Percutaneous E~~ ~~037K4DZ Dilation of Right Internal Carotid Artery with Intraluminal Device, Percutaneous Endoscopic App~~ ~~037K4ZZ Dilation of Right Internal Carotid Artery, Percutaneous Endoscopic Approach~~ ~~037L34Z Dilation of Left Internal Carotid Artery with Drug-eluting Intraluminal Device, Percutaneous Ap~~ ~~037L3DZ Dilation of Left Internal Carotid Artery with Intraluminal Device, Percutaneous Approach~~ ~~037L3ZZ Dilation of Left Internal Carotid Artery, Percutaneous Approach~~ ~~037L44Z Dilation of Left Internal Carotid Artery with Drug-eluting Intraluminal Device, Percutaneous En~~ ~~037L4DZ Dilation of Left Internal Carotid Artery with Intraluminal Device, Percutaneous Endoscopic Appr~~ ~~037L4ZZ Dilation of Left Internal Carotid Artery, Percutaneous Endoscopic Approach~~ ~~037M34Z Dilation of Right External Carotid Artery with Drug-eluting Intraluminal Device, Percutaneous A~~ ~~037M3DZ Dilation of Right External Carotid Artery with Intraluminal Device, Percutaneous Approach~~ ~~037M3ZZ Dilation of Right External Carotid Artery, Percutaneous Approach~~ ~~037M44Z Dilation of Right External Carotid Artery with Drug-eluting Intraluminal Device, Percutaneous E~~ ~~037M4DZ Dilation of Right External Carotid Artery with Intraluminal Device, Percutaneous Endoscopic~~

	2027 Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization
	~~App~~ ~~037M4ZZ Dilation of Right External Carotid Artery, Percutaneous Endoscopic Approach~~ ~~037N34Z Dilation of Left External Carotid Artery with Drug-eluting Intraluminal Device, Percutaneous Ap~~ ~~037N3DZ Dilation of Left External Carotid Artery with Intraluminal Device, Percutaneous Approach~~ ~~037N3ZZ Dilation of Left External Carotid Artery, Percutaneous Approach~~ ~~037N44Z Dilation of Left External Carotid Artery with Drug-eluting Intraluminal Device, Percutaneous En~~ ~~037N4DZ Dilation of Left External Carotid Artery with Intraluminal Device, Percutaneous Endoscopic Appr~~ ~~037N4ZZ Dilation of Left External Carotid Artery, Percutaneous Endoscopic Approach~~ ~~037P34Z Dilation of Right Vertebral Artery with Drug-eluting Intraluminal Device, Percutaneous Approach~~ ~~037P3DZ Dilation of Right Vertebral Artery with Intraluminal Device, Percutaneous Approach~~ ~~037P3ZZ Dilation of Right Vertebral Artery, Percutaneous Approach~~ ~~037P44Z Dilation of Right Vertebral Artery with Drug-eluting Intraluminal Device, Percutaneous Endoscop~~ ~~037P4DZ Dilation of Right Vertebral Artery with Intraluminal Device, Percutaneous Endoscopic Approach~~ ~~037P4ZZ Dilation of Right Vertebral Artery, Percutaneous Endoscopic Approach~~ ~~037Q34Z Dilation of Left Vertebral Artery with Drug-eluting Intraluminal Device, Percutaneous Approach~~ ~~037Q3DZ Dilation of Left Vertebral Artery with Intraluminal Device, Percutaneous Approach~~ ~~037Q3ZZ Dilation of Left Vertebral Artery, Percutaneous Approach~~ ~~037Q44Z Dilation of Left Vertebral Artery with Drug-eluting Intraluminal Device, Percutaneous Endoscopi~~ ~~037Q4DZ Dilation of Left Vertebral Artery with Intraluminal Device, Percutaneous Endoscopic Approach~~ ~~037Q4ZZ Dilation of Left Vertebral Artery, Percutaneous Endoscopic Approach~~ ~~03CH0ZZ Extirpation of Matter from Right Common Carotid Artery, Open Approach~~ ~~03CH3ZZ Extirpation of Matter from Right Common Carotid Artery, Percutaneous Approach~~ ~~03CH4ZZ Extirpation of Matter from Right Common Carotid Artery, Percutaneous Endoscopic Approach~~ ~~03CJ0ZZ Extirpation of Matter from Left Common Carotid Artery, Open Approach~~ ~~03CJ3ZZ Extirpation of Matter from Left Common Carotid Artery, Percutaneous Approach~~ ~~03CJ4ZZ Extirpation of Matter from Left Common Carotid Artery, Percutaneous Endoscopic Approach~~ ~~03CK0ZZ Extirpation of Matter from Right Internal Carotid Artery, Open Approach~~ ~~03CK3ZZ Extirpation of Matter from Right Internal Carotid Artery, Percutaneous Approach~~ ~~03CK4ZZ Extirpation of Matter from Right Internal Carotid Artery, Percutaneous Endoscopic Approach~~ ~~03CL0ZZ Extirpation of Matter from Left Internal Carotid Artery, Open Approach~~ ~~03CL3ZZ Extirpation of Matter from Left Internal Carotid Artery, Percutaneous Approach~~ ~~03CL4ZZ Extirpation of Matter from Left Internal Carotid Artery, Percutaneous Endoscopic Approach~~ ~~03CM0ZZ Extirpation of Matter from Right External Carotid Artery, Open Approach~~ ~~03CM3ZZ Extirpation of Matter from Right External Carotid Artery, Percutaneous Approach~~ ~~03CM4ZZ Extirpation of Matter from Right External Carotid Artery, Percutaneous Endoscopic Approach~~ ~~03CN0ZZ Extirpation of Matter from Left External Carotid Artery, Open Approach~~ ~~03CN3ZZ Extirpation of Matter from Left External Carotid Artery, Percutaneous Approach~~ ~~03CN4ZZ Extirpation of Matter from Left External Carotid Artery, Percutaneous Endoscopic Approach~~ ~~03CP0ZZ Extirpation of Matter from Right Vertebral Artery, Open Approach~~ ~~03CP3ZZ Extirpation of Matter from Right Vertebral Artery, Percutaneous Approach~~ ~~03CP4ZZ Extirpation of Matter from Right Vertebral Artery, Percutaneous Endoscopic Approach~~ ~~03CQ0ZZ Extirpation of Matter from Left Vertebral Artery, Open Approach~~ ~~03CQ3ZZ Extirpation of Matter from Left Vertebral Artery, Percutaneous Approach~~ ~~03CQ4ZZ Extirpation of Matter from Left Vertebral Artery, Percutaneous Endoscopic Approach~~

