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Metrics for Measuring Quality of Care in Comprehensive Stroke Centers: Detailed Follow-up to Brain Attack Coalition Comprehensive Stroke Center Recommendations

A Guideline for Healthcare Professionals From the American Heart Association & American Stroke Association

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Endorsed by the Society of Vascular and Interventional Neurology

On behalf of the American Heart Association Stroke Council; Council on Cardiovascular Nursing; Council on Epidemiology and Prevention; Council for High Blood Pressure Research; Council on Peripheral Vascular Disease; and Interdisciplinary Council on Quality of Care and Outcomes Research

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Definition of Classes and Levels of Evidence Used in AHA Recommendations

Class I Conditions for which there is evidence for and/or general agreement that the procedure or treatment is useful and effective.

Class II Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a procedure or treatment.

Class IIa The weight of evidence or opinion is in favor of the procedure or treatment.

Class IIb Usefulness/efficacy is less well established by evidence or opinion.

Class III Conditions for which there is evidence and/or general agreement that the procedure or treatment is not useful/effective and in some cases may be harmful.

Therapeutic Recommendations

Level of Evidence A Data derived from multiple randomized clinical trials or meta-analyses

Level of Evidence B Data derived from a single randomized trial or nonrandomized studies

Level of Evidence C Consensus opinion of experts, case studies, or standard of care

Diagnostic Recommendations

Level of Evidence A Data derived from multiple prospective cohort studies using a reference standard applied by a masked evaluator

Level of Evidence B Data derived from a single grade A study, or one or more case-control studies, or studies using a reference standard applied by an unmasked evaluator

Level of Evidence C Consensus opinion of experts

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Background and Significance

- After the proposal of Primary stroke center (PSC) concept, the certification process was created
- Metrics have allowed for continual improvement in the PSC performances and quality improvement
- Comprehensive Stroke Centers (CSCs) concept is being developed at state the level, as a result metrics being proposed
- The proposed metrics are not used to rate hospitals, but method to improve quality of care

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- Metrics selected with regards to feasibility as well as to improve quality of care
- Some metrics had stronger evidence in the literature and are labeled as core metrics, while others are supplemental metrics

- Three stroke categories:
  1) Ischemic cerebrovascular disease
  2) Aneurysmal SAH and non-ruptured aneurysms
  3) Non traumatic intracerebral hemorrhage

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Ischemic Stroke Metrics

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Metric 1: Percent of Patients with documented NIHSS at time of initial admission note

- NIHSS should be performed by a certified examiner
- Numerator: will include all patients with an ischemic stroke or TIA at the time of admission. Patients receiving reperfusion therapies must have NIHSS documented prior to initiation of treatment to be included in the numerator.
- Denominator: will include all patients who have an ischemic stroke or TIA at the time of initial admitting note or consult note

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NIHSS

Justification	Class/Level of Evidence
NIHSS is an established and reproducible indicator of stroke severity and provides a standard neurological assessment of stroke patients.	Class I; Level of Evidence B

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Metric 2: Percentage of ischemic stroke patients eligible for intravenous thrombolysis who receive it within the appropriate time window

- Numerator: is the number of patients receiving tPA who present within 3.5 hours of last being normal and a subset of those who present within 2.0 hours of symptom onset
- Denominator: is number of patients who arrive within 3.5 hours of last being normal and are candidates for intravenous tPA up to 4.5 hours and a subset of patients who arrive within 2 hours and are candidates up to 3 hours.
- If tPA initiated at outside hospital they are excluded, if stroke occurs in hospital time of arrival is time patient found

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IV tPA administration

Justification	Class/Level of Evidence
Eligible patients within the treatment window of 3 hours receive intravenous tPA	Class I; Level of Evidence A
Eligible patients in the 3 to 4.5 hour time window can be considered for intravenous tPA.	Class I; Level of Evidence B

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Metric 3: Percentage of eligible ischemic stroke patients treated with intravenous thrombolysis ≤ 60 minutes from arrival

- Numerator: is the number of patients receiving thrombolysis within 60 minutes from arrival to the hospital.
- Denominator: is number of patients treated with intravenous thrombolysis for acute ischemic stroke
- This metric is not currently harmonized for primary stroke centers by AHA, CDC and Joint Commission, but has become an accepted target for stroke centers and part of a national campaign (TARGET STROKE)

