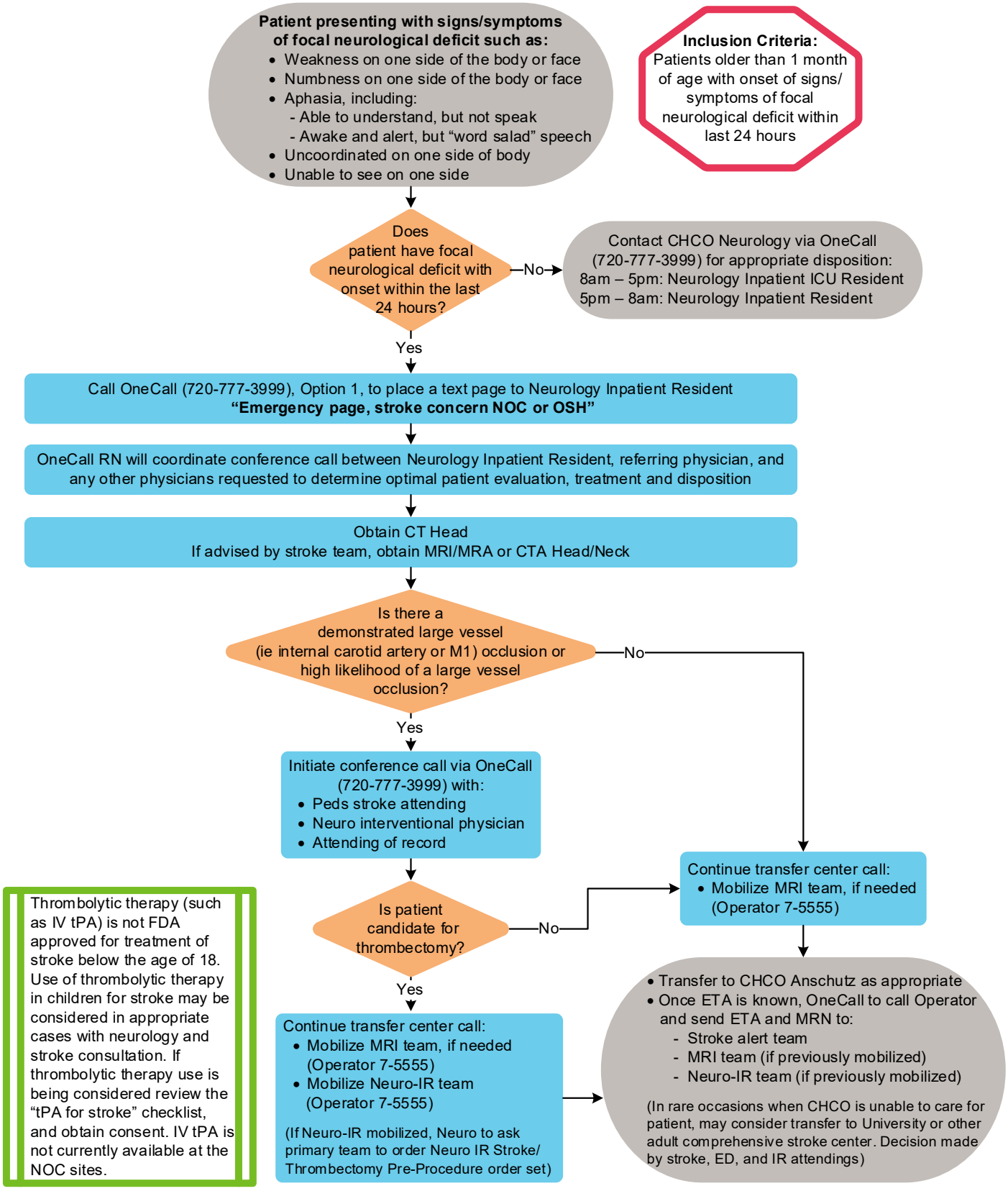
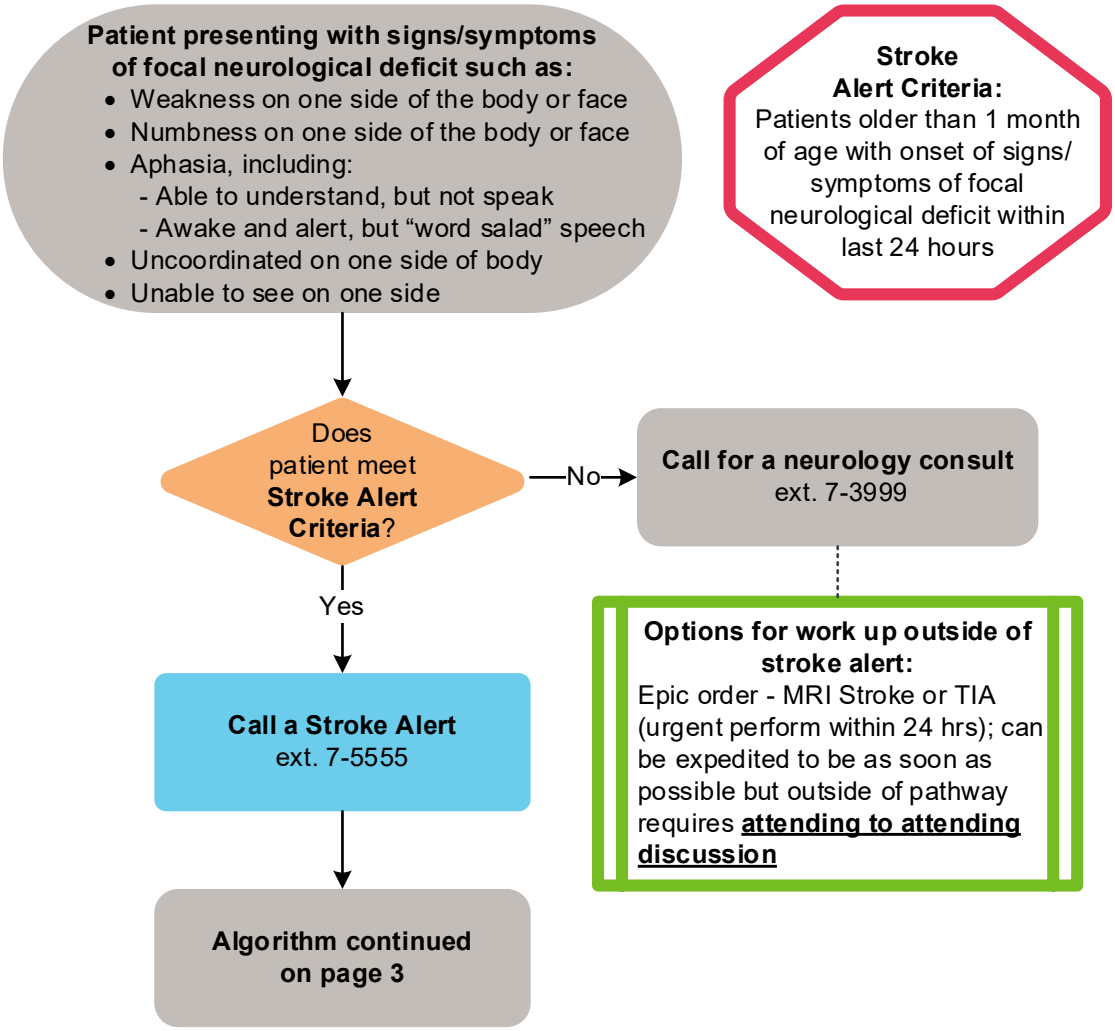
PEDIATRIC ARTERIAL ISCHEMIC STROKE (AIS)

