# Clinical Pathways

## Ischemic Stroke Evaluation and Management

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Connecticut Children's

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# What is a Clinical Pathway?

An evidence-based guideline that decreases unnecessary variation and helps promote safe, effective, and consistent patient care.

# Objectives of Pathway

- Recognize children with signs and symptoms of stroke

- Establish a standardized team approach for; rapid evaluation, immediate treatment, and in-hospital management of acute stroke.

# Why is this pathway necessary?

- In 2013 there were 97,792 cases of ischemic stroke & 67,621 cases of hemorrhagic stroke in children, that is a 35% increase from 1990.[2]
- Pediatric stroke rates in developed countries range from 3 -25 per 100,000 children. [2]
- Connecticut Children's does not have a stroke protocol in place.
- The AHA/ASA developed a scientific statement in 2019; which provides updates on pediatric stoke. [2]
- The American Academy of Neurology supports the new statement. [2]
- Doctors and nurses should be able to recognize stroke symptoms. [2]
- There are 2 major reasons for delay in diagnosis of pediatric stroke.
    1) delayed consideration among frontline healthcare professionals
    2) delay in accessing MRI. [2]

# Background

- Stroke is a neurological injury caused by the occlusion or rupture of cerebral blood vessels. Stroke can be ischemic, hemorrhagic or both.
- A stroke usually implies some type of injury to the brain that carries lasting consequences.
- Etiologies and risk factors for ischemic stroke include; cardiac abnormalities, hematologic abnormalities, infections, head and neck trauma, genetic conditions, vasculopathy, illicit drugs, pregnancy, hypertension, hypercoagulable states, infections, and medications.
- Clinical presentation varies based on age, etiology, and stroke location.
- Knowing the sign and symptoms to facilitate early initiation of treatment will minimize acute brain injury and maximize patient recovery.

# Emergency Department Management

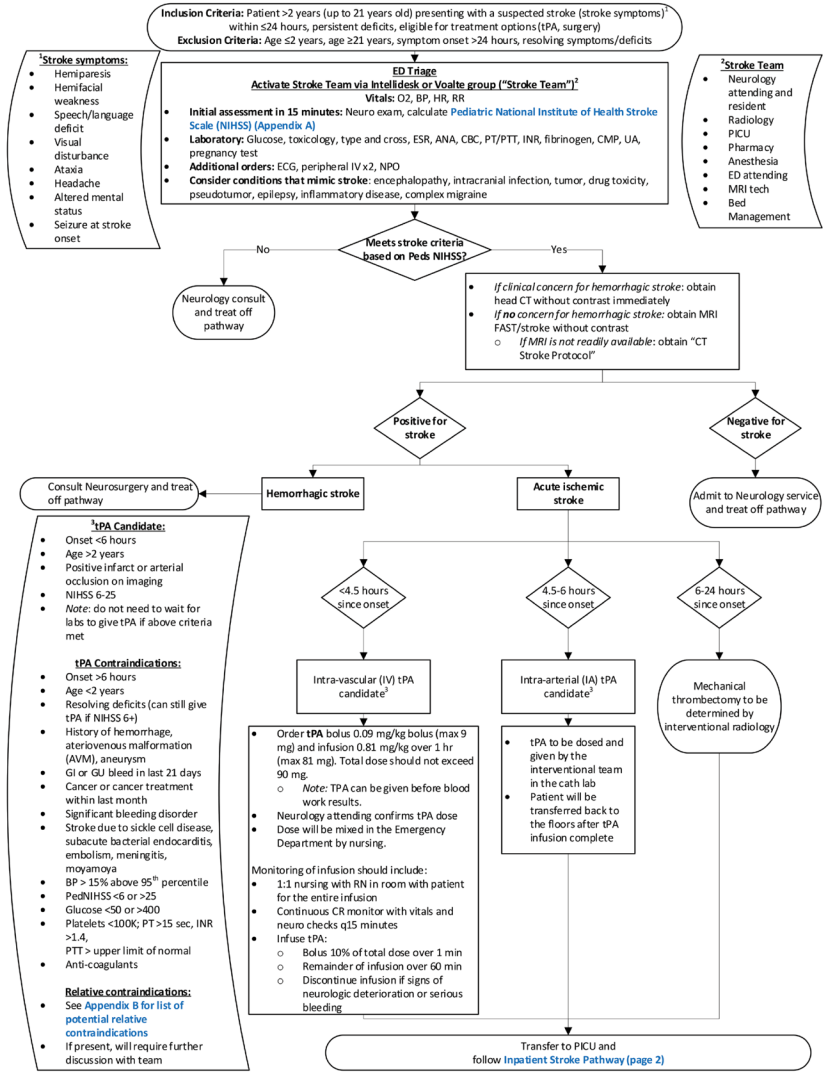
This is the Stroke Clinical Pathway.

It is divided into Emergency Department Management and Inpatient Management.

We will review Emergency Department Management first.

***CLINICAL PATHWAY:***
**Ischemic Stroke Evaluation and Management**
**Emergency Department Management**

THIS PATHWAY SERVES AS A GUIDE AND DOES NOT REPLACE CLINICAL JUDGMENT.

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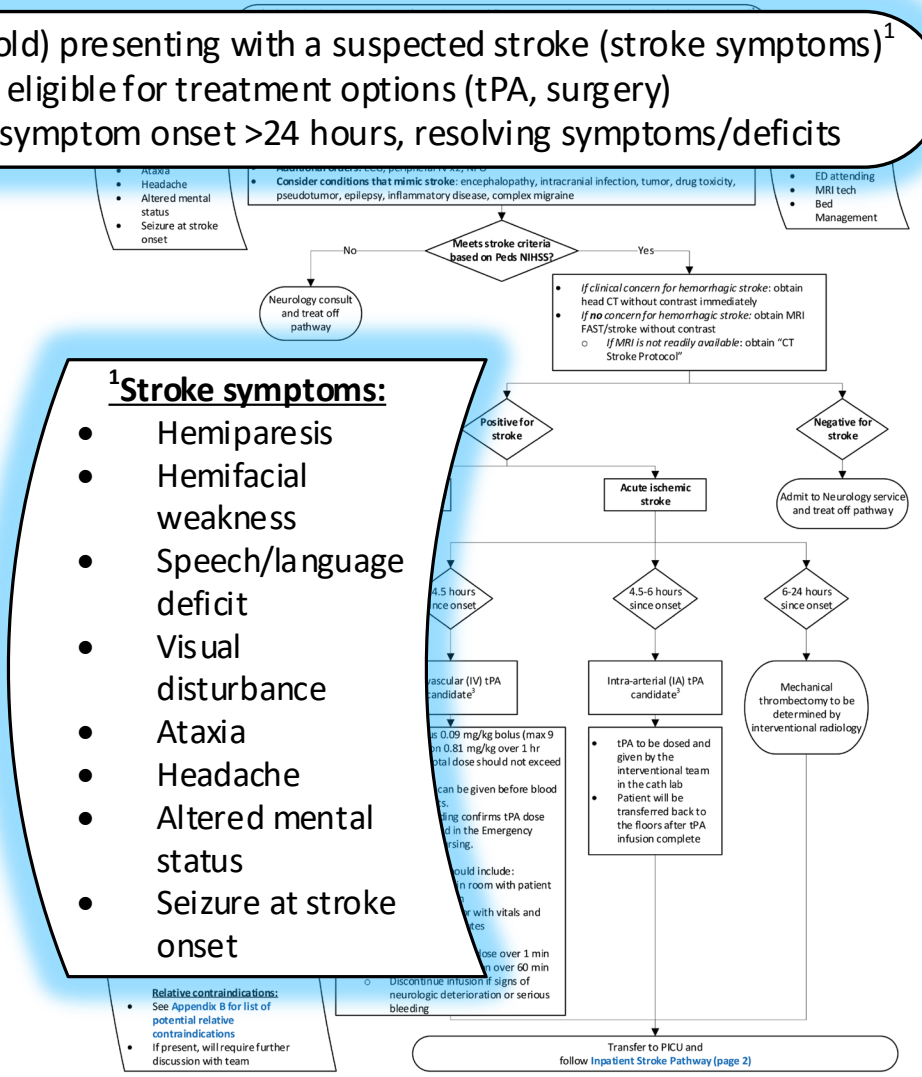
# Emergency Department Management



**Inclusion Criteria:** Patient >2 years (up to 21 years old) presenting with a suspected stroke (stroke symptoms)[1] within ≤24 hours, persistent deficits, eligible for treatment options (tPA, surgery)
**Exclusion Criteria:** Age ≤2 years, age ≥21 years, symptom onset >24 hours, resolving symptoms/deficits

Per the AHA and ASA, stroke symptoms are the same in children as adults and should be managed the same.

This pathway is exclusively for children 2 years and older with symptoms that present within 24 hours.[1]

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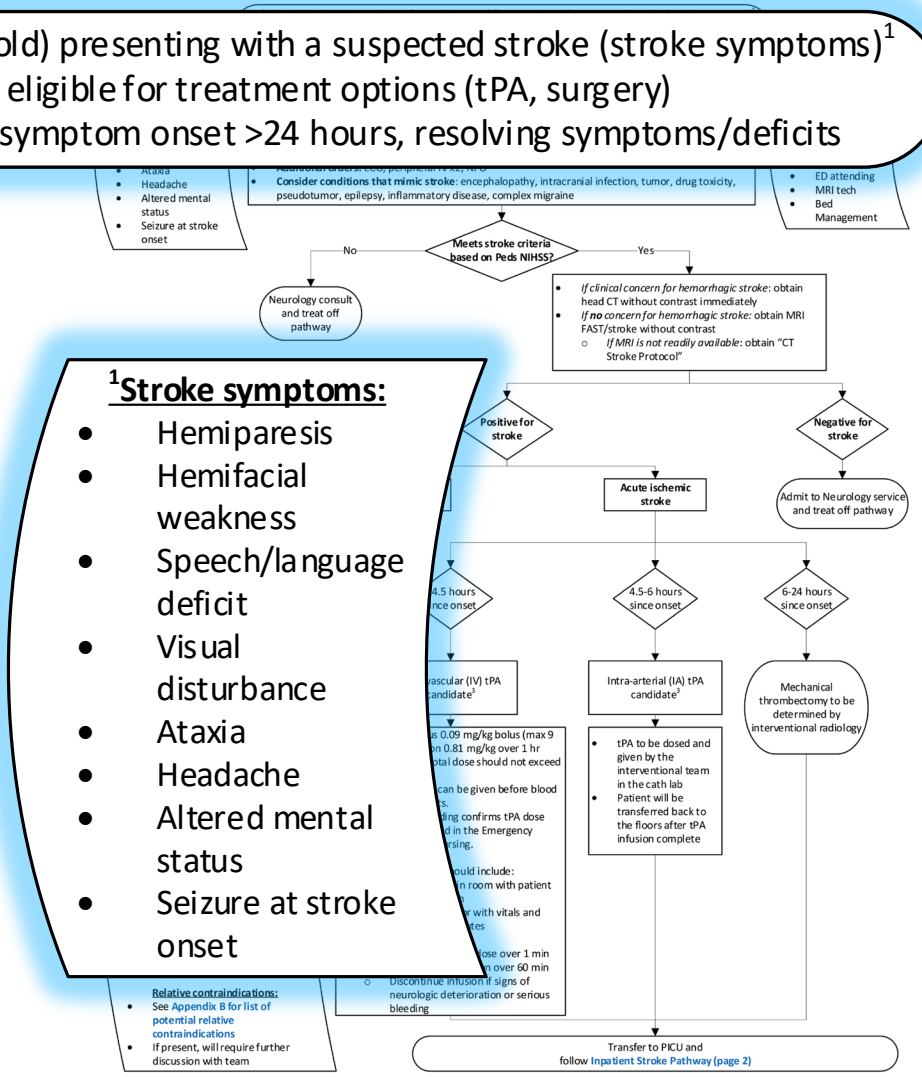
Stroke symptoms are listed here.

