This care process model (CPM) was created by the Neurosciences, Intensive Medicine, and Cardiovascular Clinical Programs at Intermountain Healthcare. These groups include multidisciplinary representation from neurovascular medicine, interventional radiology, cardiology, anesthesiology, hospitalists, and others. This CPM provides expert advice for the emergency management of acute ischemic stroke and summarizes current medical literature and national practice guidelines (see page 8).

Intermountain’s care management system for stroke also includes:

• Education materials and programs for providers and patients
• Data systems that help providers and facilities track stroke management success
• Multidisciplinary coordination of stroke care

**Why Focus ON ISCHEMIC STROKE?**

- **Incidence and mortality.** In the U.S., about 795,000 strokes occur each year, 610,000 of which are first attacks, and nearly 134,000 of which are fatal. About 87% of all strokes are ischemic strokes, when considered separately from other cardiovascular diseases, stroke is the fifth leading cause of death.

- **Impairment.** Stroke is a leading cause of disability. Six months after a stroke, 26% of patients still need institutional care; 15% to 30% are permanently disabled.

- **Cost.** U.S. stroke-related, direct and indirect costs in 2011 were $33.6 billion. Between 2012 and 2030, total direct medical stroke-related costs are projected to triple.

- **Improved outcomes when key processes are followed.** Multiple studies have shown that patients suffering from stroke are more likely to have improved outcomes and fewer complications when hospitals use standardized care processes.

Key processes for emergency management of ischemic stroke include:

- Initial assessment, rapid transport, and early notification by EMS personnel.
- A system for prompt evaluation, diagnosis, and treatment decisions by ED personnel, incorporating limited laboratory testing, stat brain imaging, and a stroke rating scale such as NIHSS. Smaller or rural facilities should treat to capacity using the Telestroke process and transport to a stroke center as quickly as possible.
- Administration of the thrombolytic drug alteplase (tPA), recombinant tissue-type plasminogen activator, within 3 hours of the onset of stroke symptoms in all eligible patients, and within 4.5 hours in more carefully selected patients.

### What’s new IN THIS UPDATE?

- Updated treatment algorithms for diagnosis and classification, emergency management of acute ischemic stroke, and endovascular therapy (see pages 2–7)
- Telestroke process details (see page 2)
- New ED Acute Stroke Process Checklist (see page 6)
- Concentrated focus on emergency management

**What’s INSIDE?**

**ALGORITHMS:**
- Diagnosis and Classification ................. 2
- Emergency Management of Acute Ischemic Stroke ................. 4
- Assessment for Endovascular Therapy ................. 7
- ED Acute Stroke Process Checklist... 6
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**Program Goals & Measurements**

- % of all stroke patients with documented NIH Stroke Scale score
- Time from ED arrival to imaging
  - **GOAL:** <15 min from ED arrival to imaging
- Time from ED arrival to treatment
  - **GOAL:** <60 min from ED arrival to alteplase (tPA) treatment (with >50% in less than 45 min)
- % of eligible ED patients treated with endovascular therapy
- % of eligible ED patients treated with tPA within 3 to 4.5 hours of symptom onset

Indicates an Intermountain measure
EMERGENCY MANAGEMENT OF ACUTE ISCHEMIC STROKE

DECEMBER 2017

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ALGORITHM 1: DIAGNOSIS AND CLASSIFICATION
(see also algorithm notes on next page)

– PERFORM EMS pre-assessment and transport
– Patient/family calls 911

– ASSESS for acute stroke
– (Also see ED Acute Stroke Process Checklist, page 6)

≤10 min from ED arrival to seen by MD
≤10 min from ED arrival to telestroke activation

– ASSESS for acute stroke
– (Also see ED Acute Stroke Process Checklist, page 6)

< 15 min from ED arrival to imaging
< 45 min from ED arrival to treatment

≤10 min from ED
ED PHYSICIAN
• Order ED stroke STAT imaging (power plans) (b)
• Assess patient: ABC, PMH, medications, NIHSS (c) / other neuro assessment per protocol
• Review IV alteplase (tPA) contraindications (see page 5)
• IF telestroke facility, activate Telestroke process (see info at right)
• If patient < 18, contact PCH ED 801-662-1200