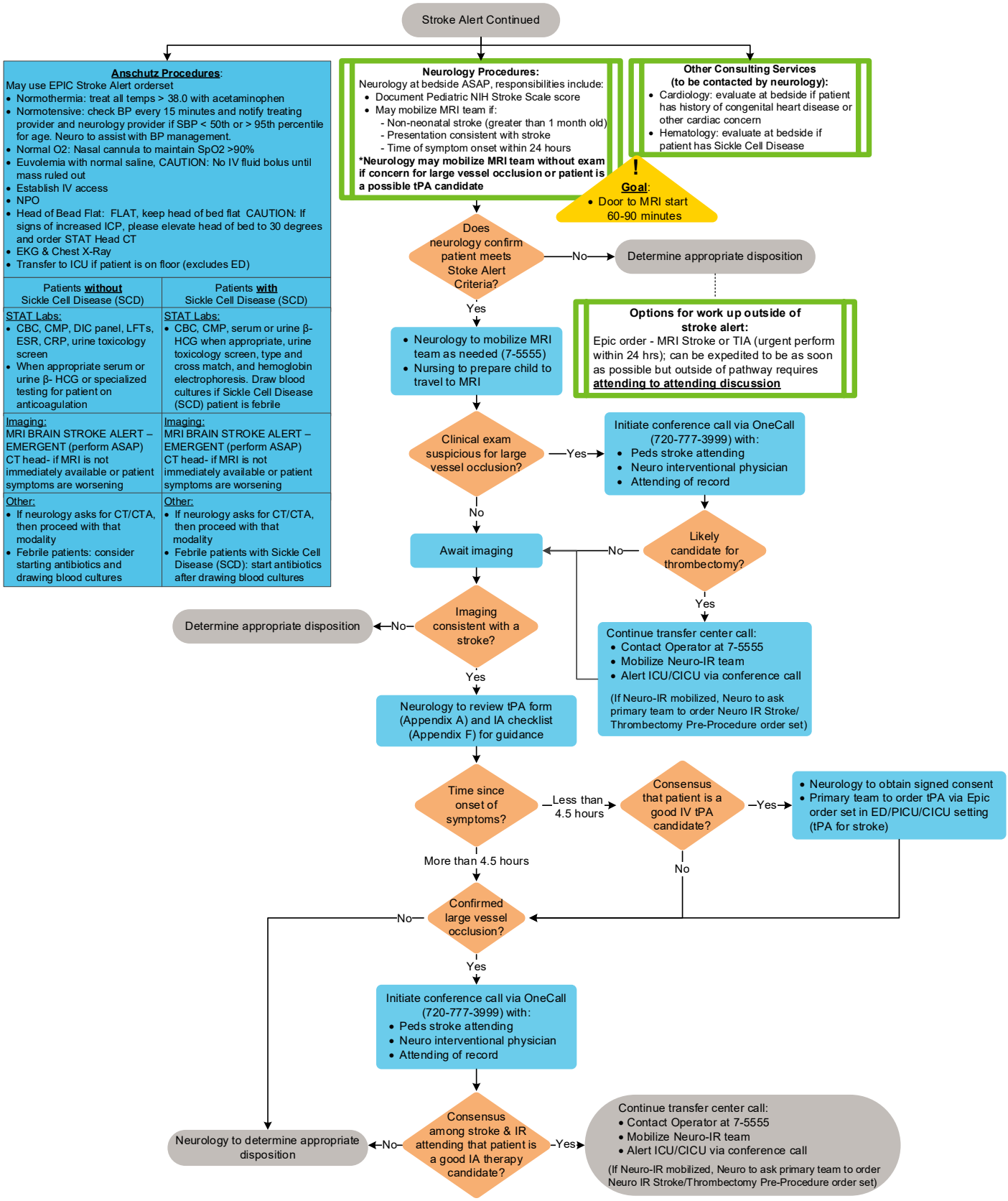
Algorithm 1. Stroke Alert - Network of Care (NOC) or Outside Hospital (OSH)