Because treatment delay can cause irreversible brain injury, it is critical that timely recognition and activation of the pathway occurs.[1]




**[1]Stroke symptoms:**

- Hemiparesis
- Hemifacial weakness
- Speech/language deficit
- Visual disturbance
- Ataxia
- Headache
- Altered mental status
- Seizure at stroke onset

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# Emergency Department Management





**ED Triage**

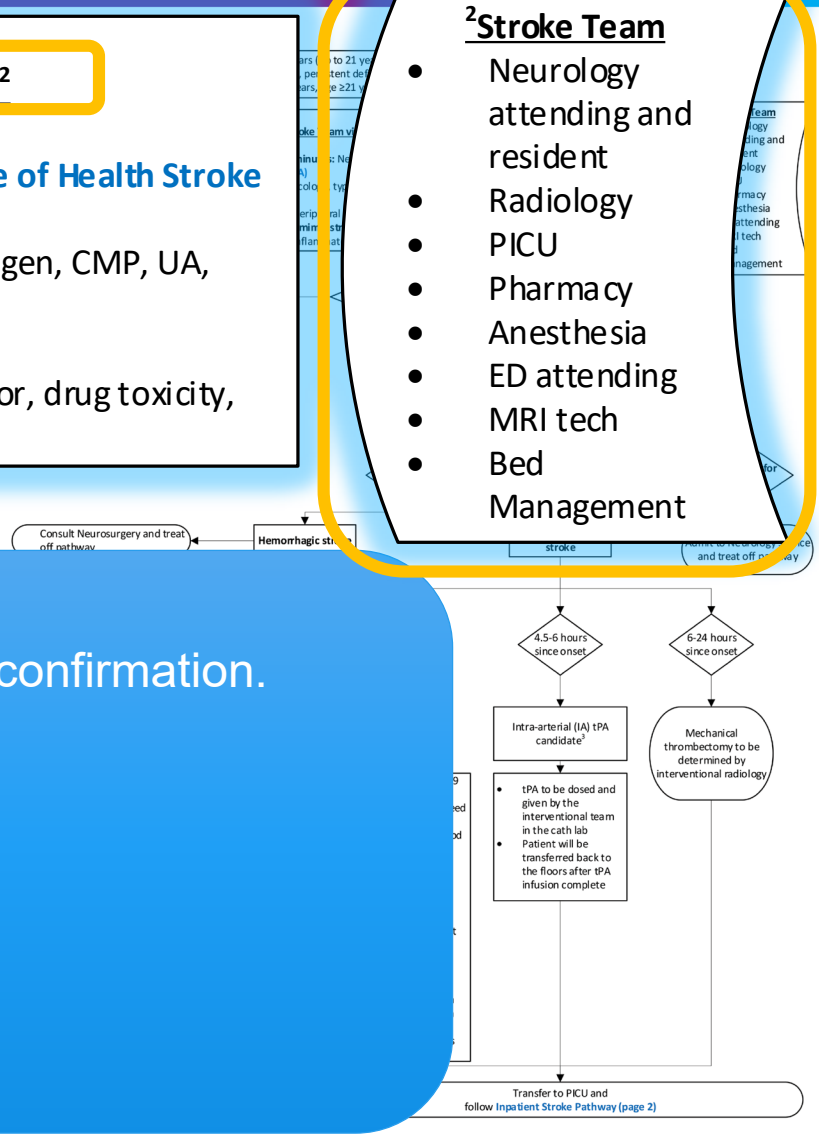
**Activate Stroke Team via Intellidesk or Voalte group ("Stroke Team")[2]**

**Vitals:** O2, BP, HR, RR

- **Initial assessment in 15 minutes:** Neuro exam, calculate **Pediatric National Institute of Health Stroke Scale (NIHSS) (Appendix A)**
- **Laboratory:** Glucose, toxicology, type and cross, ESR, ANA, CBC, PT/PTT, INR, fibrinogen, CMP, UA, pregnancy test
- **Additional orders:** ECG, peripheral IV x2, NPO
- **Consider conditions that mimic stroke**: encephalopathy, intracranial infection, tumor, drug toxicity, pseudotumor, epilepsy, inflammatory disease, complex migraine

**[2]Stroke Team**

- Neurology attending and resident
- Radiology
- PICU
- Pharmacy
- Anesthesia
- ED attending
- MRI tech
- Bed Management




With the first suspicion, activate the "Stroke Team". Do NOT wait for confirmation.

- Neurology: to do initial evaluation
- Radiology + MRI Tech: to complete MRI
- PICU and bed management: notification for continued treatment
- Pharmacy: for tPA
- Anesthesia: possibly required for imaging based on age of child

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# Emergency Department Management

**CLINICAL PATHWAY:**
**Ischemic Stroke Evaluation and Management**
**Emergency Department Management**

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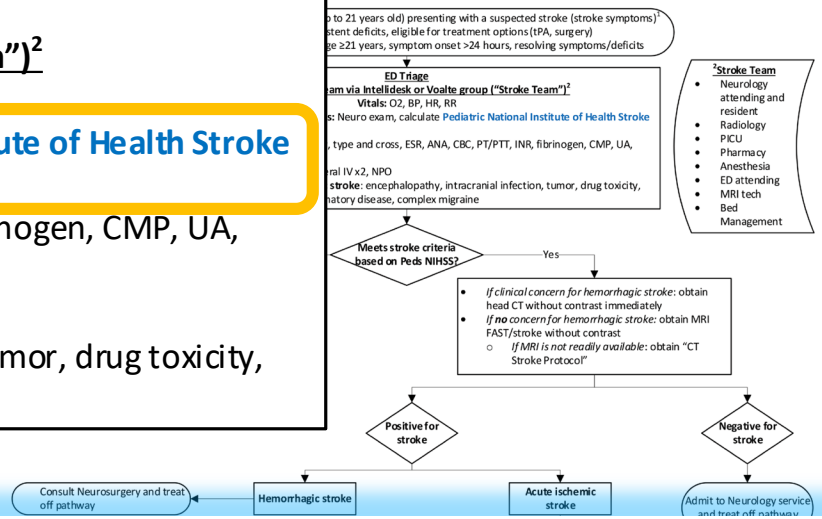


- A basic evaluation of children with arterial ischemic stroke should be done.
- Calculate the Pediatric NIHSS. Appendix A has the scoring. This should be done within 15 minutes upon arrival to the Emergency Department. [1]
- The NIHSS is used to assess the impact of potential strokes.[4]
- Stroke scales are useful to aid and improve diagnostic accuracy, determine the appropriateness of treatment, and to monitor neurological defects through the continuum of care. [4]

If it is positive, proceed with pathway recommendations (do not need to wait for other lab results).

**CLINICAL PATHWAY:**
**Ischemic Stroke Evaluation and Management**
**Appendix A: Pediatric National Institute of Health Stroke Scale (NIHSS)**

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## PedNIHSS

Administer stroke scale items in the order listed. Follow directions provided for each exam item. Scores should reflect what the patient does, not what the clinician thinks the patient can do. **Modifications for children are shown in bold.**

| Item # and instructions | Scale Definition and Scoring Guide |
|---|---|
| **1a. Level of Consciousness:** A 3 is scored only if the patient makes no movement (other than reflexive posturing) in response to noxious stimuli. | 0 = Alert, keenly responsive<br>1 = Not alert, but arousable by minor stimulation to obey, answer, or respond<br>2 = Not alert, requires repeated stimulation to attend, or is obtunded and requires strong or painful stimulation to make movements<br>3 = Responds only with reflexive motor or autonomic effects or totally unresponsive |
| **1b. LOC Questions:** The patient is asked the | 0 = Answers both questions correctly |

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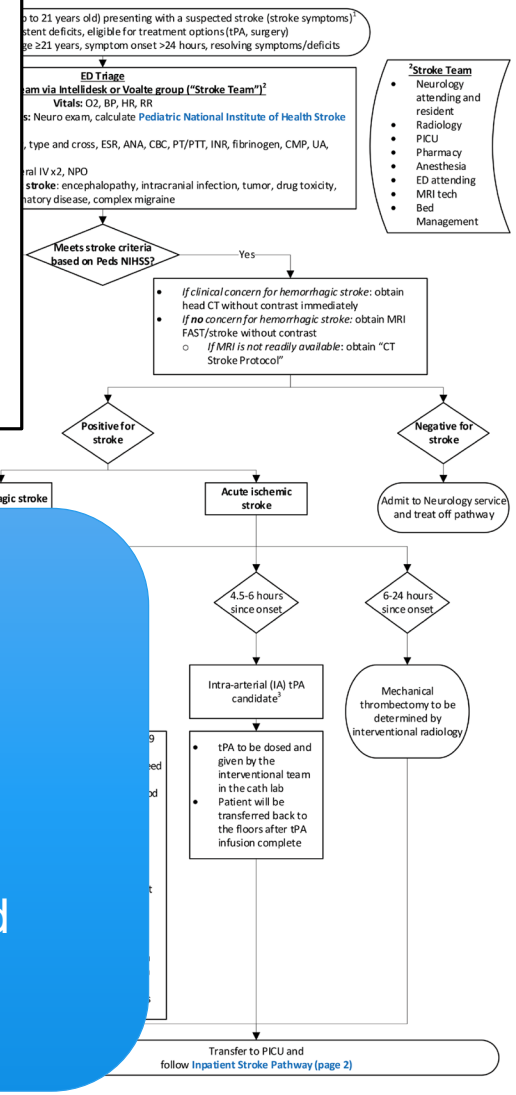


At the same time, additional testing should be completed, including labs and consideration of stroke mimics. [1]

- Hyperglycemia is common in adult stroke and likely a detrimental risk factor in children. [1]
- Drug toxicity can mimic stroke. [1]
- Thrombus composition is integral to determining susceptibility to mechanical and pharmacological disruption and recanalization.[1]

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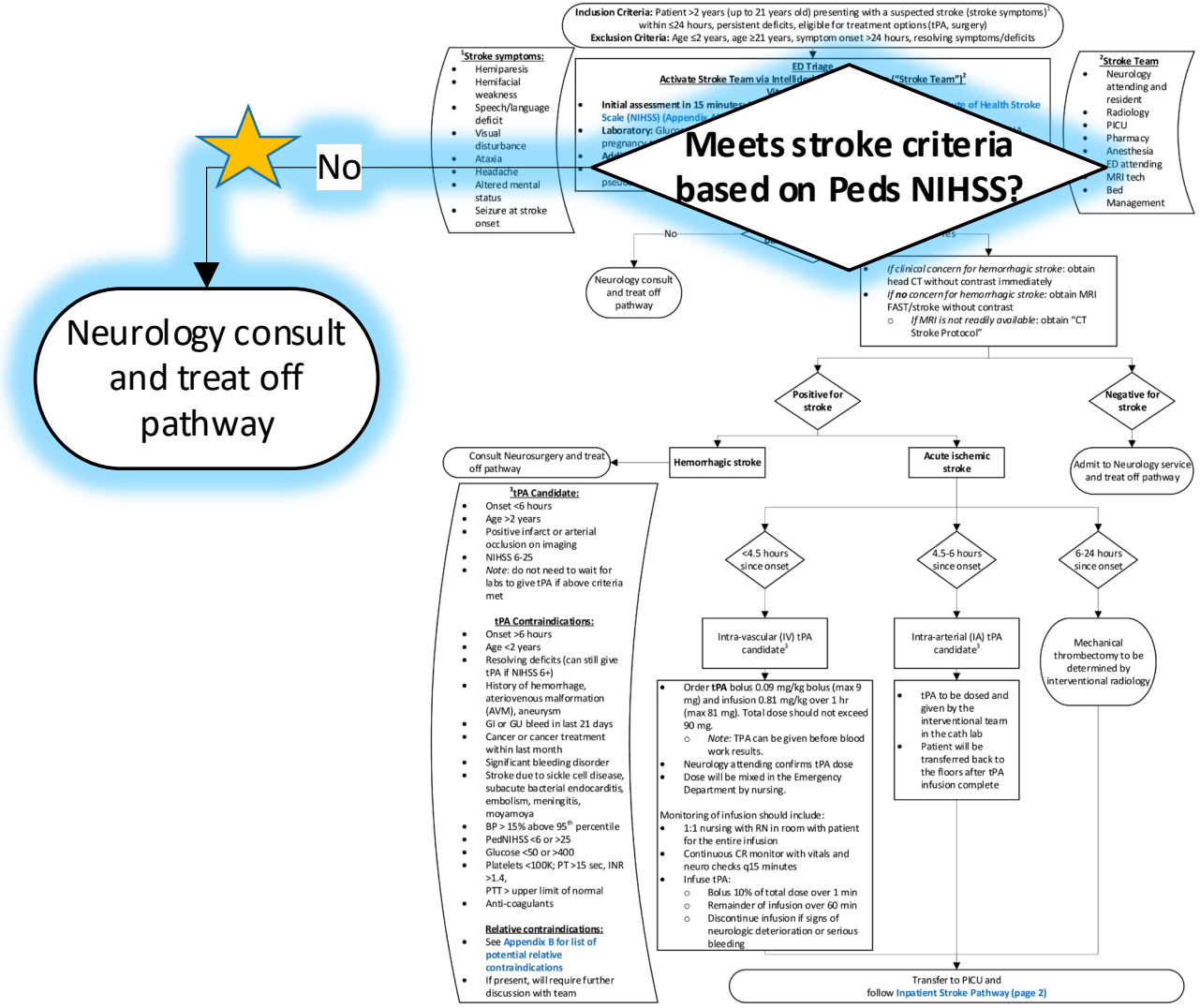
If the patient does not meet stroke criteria based on the NIHSS scoring system, then a neurology consult should be placed and patient should be treated off the pathway.

