CLINICAL PATHWAY

Neurosciences

Acute Ischemic Stroke
Acute Ischemic Stroke

Table of Contents (tap to jump to page)

INTRODUCTION 1
   Scope of This Pathway 1
   Pathway Contacts 2
A Review of the Evidence 2
   Evidence Definitions 2
Pre-Hospital Management 3
Emergency Evaluation and Diagnosis 4
Early Diagnosis: Brain and Vascular Imaging 4
General Supportive Care and Treatment of Acute Complications 7
Intravenous Fibrinolysis 9
Endovascular Interventions 10
Anticoagulants 13
Antiplatelet Agents 14
Volume Expansion, Vasodilators and Induced Hypertension 15
Surgical Interventions 15
Admission to the Hospital and General Acute Treatment after Hospitalization 16
Treatment of Acute Neurological Complications 17
Comprehensive and Primary Stroke Certifications 18

CLINICAL PATHWAY 20

CLINICAL PATHWAY ALGORITHMS AND FIGURES 30
   Table 1: Acute ischemic stroke pathway implementation tool 30
   Algorithm 1: Acute Ischemic Stroke 34
   Algorithm 2: Stroke Alert/Code Pathway 35
   Algorithm 3: Stroke Depression Assessment 36
   Algorithm 4: MRI Brain Algorithm Ischemic Stroke/TIA Clinical Pathway* 37
   Algorithm 5: Transthoracic Echocardiogram (TTE) Algorithm: Ischemic Stroke/TIA Clinical Pathway 38
INTRODUCTION

Stroke is a major cause of death and disability worldwide, with approximately 795,000 people experiencing an acute stroke annually. In the United States stroke is the fifth leading cause of death and the leading cause of preventable disability. Incidence of stroke and overall stroke-related mortality has dropped dramatically over the last 40 years related to both improved preventive care and innovations in acute therapies.

Scope of This Pathway

This clinical pathway will serve adult patients (18 and older) who present for acute care with primary diagnosis of acute ischemic stroke. Patients with suspected diagnosis of acute ischemic stroke or TIA will be included in the pathway until alternative diagnosis is determined. The pathway will include recommendations for the acute episode of care spanning from symptom recognition to discharge from acute care.
Pathway Contacts

The content of this pathway is developed and maintained by the Neurosciences service line of Christiana Care Health System. Questions or feedback about the content may be directed to:

Administrative Lead: Doug Huisenga MPT, ATC  
phone: 302-733-5221  
e-mail: DHuisenga@christianacare.org

Physician Lead: Jonathan Raser-Schramm M.D., PhD  
phone: 302-287-0449  
e-mail: JRaser-Schramm@christianacare.org

A Review of the Evidence

This section summarizes the strongest recommendations from the American Stroke Association’s 2013 Guidelines for the Early Management of Adults with Ischemic Stroke, including the 2015 AHA/ASA Focused Update of the 2013 Guidelines. These evidence-based recommendations strongly informed the recommendations within this clinical pathway.

Evidence Definitions

- Class I: Conditions for which there is evidence, general agreement, or both that a given procedure or treatment is useful and effective.
• Class II: Conditions for which there is conflicting evidence, a divergence of opinion, or both about the usefulness/efficacy of a procedure or treatment.

• Class IIa: Weight of evidence/opinion is in favor of usefulness/efficacy.

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

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

• Level of Evidence A: Data derived from multiple randomized clinical trials.

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

• Level of Evidence C: Consensus opinion of experts.

Pre-Hospital Management

• Activation of the 9-1-1 system by patients or other members of the public is strongly recommended (Class I; Level of Evidence B). 9-1-1 Dispatchers should make stroke a priority dispatch and transport.

• Prehospital care providers should use prehospital stroke assessment tools, such as the Los Angeles Prehospital Stroke Screen or Cincinnati Prehospital Stroke Scale (Class I; Level of Evidence B).

• EMS personnel should begin the initial management of stroke in the field, as outlined in Table 4 (Class I; Level of Evidence B). Development of a stroke protocol to be used by EMS personnel is strongly encouraged.

• Patients should be transported rapidly to the closest available certified PSC or CSC or, if no such centers exist, the most appropriate institution that provides emergency stroke care as described in the statement (Class I; Level of Evidence A).
Emergency Evaluation and Diagnosis

- An organized protocol for the emergency evaluation of patients with suspected stroke is recommended (Class I; Level of Evidence B). The goal is to complete an evaluation and to begin fibrinolytic treatment within 60 minutes of the patient’s arrival in an emergency department. Designation of an acute stroke team that includes physicians, nurses and laboratory/radiology personnel is encouraged.

- The use of a stroke rating scale, preferably the NIHSS, is recommended (Class I, Level of evidence B).

- A limited number of hematologic, coagulation and biochemistry tests are recommended during the initial emergency evaluation, and only the assessment of blood glucose must precede the initiation of intravenous alteplase (rtPA) (Class I; Level of Evidence B).

- Baseline electrocardiogram assessment is recommended in patients presenting with acute ischemic stroke but should not delay initiation of intravenous alteplase (rtPA) (Class I; Level of Evidence B).

- Baseline troponin assessment is recommended in patients presenting with acute ischemic stroke but should not delay initiation of intravenous alteplase (rtPA) (Class I; Level of Evidence C).

- The usefulness of chest radiographs in the hyperacute stroke setting in the absence of evidence of acute pulmonary, cardiac, or pulmonary vascular disease is unclear. If obtained, they should not unnecessarily delay administration of fibrinolysis (Class IIb; Level of Evidence B).

Early Diagnosis: Brain and Vascular Imaging

Recommendations for patients with acute cerebral ischemic symptoms that have not yet resolved:
• Emergency imaging of the brain is recommended before initiating any specific therapy to treat acute ischemic stroke (Class I; Level of Evidence A). In most instances, non-contrast CT of the head will provide the necessary information to make decisions about emergency management.

• Either non-contrast CT of the head or MRI is recommended before intravenous alteplase (rtPA) administration to exclude ICH (absolute contraindication) and to determine whether CT hypodensity or MRI hyperintensity of ischemia is present (Class I; Level of Evidence A).

• Intravenous fibrinolytic therapy is recommended in the setting of early ischemic changes (other than frank hypodensity) on CT, regardless of their extent (Class I; Level of Evidence A).

• If endovascular therapy is contemplated, a noninvasive intracranial vascular study is strongly recommended during the initial imaging evaluation of the acute stroke patient but should not delay intravenous alteplase (rtPA) if indicated. For patients who qualify for intravenous alteplase (rtPA) according to guidelines from professional medical societies, initiating intravenous alteplase (rtPA) before noninvasive vascular imaging is recommended for patients who have not had noninvasive vascular imaging as part of their initial imaging assessment for stroke. Noninvasive intracranial vascular imaging should then be obtained as quickly as possible (Class I; Level of Evidence A).

• In intravenous fibrinolysis candidates, the brain imaging study should be interpreted within 45 minutes of patient arrival in the ED by a physician with expertise in reading CT and MRI studies of the brain parenchyma (Class I; Level of Evidence C).

• The benefits of additional imaging beyond CT and CTA or MR and MRA, such as CT perfusion or diffusion- and perfusion-weighted imaging, for selecting patients for endovascular therapy are unknown (Class IIb; Level of Evidence C). Further randomized, controlled trials may be helpful to determine whether advanced imaging paradigms employing CT perfusion, CTA, and MRI perfusion and diffusion imaging, including measures of infarct core, collateral flow status, and penumbra, are beneficial for selecting patients for acute
reperfusion therapy who are within six hours of symptom onset and have an ASPECTS <6. Further randomized, controlled trials should be done to determine whether advanced imaging paradigms using CT perfusion and MRI perfusion, CTA, and diffusion imaging, including measures of infarct core, collateral flow status, and penumbra, are beneficial for selecting patients for acute reperfusion therapy who are beyond 6 hours from symptom onset.

- Frank hypodensity on non-contrast CT of the head may increase the risk of hemorrhage with fibrinolysis and should be considered in treatment decisions. If frank hypodensity involves more than one third of the MCA territory, intravenous alteplase (rtPA) treatment should be withheld (Class III; Level of Evidence A).