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Administration of thrombolysis under 60 minutes

Justification	Class/Level of Evidence
Earlier initiation of thrombolysis is associated with improved clinical outcomes in ischemic stroke	Class I; Level of Evidence A

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Metric 4: Median time from arrival to start of multimodal imaging with CT/CTA or MRI/MRA in patients under 6 hours from symptom onset

- The start time for multimodal imaging should be recorded at the start of first sequence acquisition
- If the patient not taken off the table with non contrast CT then start time is first image of non contrast head CT
- Purpose is to measure length of time it takes to obtain multimodal imaging

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Multimodal Imaging

Justification	Class/Level of Evidence
Multimodal CT and MRI may provide additional information that will improve diagnosis of stroke	Class I; Level of Evidence A
Vascular imaging may help in selection of intravenous or intra-arterial therapies	Level of Evidence B
Vascular imaging should be performed if intra-arterial therapy is being considered beyond 3 hours from symptoms onset	Level of Evidence A

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Metric 5:
Percentage of patients seen within 6 hours from symptom onset with documentation of performance or consideration of an endovascular procedure

- Numerator: is the number of patients seen within 6 hours from symptom onset treated with endovascular therapy or documented not to be a candidate
- Denominator: is the number of ischemic stroke patients seen within 6 hours from symptom onset
- CSC's who may have equipment failure, staffing difficulties should try and divert patients to centers able to treat patients or transfer patients immediately
- CSC's should consider participation in clinical trials for patients under 8 hours
- CSC's should consider tracking posterior circulation strokes up to 24 hours from symptoms onset to determine if they were treated

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Endovascular Treatment

Justification	Class/Level of Evidence
Endovascular thrombolysis under 6 hours from symptom onset is an option for patients with ischemic stroke	Class I; Level of Evidence B
Mechanical thrombolysis with the Merci retriever or Penumbra aspiration catheter are options in patients with ischemic stroke	Class IIb;Level of Evidence B

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Metric 6: Median time from arrival to start of treatment for acute ischemic stroke patients undergoing an endovascular intervention.

- Start of treatment defined as initiation of intra-arterial infusion of thrombolytic or first pass with mechanical device
- Speed of reperfusion appears to be beneficial and goal for CSC's is to achieve a door to treatment time of 2 hours
- Elements collected should include TICI or TIMI grades prior to and after reperfusion
- As experience is gained expect this metric to move towards time of reperfusion as in the coronary literature

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Metric 7: Percentage of patients treated with IV thrombolysis who have a symptomatic intracranial hemorrhage within 36 hours of treatment.

- Defined as any hemorrhage on CT scan within 36 hours post IV tPA and a neurological worsening not explained by other causes (i.e. cerebral edema, seizure, etc)
- Understanding that parenchymal hematomas are more likely to be associated with worsening compared to hemorrhagic infarctions
- Denominator: is all patients treated with IV thrombolysis including those bridged to endovascular

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Symptomatic Intracranial Hemorrhage

Justification	Class/Level of Evidence
Symptomatic intracranial hemorrhage is increased when NINDS protocol is not followed	
Symptomatic intracranial hemorrhage is associated with a worse neurological outcome	Class I; Level of evidence A

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Metric 8: Percentage of ischemic stroke patients treated with endovascular interventions who develop symptomatic intracranial hemorrhage within 36 hours of treatment.

- Defined as any hemorrhage on CT scan within 36 hours post endovascular treatment and a neurological worsening not explained by other causes (i.e. cerebral edema, seizure, etc)
- Understanding that parenchymal hematomas are more likely to be associated with worsening compared to hemorrhagic infarctions
- Denominator: is all patients treated with endovascular treatment
- Same as metric 7

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Metric 9: Percentage of ischemic stroke patients treated with IV thrombolysis or endovascular therapy for which there is a 90 day modified rankin score

- The mRS is reliable and reproducible and considers functional ability and impairment of stroke victim
- It has been an accepted metric in 3 month measures of assessment of recovery from stroke.
- Standardized interview can be performed via telephone or at an office visit by certified examiner
- Due to heterogeneity of care post discharge from the CSC, there is not a defined percentage of patients who should achieve a certain mRS

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Modified Rankin Score

Justification	Class/Level of Evidence
Interview to obtain mRS can be performed via telephone by certified examiner.	Class I;Level of Evidence B

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Metric 10: Percentage of patients undergoing carotid endarterectomy or carotid angioplasty or stenting with stroke or death within 30 days of procedure.