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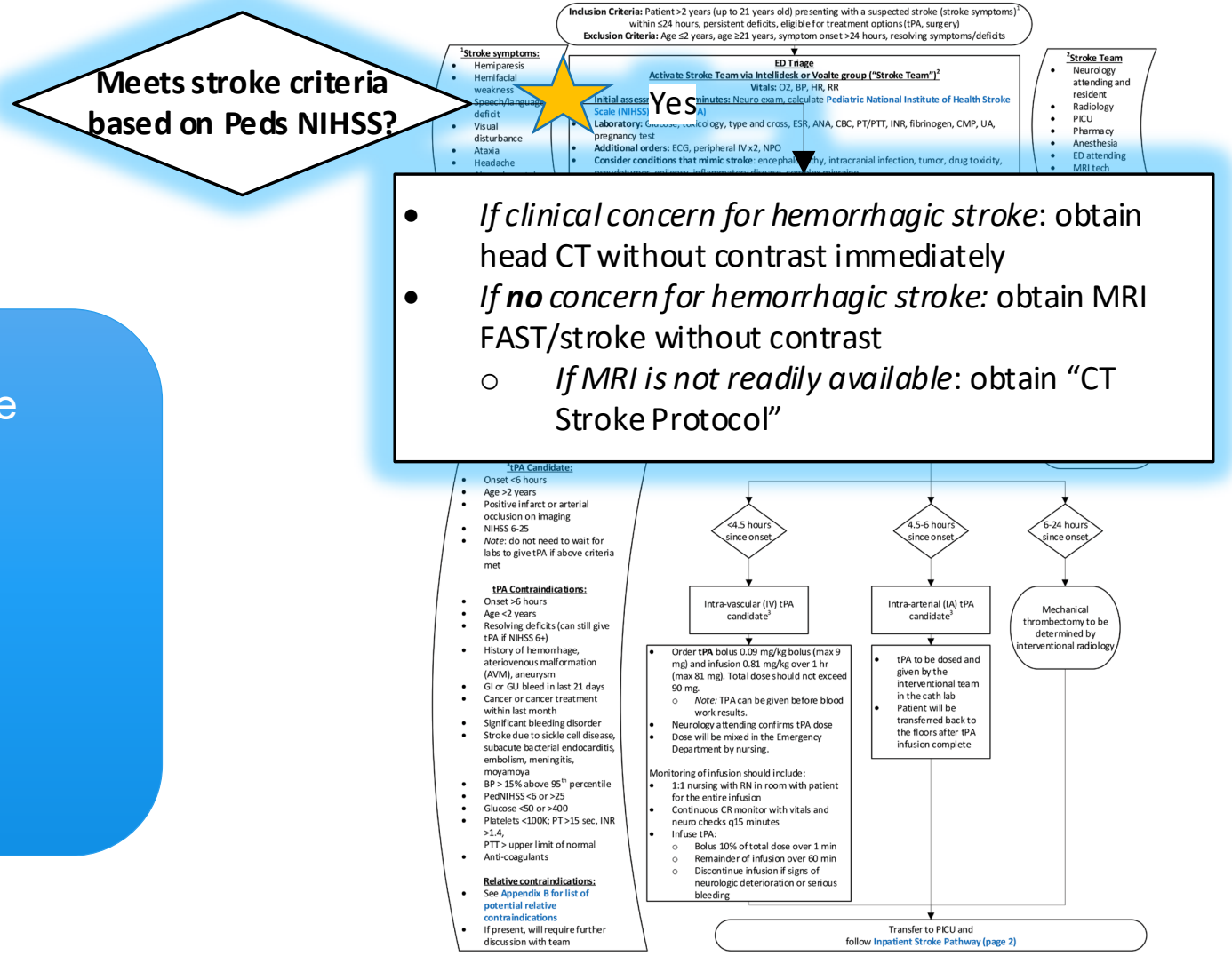
# Emergency Department Management



If the patient scores positive for stroke on the NIHSS, then imaging should be obtained immediately.

Do not wait for labs to return.

Imaging type will depend on concern of hemorrhagic stroke and availability.

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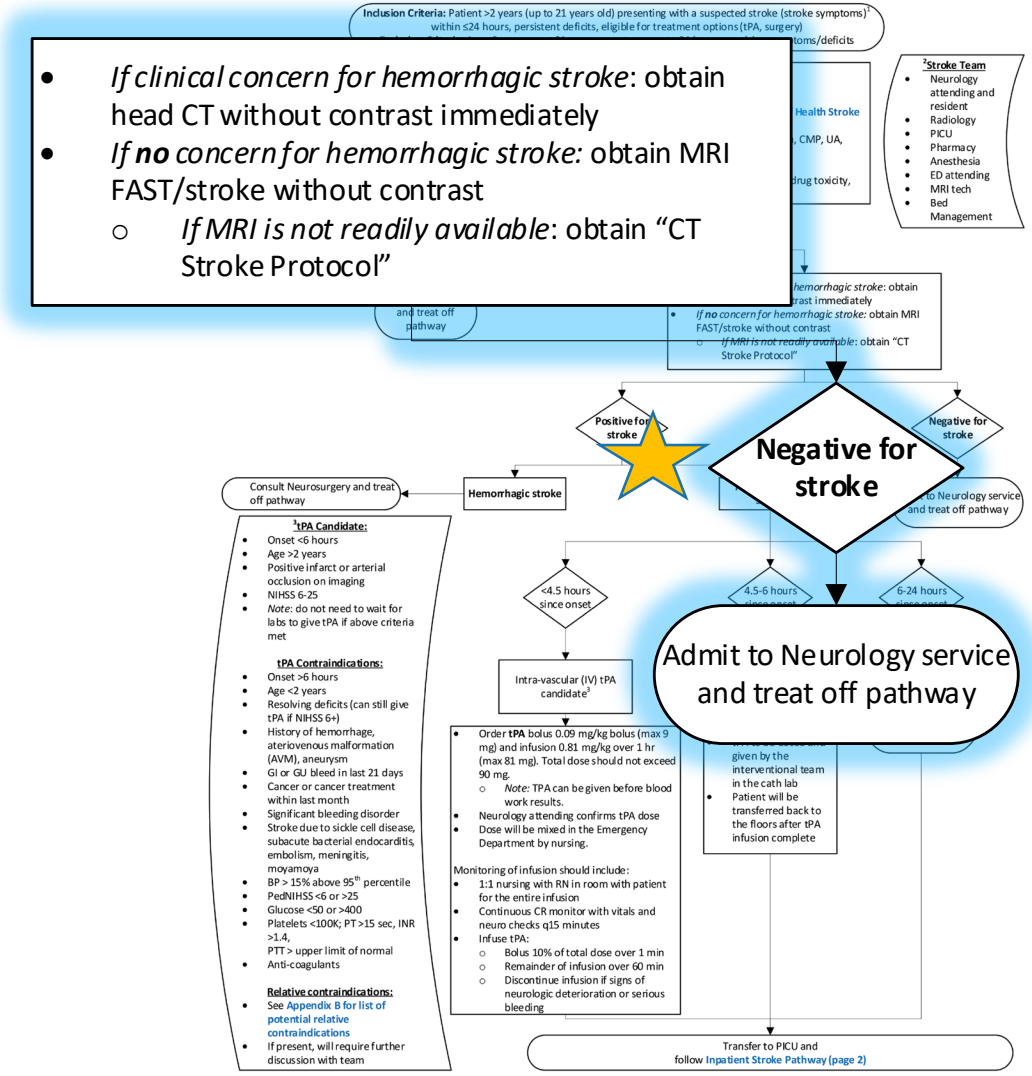
# Emergency Department Management

If the imaging is negative for stroke despite having a positive screen on NIHSS, consult neurology and treat off pathway.



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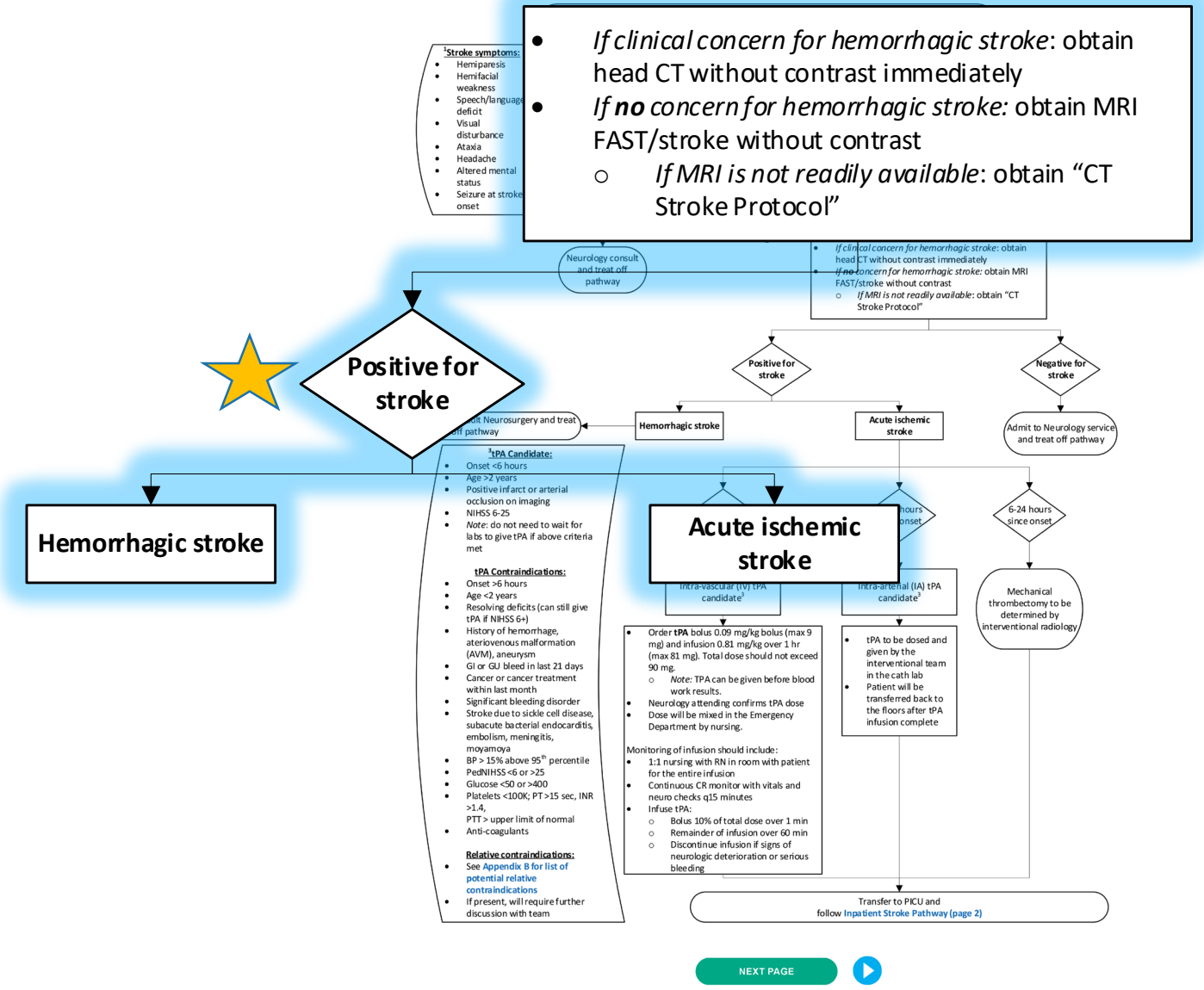
# Emergency Department Management

If the imaging is positive for a stroke, management depends on if the stroke is hemorrhagic vs acute ischemic.