**Recommendations for patients with cerebral ischemic symptoms that have resolved:**

- Noninvasive imaging of the cervical vessels should be performed routinely as part of the evaluation of patients with suspected TIAs (Class I; Level of Evidence A).

- Noninvasive imaging by means of CTA or MRA of the intracranial vasculature is recommended to exclude the presence of proximal intracranial stenosis or occlusion (Class I; Level of Evidence A) and should be obtained when knowledge of intracranial steno-occlusive disease will alter management.

- Patients with transient ischemic neurological symptoms should undergo neuroimaging evaluation within 24 hours of symptom onset or as soon as possible in patients with delayed presentations. MRI, including DWI, is the preferred brain diagnostic imaging modality. If MRI is not available, head CT should be performed (Class I; Level of Evidence B).
General Supportive Care and Treatment of Acute Complications

- Cardiac monitoring is recommended to screen for atrial fibrillation and other potentially serious cardiac arrhythmias that would necessitate emergency cardiac interventions. Cardiac monitoring should be performed for at least the first 24 hours (Class I; Level of Evidence B).

- Patients who have elevated blood pressure and are otherwise eligible for treatment with intravenous alteplase (rtPA) should have their blood pressure carefully lowered so that their systolic blood pressure is <185 mm Hg and their diastolic blood pressure is <110 mm Hg (Class I; Level of Evidence B) before fibrinolytic therapy is initiated. If medications are given to lower blood pressure, the clinician should be sure that the blood pressure is stabilized at the lower level before beginning treatment with intravenous alteplase (rtPA) and maintained below 180/105 mm Hg for at least the first 24 hours after intravenous alteplase (rtPA) treatment.

- Airway support and ventilatory assistance are recommended for the treatment of patients with acute stroke who have decreased consciousness or who have bulbar dysfunction that causes compromise of the airway (Class I; Level of Evidence C).

- Supplemental oxygen should be provided to maintain oxygen saturation >94% (Class I; Level of Evidence C).

- Sources of hyperthermia (temperature >38°C) should be identified and treated, and antipyretic medications should be administered to lower temperature in hyperthermic patients with stroke (Class I; Level of Evidence C). Supplemental oxygen is not recommended in nonhypoxic patients with acute ischemic stroke (Class III, Level B).

- Until other data become available, consensus exists that the previously described blood pressure commendations should be followed in patients
undergoing other acute interventions to recanalize occluded vessels, including intra-arterial fibrinolysis (Class I; Level of Evidence C).

- In patients with markedly elevated blood pressure who do not receive fibrinolysis, a reasonable goal is to lower blood pressure by 15% during the first 24 hours after onset of stroke. The level of blood pressure that would mandate such treatment is not known, but consensus exists that medications should be withheld unless the systolic blood pressure is >220 mm Hg or the diastolic blood pressure is >120 mm Hg (Class I; Level of Evidence C).

- Hypovolemia should be corrected with intravenous normal saline, and cardiac arrhythmias that might be reducing cardiac output should be corrected (Class I; Level of Evidence C).

- Hypoglycemia (blood glucose <60 mg/dL) should be treated in patients with acute ischemic stroke (Class I; Level of Evidence C).

- Evidence from one clinical trial indicates that initiation of antihypertensive therapy within 24 hours of stroke is relatively safe. Restarting antihypertensive medications is reasonable after the first 24 hours for patients who have preexisting hypertension and are neurologically stable unless a specific contraindication to restarting treatment is known (Class IIa; Level of Evidence B).

- Evidence indicates that persistent in-hospital hyperglycemia during the first 24 hours after stroke is associated with worse outcomes than normoglycemia, and thus, it is reasonable to treat hyperglycemia to achieve blood glucose levels in a range of 140 to 180 mg/dL and to closely monitor to prevent hypoglycemia in patients with acute ischemic stroke (Class IIa; Level of Evidence C).
Intravenous Fibrinolysis

- Intravenous alteplase (rtPA) (0.9 mg/kg, maximum dose 90 mg) is recommended for selected patients who may be treated within 3 hours of onset of ischemic stroke (Class I; Level of Evidence A).

- Intravenous alteplase (rtPA) (0.9 mg/kg, maximum dose 90 mg) is recommended for administration to eligible patients who can be treated in the time period of 3 to 4.5 hours after stroke onset with some additional eligibility criteria (Class I; Level of Evidence B).

- In patients eligible for intravenous alteplase (rtPA), benefit of therapy is time dependent, and treatment should be initiated as quickly as possible. The door-to-needle time (time of bolus administration) should be within 60 minutes from hospital arrival (Class I; Level of Evidence A).

- In patients undergoing fibrinolytic therapy, physicians should be aware of and prepared to emergently treat potential side effects, including bleeding complications and angioedema that may cause partial airway obstruction (Class I; Level of Evidence B).

- Intravenous alteplase (rtPA) is reasonable in patients with a seizure at the time of onset of stroke if evidence suggests that residual impairments are secondary to stroke and not a postictal phenomenon (Class IIa; Level of Evidence C).

- The usefulness of intravenous administration of tenecteplase, reteplase, desmoteplase, urokinase, or other fibrinolytic agents and the intravenous administration of ancrod or other defibrinogenating agents is not well established, and they should only be used in the setting of a clinical trial (Class IIb; Level of Evidence B). The use of IV streptokinase for treatment of stroke is not recommended (Class III, Level A).

- Use of intravenous fibrinolysis in patients with conditions of mild stroke deficits, rapidly improving stroke symptoms, major surgery in the preceding 3 months, and recent myocardial infarction may be considered, and potential
increased risk should be weighed against the anticipated benefits (Class IIb; Level of Evidence C).

- The use of intravenous alteplase (rtPA) in patients taking direct thrombin inhibitors or direct factor Xa inhibitors may be harmful and is not recommended unless sensitive laboratory tests such as aPTT, INR, platelet count, and ECT, TT, or appropriate direct factor Xa activity assays are normal, or the patient has not received a dose of these agents for >2 days (assuming normal renal metabolizing function). Similar consideration should be given to patients being considered for intra-arterial alteplase (rtPA) (Class III; Level of Evidence C).

Endovascular Interventions

- Patients eligible for intravenous alteplase (rtPA) should receive intravenous alteplase (rtPA) even if endovascular treatments are being considered (Class I; Level of Evidence A).

- Patients should receive endovascular therapy with a stent retriever if they meet all the following criteria (Class I; Level of Evidence A):
  - Pre-stroke modified Rankin Scale (mRS) score 0 to 1.
  - Acute ischemic stroke receiving intravenous alteplase (rtPA) within 4.5 hours of onset according to guidelines from professional medical societies.
  - Causative occlusion of the internal carotid artery or proximal MCA (M1).
  - Age ≥18 years.
  - NIHSS score of ≥6.
  - ASPECTS of ≥6.
  - Treatment can be initiated (groin puncture) within 6 hours of symptom onset.
• As with intravenous alteplase (rtPA), reduced time from symptom onset to reperfusion with endovascular therapies is highly associated with better clinical outcomes. To ensure benefit, reperfusion to TICI grade 2b/3 should be achieved as early as possible and within 6 hours of stroke onset (Class I; Level of Evidence B-R).

• When treatment is initiated beyond 6 hours from symptom onset, the effectiveness of endovascular therapy is uncertain for patients with acute ischemic stroke who have causative occlusion of the internal carotid artery or proximal MCA (M1) (Class IIb; Level of Evidence C).

• In carefully selected patients with anterior circulation occlusion who have contraindications to intravenous alteplase (rtPA), endovascular therapy with stent retrievers completed within 6 hours of stroke onset is reasonable (Class IIa; Level of Evidence C).

• There are inadequate data available at this time to determine the clinical efficacy of endovascular therapy with stent retrievers for those patients whose contraindications are time-based or non-time based (e.g., prior stroke, serious head trauma, hemorrhagic coagulopathy, or receiving anticoagulant medications).

• Although the benefits are uncertain, use of endovascular therapy with stent retrievers may be reason-able for carefully selected patients with acute ischemic stroke in whom treatment can be initiated (groin puncture) within 6 hours of symptom onset and who have causative occlusion of the M2 or M3 portion of the MCAs, anterior cerebral arteries, vertebral arteries, basilar artery, or posterior cerebral arteries (Class IIb; Level of Evidence C).