- The numbers should be reported as one for all patients being treated with revascularization, but additionally should be separated with regards to if the lesion was symptomatic and modality of treatment used.
- Defined as stroke if focal deficit lasts more than 24 hours, or if MRI confirmation of a stroke seen
- Centers should record whether patients undergoing stenting are at high risk for complications of CEA
- Also tracking of if dual anti-platelet therapy was used

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Carotid Revascularization

Justification	Class/Level of Evidence
Patient with a TIA or stroke within 6 months and an ipsilateral carotid stenosis of 70-99% should undergo endarterectomy by surgeon with morbidity and mortality < 6%	Class I;Level of Evidence A
For patients with TIA or stroke and ipsilateral stenosis of 50-69%, endarterectomy recommended depending on patient specific factors and if anticipated morbidity and mortality < 6%	Class I; Level of evidence B
Patients with a stenosis of >70% in whom surgery technically difficult or restenosis after prior CEA or radiation injury to the neck carotid angioplasty and stenting is not inferior to CEA	Class IIb; Level of Evidence B
CEA may be useful in high grade asymptomatic patients with carotid stenosis if performed with a morbidity and mortality of < 3%	Class IIa; Level of Evidence A
CAS as an alternative to CEA in asymptomatic patients is uncertain in patients with high risk for CEA	Class IIb; Level of evidence C

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Metric 11: Percentage of patients undergoing intracranial angioplasty and/or stenting with stroke or death within 30 days of procedure.

- This metric is for atherosclerosis only and does not include patients with dissection or other etiologies
- Stroke defined the same as metric 10
- Currently being employed as part of clinical trials and practice
- CSC's should consider also tracking degree of stenosis prior to and after treatment as well as dual anti-platelet therapy at time of discharge and prior to treatment.

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Stenting and angioplasty for intracranial atherosclerosis

Justification	Class/Level of Evidence
Angioplasty and stenting for intracranial atherosclerosis for secondary stroke prevention has been classified as investigational	Class IIb; Level of evidence C
For acute ischemic stroke, angioplasty and stenting have been classified as investigational	Class IIb; Level of evidence C

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Intracranial Hemorrhage

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Metric 12: Percentage of SAH, ICH and AVM patients for whom initial severity measure documented.

- SAH patients should have a Hunt and Hess score documented
- Patients with ICH with or without AVM should have a ICH score documented. This score has been validated to predict 30 day mortality.
- Non ruptured AVMs should have a Spetzler Martin Score recorded. This scale helps predict outcome after surgical intervention.

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Severity measures for Hemorrhagic Stroke

Metric Measurement	Class/Level of Evidence
For SAH, scales relying heavily on the severity of initial hemorrhage are helpful in planning future care.	Class I; Level of evidence B
Degree of neurological impairment using an accepted SAH grading system can be useful for prognosis and triage	Class IIa; Level of evidence B

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Metric 13:
Median time from admission to start of procedure intended to obliterate a ruptured aneurysm by surgical clipping or endovascular coiling within 48 hours of the hemorrhage.

- There is a 3-4% risk of re-bleeding in the first 24 hours and 1-2% risk per day in the first month after SAH
- Time to treatment should be recorded to the closest hour
- Patients with sentinel hemorrhages should also be included
- 48 hours selected as risk of re-bleeding decreases each day after initial rupture

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Timing of Securing Ruptured Cerebral Aneurysm

Justification	Class/Level of Evidence
Urgent evaluation and treatment of patients with suspected SAH	Class I; Level of evidence B

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Metric 14: Percentage of patients with aneurysmal SAH arriving within 48 hours of hemorrhage for whom surgical intervention started within 36 hours of arrival

- CSC's should have 24/7 coverage but should there be an exception. Centers should not accept such patients if there is anticipated lapses in coverage of endovascular and neurosurgical coverage
- Reasons for not treating may include futility, medical instability, family or patient wishes.