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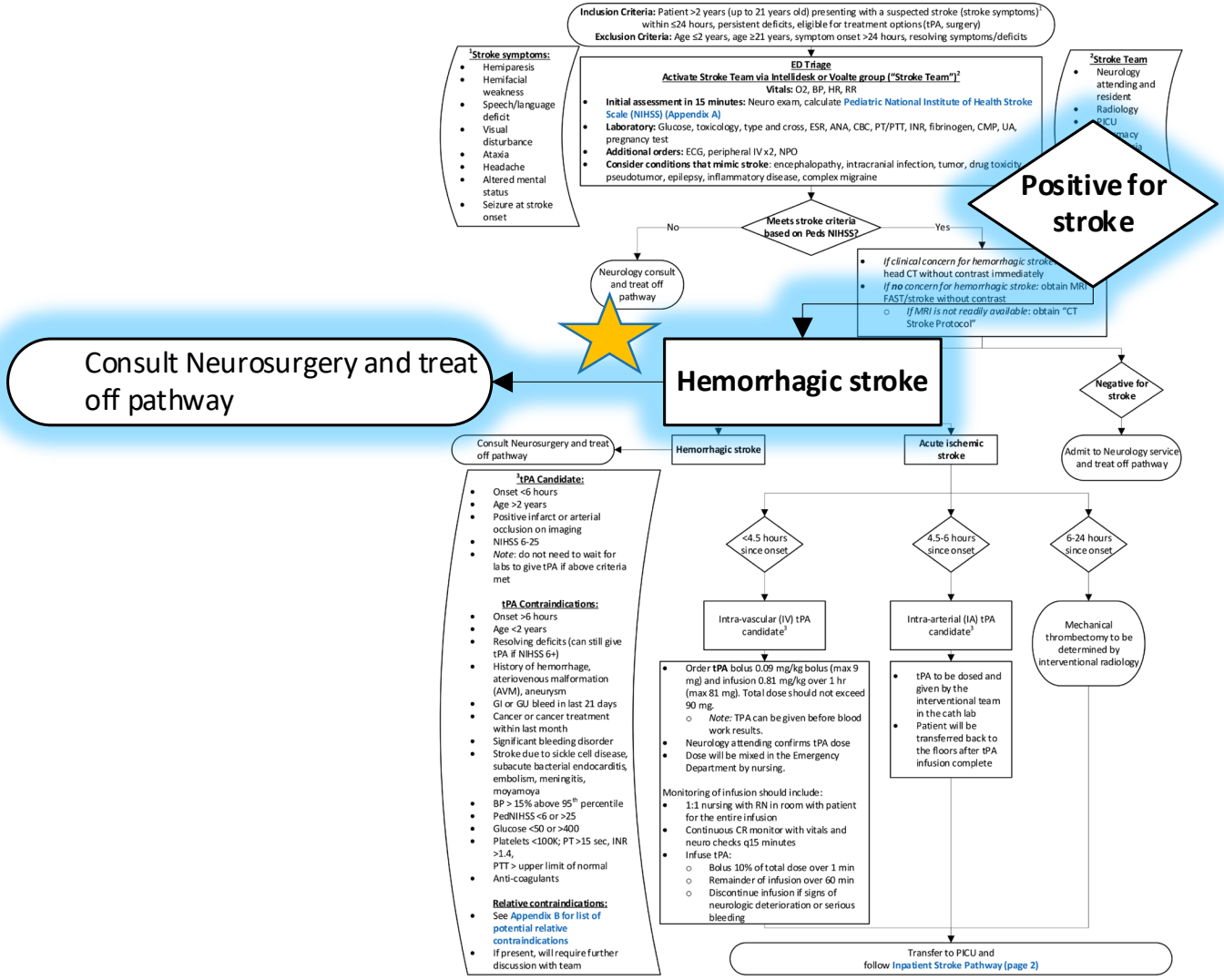
# Emergency Department Management



If the stroke is hemorrhagic, the patient should be treated off pathway with neurosurgery consultation.[2]

Management goals include ensuring cerebral perfusion.

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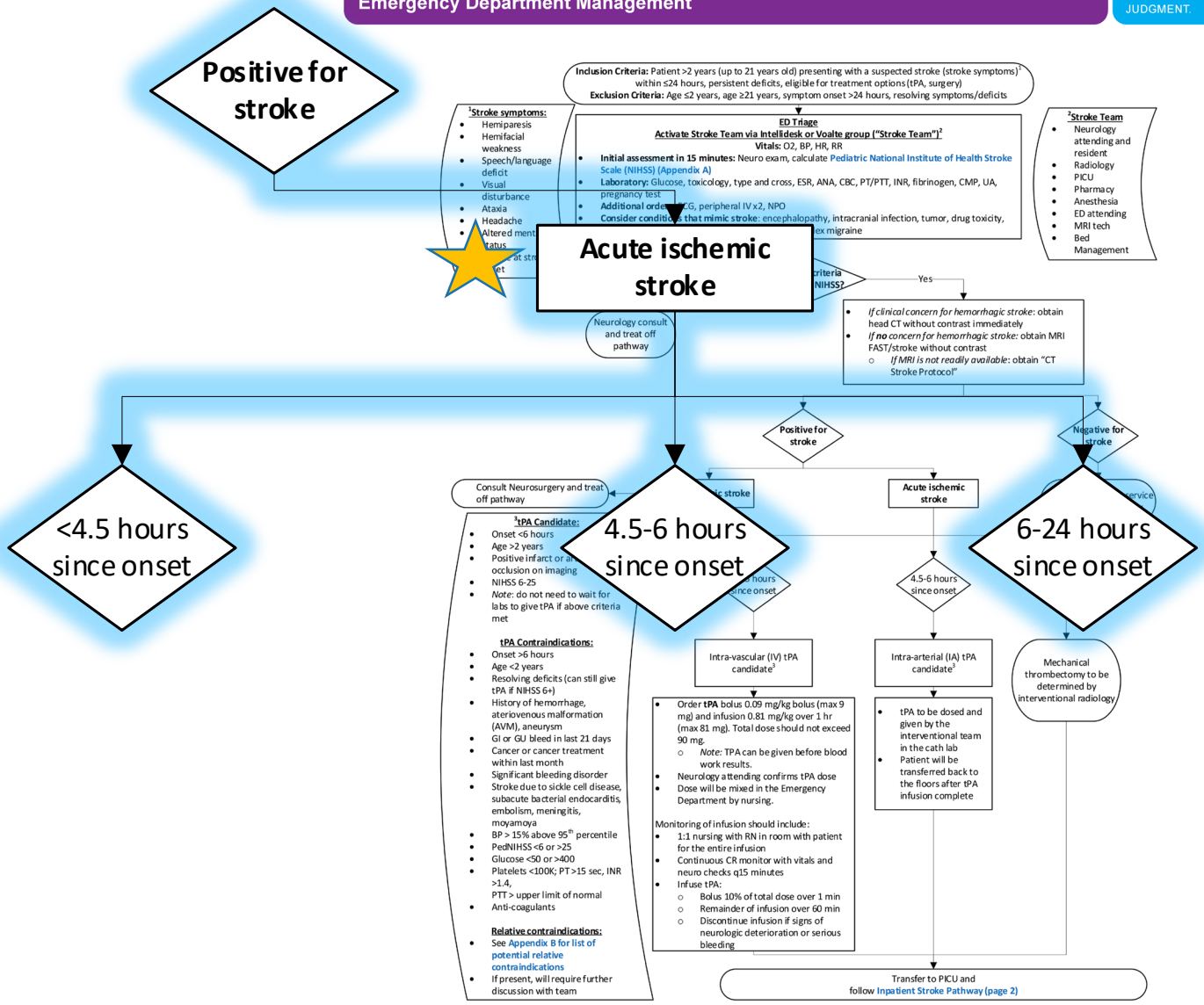
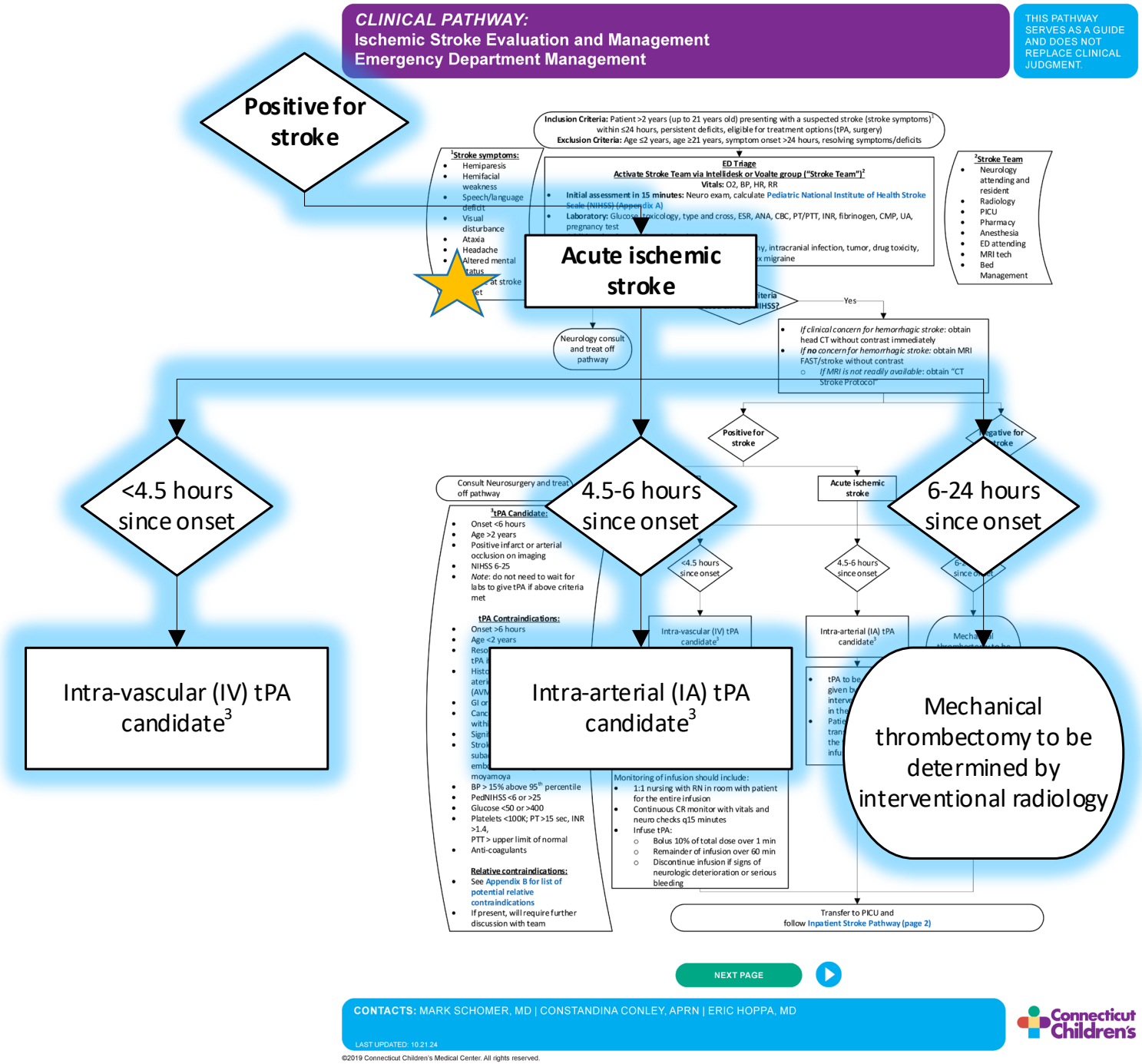
# Emergency Department Management

If the stroke is an acute ischemic stroke, management depends on the hours since onset.