• Endovascular therapy with stent retrievers may be reasonable for some patients <18 years of age with acute ischemic stroke who have demonstrated large vessel occlusion in whom treatment can be initiated (groin puncture) within 6 hours of symptom onset, but the benefits are not established in this age group (Class IIb; Level of Evidence C).
Although the benefits are uncertain, use of endovascular therapy with stent retrievers may be reasonable for patients with acute ischemic stroke in whom treatment can be initiated (groin puncture) within 6 hours of symptom onset and who have prestroke mRS score of >1, ASPECTS <6, or NIHSS score <6 and causative occlusion of the internal carotid artery or proximal MCA (M1) (Class IIb; Level of Evidence B-R).

Observing patients after intravenous alteplase (rtPA) to assess for clinical response before pursuing endovascular therapy is not required to achieve beneficial outcomes and is not recommended. (Class III; Level of Evidence B-R). Use of stent retrievers is indicated in preference to the MERCI device. (Class I; Level of Evidence A). The use of mechanical thrombectomy devices other than stent retrievers may be reasonable in some circumstances (Class IIb, Level B-NR).

The use of proximal balloon guide catheter or a large bore distal access catheter rather than a cervical guide catheter alone in conjunction with stent retrievers may be beneficial (Class IIa; Level of Evidence C).

The technical goal of the thrombectomy procedure should be a TICI 2b/3 angiographic result to maximize the probability of a good functional clinical outcome (Class I; Level of Evidence A). Use of salvage technical adjuncts including intra-arterial fibrinolysis may be reasonable to achieve these angiographic results, if completed within 6 hours of symptom onset (Class IIb; Level of Evidence B-R).

Angioplasty and stenting of proximal cervical atherosclerotic stenosis or complete occlusion at the time of thrombectomy may be considered but the usefulness is unknown (Class IIb; Level of Evidence C).

Initial treatment with intra-arterial fibrinolysis is beneficial for carefully selected patients with major ischemic strokes of <6 hours’ duration caused by occlusions of the MCA (Class I; Level of Evidence B-R). However, these data derive from clinical trials that no longer reflect current practice, including use of fibrinolytic drugs that are not available. A clinically beneficial dose of intra-arterial alteplase (rtPA) is not established, and alteplase (rtPA) does not have
FDA approval for intra-arterial use. As a consequence, endovascular therapy with stent retrievers is recommended over intra-arterial fibrinolysis as first-line therapy (Class I; Level of Evidence E).

- Intra-arterial fibrinolysis initiated within 6 hours of stroke onset in carefully selected patients who have contraindications to the use of intravenous alteplase (rtPA) might be considered, but the consequences are unknown (Class IIb; Level of Evidence C).

- It might be reasonable to favor conscious sedation over general anesthesia during endovascular therapy for acute ischemic stroke. (Class IIb; Level of Evidence C).

**Anticoagulants**

- At present, the usefulness of argatroban or other thrombin inhibitors for treatment of patients with acute ischemic stroke is not well established (Class IIb; Level of Evidence B). These agents should be used in the setting of clinical trials.

- The usefulness of urgent anticoagulation in patients with severe stenosis of an internal carotid artery ipsilateral to an ischemic stroke is not well established (Class IIb; Level of Evidence B).

- Urgent anticoagulation, with the goal of preventing early recurrent stroke, halting neurological worsening, or improving outcomes after acute ischemic stroke, is not recommended for treatment of patients with acute ischemic stroke (Class III; Level of Evidence A).

- Urgent anticoagulation for the management of noncerebrovascular conditions is not recommended for patients with moderate-to-severe strokes because of an increased risk of serious intracranial hemorrhagic complications (Class III; Level of Evidence A).
• Initiation of anticoagulant therapy within 24 hours of treatment with intravenous alteplase (rtPA) is not recommended (Class III; Level of Evidence B).

**Antiplatelet Agents**

• Oral administration of aspirin (initial dose is 325 mg) within 24 to 48 hours after stroke onset is recommended for treatment of most patients (Class I; Level of Evidence A).

• The usefulness of clopidogrel for the treatment of acute ischemic stroke is not well established (Class IIb; Level of Evidence C).

• The efficacy of intravenous tirofiban and eptifibatide is not well established, and these agents should be used only in the setting of clinical trials (Class IIb; Level of Evidence C).

• Aspirin is not recommended as a substitute for other acute interventions for treatment of stroke, including intravenous alteplase (rtPA) (Class III; Level of Evidence B).

• The administration of other intravenous antiplatelet agents that inhibit the glycoprotein IIb/IIIa receptor is not recommended (Class III; Level of Evidence B).

• The administration of aspirin (or other antiplatelet agents) as an adjunctive therapy within 24 hours of intravenous fibrinolysis is not recommended (Class III; Level of Evidence C).

• Initiation of anticoagulant therapy within 24 hours of treatment with intravenous alteplase (rtPA) is not recommended (Class III; Level of Evidence B).
Volume Expansion, Vasodilators and Induced Hypertension

- In exceptional cases with systemic hypotension producing neurological sequelae, a physician may prescribe vasopressors to improve cerebral blood flow. If drug-induced hypertension is used, close neurological and cardiac monitoring is recommended (Class I; Level of Evidence C).

- The administration of high-dose albumin is not well established as a treatment for most patients with acute ischemic stroke until further definitive evidence regarding efficacy becomes available (Class IIb; Level of Evidence B).

- At present, use of devices to augment cerebral blood flow for the treatment of patients with acute ischemic stroke is not well established (Class IIb; Level of Evidence B).

- The usefulness of drug-induced hypertension in patients with acute ischemic stroke is not well established (Class IIb; Level of Evidence B).

- Hemodilution by volume expansion is not recommended for treatment of patients with acute ischemic stroke (Class III; Level of Evidence A).

- The administration of vasodilatory agents, such as pentoxifylline, is not recommended for treatment of patients with acute ischemic stroke (Class III; Level of Evidence A).

Surgical Interventions

- The usefulness of emergent or urgent CEA when clinical indicators or brain imaging suggests a small infarct core with large territory at risk (e.g. penumbra), compromised by inadequate flow from a critical carotid stenosis or occlusion, or in the case of acute neurological deficit after CEA, in which acute thrombosis of the surgical site is suspected, is not well established (Class IIb; Level of Evidence B).
In patients with unstable neurological status (either stroke-in-evolution or crescendo TIA), the efficacy of emergent or urgent CEA is not well established (Class IIb; Level of Evidence B).

**Admission to the Hospital and General Acute Treatment after Hospitalization**

- The use of comprehensive specialized stroke care (stroke units) that incorporates rehabilitation is recommended (Class I; Level of Evidence A).
- Patients with suspected pneumonia or UTIs should be treated with appropriate antibiotics (Class I; Level of Evidence A).
- Subcutaneous administration of anticoagulants is recommended for treatment of immobilized patients to prevent DVT (Class I; Level of Evidence A).
- The use of standardized stroke care order sets is recommended to improve general management (Class I; Level of Evidence B).
- Assessment of swallowing before the patient begins eating, drinking, or receiving oral medications is recommended (Class I; Level of Evidence B).
- Patients who cannot take solid food and liquids orally should receive NG, nasoduodenal, or PEG tube feedings to maintain hydration and nutrition while undergoing efforts to restore swallowing (Class I; Level of Evidence B).
- Early mobilization of less severely affected patients and measures to prevent subacute complications of stroke are recommended (Class I; Level of Evidence C).
- Treatment of concomitant medical diseases is recommended (Class I; Level of Evidence C).
- Early institution of interventions to prevent recurrent stroke is recommended (Class I; Level of Evidence C).
• The use of aspirin is reasonable for treatment of patients who cannot receive anticoagulants for DVT prophylaxis (Class IIa; Level of Evidence A).

• In selecting between NG and PEG tube routes of feeding in patients who cannot take solid food or liquids orally, it is reasonable to prefer NG tube feeding until 2 to 3 weeks after stroke onset (Class IIa; Level of Evidence B).

• The use of intermittent external compression devices is reasonable for treatment of patients who cannot receive anticoagulants (Class IIa; Level of Evidence B).

• Routine use of nutritional supplements has not been shown to be beneficial (Class III; Level of Evidence B).