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Metric 15: Percentage of patients with aneurysmal SAH started on nimodipine 60 mg every 4 hours within 24 hours of diagnosis and treated until 21 days post hemorrhage.

- Nimodipine has been shown to be beneficial in randomized controlled trials by reducing the incidence and severity of ischemic deficits in patients with SAH from a ruptured aneurysm
- Patients may be given a reduced dose if there is associated hypotension with the medication

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Initiation of Nimodipine in SAH

Justification	Class/Level of Evidence
Nimodipine reduces the risk of poor outcomes after aneurysmal SAH	Class I; Level of evidence A

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Metric 16: Percentage of SAH patients with diminished level of consciousness and ventriculomegaly who are treated with EVD

- **Numerator: SAH patients with diminished LOC and ventriculomegaly who are treated with EVD**
- **Denominator: SAH patients with diminished LOC ventriculomegaly**

Justification	Class/Level of Evidence
EVD can be beneficial in patients with ventriculomegaly and dinished LOC following acute SAH	Class IIa; Level of evidence B

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Metric 17: Median frequency of noninvasive monitoring performed for surveillance for vasospasm in patients with aneurysmal SAH during the period between 3-14 days of SAH

- Typically TCD has been the monitoring modality of choice for detecting vasospasm. Recent reports show some variable reports on its sensitivity and specificity for detecting vasospasm.
- The intent is to track the number of studies performed for quality improvement purposes in monitoring for vasospasm. It is not the intention of writing group that more studies are better.
- Each study completed for the purpose of detecting vasospasms should be counted when calculating the frequency of monitoring daily.

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Metric 18: Complication rates for aneurysm coiling and clipping.

- **Numerator: Patients who have complications when being coiled or clipped.**
  - **Complications include:**
    - **Ischemic stroke or death within 24 hours of the procedure**
    - **Any re-bleeding**
    - **Second treatment for residual aneurysm within 30 days of the procedure**
- **Denominator: Patients undergoing coiling or clipping of a ruptured or an unruptured cerebral aneurysm.**

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Complication Rates

- **Justification – endpoints chosen on basis of direct relevance to the procedure and reproducible across studies. Endpoints include:**
  - **Stroke within 24 hours of procedure**
  - **Three types of rebleeding:**
    - **Preprocedural bleeding – related to time interval between onset and treatment. Rebleeding prior to procedure higher among those randomized to surgery compared with endovasular treatmen**
    - **Procedural if it occurred during the procedure- reflects adequacy of obliteration. Incomplete obliteration associated with increased risk of bleeding**
    - **Postprocedural in the first 30 days – related to incomplete obliteration of the target aneurysm in initial procedure.**
  - **Death within 24 hours of procedure**

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Additional Data Elements:

- Consider tracking
  - Location and size of aneurysms
  - Development of vasospasms
  - Delayed cerebral ischemia
  - Presence of residual aneurysm after treatment

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Intracerebral Hemorrhage

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Metric 19: Median time from arrival to start of treatment to reversal of INR < 1.4

Justification	Class/Level of Evidence
Hemorrhage expansion appears to occur primarily in the first hours, treatment should be initiated quickly with a goal of rapid correction of INR. AHA/ASA guidelines recommend treatment with IV vitamin K and replacement of clotting factors.	Class I; Level of evidence B

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Metric 20: Percentage of patients undergoing surgical or endovascular treatment of an AVM with stroke or death within 30 days of procedure.

Numerator: Patients with new intracranial hemorrhage or ischemic stroke or death with 30 days of procedure.

Denominator: All patients undergoing surgical of endovascular treatment of and AVM

Justification:

Endpoint derived from the "A randomized Multicenter Clinical Trial of Unruptured Brain AVMs (ARUBA)" trial. First randomized trial of AVM treatment comparing medical management of unruptured AVMs to interventional treatment, ie endovascular, surgical, radiosurgical or and combination.

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Stroke Systems of Care

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Metric 21: Percentage of patients with ischemic or hemorrhagic stroke or TIA transferred from another hospital to the CSC with documentation of the time from the first call to arrival time at CSC.

Numerator: Patients with ischemic or hemorrhagic stroke or TIA transferred from another hospital for which time from initial call to arrival is documented in hours and minutes.