# Emergency Department Management

- If the stroke is an acute ischemic stroke, management depends on the hours since onset.
- Reperfusion reduces ischemic injury. [2]
- The optimal time window to reduce ischemic injury is ideally <6 hours from symptom onset.[1]
- Treatment with IV tPA should begin <4.5 hours from symptom onset. [1]
- Treatment with IA tPA should begin within 4.5-6 hours of symptom onset. [1]
- From 6-24 hours, endovascular thrombectomy should be done, at the discretion of the interventional radiologist (generally completed at Hartford Hospital) [1]



# Emergency Department Management

- The tPA candidate should be a patient with less than 6 hours since symptom onset, older than 2 years, positive imaging, NIHSS score of 6-25.
- tPA contraindications are listed here.
  - Note that patients with resolving deficits may still be given tPA if NIHSS score is 6+
- Relative contraindications are listed in Appendix B. The team will decide if tPA can proceed.
- TIME is BRAIN! Do not wait to begin tPA infusion!

**[3]tPA Candidate:**

- Onset <6 hours
- Age >2 years
- Positive infarct or arterial occlusion on imaging
- NIHSS 6-25
- *Note*: do not need to wait for labs to give tPA if above criteria met

**tPA Contraindications:**

- Onset >6 hours
- Age <2 years
- Resolving deficits (can still give tPA if NIHSS 6+)
- History of hemorrhage, ateriovenous malformation (AVM), aneurysm
- GI or GU bleed in last 21 days
- Cancer or cancer treatment within last month
- Significant bleeding disorder
- Stroke due to sickle cell disease, subacute bacterial endocarditis, embolism, meningitis, moyamoya
- BP > 15% above 95th percentile
- PedNIHSS <6 or >25
- Glucose <50 or >400
- Platelets <100K; PT >15 sec, INR >1.4,
  PTT > upper limit of normal
- Anti-coagulants

**Relative contraindications:**

- See **Appendix B for list of potential relative contraindications**
- If present, will require further discussion with team

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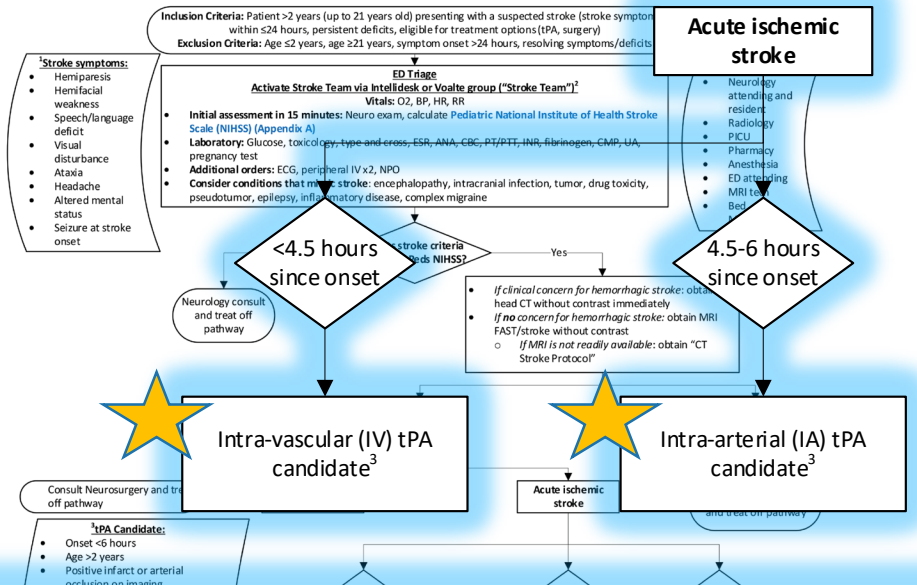


***CLINICAL PATHWAY:***
**Ischemic Stroke Evaluation and Management**
**Appendix B: Potential Relative Contraindications for tPA**

*If present, discuss risks and benefits of treatment with team.*

- Minor or rapidly improving stroke symptoms
- Major surgery or non-head trauma in past 14 days
- Recent arterial puncture at non-compressible site
- Recent lumbar puncture
- Post myocardial infarction pericarditis
- Pregnancy
- History of prior strokes, diabetes
- Active anticoagulant use
- CT with infarction involving >1/3 of a hemisphere

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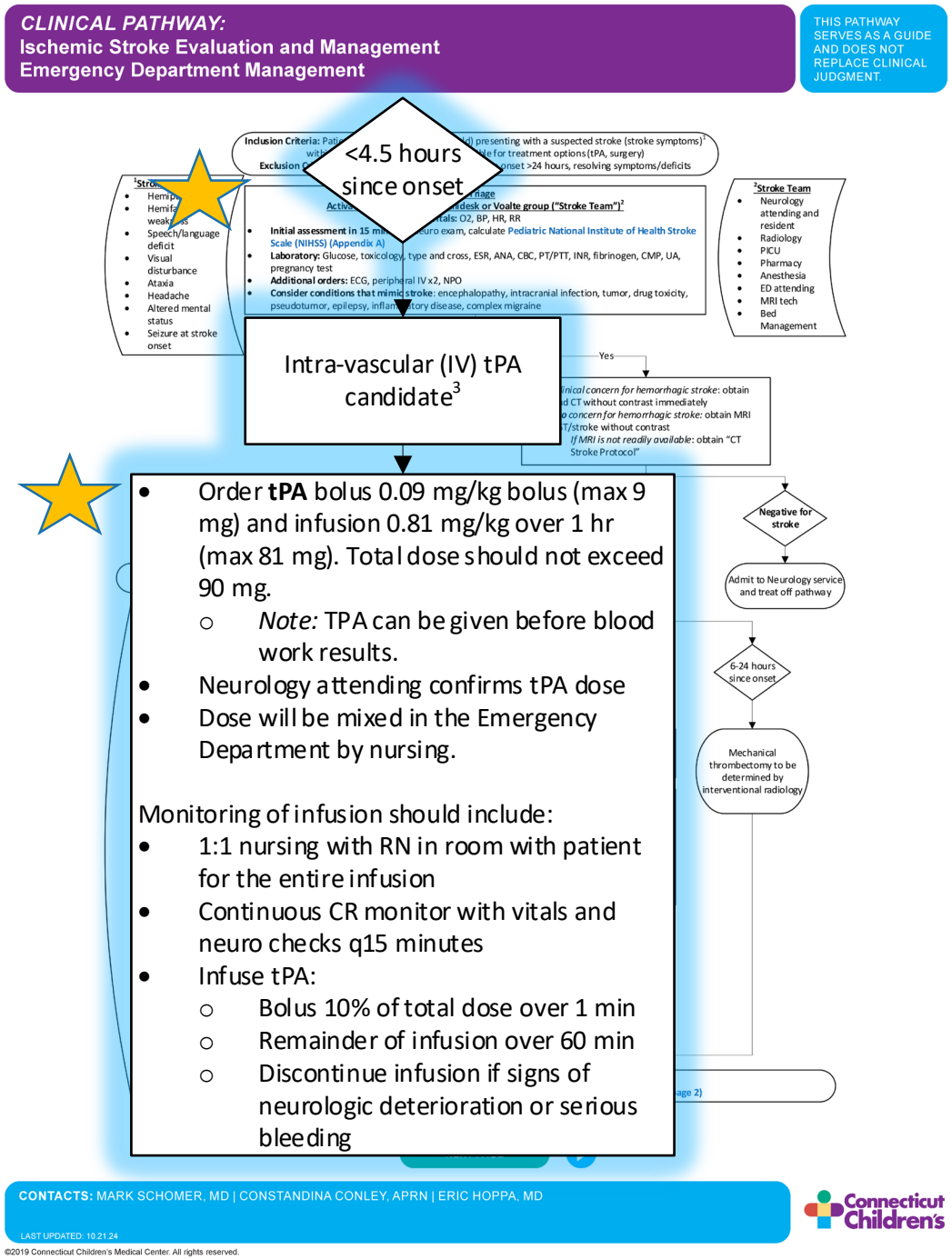
# Emergency Department Management

## <4.5 hours since symptom onset

- If IV tPA is indicated, the dose should be confirmed by neurology and will be mixed by the ED RNs to be administered.
- Do NOT wait to administer tPA for transfer onto the floors or for labs to return.
- Once tPA starts, patient should be continuous R monitoring with neuro checks every 15 minutes. [2]
- Infusion directions include giving a bolus, which is 10% of the total dose, over 1 minute, and then the remainder of the infusion over 60 minutes.
- If there are signs of neurologic deterioration of bleeding, it should be stopped.



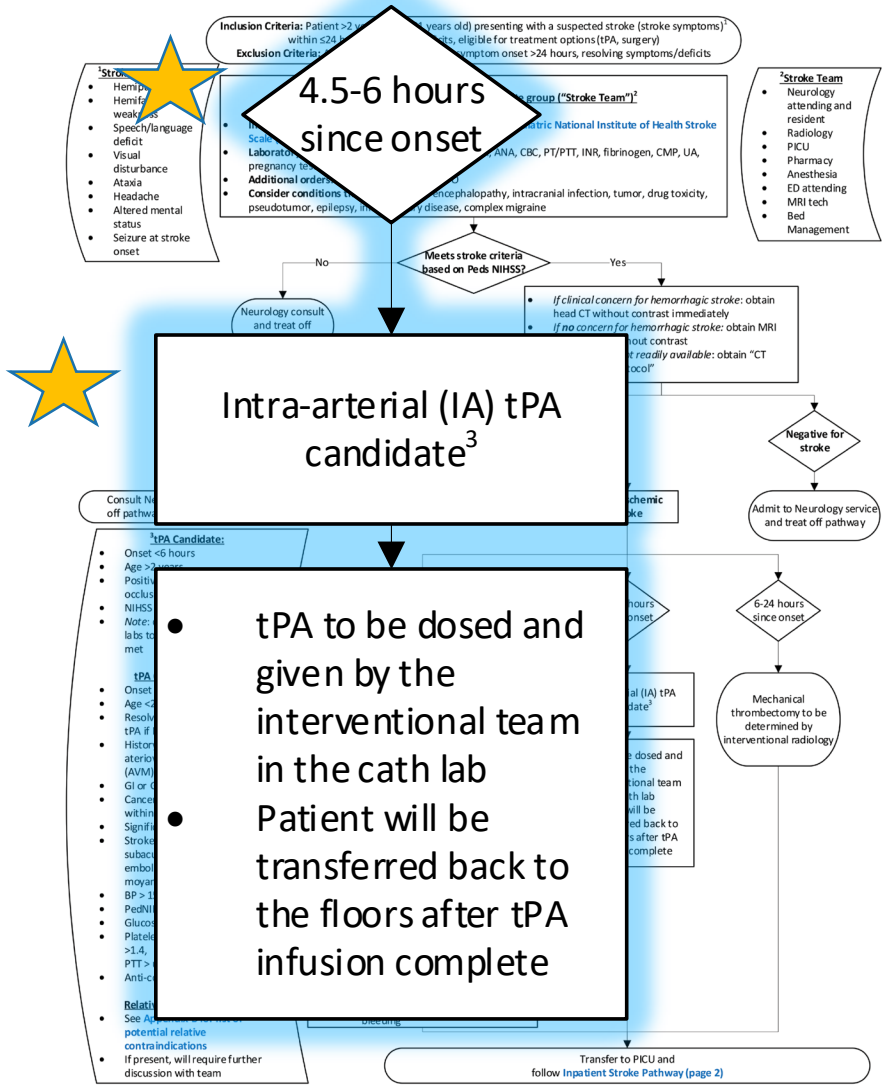
# Emergency Department Management

**4.5 – 6 hours since symptom onset**

- If IA tPA is indicated, it will be given by the interventional team in the cath lab.
- After the infusion is complete, the patient will be transferred to the PICU.