• Routine use of prophylactic antibiotics has not been shown to be beneficial (Class III; Level of Evidence B).

**Treatment of Acute Neurological Complications**

• Patients with major infarctions are at high risk for complicating brain edema and increased ICP. Measures to lessen the risk of edema and close monitoring of the patient for signs of neurological worsening during the first days after stroke are recommended (Class I; Level of Evidence A). Early transfer of patients at risk for malignant brain edema to an institution with neurosurgical expertise should be considered.

• Decompressive surgical evacuation of a space-occupying cerebellar infarction is effective in preventing and treating herniation and brain stem compression (Class I; Level of Evidence B).

• Decompressive surgery for malignant edema of the cerebral hemi-sphere is effective and potentially lifesaving (Class I; Level of Evidence B). Advanced patient age and patient/family valuations of achievable outcome states may affect decisions regarding surgery.
• Recurrent seizures after stroke should be treated in a manner similar to other acute neurological conditions, and antiepileptic agents should be selected by specific patient characteristics (Class I; Level of Evidence B).

• Placement of a ventricular drain is useful in patients with acute hydrocephalus secondary to ischemic stroke (Class I; Level of Evidence C).

• Although aggressive medical measures have been recommended for treatment of deteriorating patients with malignant brain edema after large cerebral infarction, the usefulness of these measures is not well established (Class IIb; Level of Evidence C).

• Because of lack of evidence of efficacy and the potential to increase the risk of infectious complications, corticosteroids (in conventional or large doses) are not recommended for treatment of cerebral edema and increased ICP complicating ischemic stroke (Class III; Level of Evidence A).

• Prophylactic use of anticonvulsants is not recommended (Class III; Level of Evidence C).

**Comprehensive and Primary Stroke Certifications**

The Joint Commission oversees certification for Primary and Comprehensive Stroke centers.

Christiana Hospital received a Comprehensive Stroke Center Certification from The Joint Commission in May 2014. As a Comprehensive Stroke Center, Christiana Hospital tracks performance on core measures for quality stroke care. Wilmington Hospital received a Primary Stroke Center Certification from the Joint Commission in 2009.

Eight primary and eight comprehensive core stroke measures, subject to modification by the Joint Commission, are tracked and reported:
PRIMARY CORE MEASURES

- STK-1 Venous Thromboembolism (VTE) Prophylaxis.
- STK-2 Discharged on Antithrombotic Therapy.
- STK-3 Anticoagulation Therapy for Atrial Fibrillation/Flutter.
- STK-4 Thrombolytic Therapy.
- STK-5 Antithrombotic Therapy by End of Hospital Day 2.
- STK-6 Discharged on Statin Medication.
- STK-8 Stroke Education.
- STK-10 Assessed for Rehabilitation.

COMPREHENSIVE CORE MEASURES

- CSTK-01: National Institutes of Health Stroke Scale (NIHSS) Score Performed for Ischemic Stroke Patients.
- CSTK-02: Modified Rankin Score (mRS) at 90 Days.
- CSTK-03 Severity Measurement Performed for Subarachnoid Hemorrhage (SAH) and Intracerebral Hemorrhage (ICH) Patients (Overall Rate).
- CSTK-04: Procoagulant Reversal Agent Initiation.
- CSTK-05: Hemorrhagic Transformation (Overall Rate).
- CSTK-06: Nimodipine Treatment Administered for patients with aneurysmal SAH.
- CSTK-07: Median Time to Revascularization.
- CSTK-08 Thrombolysis in Cerebral Infarction (TICI) Post-Treatment Reperfusion Grade.
1. Recognize signs and symptoms of acute stroke.
   
   A. Sudden onset of the following symptoms should be recognized as potential signs of acute stroke.
      
      1. Weakness especially when unilateral.
      2. Numbness especially when unilateral.
      3. Inability to speak or understand speech.
      4. Slurred speech.
      5. Dizziness/vertigo.
      7. Acute Vision changes.

   B. Posterior circulation ischemia should be considered in cases of unexplained unresponsiveness with sudden onset.

2. EMS Initial Assessment and Transport.
   
   A. Community is encouraged to activate 9-1-1 for stroke symptoms via community education/outreach.
   B. Stroke Scale, as determined by EMS standing orders and protocols, completed for patients with symptoms of stroke.
   C. Last known normal time documented.
   D. Pre arrival call to emergency department base station with medical control when initial screening consistent with stroke and last known normal time less than 6 hours to request Stroke Alert activation.
   E. IV, blood glucose and preliminary blood draw maybe completed during transport when appropriate.

3. Emergent evaluation to determine potential candidacy for thrombolysis (Time goal for ED physician evaluation is < 10 minutes from arrival).
   
   A. Confirm time last seen normal (LSN) and presence of neurologic signs/symptoms.
1. If LSN less than 4.5 hours initiate STROKE ALERT.
2. If LSN less than 6 hours or symptoms were identified upon awakening with severe weakness or language impairment initiate STROKE ALERT.
3. If stroke symptoms are suspected to be due to basilar artery thrombosis (Coma, respiratory failure, quadriplegia) initiate stroke alert at any time after onset.

B. If patient does not meet criteria for STROKE ALERT proceed to section V, INITIAL EVALUATION FOR PATIENTS NOT MEETING STROKE ALERT CRITERIA.

4. STROKE ALERT/STROKE CODE (Algorithm 7)

A. Alert sent to stroke alert pager.
   1. Goal time for Neurology call back < 15 minutes from alert.
   2. Neuro ICU, Stroke unit charge nurses alerted to prepare stroke bed.
   3. CT alerted to clear CT scanner.
   4. ED pharmacist alerted.

B. Vital Signs obtained and medical stability assessed.
C. History reviewed with attention to contraindications to IV tPA.
D. Revascularization checklist completed including inclusion and exclusion criteria.
E. Neurological Assessment completed and NIHSS documented.
F. ED1 Stroke Alert MD1075 Power plan initiated, as per protocol.
G. IV appropriate for CTA obtained.
H. STAT labs sent. Goal time for lab report 45 minutes. Labs, with the exception of blood glucose and PT/PTT if on anticoagulation, should not delay administration of IV tPA.
   2. PT/PTT.
   3. Electrolytes, BUN and Creatinine.
   4. CBC.
   5. Cardiac Enzymes.
I. Obtain patient weight via sling scale during transport to CT scanner.

J. STAT Stroke alert imaging.
   1. Obtain Non-contrast CT of head.
      a. Interpretation by radiology with report to provider.
      b. Goal report time < 45 minutes from time of stroke alert.
      c. Evaluate for presence of hemorrhage or completed infarct.
   2. Obtain CTA of head and neck unless contraindicated.
      a. CTA should not delay administration of IV tPA.
      b. Evaluate for proximal occlusion of cerebral vasculature.
      c. Calculate ASPECTS score if considering endovascular therapy.

K. Collaborative decision by neurological subspecialists and other providers regarding administration of IV tPA.
   1. As recommended by the AHA the indications and contraindication for the use of IV tPA may be modified by a physician with expertise in stroke care. We recognize the revised FDA indications, AHA/ASA, expert guidelines, evidence from randomized controlled trials, and peer reviewed published observations studies support the use of IV tPA in distinct patient populations.
   2. If Patient not a candidate for IV tPA.
      a. Document reason that patient is not a candidate for IV tPA.
      b. Continue with evaluation for mechanical thrombectomy.
   3. If patient is a candidate for IV tPA. Goal door to needle time is < 60 minutes from arrival but < 45 minutes is preferred.
      a. STROKE CODE called via page operator.
      b. Stroke Code Power Plan (ED1 Stroke Code Alteplase (tPA) MD 1076) initiated including IV tPA order.
      c. tPA mixed by pharmacist, nursing or physician if not pre-mixed.
      d. Stroke code flowsheet initiated and pre-tPA exam documented.
      e. Blood pressure confirmed to be within tPA parameters (185/110).
f. Time out performed prior to bolus dose of IV tPA.
g. IV tPA administered.
h. Neurological Assessments completed per Stroke Code flowsheet.
i. Maintain blood pressure within post IV tPA parameters (180/105).