Denominator: All patients with stroke or TIA transferred from another hospital to the CSC

Justification:

CSC's need to demonstrate the existence of functioning network and effective transfer protocols for timely transfer. CSC's should serve as the foundation of stroke care in a region. Data clearly demonstrate the important association of time to initiation of IV or endovascular treatment.

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ICU and Stroke Unit

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Metric 22: Percentage of patients admitted to each type of unit to which all patients with ischemic or hemorrhagic stroke or TIA are initially admitted

- **Numerator:** Patients admitted to each type of unit to which all patients with ischemic or hemorrhagic stroke or TIA could be initially admitted.
- **Denominator:** All patients with ischemic or hemorrhagic stroke or TIA.
- Patients with in-hospital strokes are excluded from this measure

Justification	Class/Level of Evidence
The BAC PSC paper emphasizes that PSC's must have a stroke unit and this is re-affirmed for CSC's.	Class I; Level of Evidence A

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Outcomes and Complications

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Metric 23: Percentage of patients with stroke or death within 24 hours of diagnostic neuroangiography.

- **Numerator: Patients with death or stroke after diagnostic neuroangiography within 24 hours of the procedure or prior to discharge, whichever comes first.**
- **Denominator: All patients who undergo a diagnostic neuroangiographic procedure.**
- **Patients should be excluded if they undergo a therapeutic angiographic intervention as part of the same procedure or within the first 24 hours after the diagnostic procedure unless the complication is identified before the therapeutic intervention begins.**

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Metric 24: Percentage of patients who have a diagnosis of ischemic or hemorrhagic stroke and undergo external ventricular drainage (EVD) and then develop ventriculitis.

- Ventriculitis is defined as the presence of positive CSF cultures in a patient with EVD if there is no documentation in the medical record stating that the culture results are thought to be the result of a contaminant or of some other process (e.g., pre-existing infection or infection resulting from another surgical procedure).

- Numerator: All patients with ventriculitis following EVD, as defined above, and a diagnosis of ischemic or hemorrhagic stroke.

- Denominator: All patients who undergo ventriculostomy because of problems related to ischemic or hemorrhagic stroke.

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Post Stroke Rehabilitation

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Metric 25: Median number of days from admission to completion of evaluations for physical therapy (PT), occupational therapy (OT), speech-language pathology (SLP), and rehabilitation medicine.

- If some or all of these evaluations are not needed or if the patient cannot tolerate them because of medical instability, there should be documentation to this effect.
- CSC's should track each discipline separately; however the overall metric recorded for each patient would be the time when the last of the consults that were deemed necessary on admission was completed.

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Post-stroke Rehabilitation

Justification	Class/Level of Evidence
Early initiation of stroke rehabilitation is associated with improved functional outcomes.	Class I; Level of Evidence B
Early mobilization is associated with improved outcome.	Class I; Level of Evidence B
Organized multidisciplinary stroke rehabilitation reduces death, death or disability, and death or institutionalization.	Class I; Level of Evidence B

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Research

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Metric 26: Percentage of patients admitted with diagnoses of ischemic stroke, SAH, ICH, extracranial cervical stenosis, intracranial stenosis, or TIA, who are enrolled in a clinical research study.

- **Numerator: Patients admitted with diagnoses above and are enrolled in a clinical research trial studying acute ischemic or hemorrhagic stroke or TIA, prevention of ischemic or hemorrhagic stroke, or rehabilitation after stroke, or other aspects of cerebrovascular disease.**
- **Denominator: All patients admitted with diagnoses of ischemic stroke, subarachnoid hemorrhage, intracranial hemorrhage, extracranial cervical stenosis, intracranial stenosis, or TIA.**
- **Any protocol approved by the institutional review board of the CSC is considered a clinical research study for the purposes of this metric.**
- **If a patient meets all criteria for enrollment in a clinical study that is active at the center and is not enrolled in that study, the reasons should be documented and tracked.**

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Other Considerations

- Decompressive Surgery
- Other complications
- Risk Adjustment
- Registries

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Final Thoughts

- Proposed set of metrics and related data elements to facilitate monitoring the quality of care delivered at CSC's.
- Essential to the quality expected of CSC's.
- CSC's should share data between centers for refinement of these proposed metrics.
- These proposed metrics should help provide a framework for establishing CSC's and a foundation for improving care once they are established.