ED RN / TECH
• If MD unavailable, order PR Stroke Power Plan
• Document time “Last Seen Normal”
• Weigh in kg
• Monitor VS Q 15 minutes; keep ats > 94 %
• Start IV; draw labs (BMP, CBC, PT-INR, PTT); fingerstick glucose. Use ISTAT if available
• IF telestroke facility: Explain telestroke to patient and family; remain with patient to assist with on-camera neuro exam

ED HUC
• Initiate stroke alert
• IF telestroke facility, activate telestroke process (see telestroke info at right and process checklist on page 6)

CONDUCT stat imaging (c)

< 15 min from ED arrival to imaging

CT Tech
• Performs
  • Non-contrast CT of brain
  • CTA and CT perfusion if requested by neurologist and available at facility (if requested but not available, see info at right)
• Alerts radiologist to read STAT CT scan

Radiologist
• Reads scan and reports to neurologist the “bleed/no bleed” and ASPECTS score
• IF telestroke facility, radiologist contacts neurologist through the Transfer Center (See telestroke info at right)

no

Intracerebral hemorrhage?

yes

In-hospital onset of symptoms

– ACTIVATE medical emergency or rapid response team

– MANAGE per Hospital Care and Rehabilitation for Adult Stroke and TIA Patients CPM

– MANAGE as TIA (See Suspected TIA Clinical Guideline)

– TELESTROKE — HOW IT WORKS
  • Activate process; ED HUC initiates process by:
    – Calling Transfer Center at 1-800-417-8112
    – Saying "telestroke"
    – Providing patient name, DOB, ED room #, and ED MD name / phone
  • Alert telestroke MD: Transfer center texts message, "TELESTROKE at [hospital], room # __; please call Transfer Center at 855-932-3648."
  • Connect neurologist & ED MD: Transfer Center sets up conference call and facilitates tech support during call, if needed. (Also include accepting physician at receiving facility if other than IMC.)
  • Follow up and transfer (if needed): Transfer Center contacts and connects with ED physician for consult (video link tech support); follows up with neurologist (30 – 45 minutes later); facilitates patient transfer as needed.

Indicates an Intermountain measure

MANAGE as ACUTE ISCHEMIC STROKE
(See page 4)

MANAGE as HEMORRHAGIC STROKE
(See AHA/ASA 2015 Guideline)
National Institutes of Health Stroke Scale\textsuperscript{NIH} — Plain English Version (NIHSS-PE)*

<table>
<thead>
<tr>
<th>Item</th>
<th>Title</th>
<th>Responses and Score</th>
</tr>
</thead>
</table>
| 1A   | Level of Consciousness | 0—Alert  
1—Sleepy but arouses  
2—Can’t stay awake  
3—No purposeful response |
| 1B   | Orientation Questions (2) | 0—Both correct  
1—One correct / intubated  
2—Neither correct |
| 1C   | Commands (2) | 0—Obeys both  
1—Obeys one  
2—Obeys neither |
| 2    | Lateral Gaze | 0—Normal side-to-side movements  
1—Partial side-to-side movements  
2—No side-to-side movement |
| 3    | Visual Fields | 0—Normal visual fields  
1—Blind upper OR lower field, one side  
2—Blind upper AND lower field, one side  
3—Blind in both eyes / four fields  
4—No movement |
| 4    | Facial Weakness | 0—Normal  
1—Mild one-sided droop with smile  
2—Obvious droop at rest  
3—Upper and lower face is weak |
| 5    | Arm weakness (left and right) | 0—No drift (X—Joint fused / amputee)  
1—Drifts down, does not hit bed  
2—Drifts down to hit bed  
3—Can move, but cannot lift  
4—No movement |
| 6    | Leg weakness (left and right) | 0—No drift (X—Joint fused / amputee)  
1—Drifts down, does not hit bed  
2—Drifts down to hit bed  
3—Can move, but cannot lift  
4—No movement |
| 7    | Coordination | 0—Normal or no movement  
1—Clumsy in one limb  
2—Clumsy in two limbs |
| 8    | Sensation (feeling) | 0—Normal  
1—Decreased sensation  
2—Can’t feel, no pain withdrawal |
| 9    | Speech (content) | 0—Correct full sentences  
1—Wrong or incomplete sentences  
2—Words don’t make sense  
3—Can’t speak at all |
| 10   | Speech (slurring) | 0—No slurring (X—Intubated / barrier)  
1—Slurs, but you can understand  
2—Slurs (you can’t understand) or mute |
| 11   | Neglect | 0—Sees & feels as both sides tested at once  
1— Doesn’t see OR feel one side  
2—Doesn’t see AND feel one side |