L. Continue with assessment for mechanical thrombectomy.
M. Evaluation for Mechanical Thrombectomy.
   1. Evaluate patients with large vessel cerebral artery occlusions and severe symptoms presenting within 6 hours or upon awakening of symptoms onset for mechanical thrombectomy.
   2. Patients with contraindications to IV tPA should be considered for mechanical thrombectomy.
   3. Administration of IV tPA should not be delayed by evaluation for mechanical thrombectomy.
   4. Patients presenting outside of the 6 hour window may be considered for mechanical thrombectomy particularly when the posterior circulation is affected or when a perfusion mismatch is suspected.
   5. Collaborative decision by neurological subspecialists and other providers regarding mechanical thrombectomy.
   6. “HVIS STROKE CODE” will be called via the Page operator when patient is taken for mechanical thrombectomy.

N. Medical Management following IV tPA or mechanical thrombectomy.
   1. Admission to neurointensivist service in ICU with preference for Neurocritical Care Unit.
   3. No antiplatelet medications or anticoagulants for 24 hours from IV tPA.
   4. Maintain strict blood pressure control with goal < 180/105.
   5. Repeat urgent CT head for decline in neuro examination or new headache.
   6. Repeat imaging 12-24 hours from IV tPA to evaluate for asymptomatic hemorrhage.
5. Ongoing evaluation and management of stroke patients with persistent symptoms or high risk TIA patients.

A. Admission.
   1. Utilize the Stroke Power Plan or module for order entry.
   2. Location.
      a. The following ischemic stroke patients typically require admission to the Intensive Care Unit. Admission to the Neurocritical Care Unit is preferred.
         1. Patients who received IV tPA or mechanical thrombectomy.
         2. Acute ischemic stroke of the cerebellum with mass effect.
         3. Large ischemic stroke of the full middle cerebral artery territory at risk for cerebral edema.
         4. Patients with acute ischemic stroke who are otherwise unstable due to hemodynamic or pulmonary concerns.
      b. Ischemic stroke patients who do not meet the criteria above should be admitted to a designated stroke unit.
      c. High Risk Transient Ischemic Attack (TIA) patients including all TIA patients with ABCD2 score greater than or equal to 4 and patients with prior clinical history of stroke should be admitted to a designated stroke unit.
      d. The management of low risk TIA patients is outside the scope of this pathway.

B. Nursing Assessments.
   1. Follow neurological assessments at least every 4 hours.
   2. Document NIHSS daily.
   3. Document swallow screening prior to giving anything by mouth.
   4. Follow vital signs at least every 4 hours.
      a. Blood Pressure Parameters.
      b. Avoid hypotension.
c. Upper blood pressure (BP) parameters for patient who did not receive thrombolysis are typically 220/120 unless otherwise contraindicated.

d. BP parameters for patients who received IV tPA are < 180/105 for first 24 hours.

e. Restarting antihypertensive medications is reasonable after the first 24 hours for patients that are neurologically stable and do not have significant vascular stenosis.

1. Utilize supplemental O2 as necessary to maintain O2 Sat of > 94%

f. Document stroke depression screen upon admission and discharge and follow depression algorithm (Algorithm 3).


C. Diagnostics: Goal is to determine associated risk factors and ideal choice of long term prevention strategies.

1. Classify stroke etiology by modified TOAST criteria for all patients to minimize variability in diagnostic testing.

2. MRI may be utilized to help define stroke etiology but is not necessary for all patients with ischemic stroke. Refer to MRI algorithm for suggested criteria to define patients who are most likely to benefit from MRI (Algorithm 4).

3. Evaluate for cardioembolic source.

   a. Obtain 12 lead EKG on all stroke patients.

   b. Telemetry monitoring for at least 48 hours is recommended unless patient has known history of atrial fibrillation. Monitoring for the first five days of hospitalization is preferred for patients with cryptogenic stroke.

   c. Echocardiogram may be useful to further evaluate for cardioembolic source of stroke but is not necessary for all patients with ischemic stroke. Refer to Echocardiogram algorithm for suggested criteria to define patients who are most likely to benefit from Echocardiogram (Algorithm 5).
d. Some patients benefit from prolonged cardiac monitoring after discharge. Please see algorithm for suggested referral guidelines (Table 2).

4. Evaluate for large vessel vascular disease.
   a. Imaging of the intracranial and extracranial vasculature is often necessary to exclude large thrombotic disease. Available imaging modalities include ultrasound, CTA, MRA and conventional angiogram. Refer to vascular imaging algorithm for suggested criteria to guide selection of intracranial and cervical vascular imaging (Algorithm 6)
   b. Duplicate carotid artery imaging in the absence of initial abnormality is not routinely recommended. (e.g. carotid ultrasound or MRA of neck after CTA performed).

5. Assessment of medical risk factors.
   a. Check fasting lipid profile or document recent outpatient results.
   b. Check HgbA1C or document recent outpatient results.
   c. Assess for tobacco utilization.
   d. Assess for obesity.
   e. Additional testing is determined by clinical characteristics and expert guidance, and may include TSH, hyper coagulable panel autoimmune panel.

   a. Transesophagaeal Echocardiogram (TEE) may be considered in select patients.
   b. Refer for stroke clinic follow up at time of discharge.
   c. Consider long term cardiac monitoring per algorithm.

D. Therapeutics: Goal is to reduce the risk of recurrent stroke or secondary complications of stroke.

1. Antiplatelet medication should be initiated as soon as possible but prior to the end of the 2nd calendar day of admission or contraindication
documented. Antiplatelet medications should be continued throughout the hospitalization and at discharge or contraindication documented.

2. Initiate venous thromboembolism (VTE) prophylaxis prior to end of hospital day 2 or document exclusion.

3. Initiate statin therapy prior to discharge or document contraindication. Dose of statin therapy in accordance with American Heart Association cardiac risk guideline.

4. Initiate anticoagulant for patients with atrial fibrillation or document anticipated.

E. Rehabilitation Services: Goal is to maximize functional recovery.

1. All stroke patients must be assessed for rehabilitation needs prior to discharge.

2. Consult to appropriate therapies (physical, occupational, speech) should be placed as soon as medically appropriate and preferably on day of admission. Initial evaluation should be completed within 24 hours of consult.

3. Daily interdisciplinary rounds are preferred providing a forum for therapists, social services and clinical teams to share information.

4. Complete cognitive assessment prior to discharge following algorithm (Figure 1).

5. Complete Depression Assessment at admission and discharge and refer for psychiatric support if necessary per algorithm (Algorithm 3).

6. Early referral and transfer to acute rehabilitation is recommended if appropriate.

7. Inpatient physiatry consultation should be considered for select patients.

8. Consider necessity for outpatient physiatry consult at time of discharge using the following criteria as a guide.

   a. Patients who are discharged home without deficits or need for physical, occupational, or speech therapy services may follow up with physiatry if functional deficits are identified after discharge.
b. Consider physiatry follow up 2 weeks post discharge for patients discharged home with outpatient physical, occupational, or speech therapy services.
c. Consider physiatry follow up 2 weeks post hospital discharge for patients discharged to skilled nursing facilities.
d. Consider recommending physiatry follow up at time of discharge from acute rehabilitation facilities.

F. Transition Planning: Goal is to anticipate and provide for patient's post discharge needs.
   1. Social Work or Case management performs initial assessment within 24 hours of admission.
      a. Assesses preadmission functional status.
      b. Assesses family and home resources.
      c. Identifies insurance status or other social barriers to care.
   2. Projected discharge location and needs discussed on interdisciplinary rounding.
   3. Referrals for acute rehabilitation, skilled nursing, and home health resources are made by social work in collaboration with interdisciplinary care team.
   4. For patients that will be discharged home assessment of family skills, capacity and resources is completed and documented prior to discharge.

G. Education.
   Provide stroke education to the patient and their family including:
   2. Signs and symptoms of stroke.
   3. Utilization of 911 and emergency services.
   4. Medications including side effects.
   5. Smoking cessation counseling.
H. Peri-Discharge follow-up.