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# Emergency Department Management

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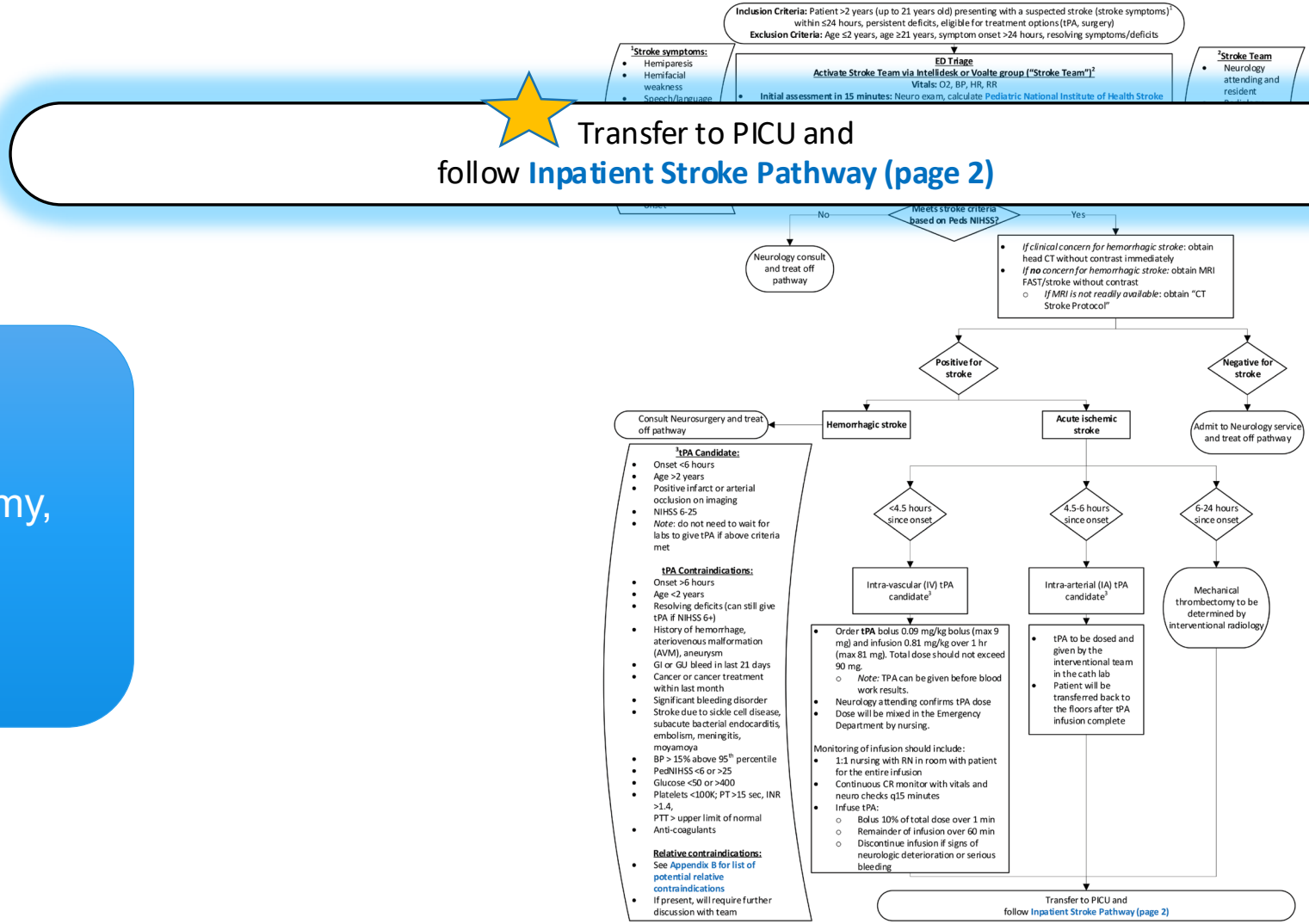
After tPA infusion or mechanical thrombectomy, the patient should be transferred to the PICU.

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# Inpatient Management

We will next review the inpatient management for stroke.

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**Inpatient Management**

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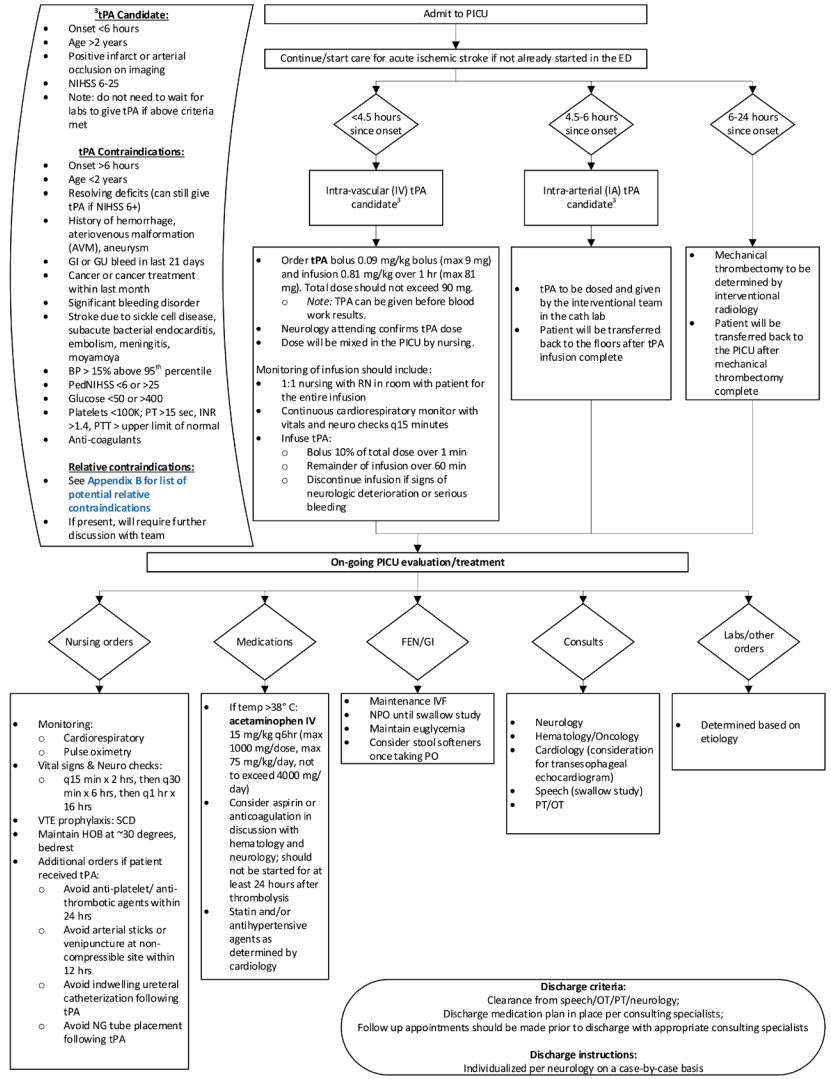


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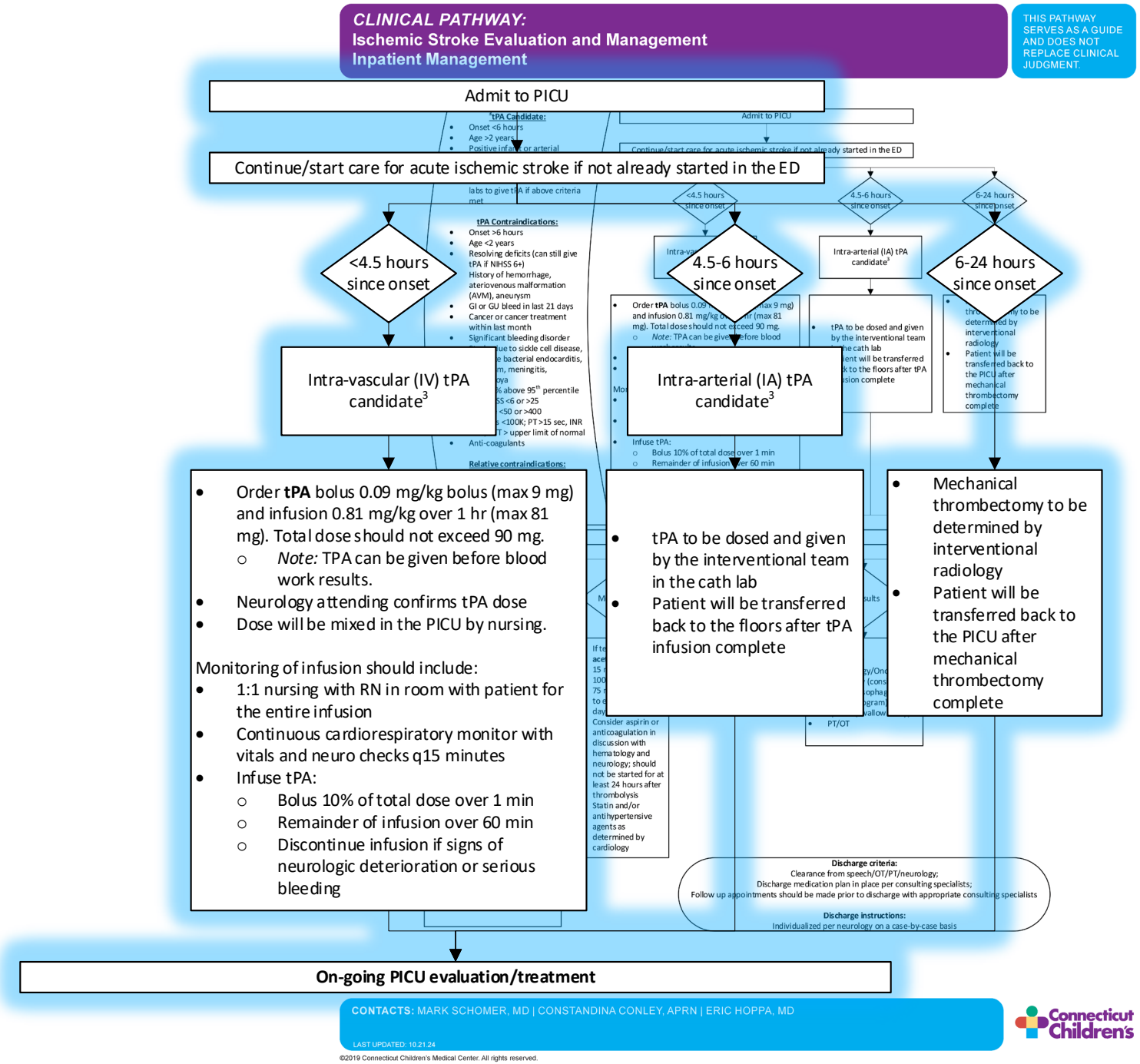
# Inpatient Management

Care should be continued as started in the ED.

Again, tPA should be started immediately and shouldn't wait for transfer.