	2027 Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization
	~~03CR0ZZ Extirpation of Matter from Face Artery, Open Approach~~ ~~03CR3ZZ Extirpation of Matter from Face Artery, Percutaneous Approach~~ ~~03CR4ZZ Extirpation of Matter from Face Artery, Percutaneous Endoscopic Approach~~ ~~03CS0ZZ Extirpation of Matter from Right Temporal Artery, Open Approach~~ ~~03CS3ZZ Extirpation of Matter from Right Temporal Artery, Percutaneous Approach~~ ~~03CS4ZZ Extirpation of Matter from Right Temporal Artery, Percutaneous Endoscopic Approach~~ ~~03CT0ZZ Extirpation of Matter from Left Temporal Artery, Open Approach~~ ~~03CT3ZZ Extirpation of Matter from Left Temporal Artery, Percutaneous Approach~~ ~~03CT4ZZ Extirpation of Matter from Left Temporal Artery, Percutaneous Endoscopic Approach~~ ~~03CU0ZZ Extirpation of Matter from Right Thyroid Artery, Open Approach~~ ~~03CU3ZZ Extirpation of Matter from Right Thyroid Artery, Percutaneous Approach~~ ~~03CU4ZZ Extirpation of Matter from Right Thyroid Artery, Percutaneous Endoscopic Approach~~ ~~03CV0ZZ Extirpation of Matter from Left Thyroid Artery, Open Approach~~ ~~03CV3ZZ Extirpation of Matter from Left Thyroid Artery, Percutaneous Approach~~ ~~03CV4ZZ Extirpation of Matter from Left Thyroid Artery, Percutaneous Endoscopic Approach~~ ~~057M3DZ Dilation of Right Internal Jugular Vein with Intraluminal Device, Percutaneous Approach~~ ~~057M4DZ Dilation of Right Internal Jugular Vein with Intraluminal Device, Percutaneous Endoscopic Appro~~ ~~057N3DZ Dilation of Left Internal Jugular Vein with Intraluminal Device, Percutaneous Approach~~ ~~057N4DZ Dilation of Left Internal Jugular Vein with Intraluminal Device, Percutaneous Endoscopic Approa~~ ~~057P3DZ Dilation of Right External Jugular Vein with Intraluminal Device, Percutaneous Approach~~ ~~057P4DZ Dilation of Right External Jugular Vein with Intraluminal Device, Percutaneous Endoscopic Appro~~ ~~057Q3DZ Dilation of Left External Jugular Vein with Intraluminal Device, Percutaneous Approach~~ ~~057Q4DZ Dilation of Left External Jugular Vein with Intraluminal Device, Percutaneous Endoscopic Approa~~ ~~057R3DZ Dilation of Right Vertebral Vein with Intraluminal Device, Percutaneous Approach~~ ~~057R4DZ Dilation of Right Vertebral Vein with Intraluminal Device, Percutaneous Endoscopic Approach~~ ~~057S3DZ Dilation of Left Vertebral Vein with Intraluminal Device, Percutaneous Approach~~ ~~057S4DZ Dilation of Left Vertebral Vein with Intraluminal Device, Percutaneous Endoscopic Approach~~ ~~057T3DZ Dilation of Right Face Vein with Intraluminal Device, Percutaneous Approach~~ ~~057T4DZ Dilation of Right Face Vein with Intraluminal Device, Percutaneous Endoscopic Approach~~ ~~0NB00ZZ Excision of Skull, Open Approach~~ ~~0NB03ZZ Excision of Skull, Percutaneous Approach~~ ~~0NB04ZZ Excision of Skull, Percutaneous Endoscopic Approach~~ ~~0NP00JZ Removal of Synthetic Substitute from Skull, Open Approach~~ ~~0NP03JZ Removal of Synthetic Substitute from Skull, Percutaneous Approach~~ ~~0NP04JZ Removal of Synthetic Substitute from Skull, Percutaneous Endoscopic Approach~~ ~~0NQ00ZZ Repair Skull, Open Approach~~ ~~0NQ03ZZ Repair Skull, Percutaneous Approach~~ ~~0NQ04ZZ Repair Skull, Percutaneous Endoscopic Approach~~ ~~0NR007Z Replacement of Skull with Autologous Tissue Substitute, Open Approach~~ ~~0NR007Z Replacement of Skull with Autologous Tissue Substitute, Open Approach~~ ~~0NR00JZ Replacement of Skull with Synthetic Substitute, Open Approach~~ ~~0NR00KZ Replacement of Skull with Nonautologous Tissue Substitute, Open Approach~~ ~~0NR00KZ Replacement of Skull with Nonautologous Tissue Substitute, Open Approach~~ ~~0NR037Z Replacement of Skull with Autologous Tissue Substitute, Percutaneous Approach~~ ~~0NR037Z Replacement of Skull with Autologous Tissue Substitute, Percutaneous Approach~~ ~~0NR03JZ Replacement of Skull with Synthetic Substitute, Percutaneous Approach~~ ~~0NR03KZ Replacement of Skull with Nonautologous Tissue Substitute, Percutaneous Approach~~ ~~0NR03KZ Replacement of Skull with Nonautologous Tissue Substitute, Percutaneous Approach~~ ~~0NR047Z Replacement of Skull with Autologous Tissue Substitute, Percutaneous Endoscopic Approach~~