*Notes:  
- The NIHSS-PE is used with permission of the Providence Brain Institute.  
- The original NIH form and instructions are available on the NIH website ([http://www.ninds.nih.gov/disorders/stroke/strokescales.htm](http://www.ninds.nih.gov/disorders/stroke/strokescales.htm)).
ALGORITHM 2: EMERGENCY MANAGEMENT OF ACUTE ISCHEMIC STROKE
(see also algorithm notes on next page)

Acute Ischemic Stroke

Further CLASSIFY stroke based on CT findings and time since onset

Symptom onset < 4.5 hours

REVIEW criteria for IV alteplase (tPA)

< 3 hours (a)

3 – 4.5 hours (a) (b)

Appropriate per criteria?

yes

no

DISCUSS tPA risk and benefits with patient/surrogate decision maker (written consent not required)

ADMINISTER intravenous (IV) alteplase (tPA) (c), and monitor (d)

Based on assessment, is patient a candidate for endovascular therapy?

no

yes

ADMIT to ICU or stroke unit
If telestroke site, transport to nearest stroke center

PAGE IR for immediate intervention, and OBTAIN consent; MOVE to IR suite

MANAGE per Hospital Care and Rehabilitation for Adult Stroke and TIA Patients CPM

Indicates an Intermountain measure
### Contraindications (risk of bleeding is greater than the potential benefit)
- Thrombolytic therapy initiated by another hospital prior to arrival
- CT findings (ICH, SAH, or major infarct signs)
- SBP > 185 or DBP > 110 mmHg despite maximal treatment
- Plts < 100,000, PTT > 40 sec after heparin use, PT > 15, or known bleeding diathesis
- INR > 1.7 (for known or suspected warfarin use, wait for lab INR result to determine if contraindicated when POC INR 1.6 – 2.3)
- Confirmed use, in the last 48 hours, of direct oral anticoagulants (DOACs), such as dabigatran (Pradaxa), rivaroxaban (Xarelto), apixaban (Eliquis), edoxaban (Savaysa)

### Warnings and Precautions (use clinical judgment)
- Blood glucose concentration ≤ 50 mg/dL or ≥ 400 mg/dL
- Seizure at onset
- Recent surgery / major trauma (< 15 days)
- Active internal bleeding (< 22 days)
- Significant stroke or head trauma (< 3 mo)
- Intracranial or spinal surgery (< 3 mo)
- Myocardial infarction (MI) (< 3 mo)
- Non-disabling stroke symptoms
- Life expectancy < 1 year or severe comorbid illness
- History of vascular malformation
- History of intracranial hemorrhage
- History of brain aneurysm or brain tumor
- Pregnant or lactating

### (b) Additional criteria for IV alteplase (tPA) at 3 – 4.5 hours
- Age > 80
- Imaging finding of infarction with hypodensity involving > 33 % of the cerebral hemisphere
- History of both stroke and diabetes
- NIHSS > 25
- Oral anticoagulant regardless of INR