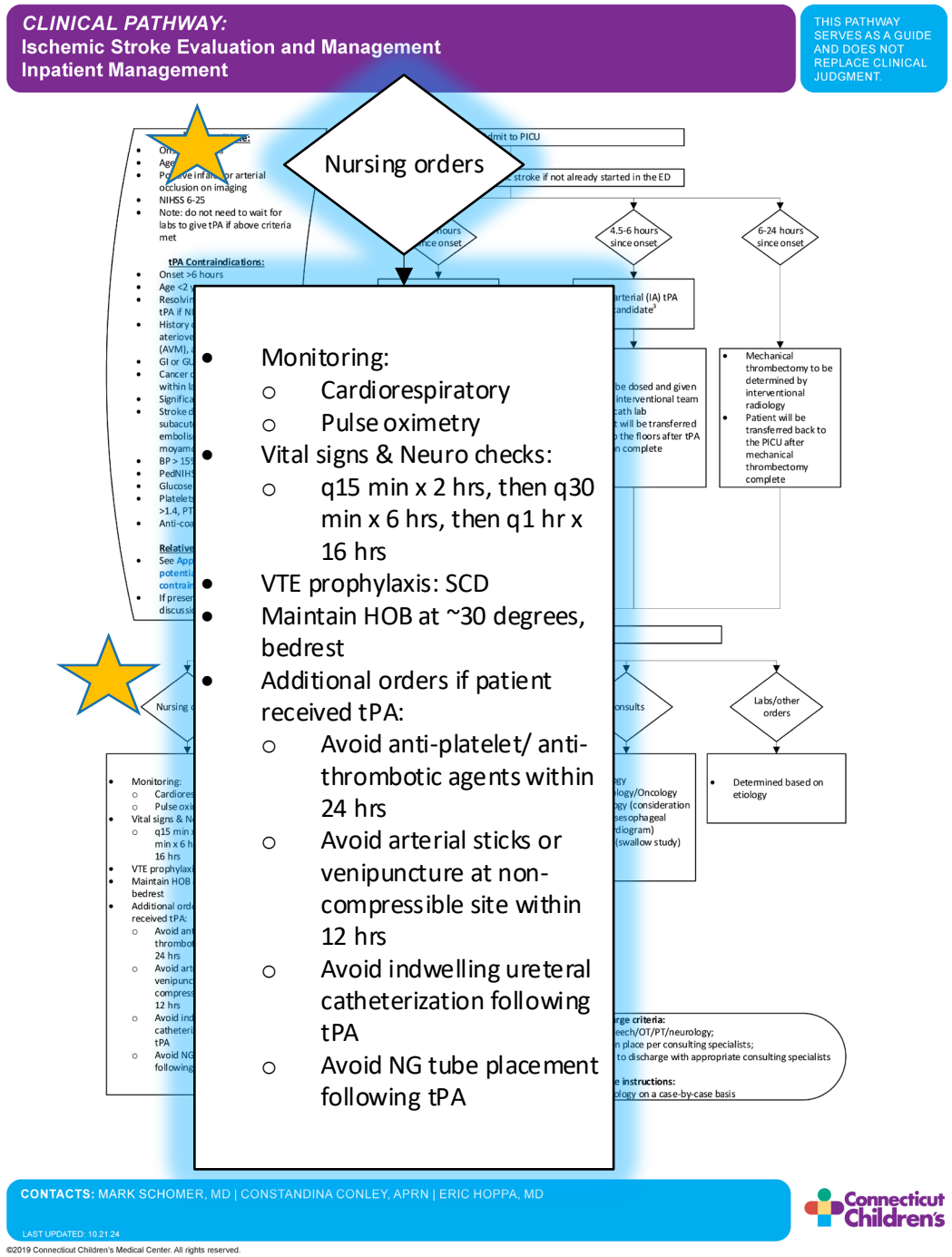


# Inpatient Management

Patient should be on continuous monitoring with frequent vitals and neuro checks. [2]

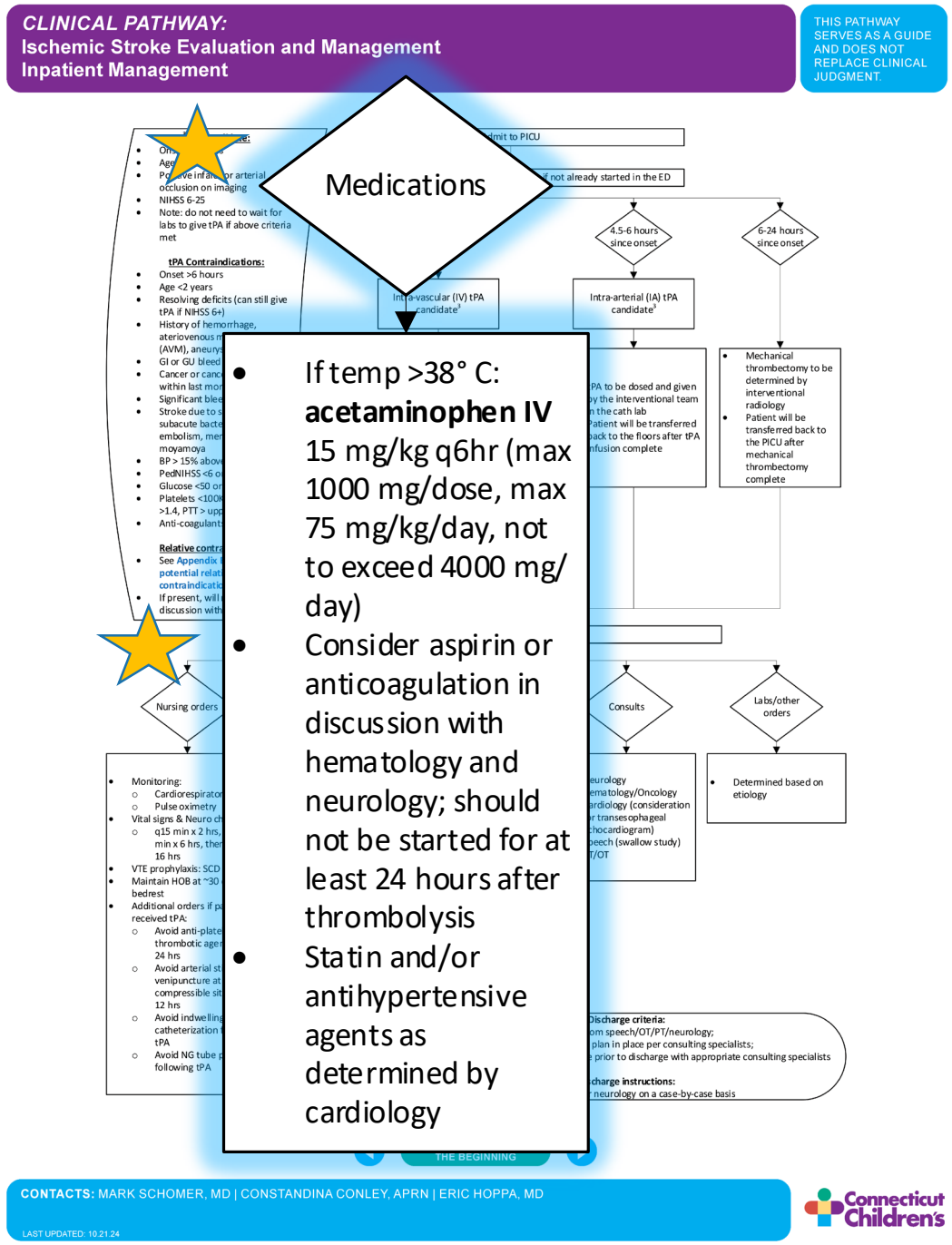
HOB should be placed at about 30 degrees.

Precautions to reduce bleeding should be made if the patient received tPA – such as avoiding anti-platelets/anti-thrombotic agents, avoiding arterial sticks, avoiding indwelling ureteral catheterizations, and avoiding NGT placement.



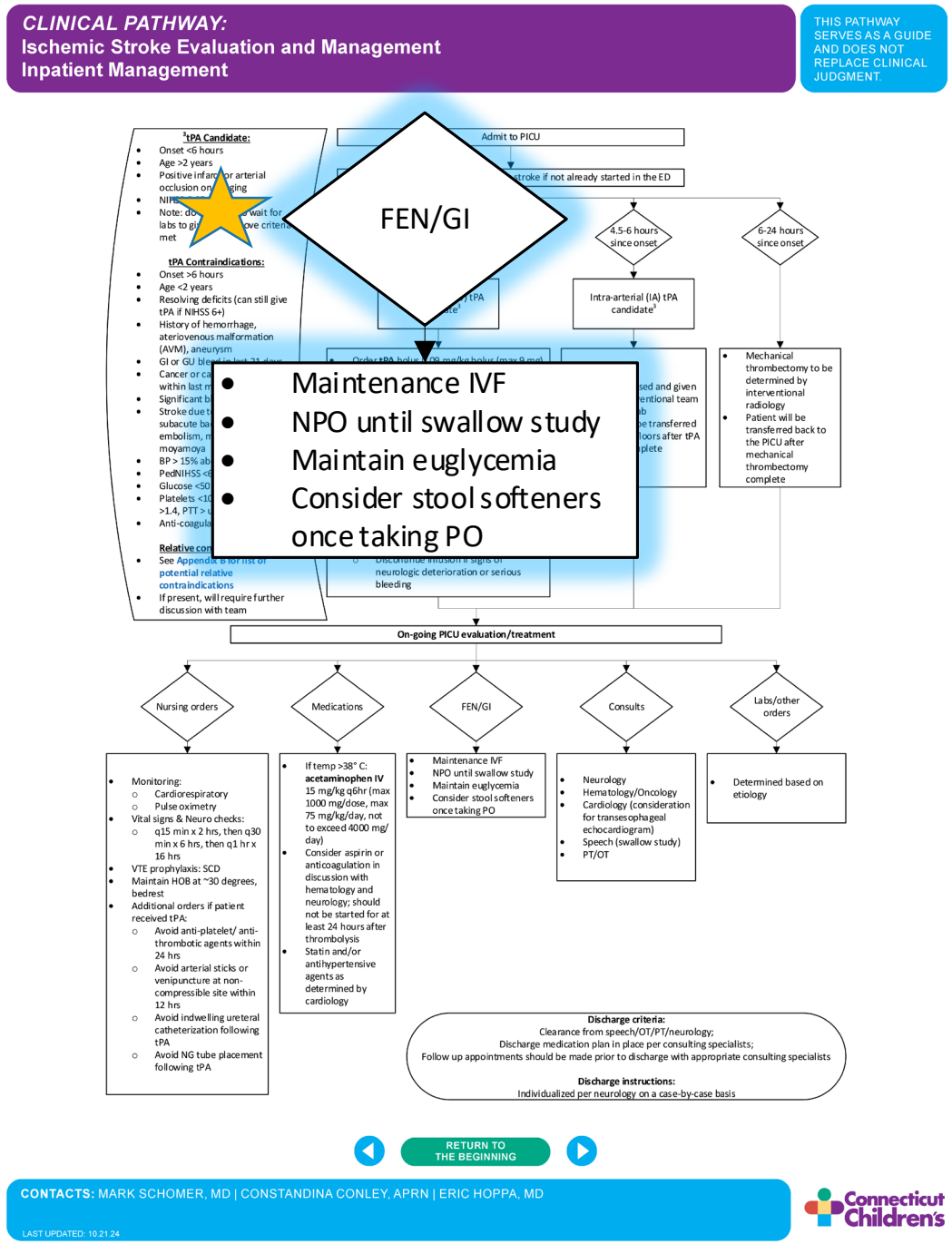
# Inpatient Management

- Aspirin or anticoagulation shouldn't begin until 24 hours after thrombolysis to reduce the risk of bleeding. [2]
  - Patient will be discharged home on appropriate medications after consulting neurology and hematology.
- Antihypertensions may be needed if BP is high; statins may be needed based on stroke cause. Both will be determined by cardiology.[2]