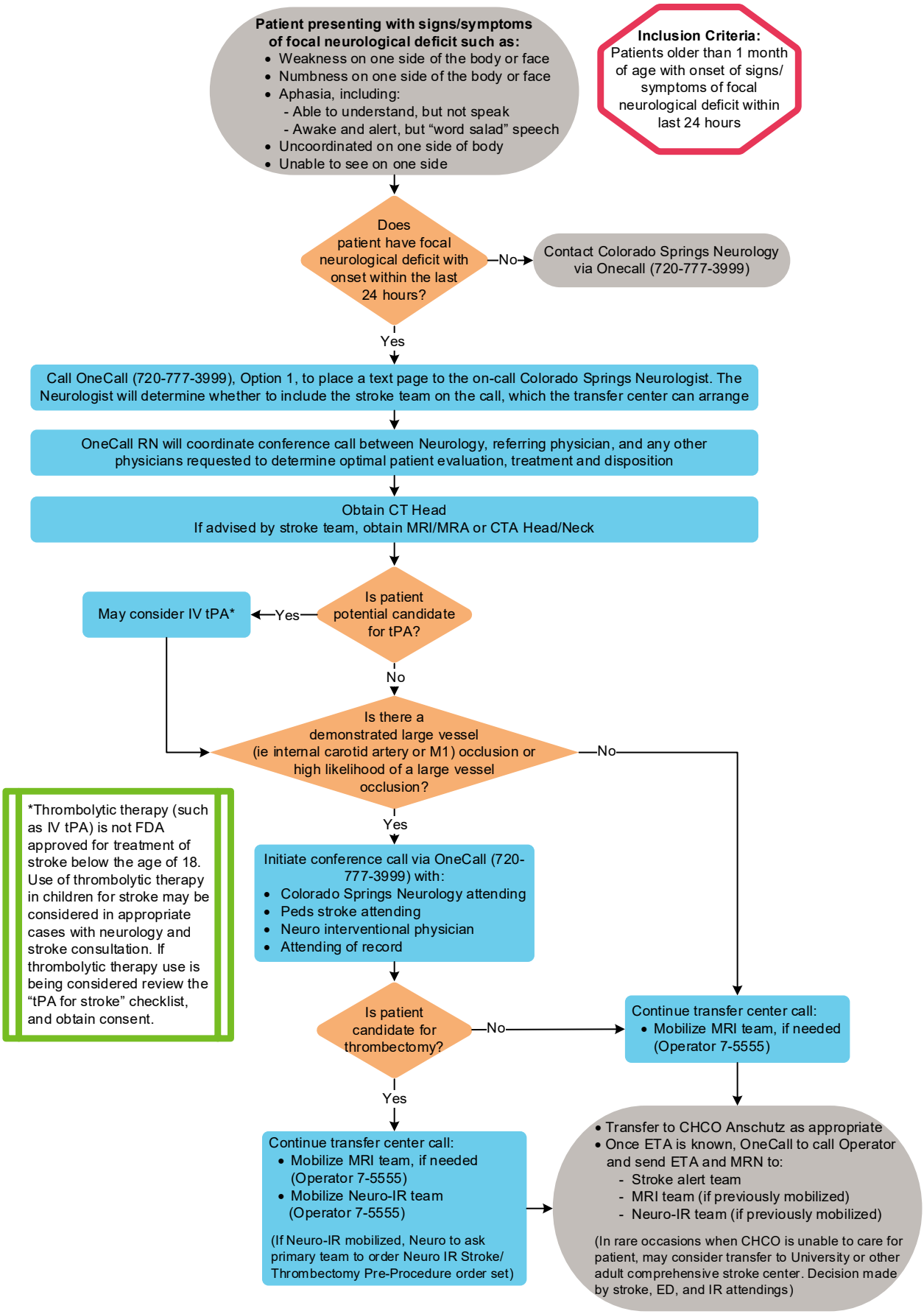
Algorithm 2. Stroke Alert - Anschutz Campus