### (c) Sterile preparation and administration of IV alteplase (Activase®) by ED nurses
1. Reconstitute immediately before administration, using aseptic techniques at all times. IV alteplase will be reconstituted using the 100-mL vial of sterile water for injection (SWFI) provided.
2. Remove the protective cap from the top of the alteplase (Activase®) vial and the vial of SWFI. Swab the top of each vial with an alcohol wipe to reduce the risk of contamination.
3. Using aseptic technique, pierce the vial of sterile water with the provided transfer device. DO NOT invert the vial of sterile water. Holding the vial of alteplase (Activase®) powder upside down, place the center of the stopper over the exposed piercing pin and insert.
4. Invert the 2 vials, allowing the sterile water to flow into the alteplase (Activase) vial. (This may take a couple of minutes.) DO NOT shake; gently swirl only. DO NOT HANG AND INFUSE THE ENTIRE VIAL! Vial contains 100 mg (1 mg/mL) when reconstituted. NOTE: Slight foaming of the solution is normal. Let the solution stand undisturbed for several minutes to allow any large bubbles to dissipate.
5. Visually inspect the alteplase (Activase®) solution for particulate matter and discoloration before dispensing.
6. Determine the total dose needed, and draw out the excess from the vial and discard.
7. Draw the bolus dose (10 % of the total dose) into the appropriately sized IV syringe. Place the bolus label on the IV syringe. (If your hospital uses a tube system, put a DO NOT TUBE label on the alteplase (Activase) bolus syringe.
8. Inject bolus dose through peripheral IV over 1 – 2 minutes.
9. Infuse the remaining dose over 60 minutes.
10. Flush tubing after infusion with 50 cc of 0.9 % normal saline.

NOTE: Reconstituted alteplase (Activase) is stable for up to 8 hours in solution at room temperature.

### (d) Monitoring frequency:
Monitor vital signs and conduct neuro assessment (per facility guideline) from start of alteplase (tPA): Every 15 minutes for 2 hours; then, every 30 minutes for 6 hours; then, every hour for 16 hours.
<table>
<thead>
<tr>
<th>Role</th>
<th>Action (for patient presenting with stroke-like symptoms)</th>
<th>Tips</th>
</tr>
</thead>
<tbody>
<tr>
<td>RN</td>
<td>□ Determines acuity: RN determines if patient is possible stroke alert (remains symptomatic AND LSN &lt; 6 hrs)</td>
<td>Example scripting: “Code Stroke for room XX.”</td>
</tr>
<tr>
<td></td>
<td>□ Notifies HUC of Code Stroke</td>
<td>Example scripting: “Stroke alert in room “XX”</td>
</tr>
<tr>
<td>HUC</td>
<td>□ Notifies stroke alert to ED staff and stroke team, if available, using standard communication methods</td>
<td></td>
</tr>
</tbody>
</table>
| MD     | □ Assesses for stroke immediately                                                                                       | For BP treatment, consider:
|        | □ Order “ED Neuro Stroke / TIA power plan” (if at thrombectomy center); order “ED Code Stroke” power plan (if at IMED)     | • Labetalol (10–20 mg IV over 1–2 minutes, may repeat 1 time)
|        | □ Notifies HUC to activate telestroke if applicable                                                                  | • Nicardipine (5 mg/h IV, titrate up by 2.5 mg/h every 5–15 minutes to a maximum of 15 mg/h; when desired BP reached, adjust to maintain proper BP limits)
|        | □ Conducts NIHSS-PE ([page 3](#)) / reviews alteplase (tPA) contraindications ([page 5](#)) and eligibility for endovascular therapy ([page 7](#)) | • Hydralazine or enalaprilat may be considered when appropriate    |
|        | □ Treats BP if > 185 / 110 (see “Tips” column for medication considerations)                                             |                                                                      |
|        | □ Consults with neurologist via phone; assists with telestroke exam if requested                                            |                                                                      |
| HUC    | □ Calls CT tech                                                                                                         | Example scripting: “This is a telestroke patient [provide patient’s name, DOB, ED room #, and ED MD name and phone number].” |
| RN*    | □ Responds immediately to room with i-STAT® machines and travel monitor (scale if requested)                             | For patients where warfarin use is known or suspected, if POC INR is 1.6–2.3, use lab INR result. |
|        | □ Starts IV and draws blood samples, runs i-STATs (INR, creatinine, glucose)                                             |                                                                      |
|        | □ Documents time LSN (Last Seen Normal) in ED triage form (iCentra)                                                      |                                                                      |
|        | □ Determines patient weight in kg                                                                                        |                                                                      |
|        | □ Redies patient for immediate transport to CT                                                                           |                                                                      |
|        | □ Explains telestroke services to patient and family as appropriate                                                   |                                                                      |
|        | □ Prepares to assist with telestroke neuro exam as needed                                                                |                                                                      |
|        | □ Notifies pharmacist of alteplase (tPA) need once determined                                                           |                                                                      |
| RN*    | □ Responds to patient room ASAP                                                                                         |                                                                      |
|        | □ Obtains brief medication history                                                                                    |                                                                      |
|        | □ Reviews alteplase (tPA) eligibility criteria, as needed                                                               |                                                                      |
|        | □ Prepares for possible alteplase (tPA) administration/pharmacy protocol                                                |                                                                      |
| Pharmacist* | □ Responds to patient room ASAP                                                                                     |                                                                      |
|        | □ Obtains brief medication history                                                                                      |                                                                      |
| ECG/RT Tech* | □ Performs 12-lead ECG                                                                                           |                                                                      |