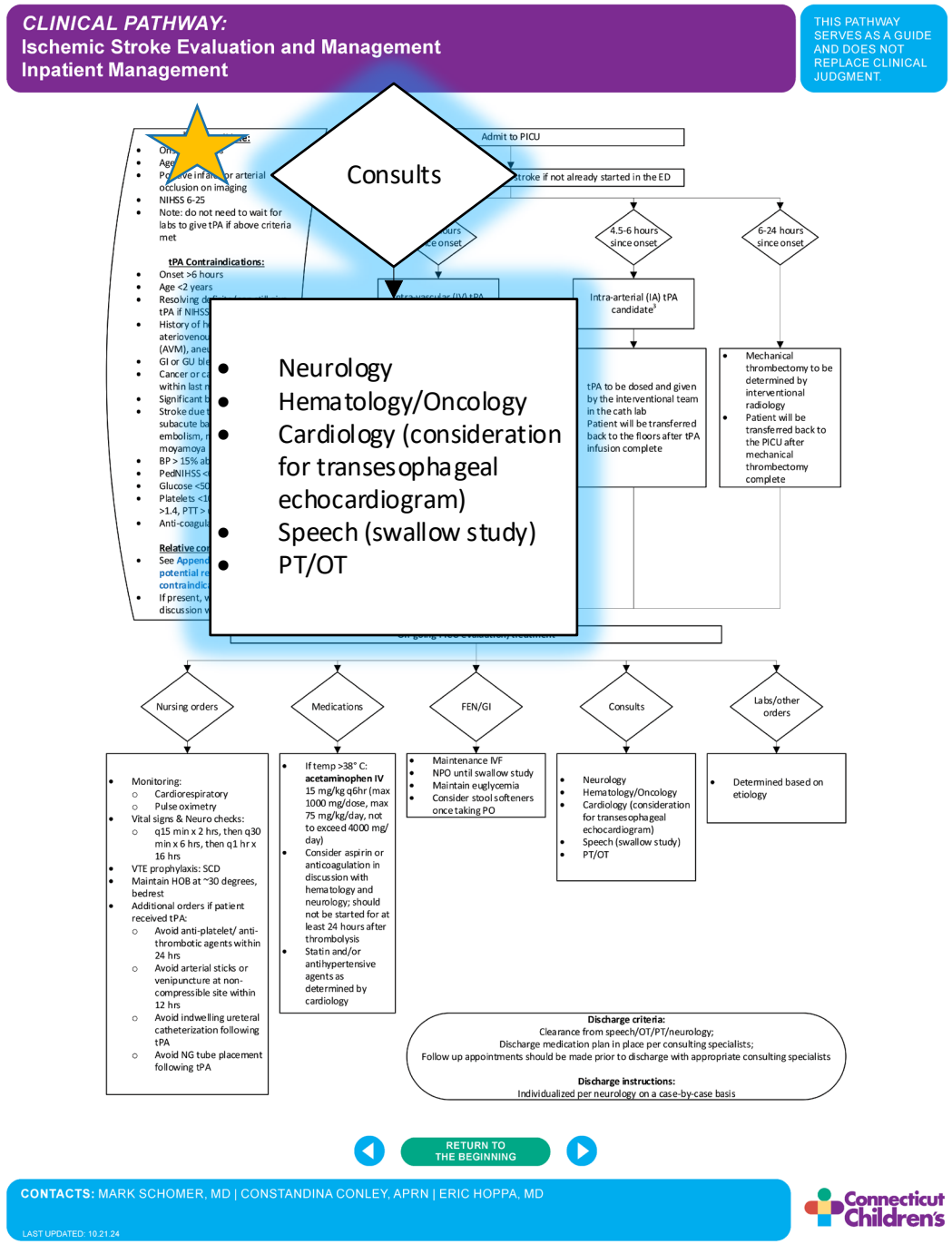
# Inpatient Management

- The patient should remain NPO until cleared by OT/swallow study.
- Place on maintenance IVF.



# Inpatient Management

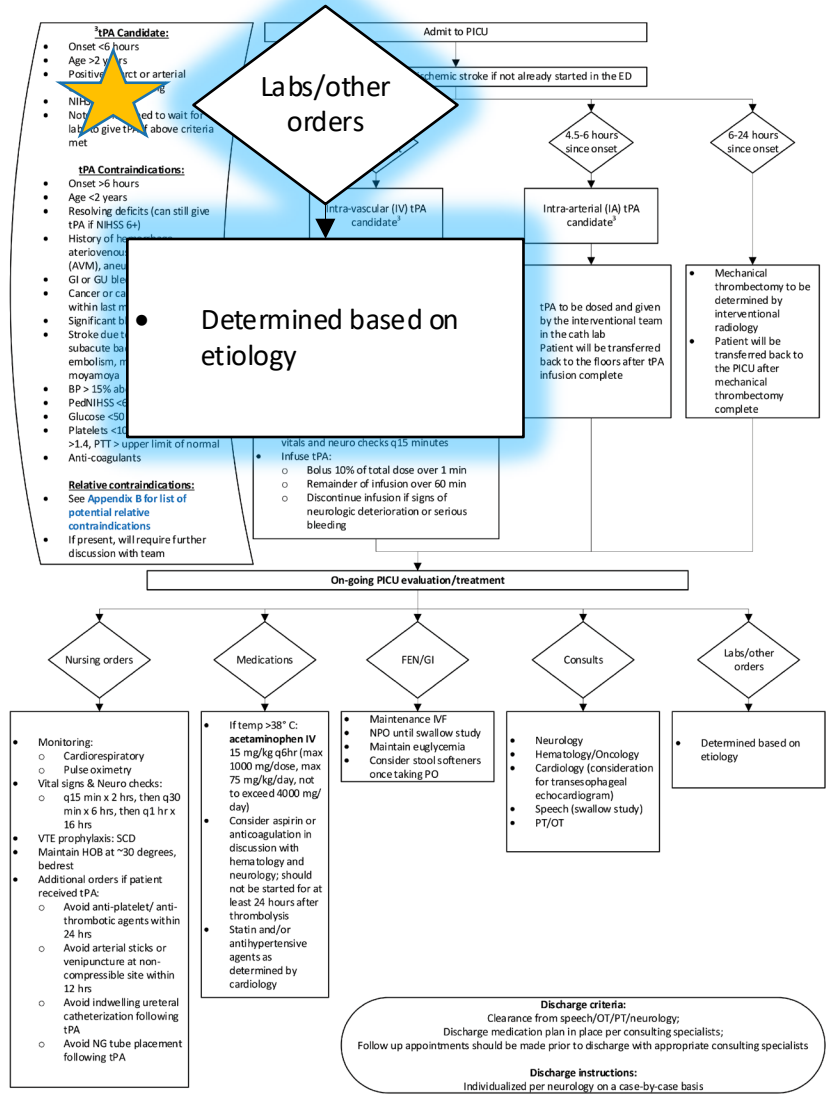
- Consults include neurology, heme/onc, cardiology, speech and PT/OT.



# Inpatient Management

- Labs and other orders in the PICU will be determined based on the etiology of the stroke.



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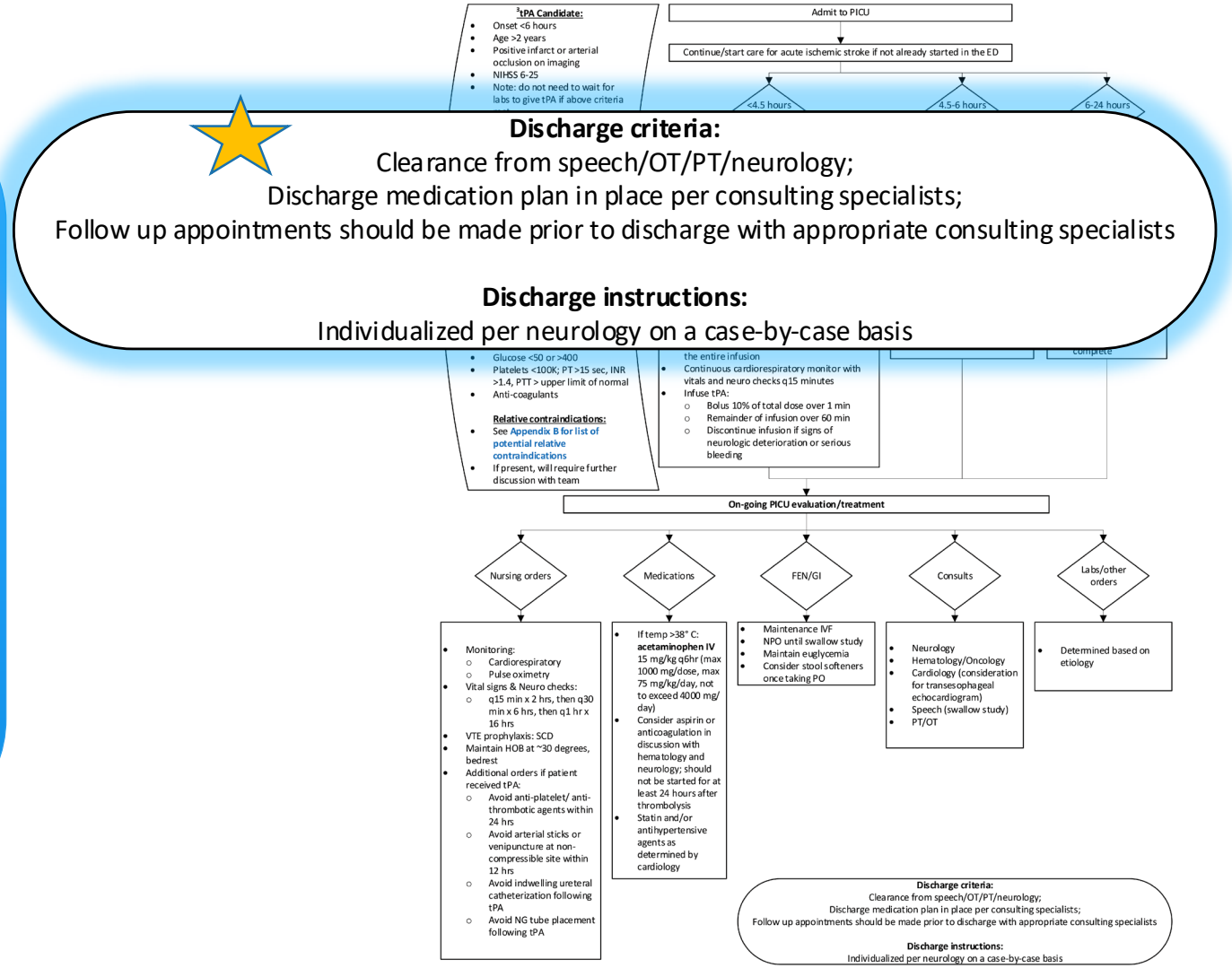
# Inpatient Management



## Discharge criteria:

- Patient should be cleared by all departments involved in their care.
- Subsequent appointments should be made with each department prior to discharge to avoid lapses in care.

**Discharge instructions** are individualized for each patient, based on stroke etiology.




**Discharge criteria:**
Clearance from speech/OT/PT/neurology;
Discharge medication plan in place per consulting specialists;
Follow up appointments should be made prior to discharge with appropriate consulting specialists

**Discharge instructions:**
Individualized per neurology on a case-by-case basis

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# Review of Key Points

## Time is Brain!

- The “Stroke Team” should be activated upon first suspicion of stroke. Do NOT wait for confirmation!
- The Pediatric NIHSS scoring should be done within 15 minutes of presentation. If it is positive, imaging should be done right away. Do NOT wait for labs to return.
- If tPA is indicated, it should be given right away.
  - Do NOT wait for labs to return. Do NOT wait to transfer the patient to the floors.
- Reperfusion reduces ischemic injury, and the optimal time to reduce ischemic injury is <6 hours from symptom onset.

# Quality Metrics

- % patients with pathway order set utilization
- Time to arrival to MD assessment (minutes)
- Time from arrival to MRI/CTA (minutes)
- Time from arrival to treatment (tPA; minutes)
- Average length of stay (days for inpatient; minutes for Emergency Department)

# References


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# Thank You!

## About Connecticut Children's Pathways Program

Clinical pathways guide the management of patients to optimize consistent use of evidence-based practice. Clinical pathways have been shown to improve guideline adherence and quality outcomes, while decreasing length of stay and cost. Here at Connecticut Children's, our Clinical Pathways Program aims to deliver evidence-based, high value care to the greatest number of children in a diversity of patient settings. These pathways serve as a guide for providers and do not replace clinical judgment.