Algorithm 2. Continuation of Stroke Alert - Anschutz Campus



Algorithm 3. Stroke Alert - Colorado Springs Hospital



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TARGET POPULATION

Inclusion Criteria

- Patients older than 1 month of age, with onset of signs/symptoms of focal neurological deficit within last 24 hours

Age Considerations

- Patients appropriate for acute stroke care at Children's Hospital Colorado (CHCO) Anschutz:
    - Children under the age of 18
    - Young adults admitted to CHCO (or in the CHCO Anschutz ED) with pediatric disease
    - Adults admitted to CHCO for heart procedures or other care

- Patients who should usually be transferred to an Adult Stroke Center if they have acute stroke symptoms:
    - Employees, Visitors or Parents in our facility who are 18 years of older

- Adult Patients (18 years or older) cared for at CHCO who are outside of our facility should usually be triaged to an Adult Stroke Center

BACKGROUND | DEFINITIONS

Focal neurological deficit: signs/symptoms of focal neurological deficit may include one or more of the following:

- Weakness on one side of body or face
- Numbness on one side of the body or face
- Aphasia, including:
  - Able to understand, but not speak
  - Awake and alert, but "word salad" speech
- Uncoordinated on one side of body
- Unable to see on one side

INITIAL TRIAGE (SEE ALGORITHM 1. STROKE ALERT NOC OR OSH)

For children located in Children's Hospital Colorado Network of Care (NOC) or OUTSIDE Children's Hospital Colorado

If patient displays symptoms 24 hours or less and focal neurological deficit:

- Call OneCall (720-777-3999), Option 1, to place a text page to Neurology Inpatient Resident: "Emergency page, stroke concern NOC or OSH".
- OneCall RN will coordinate conference call between Neurology Inpatient Resident, referring physician, and any other physicians requested, to determine optimal patient evaluation, treatment, and disposition.
- The Neurology fellow is expected to call back immediately and provide further guidance.
- If the patient has sickle cell disease (SCD) or known bleeding disorder, the neurology resident and transfer center will conference in the hematology fellow/attending immediately.
- If the patient has heart disease the neurology resident and transfer center will conference in the cardiology fellow/attending immediately.

Most patients who need stroke care, including intra-arterial such as mechanical thrombectomy, will be transferred to Children's Hospital Colorado Anschutz Campus.

In rare occasions when CHCO is unable to care for patient, may consider transfer to University or another adult comprehensive stroke center. Decision made by stroke, ED, and IR attending.

Treatment considerations for NOC or OSH provider to discuss with Neurology:

- Notify hematology for SCD patients or known bleeding disorder
- Notify cardiology for children with known heart disease
- Obtain CT head (or MRI brain, if indicated) prior to transport, if available
- Thrombolytic therapy (such as IV tPA) is not FDA approved for treatment of stroke below the age of 18. Use of thrombolytic therapy in children for stroke may be considered in appropriate cases with neurology and stroke consultation. If thrombolytic therapy use is being considered review the "tPA for stroke" checklist, and obtain consent. IV tPA is not currently available at the NOC sites.
- Consider aspirin after hemorrhage ruled out by imaging
- Transportation
  - Utilize most rapid means of transportation available for hyperacute therapy candidates, based upon timeframe for potential treatment. Take into account distance, weather, and the patient's clinical status

- Transfer Center can assist in arranging transportation
- Transport with 1 parent if possible, to facilitate rapid stroke treatment consent
- Frequent neurological checks en route
- Obtain CT head (or MRI brain, if indicated) prior to transport, if available

Symptoms more than 24 hours:

Contact CHCO Neurology via OneCall (720-777-3999) for appropriate disposition:

- 8am – 5pm: Neurology Inpatient ICU Resident
- 5 pm – 8am: Neurology Inpatient Resident

INITIAL TRIAGE (SEE ALGORITHM 3. STROKE ALERT COLORADO SPRINGS HOSPITAL)

For children located at Colorado Springs Hospital Campus

If patient displays symptoms 24 hours or less and focal neurological deficit:

- Call OneCall (720-777-3999), Option 1, to place a text page to the on-call Colorado Springs Neurologist. The Colorado Springs Neurologist will determine whether to include the stroke team on the call, which the transfer center can arrange.
- OneCall RN will coordinate conference call between the on-call Colorado Springs Neurologist, referring physician, and any other physicians requested, to determine optimal patient evaluation, treatment, and disposition.
- The Neurology fellow is expected to call back immediately and provide further guidance.
- If the patient has sickle cell disease (SCD) or known bleeding disorder, the neurology resident and transfer center will conference in the hematology fellow/attending immediately.
- If the patient has heart disease the neurology resident and transfer center will conference in the cardiology fellow/attending immediately.

Most patients who need stroke care, including intra-arterial such as mechanical thrombectomy, will be transferred to Children's Hospital Colorado Anschutz Campus.

In rare occasions when CHCO is unable to care for patient, may consider transfer to University or other adult comprehensive stroke center. Decision made by stroke, ED, and IR attending.