1. Follow up with Primary Care Provider is recommended upon discharge
2. Vascular neurologist follow-up per algorithm (Figure 2).
3. Provide prescriptions for outpatient physical, occupational and speech therapy upon discharge if indicated.
4. Follow up phone calls will be made within 7 days post discharge to all stroke patients who are discharged home.
5. Follow up phone calls within 75 to 105 days to complete the modified Rankin scale for patients who received IV tPA or mechanical thrombectomy.
### Clinical Pathway Algorithms and Figures

**Table 1: Acute Ischemic Stroke Pathway Implementation Tool**

<table>
<thead>
<tr>
<th>Day</th>
<th>Day 1, Emergency Department</th>
<th>Day 1 After Admission</th>
<th>Day 2</th>
<th>Day 3 + Interim Days</th>
<th>Discharge</th>
<th>Post D/C Care</th>
</tr>
</thead>
</table>
| **Clinical Goals** | • Recognition of stroke symptoms  
• Evaluation for revascularization | • Initiate evaluation for stroke etiology  
• Initial evaluation for disposition needs | • Ongoing testing for etiology of stroke and discharge planning | • Etiology of stroke and discharge planning  
• Complete evaluation for stroke etiology  
• Prepare for discharge | • Discharge to home or acute rehabilitation | • Prevention of re-admission |
| **Assessments & Documentation** | • Assess for Stroke Alert by completing the revascularization check list. Include time last seen normal (LSN) and any exclusion for tPA/mechanical thrombectomy¹  
• Obtain initial NIHSS <12 hour from arrival and prior to revascularization ¹ | • Daily NIHSS ordered and documented¹  
• Complete and document swallow screen prior to giving anything by mouth¹  
• Frequent neurological assessments and vital signs ordered no less than Q4 hrs or per post tPA or mechanical thrombectomy protocol when applicable²  
• Stroke Depression Screen documented and evaluate per algorithm¹  
• Document patient's own goals¹ | • Daily NIHSS documented¹  
• Document patient's own goals¹  
• Document assessment for cognitive decline per algorithm⁷ | • Documentation includes specifics of stroke type, location, lateralization and etiology or documentation that these details are unknown²  
• NIHSS at discharge documented¹  
• Depression screen documented at discharge³  
• Document assessment for rehab services prior to discharge or documented none needed⁵ | • 7 day and 90 day follow-up phone calls completed¹  
• 90 Day Modified Rankin Score completed and documents for patients who received IV tPA or mechanical thrombectomy¹ |
| **Diagnostics** | • Obtain CT head prior to admission²  
• Check Blood Glucose and INR if patient anticoagulated on warfarin² | • Stroke Power Plan or Module initiated for order entry¹  
• Obtain 12 lead EKG  
• Initiate telemetry monitoring or document exclusion²  
• Order MRI brain if indicated per protocol or document deviation from protocol² | • Goal MRI complete < 48 hours from admission when indicated⁶  
• Goal Echo complete < 48 hours from admission when indicated⁶  
* Goal vascular imaging complete < 48 hours from | • Evaluate long term cardiac monitoring if appropriate per algorithm⁷ |
<table>
<thead>
<tr>
<th>DAY</th>
<th>DAY 1, EMERGENCY DEPARTMENT</th>
<th>DAY 1 AFTER ADMISSION</th>
<th>DAY 2</th>
<th>DAY 3 + INTERIM DAYS</th>
<th>DISCHARGE</th>
<th>POST D/C CARE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>• Order vascular imaging of neck and/or head if indicated per protocol or document deviation from protocol&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>admission when indicated&lt;sup&gt;6&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Order echocardiogram if indicated per protocol or document deviation from protocol&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>• Lipid profile and HgbA1C completed if indicated</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Order Lipid panel, and HgbA1C or documentation of outpatient values&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Neurology consult ordered if not admitted to neurointensivist&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Therapeutics</td>
<td>• Administer IV tPA to eligible patients within 60 minutes of arrival to ED or document exclusions or reason for increased time&lt;sup&gt;1&lt;/sup&gt;</td>
<td>• If patient received IV tPA maintain Blood Pressure &lt; 180/105 for 24 hrs&lt;sup&gt;4&lt;/sup&gt;</td>
<td></td>
<td>• Initiate or modify statin therapy in accordance with the AHA Cardiac risk guidelines or document contraindications&lt;sup&gt;3&lt;/sup&gt;</td>
<td>• Antplatelets prescribed at discharge or contraindication documented&lt;sup&gt;9&lt;/sup&gt;</td>
<td>• Carelink determines and documents if patient is taking prescribed medication,&lt;sup&gt;10&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• For patients who did NOT receive IV tPA no treatment for elevations in BP up to 220/120 or documentation of specific indications&lt;sup&gt;4&lt;/sup&gt;</td>
<td></td>
<td>• Consult vascular surgery if symptomatic carotid artery stenosis &gt; 50% identified or document exclusion treatment&lt;sup&gt;2&lt;/sup&gt;</td>
<td>• Anticoagulation for atrial fibrillation prescribed at discharge or contraindication documented&lt;sup&gt;9&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Antiplatelet therapy ordered with first dose given prior to end of 2&lt;sup&gt;nd&lt;/sup&gt; calendar day of admission if not given in ED or contraindication documented&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
<td></td>
<td>• Statin prescribed at discharge or contraindication documented&lt;sup&gt;9&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• VTE prophylaxis ordered and administered prior to end of Day 2 or contraindication documented&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Initiate treatment for hyperglycemia when blood sugar &gt; 180&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrition</td>
<td>• Consult Speech Therapy as needed</td>
<td>• Consult dietitian if PO diet</td>
<td></td>
<td></td>
<td>• Diet and regular activity recommended on</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Consult dietitian if PO diet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAY</td>
<td>DAY 1, EMERGENCY DEPARTMENT</td>
<td>DAY 1 AFTER ADMISSION</td>
<td>DAY 2</td>
<td>DAY 3 + INTERIM DAYS</td>
<td>DISCHARGE</td>
<td>POST D/C CARE</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------</td>
<td>-----------------------</td>
<td>-------</td>
<td>----------------------</td>
<td>-----------</td>
<td>--------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>for dysphagia&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>inadequate&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>discharge</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Initiate cardiac diet if pt passes speech evaluation&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td>summary&lt;sup&gt;6&lt;/sup&gt;</td>
</tr>
<tr>
<td>Activity/Safety</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evaluate for Fall Precautions&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td>Mobilize daily or document exclusion&lt;sup&gt;7&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interdisciplinary</td>
<td></td>
<td>PT/OT/ST Consulted or document exclusion&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>Interdisciplinary rounds performed daily and document&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PT/OT/ST performs initial assessments within 24 hours of order placement and document treatment plan&lt;sup&gt;6&lt;/sup&gt;</td>
<td></td>
<td>Ongoing PT/OT/ST as indicated in therapist plan of care&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Social Work/Case Management initial assessments completed within 24 hrs of consult&lt;sup&gt;6&lt;/sup&gt;</td>
<td></td>
<td>For NCCU patients review condition and establish current goals of care via family meeting by end of Day 4&lt;sup&gt;7&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Referral for Rehabilitative services as necessary (Acute rehab, SNF, home health, or outpatient)&lt;sup&gt;5, 9&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Referral for behavioral health resources at d/c if depression screen positive&lt;sup&gt;9&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Evaluate for outpatient physiatri. Follow-up prior to discharge&lt;sup&gt;7&lt;/sup&gt; or&lt;sup&gt;9&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Patient receives recommended rehabilitative Services: Acute Rehab, Sub-Acute Rehab, Home health or outpatient PT/OT/ST&lt;sup&gt;10&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Patient appointment scheduled with providers they are referred to per d/c instructions&lt;sup&gt;10&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td>Stroke education initiated and documented&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td>Patient own goals documented&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stroke education materials provided to patient or family and documented&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td>Continue required stroke education&lt;sup&gt;7&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tobacco cessation education counseling initiated when indicated&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td>Tobacco cessation education counseling completed prior to d/c&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>All required stroke education completed and documented prior to d/c&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Perform 7 day phone call and document if patient is able to express signs and symptoms of stroke, what to do if they have S&amp;S of a stroke, and the role of their medication in preventing a reoccurring stroke&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transition Planning</td>
<td></td>
<td>Admit to designated stroke unit&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>Daily documentation of assessment for appropriateness of acute, subacute, home health, or outpatient therapy services&lt;sup&gt;6&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Daily documentation of assessment for appropriateness of referral for acute, subacute, home health, or outpatient therapy services&lt;sup&gt;6&lt;/sup&gt;</td>
<td></td>
<td>Stroke Clinic per referral follow-up algorithm&lt;sup&gt;9&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Smoke Clinic per referral follow-up algorithm&lt;sup&gt;9&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CareLink follows pt&lt;sup&gt;10&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>If patient is d/c'd to home, PCP appointment scheduled within 14 days&lt;sup&gt;10&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DAY</td>
<td>DAY 1, EMERGENCY DEPARTMENT</td>
<td>DAY 1 AFTER ADMISSION</td>
<td>DAY 2</td>
<td>DAY 3 + INTERIM DAYS</td>
<td>DISCHARGE</td>
<td>POST D/C CARE</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------</td>
<td>----------------------</td>
<td>-------</td>
<td>---------------------</td>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Family assessed for skills, capacity, and resources or document not relevant</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1Powerform 2Powerchart Order 3Powerchart EMAR 4Powerchart vital signs 5Powerchart test results 6Disc Spec Powerchart doc 7Unknown or paper 8ICD-10 coding 9D/C med reconciliation or instructions 10Aerial
ALGORITHM 1: ACUTE ISCHEMIC STROKE