	~~0NR047ZReplacement of Skull with Autologous Tissue Substitute, Percutaneous Endoscopic Approach~~ ~~0NR04JZ Replacement of Skull with Synthetic Substitute, Percutaneous Endoscopic Approach~~ ~~0NR04KZReplacement of Skull with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach~~ ~~0NR04KZReplacement of Skull with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach~~ ~~0NS004ZReposition Skull with Internal Fixation Device, Open Approach~~ ~~0NS005ZReposition Skull with External Fixation Device, Open Approach~~ ~~0NS00ZZReposition Skull, Open Approach~~ ~~0NS034ZReposition Skull with Internal Fixation Device, Percutaneous Approach~~ ~~0NS035ZReposition Skull with External Fixation Device, Percutaneous Approach~~ ~~0NS03ZZReposition Skull, Percutaneous Approach~~ ~~0NS044ZReposition Skull with Internal Fixation Device, Percutaneous Endoscopic Approach~~ ~~0NS045ZReposition Skull with External Fixation Device, Percutaneous Endoscopic Approach~~ ~~0NS04ZZReposition Skull, Percutaneous Endoscopic Approach~~ ~~0NS0XZZReposition Skull, External Approach~~ ~~0NU007ZSupplement Skull with Autologous Tissue Substitute, Open Approach~~ ~~0NU00JZSupplement Skull with Synthetic Substitute, Open Approach~~ ~~0NU00KZSupplement Skull with Nonautologous Tissue Substitute, Open Approach~~ ~~0NU037ZSupplement Skull with Autologous Tissue Substitute, Percutaneous Approach~~ ~~0NU03JZSupplement Skull with Synthetic Substitute, Percutaneous Approach~~ ~~0NU03KZSupplement Skull with Nonautologous Tissue Substitute, Percutaneous Approach~~ ~~0NU047ZSupplement Skull with Autologous Tissue Substitute, Percutaneous Endoscopic Approach~~ ~~0NU04JZSupplement Skull with Synthetic Substitute, Percutaneous Endoscopic Approach~~ ~~0NU04KZSupplement Skull with Nonautologous Tissue Substitute, Percutaneous Endoscopic Approach~~
Denominator Statement	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.
Denominator Details	**Time Window:** This measure was developed with 12 months of data. 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. ~~65 years and older who were admitted to non-federal acute care hospitals for an~~ Acute ischemic stroke ~~ia~~s defined by the following ICD-9-CM and ICD-10-CM codes and with a complete claims history for the 12 months prior to admission: 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
Exclusions	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.
Exclusion Details	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).
Risk Adjustment	Statistical risk model 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"1. 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.2 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. Attachment Stroke_Readmission_MethodologyReport9.29.10.pdf
Stratification	N/A
Type Score	Rate/proportion better quality = lower score
Algorithm	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

	2027 Hospital 30-day, all-cause, risk-standardized readmission rate (RSRR) following an acute ischemic stroke hospitalization
	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. Attachment Stroke_Readmission_Calculation_Algorithm.pdf
Copyright/ Disclaimer	N/A

Appendix B: Project Steering Committee and NQF Staff

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