Treatment considerations for CHCO-Colorado Springs provider to discuss with Neurology:

- Notify hematology for SCD patients or known bleeding disorder
- Notify cardiology for children with known heart disease
- Obtain CT head (or MRI brain, if indicated) prior to transport, if available
- Neurologist in Colorado Springs may consider IV tPA as a treatment. Thrombolytic therapy (such as IV tPA) is not FDA approved for treatment of stroke below the age of 18. Use of thrombolytic therapy in children for stroke may be considered in appropriate cases with neurology and stroke consultation. If thrombolytic therapy use is being considered review the "tPA for stroke" checklist, and obtain consent.
- Consider aspirin after hemorrhage ruled out by imaging
- Transportation
  - Utilize most rapid means of transportation available for hyperacute therapy candidates, based upon timeframe for potential treatment. Take into account distance, weather, and the patient's clinical status

- Transfer Center can assist in arranging transportation
- Transport with 1 parent if possible, to facilitate rapid stroke treatment consent
- Frequent neurological checks en route

INITIAL EVALUATION AND CLINICAL MANAGEMENT (SEE ALGORITHM 2)

For children located at Children's Hospital Colorado Anschutz Campus

STROKE ALERT - Procedures

Stroke Alert should be called for any patient who meets the following:

Stroke Alert Criteria:

- Focal Neurological Deficit
- Older than 1 month of age
- Onset of symptoms less than 24 hours ago
- **Note:** Any provider in the hospital can call a stroke alert

Roles and Responsibilities

- Neurology Inpatient Resident is expected to evaluate patient ASAP and direct management of all non-sickle cell patients. Neurology responsibilities include:
  - Document Pediatric NIH Stroke Scale score
  - Notify hematology for SCD patients or known bleeding disorder
  - Notify cardiology for children with known heart disease
  - Contact Stroke Attending for patients that may require IV tPA and/or intra-arterial therapy (call Neurology Attending for all nonacute stroke cases. Afterwards, Stroke Attending is available for consult)
  - If appropriate and approved by Stroke Attending, mobilize MRI team and/or IR team (x7-5555)
    - May activate MRI and/or IR teams without exam if concern for large vessel occlusion
- Acute Stroke Team Attending will co-attend with the neurology attending for any hyperacute treatment candidates, including thrombolysis and thrombectomy from arrival to CHCO through treatment completion. Stroke attending with be available for tPA consent and to assist with thrombectomy decision.
- Hematology fellow is expected to evaluate sickle cell disease (SCD) patients and/or known bleeding disorder ASAP and hematology will direct management of all SCD patients. If red cell exchange is indicated, hematology will contact apheresis team. Hematology fellow is also expected to review hematology/coagulation labs, dosing of tissue plasminogen activator (tPA), and contraindications for patients with known bleeding disorders.
- Primary team (ED/PICU/CICU/Floor) is expected to order initial labs and start basic stroke care (Epic orderset: ED STROKE ALERT)
- PICU Fellow is expected to identify bed in PICU (or CICU as appropriate) & prepare for possible post-tPA/IA therapy. If patient has SCD, preparations will include line placement for red cell exchange.
- Anesthesiology is expected to notify attending and prepare for sedated MRI, likely with Propofol, and possible sedation for thrombectomy.
- Radiology MR Tech is expected to schedule STAT MRI – MRI Brain STROKE ALERT – EMERGENT (performed ASAP).
- Pharmacy is expected to prepare for possible need for tPA.
- Nursing Supervisor is expected to identify bed and nursing support.

- Cardiology Fellow is expected to evaluate patient within 30 minutes if there is known/suspected cardiac disease.
- Neuroradiology attending is expected to immediately review acute imaging and contact Stroke Attending with results. May contact neurology fellow if MRI/MRA is normal.

Stabilization of Patient: In Emergency Department (ED) or PICU/CICU

May use Epic Stroke Alert orderset

- Normothermia: treat all temps greater than 38.0 with acetaminophen
- Normotensive: check BP every 15 minutes and notify treating provider and neurology provider if SBP less than 50th or greater than 95th percentile for age. Neuro to assist with BP management.
- Normal O2: Nasal cannula to maintain SpO2 greater than 90%
- Euvolemia with normal saline, CAUTION: No IV fluid bolus until mass ruled out
- Establish IV access
- NPO
- Head of Bed Flat: FLAT, keep head of bed flat. CAUTION: If signs of increased ICP, elevate head of bed to 30 degrees and order STAT Head CT
- EKG & Chest X-Ray
- Transfer to ICU if patient is on floor (excludes ED)