Acute Ischemic Stroke Algorithm

Recognition of Stroke Signs & Symptoms (I)

EMS Assessment & Transport (II)

Self transport to hospital

In-Hospital onset of symptoms

Triage: Is pt a potential candidate for thrombolysis (III)

Initial ER eval consistent with ischemic stroke (V)

Are symptoms persistent

History of prior stroke?

Is ABCD2 greater than or equal to 4

Pre alert called

Go to Stroke Alert / Code Algorithm (IV)

No

Admit to ICU or Stroke Unit (VI)

Evaluate for source of stroke

On going hospital care and rehabilitation

Disposition

No

Yes

Yes

No

No

No

Yes

Go to low risk TIA observation protocol

This algorithm serves as guideline for the inpatient evaluation of etiology of ischemic stroke, but does not supersed clinical judgment accounting for individual patient characteristics. Documentation of the rationale for variation in care from the algorithm is recommended.
This algorithm serves as guideline for the inpatient evaluation of etiology of ischemic stroke, but does not supersede clinical judgment accounting for individual patient characteristics. Documentation of the rationale for variation in care from the algorithm is recommended.
ALGORITHM 3: STROKE DEPRESSION ASSESSMENT

STROKE DEPRESSION ASSESSMENT

QUESTION: Does the patient often feel sad or depressed?
(Elicit from patient only)

Yes

RN performs PHQ9. What is the score?

Score ≥ 10 and/or suicidal thoughts
- Contact Attending MD

Score <10
- Consult case management for home health visit for behavioral health evaluation and/or Stroke Clinic follow-up as applicable

No OR Unable to answer

Prior to discharge repeat “Does the patient often feel sad or depressed?” question.
(Elicit from patient only)

Yes

Provide patient or caregiver stroke education booklet that includes a depression section

No OR Unable to answer

Refer patient or caregiver to depression section in stroke booklet and pertinent resources

This algorithm serves as a guideline for assessment of depression post stroke, but does not supersede clinical judgment accounting for individual patient characteristics. Documentation of the rationale for variation in care from the algorithm is recommended. Version 120315
ALGORITHM 4: MRI BRAIN ALGORITHM ISCHEMIC STROKE/TIA CLINICAL PATHWAY*

Initial MRI Brain Algorithm*
Ischemic Stroke/TIA Care Pathway

Was the patient a HVIS Stroke Code? 
OR 
Did the patient have a CTA stroke with large vessel occlusion corresponding to symptoms? 

*First confirm patient is MRI compatible

Yes 

Is acute cerebral infarction clearly present on Head CT? 

No 

Is MRA head and/or MRA neck recommended by vascular imaging algorithm? 

Yes 

Order MRI brain with MRA as recommended by vascular imaging algorithm 

No 

Does the patient have known atrial fibrillation and clinical symptoms diagnostic of a stroke? 

Yes 

Order MRI brain 

No 

Defer MRI brain 

Defer MRI brain

This algorithm serves as guideline for the inpatient evaluation of etiology of ischemic stroke, but does not supersede clinical judgment accounting for individual patient characteristics. Documentation of the rationale for variation in care from the algorithm is recommended.
ALGORITHM 5: TRANSTHORACIC ECHOCARDIOGRAM (TTE) ALGORITHM: ISCHEMIC STROKE/TIA CLINICAL PATHWAY

Initial Transthoracic Echocardiogram (TTE) Algorithm
Ischemic Stroke/TIA Care Pathway

Does the patient have known atrial fibrillation?

Yes

Defer TTE

No

Does the patient have heart failure or known coronary artery disease (MI, stent, etc.)?

Yes

Has the patient had a TTE in the past 12 months?

Yes

Has the patient had a TTE in the last 5 years?

No

Is there evidence of new MI or worsening heart failure since prior TTE?

Yes

Consider TTE (2D echo)

No

Defer TTE

No

Yes

Consider TTE (2D echo)

Defer TTE

Order TTE (2D echo) *

*For young patients without vascular risk factors, or for patients with suspected endocarditis, TEE may be appropriate initial study.

This algorithm serves as guideline for the inpatient evaluation of etiology of ischemic stroke, but does not supersede clinical judgment accounting for individual patient characteristics. Documentation of the rationale for variation in care from the algorithm is recommended.

Version 010716
# TABLE 2: HEART MONITORING DECISION MAKING POST STROKE

<table>
<thead>
<tr>
<th>RECOMMENDED COURSE OF ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Very High Yield (Category A)</strong> [Consider implantable loop monitor if Cardionet negative]</td>
</tr>
<tr>
<td>Acute multifocal cryptogenic stroke</td>
</tr>
<tr>
<td>Cryptogenic stroke with history of cryptogenic stroke (recurrent cryptogenic stroke)</td>
</tr>
<tr>
<td>Cryptogenic stroke with atrial dilation or palpitations</td>
</tr>
<tr>
<td>Cryptogenic stroke with unclear history of atrial fibrillation or single episode of isolated post-op a-fib</td>
</tr>
<tr>
<td><strong>Expected (Category B)</strong></td>
</tr>
<tr>
<td>Cryptogenic stroke</td>
</tr>
<tr>
<td>Lacunar stroke without vascular risk factors</td>
</tr>
<tr>
<td>Lacunar stroke with history of cryptogenic stroke</td>
</tr>
<tr>
<td>TIA with history of cryptogenic stroke, atrial dilation or palpitations</td>
</tr>
<tr>
<td><strong>Useful (Category C)</strong></td>
</tr>
<tr>
<td>Recurrent lacunar stroke despite medication therapy</td>
</tr>
<tr>
<td>Lacunar stroke with atrial dilation or palpitations</td>
</tr>
<tr>
<td>Lacunar stroke with well controlled vascular risk factors, especial on dual antiplatelet therapy</td>
</tr>
<tr>
<td>Lacunar stroke in patient over 80</td>
</tr>
<tr>
<td><strong>Unlikely to change management (Category X)</strong></td>
</tr>
<tr>
<td>Stroke with history of atrial fibrillation (should be anticoagulated regardless)</td>
</tr>
<tr>
<td>Patient with indication for long-term anticoagulation</td>
</tr>
<tr>
<td>Patients with absolute contraindication for long-term anticoagulation</td>
</tr>
</tbody>
</table>

This document serves as a guideline for heart monitoring decision making post stroke, but does not supersede clinical judgment accounting for individual patient characteristics. Documentation of the rationale for variation in care from the algorithm is recommended. Version 120315

See below for definitions
DEFINITIONS

**Cryptogenic stroke:** cortical stroke, or subcortical stroke without features typical of a lacune without other clear etiology (i.e. >1.5 cm OR not located in brainstem, cerebellum, basal ganglia, or periventricular white matter).

**Lacunar stroke:** <1.5 cm linear or ovaloid infarct located in brainstem, cerebellum, basal ganglia, or periventricular white matter.

**ILD:** Implantable loop device (cardiac monitor).
ALGORITHM 6: VASCULAR IMAGING ALGORITHM: ISCHEMIC STROKE/TIA CLINICAL PATHWAY

Initial Vascular Imaging Algorithm
Ischemic Stroke/TIA Care Pathway

Was the patient a Stroke Alert?