*Note: If these services are unavailable, RN/provider may delegate tasks as appropriate.
ALGORITHM 3: ASSESSMENT FOR ENDOVASCULAR THERAPY

Patient to be assessed for endovascular therapy

EVALUATE patient for ABSOLUTE inclusion criteria (all must apply)

- Age: 18–80
- Functionally independent
- Disabling deficit
- Occlusion location: ICA, M1, M2
- ASPECTS > 6
- Onset: < 6 hours

Patient meets ALL ABSOLUTE criteria?

yes → PAGE IR, OBTAIN consent, and MOVE patient to IR as soon as possible (a)

no → EVALUATE patient for RELATIVE inclusion criteria

- Age: > 16 (for 16 – 17 year olds, call PCMC)
- High risk for deterioration
- Limited disability
- Occlusion location: Cervical ICA, tandem occlusion, bailar, A1, P1
- ASPECTS > 5
- Onset: < 24 hours

Patient meets RELATIVE criteria?

yes → REVIEW case with IR, and DISCUSS with patient (a)

no → ADMIT to ICU or stroke unit

If telestroke site, transport to nearest stroke center

MANAGE per

Hospital Care and Rehabilitation for Adult Stroke and TIA Patients CPM

ALGORITHM NOTES

(a) Endovascular therapy — data points and metrics

Data points to be collected and reported by all endovascular sites:
- IR page time
- Groin puncture time
- Initial TICI score
- Time of first pass
- Final TICI score
- Time of final TICI score
- Symptomatic hemorrhage within 36 hours (SITS-MOST definition)

Metrics that will be monitored and reported (goal in parentheses):
- Door to IR page (goal: Undefined)
- Door to puncture (goal: 120 min)
- IR page to puncture (goal: 60 min)
- Page to IR team arrival/available (tech + RN) (goal: < 30 min)
- Door to final TICI score (goal: < 8 hours)
- Percentage final TICI 2b/3 (goal: Undefined)
- Symptomatic ICH rate (based on SITS-MOST criteria)
RESOURCES

Patient Education

Patients and their families can find these materials and links to other reliable stroke resources in the Health Library at Intermountain’s public website (intermountainhealthcare.org/stroke).

Clinicians can view or order Intermountain patient education materials for distribution to their patients.

- **View** by opening the appropriate topic page via the Clinical Programs pages on intermountain.net or intermountainphysician.org.
- **Order** from Intermountain’s iprintstore.org.

Intermountain stroke-related patient materials include the following:

- The booklet, Life After Stroke and TIA, to help educate patients and families about stroke symptoms and treatments.
- Fact sheets on:
  - Conditions that may be associated with emergency management of stroke, such as Ischemic Stroke Treatment: tPA Decision Guide
  - Anticoagulation medication, including Dabigatran, Rivaroxaban, and Warfarin
- **BE FAST** Refrigerator magnet: includes signs of stroke and reminder to call 9-1-1.

Provider Resources

This CPM and other concussion-related resources are accessible through the Clinical Programs Care Process Models page on intermountainphysician.org or the Neurosciences Clinical Program home page on intermountain.net.
Note: This document presents an evidence-based model of care that is appropriate for most patients. It should be adapted to meet the needs of individual patients and situations and should not replace clinical judgment. Send feedback to Kevin Call, MD, Director, Stroke Development Team, Intermountain Healthcare (Kevin.Call@imail.org).

KEY GUIDELINES


OTHER REFERENCES