	Patients ***without*** Sickle Cell disease (SCD)	Patients ***with*** Sickle Cell disease (SCD)
Labs:	CBC, CMP, DIC panel, LFTs, ESR, CRP, urine toxicology screen. When appropriate serum or urine β- HCG or specialized testing for patient on anticoagulation.	CBC, CMP, serum or urine β-HCG when appropriate, urine toxicology screen, type and cross match, and hemoglobin electrophoresis. Draw blood cultures if SCD patient is febrile.
Imaging:	MRI BRAIN STROKE ALERT – EMERGENT (perform ASAP) CT head - if MRI is not immediately available or patient symptoms are worsening.	MRI BRAIN STROKE ALERT – EMERGENT (perform ASAP) CT head- if MRI is not immediately available or patient symptoms are worsening.
Other:	If neurology asks for a different imaging modality, such as CT/CTA, then proceed with that modality. Febrile patients: consider starting antibiotics and drawing blood cultures.	If neurology asks for a different imaging modality, such as CT/CTA, then proceed with that modality. Febrile patients *with* SCD: start antibiotics after drawing blood cultures.

STROKE ALERT - Procedures

Post-MRI Case Review:

- Neuroradiology reviews MRI for confirmation of acute infarction with restricted diffusion in an arterial territory consistent with the clinical syndrome.
- Neuroradiology confirms no contraindications to tPA and/or provides stroke volumes (Intra-Arterial Therapy Checklist).
- Neurology to complete IA/IV tPA criteria form (Stroke Alert – tPA Form), dose tPA (via order set: tPA for stroke), and educate family. Neurology to also review IA therapy checklist (Intra-Arterial Therapy Checklist).
- Neuroradiology will call Stroke Attending to discuss abnormal MRI findings. May contact neurology fellow if MRI/MRA is normal.
- If hyperacute therapies are being considered, Stroke Attending and any other necessary services (neuroradiology, neurointerventional physician, cardiology, hematology, etc.) will review case (can be via One call, 7-3990) to discuss MRI findings, clinical presentation and treatment options. Stroke Attending will notify Attending of record of treatment decisions.
- If there is consensus that patient should be considered for IV tPA and/or thrombectomy, then therapy may be offered.
- If patient has a large stroke (greater than 50% of MCA), they should be followed by the Early Decompressive Surgery in Malignant Infarction guideline.

TREATMENT

If less than 4.5 hours from symptom onset (and does not have SCD):

If less than 4.5 hours from symptom onset and good intravenous (IV) tissue Plasminogen Activator (tPA) candidate, IV tPA will be offered if:

- Consent is signed (Patient Informed Consent – IV-tPA for Stroke)
- Care team consensus is to offer therapy

If less than 24 hours from symptom onset (and does not have SCD):

If less than 24 hours from symptom onset and good intra-arterial therapy candidate, therapy will be offered if:

- Consent is signed (Patient Informed Consent - Mechanical Thrombectomy)
- Care team consensus is to offer therapy

In special circumstances, such as basilar thrombosis, the decision to provide intra-arterial therapies beyond established guidelines may be made but are outside the scope of this guideline.

Management of tPA administration

- Once tPA is brought to the PICU for administration (or ED/CICU if appropriate), the tPA will be physically held by the Stroke Team or Pharmacist until the decision is made by the Stroke Team Attending to administer the drug.
- **Usual Dosage Range and Route for Systemic tPA (use tPA for stroke ORDERSET):**

  0.9 mg/kg to a maximum of 90 mg:

  - First 10% of calculated dose given as intravenous bolus dose.
  - Remaining 90% of calculated dose given in infusion over 1 hour.

FURTHER WORK-UP AND MANAGEMENT OF PATIENTS WITH ARTERIAL ISCHEMIC STROKE OR TIA (NON-SICKLE CELL DISEASE)

- Use Epic ordersets for complete work-up and management guidelines (see below).
- Admitted patients should be monitored in PICU or CICU for at least 24 hours.