Did the patient receive a CTA Stroke and/or CTA Head & Neck, or was the patient upgraded to HVIS Stroke Code?

Does the patient have known atrial fibrillation?

Is the patient over 60 years old with known vascular risk factors (diabetes mellitus, hypertension, hyperlipidemia, or coronary artery disease)?

Is stroke in cerebellum or brain stem?

Order carotid ultrasound

Order carotid ultrasound and MRI brain/MRA head (CTA head if unable to perform MRI)

Order MRI/MRA head/neck (or CTA head and CTA neck if unable to perform MRI)

Defer additional imaging *

No/Unknown

* If a vascular abnormality is noted on initial study, additional imaging may be recommended by consultant

This algorithm serves as guideline for the inpatient evaluation of etiology of ischemic stroke, but does not supersede clinical judgment accounting for individual patient characteristics. Documentation of the rationale for variation in care from the algorithm is recommended. Version 010706
FIGURE 1: COGNITIVE DECLINE AFTER STROKE CONSULTATION GUIDELINE

**WHO**
To Consult

- Speech Pathology
- Occupational Therapy (ADL Safety)

**WHEN**
To Consult For Cognitive Decline

- Patients with:
  - Stroke causing memory or language problems,
  - Confusion,
  - Change in Mental Status
  - Cognitive Decline as a result of new stroke symptoms

**HOW**
To Order Cognitive Evaluation

- Power Chart: Orders/ADD:
  - Consult Speech Therapy:
    - Language and/or Cognitive-Linguistic
  - and/or Consult Occupational Therapy:
    - ADL Safety Assessment

**WHERE**
To Locate Results in PowerChart

- OPTION 1
  - Documents/Rehab Therapies/Rehab Svcs
  - Note titled: Cognitive Linguistic or ADL Safety (**full text note**)

- OPTION 2
  - Documents/Rehab Therapies:
    - SLP Inpatient or OT Evaluation
    - SLP Inpatient or OT Daily Documentatio
    - (**view in full text**)

- OPTION 3
  - Results Review/Flowsheet:
    - Rehab Svcs Tab
    - (**spreadsheet view**)

This algorithm serves as a guideline for cognitive decline flow, but does not supersede clinical judgement accounting for individual patient characteristics. Documentation of the rational for variation in care from the algorithm is recommended.

Version 120315
FIGURE 2: OUTPATIENT NEUROLOGY AND PHYSIATRY FOLLOW-UP RECOMMENDATION

### Neurology Follow-Up:

<table>
<thead>
<tr>
<th>Stroke Etiology</th>
<th>Discharge Destination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Discharged to SNF/ARF</td>
</tr>
<tr>
<td>Cryptogenic</td>
<td></td>
</tr>
<tr>
<td>prolonged cardiac monitoring anticipated</td>
<td>3 months*</td>
</tr>
<tr>
<td>no cardiac monitoring anticipated</td>
<td>as needed</td>
</tr>
<tr>
<td>Cardioembolic</td>
<td></td>
</tr>
<tr>
<td>on chronic anticoagulation</td>
<td>as needed</td>
</tr>
<tr>
<td>not anticoagulated, or anticoagulation newly started at discharge</td>
<td>3 weeks</td>
</tr>
<tr>
<td>Lacunar</td>
<td></td>
</tr>
<tr>
<td>well-controlled risk factors</td>
<td>as needed</td>
</tr>
<tr>
<td>uncontrolled risk factors†</td>
<td>3 months</td>
</tr>
<tr>
<td>Large vessel disease</td>
<td></td>
</tr>
<tr>
<td>symptomatic intracranial atherosclerosis</td>
<td>3 weeks</td>
</tr>
<tr>
<td>cervical disease including dissection, recent CEA</td>
<td>3 months</td>
</tr>
</tbody>
</table>

*cardiac monitoring arranged at time of discharge; if not, then 3 week follow-up
†"uncontrolled" defined at discretion of consultant or discharging provider

Abbreviations: TIA, transient ischemic attack; SNF, skilled nursing facility; ARF, acute rehabilitation facility; PT, physical therapy; OT, occupational therapy; SLP, speech/language pathology; CEA, carotid endarterectomy.

This document serves as a guideline for outpatient stroke clinic neurology follow-up; however it does not supersede clinical judgment accounting for individual patient characteristics. Documentation of the rationale for variation in care from the algorithm is recommended.

Version 040116
Algorithm 7: Stroke Alert/Code

STROKE ALERT / STROKE CODE ALGORITHM Last Updated 3/14/2016

**Recognition**
- Non-Emergency Dept. Physician
  - IH & CH RRT areas: RRT Resident
  - ICU: Medical Resident
  - WICU: Medical Resident, intensivist, or trained designee
  - WH PACU: Medical Resident
  - CVCCC, HVIS: ICU Resident
  - SCCC, CH PACU: Surgical Resident
  - NCU, NCCU, PA/WPN

**Assessment**
- Physician will evaluate patient for any signs / symptoms of stroke < 4.5 hours or < 6 hours with disabling symptoms or > 6 hours with exceptional circumstances.
- (Physician Response Time Goal: 15 minutes)
- Initiate “STROKE ALERT” if not already activated
- Containindication to revascularization
- For all Stroke Alert Patients
  - Physician: Acute Stroke/TIA Treatment Evaluation Form
  - Neurologic assessment as outlined by NIHSS
  - Nurse:
    - 20-Gauge IV (IV can be done after CT)
    - Stroke Alert Labs (Stroke Alert Label)
    - Lab Report Time Goal: 45 minutes
    - Vital signs, Bedside Glucose, Weight
  - CT Technologist:
    - Notify CT when patient ready
    - Prepare CT Scanner for Stroke Alert Imaging
  - Decision by Neurology in collaboration with Radiology, Neuro-Interventional and Emergency Medicine or Stroke Alert Physician
  - CT Head non-contrast
  - Additional imaging per Stroke Alert Protocol
  - Interpretation by Radiology, with report to Neurology, Neuro-Interventional and/or Emergency Medicine/Stroke Alert Physician
  - Stroke Alert Imaging
  - Candidate for Revascularization
  - Not a Candidate for Revascularization

**Management**
- Neurology/Designee upgrade patient to “STROKE CODE”
  - Announced overhead
  - Notification to Stroke Alert/Code Group via Page Operator
  - IV/PA Candidate: See appropriate Stroke Code Power Plan (Refer to Stroke Code/Link Packet)
  - Door to Needle Time Goal: 45 min.
- Selected Patients: Neuro-Interventionalist/Designee upgrade
  - Patient to “HVIS STROKE CODE”
  - Announced overhead
  - Notification to Stroke Alert/Code Group via Page Operator
  - Patient transported to HVIS Suite by RN. If WHED/MED patient transfer to CHED or HVIS.
- Medical Management or Neurosurgical evaluation as appropriate
  - Admission to designated In-Patient Unit
  - Patient admitted to Neuro-ICU (1st preference)

This algorithm serves as guideline for the inpatient evaluation of etiology of ischemic stroke, but does not supersede clinical judgment accounting for individual patient characteristics. Documentation of the rationale for variation in care for the algorithm is recommended.

Version 120315
PATIENT EDUCATION MATERIALS

- Stroke Education Booklet (English) - Currently under revision–coming soon.
- Stroke Education Booklet (Spanish)
ACKNOWLEDGEMENTS

Valerie Dechant MD (Chief Editor)
Kert Anzilotti MD, MBA
Missy Bollinger RN, BSN, MBA
Mary Ciechanowski MSN, APRN, ACNS-BC
Shannon Farmer LCSW
Doug Huisenga MPT, ATC
Sofia Kim MD
Pat Leo RN, BSN, CCM
Reina McAndrew MS, FNP
Jason Nomura MD
Jonathan Raser-Schramm MD, PhD
Thinesh Sivapatham MD
Lisa Wallace FNP
Teresa Zack MSN, RN, NE-BC
THE CHRISTIANA CARE WAY

We serve our neighbors as respectful, expert, caring partners in their health. We do this by creating innovative, effective, affordable systems of care that our neighbors value.