If outside time window or excluded for other reasons, options for workup include:

- If stroke concern still exists but patient is not appropriate for acute intervention due to contraindication or timeline, obtain neurology consult to decide upon further workup and disposition.
- Admitted patients outside of the acute pathway (e.g. possible stroke outside of the 24 hour time-window or with a high suspicion Transient Ischemia Attack [TIA]) should receive cerebral and neurovascular imaging within 24 hours of presentation as tolerated, or sooner if indicated. Exact timing of MRI (and consideration of interval head CT) for patients in this latter category should involve an attending-to-attending discussion between neurology (and/or stroke attending) and radiology.
    - **MRI Stroke or TIA** (Urgent, perform within 24 hours). This will include MRI brain and MRA head and neck (time of flight with contrast and T1 fat sat images) performed at less than 24 HOURS.

EPIC ORDER SETS, PHONE NUMBERS, FORMS AND DOCUMENTS

Epic:	Important phone numbers:
Stroke alert order set: • ED Stroke Alert	Stroke Alert: Operator (**75555**)
IV tPA order set: • tPA for Stroke	Mobilize MRI and/or IR teams: Operator (**75555**)
Post-stroke management order set: • Neuro IP Stroke Management & Evaluation	Inpatient On-call Neurology Resident: One-call (**7-3990**)
Pre-thrombectomy order set: • Neuro IR Stroke/Thrombectomy Pre-Procedure	Stroke Attending: One Call (**7-3990**)
Post-thrombectomy order set: • Neuro IP Post Procedure	University Hospital Stroke Service: UH ICU (**720-848-5490**)
Resident Epic smart phrases: • NRESSTROKEALERTPHONEINTAKE • NRESSTROKEALERTCHECKLIST • NRESSTROKEALERTIATHERAPY • NRESSTROKEALERTTPACHECKLIST	Conference Call: One-Call (**7-3990)** Call One-Call with time of conference call (typically in 5-10 minutes) & desired participants. One-Call will page everyone and set-up call. Transfer center: **720-777-8838**
Stroke MRIs:	**Related forms and documents:**
MRI Stroke Alert (Emergent, perform ASAP) – MRI/MRA head and neck for stroke alert	Checklists: • INTRA-ARTERIAL THERAPY checklist • IV tPA checklist
MRI Stroke or TIA (Urgent, perform within 24 hours) – MRI/MRA head and neck for inpatient needing urgent imaging (i.e.- stroke concern greater than 24 hours or TIA)	Pediatric NIH Stroke Scale
MRI Stroke (Routine) – MRI/MRA head and neck that is not urgent	Consent Forms • IV tPA • Mechanical Thrombectomy

APPENDIX A. STROKE ALERT – TPA FORM

APPENDIX B. PATIENT INFORMED CONSENT - IV-TPA FOR STROKE

APPENDIX C. CHILDHOOD ACUTE ISCHEMIC STROKE EDUCATIONAL MATERIAL

APPENDIX D. PEDIATRIC NIH STROKE SCALE (NIHSSPED)

APPENDIX E. EARLY DECOMPRESSIVE SURGERY IN MALIGNANT INFARCTION

APPENDIX F. INTRA-ARTERIAL THERAPY CHECKLIST

APPENDIX G. PATIENT INFORMED CONSENT – MECHANICAL THROMBECTOMY

REFERENCES

Child Neurology Society Ad Hoc Committee on Stroke in Children.
http://www.ninds.nih.gov/news_and_events/proceedings/stroke_proceedings/childneurology.htm

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- Adult Neurology: Sharon Poisson
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- Transport: Joe Darmofal
- OneCall: Christine Silva, Erin Carey

APPROVED BY

Children's Hospital Colorado Stroke Council – April 15, 2021
Clinical Pathways & Measures Committee – April 26, 2021
Pharmacy & Therapeutics Committee – April 26, 2021

MANUAL/DEPARTMENT	Clinical Pathways/Quality
ORIGINATION DATE	November 14, 2014
LAST DATE OF REVIEW OR REVISION	April 26, 2021
COLORADO SPRINGS REVIEW BY	 Michael DiStefano, MD Chief Medical Officer, Children's Hospital Colorado – Colorado Springs
APPROVED BY	 Lalit Bajaj, MD, MPH Chief Quality and Outcomes Officer

REVIEW/REVISION SCHEDULE

Scheduled for full review on April 26, 2025