Through its Intermountain Imaging Criteria Project, Intermountain Healthcare has developed a suite of standardized care process models (CPMs) for the use of advanced imaging procedures in eight priority clinical areas. These evidence-based guidelines are intended to be widely implemented in order to improve patient safety, improve outcomes, and reduce unnecessary medical spending for the Medicare population and the U.S. health system overall.

**Why Focus ON INTERMOUNTAIN IMAGING CRITERIA?**

Advanced imaging procedures, including MRI, CT, PET, and nuclear medicine, facilitate rapid and accurate detection and/or diagnosis of disease. The volume of advanced imaging procedures prescribed to patients in the U.S. increased three- to four-fold from 1996 – 2010 as the technologies became widely available. The inflating costs of advanced imaging outstripped that of any other medical service. The inflating costs resulted in up to $20 – 30 billion in unnecessary advanced imaging spending each year.

- **High cost.** Although the spending growth in advanced imaging dropped off after the early 2000s, 2014 costs to Medicare Part B for advanced imaging exceeded $2.4 billion for common conditions alone.
- **Limited effectiveness.** Multiple studies suggest that up to a third of advanced imaging procedures fail to contribute to diagnosis or are clinically inappropriate.
- **Patient safety.** Advanced diagnostic imaging often exposes the patient to ionizing radiation and/or contrast media, posing additional medical risks that must be weighed against the potential benefits of the imaging procedure.
- **Overdiagnosis and overtreatment.** There is an unrecognized risk of overdiagnosis and subsequent overtreatment that carries associated risks (e.g., drug reactions or unnecessary surgical interventions) if advanced imaging is performed in patients with low pretest probability. The Intermountain Imaging Criteria approach seeks to avoid these risks.

**GOALS AND MEASURES**

This CPM was developed by Intermountain clinical experts to outline appropriate use criteria (AUC) for advanced imaging for headache. These guidelines, together with those for other priority clinical areas, will improve the quality of care provided to patients by:

- Increasing adherence to evidence-based AUC for the use of advanced imaging
- Reducing imaging tests that do not conform to AUC or for which there are no guidelines
- Decreasing system-wide spending on unnecessary advanced imaging services
- Reducing the risk of harm from unwarranted radiation exposure
- Documenting the incidence of a significant positive on advanced imaging tests and aligning with downstream care
OVERVIEW: INTERMOUNTAIN IMAGING CRITERIA APPROPRIATE USE CRITERIA CONTENT

Intermountain Imaging Criteria appropriate use criteria (AUC) support clinicians in providing evidence-based care to the patients they serve. Although appropriate use of Intermountain Imaging Criteria fulfills compliance requirements under PAMA, patients only fully benefit from their use as they are deployed within the framework of a locally driven quality improvement program. To learn more about Intermountain’s process for developing and maintaining AUC, visit: https://intermountainhealthcare.org/services/imaging-services/intermountain-imaging-criteria/.

The care process model approach

Designed as Care Process Models (CPMs), the Intermountain Imaging Criteria AUC content is a blueprint that logically guides the delivery of evidence-based care via an algorithmic visual presentation (see pages 5 through 22). Although these Intermountain Imaging Criteria CPMs specifically focus on the appropriate use of advanced imaging, they can be viewed as portions of broader CPMs that guide not only diagnostic but therapeutic interventions for a specific disease or condition.

Ideally, Intermountain Imaging Criteria CPMs are engaged early in the patient encounter and guide the various considerations that lead to the ultimate decision regarding ordering of an imaging study. Point-of-order checklists are also included (beginning on page 23). These checklist-based guidelines are logically equivalent to the algorithms from which they are derived.

Knowing that local factors will invariably impact decisions about selecting the most appropriate exam, Intermountain Imaging Criteria CPMs specify the generally preferred exam but also provide alternative choices that may be appropriate in certain clinical settings.

Relative imaging cost and radiation risk rankings

To further aid providers, each algorithm includes a ranking of relative costs and radiation risk for each advanced imaging test recommended. The cost scale is derived using global non-facility relative-value units (RVUs) published by the Centers for Medicare and Medicaid Services (CMS) as a surrogate for cost. The radiation risk is derived from data published in 2010 by the Health Physics Society.

Evidentiary review and ranking

Intermountain used the following two conceptual frameworks for evidentiary review of relevant literature:

1. The 2011 revision of the Oxford Centre for Evidence-Based Medicine (OCEBM) 2011 Levels of Evidence standard. This standard includes categorical leveling grades relevant to diagnostic studies and rates individual sources of evidence (published papers or other research data) on a five-point scale.

2. The extensively used Fryback and Thornbury conceptual framework, which uses six levels for assessing the efficacy of diagnostic imaging.

Each algorithmic presentation provides both rankings for the decision node (pairing of AUC and recommended/alternative tests).

Using the algorithms and checklists

Under “Care Pathways” on page 3, there is an annotated algorithmic sample for a typical clinical scenario found in this CPM. Under “Point-of-Order Checklist” on page 4, there is an annotated sample of a typical point-of-order checklist for an imaging procedure recommended within the above sample algorithm.
Care pathways
For each clinical scenario included (e.g., headache plus suspected infection), there is an algorithmic presentation of the care pathway context for the imaging decisions made. This pathway contains not only the appropriate use criteria (AUC) and evidence-based advanced imaging recommendations, but also what constitutes significant positive imaging results and downstream care recommendations. Note that performing neuroimaging studies for chronic but stable headache (i.e., no new features and normal neurologic exam) is not recommended.

This page presents the elements of the care pathway below and key information provided in each test recommendation box at right. There is a legend at the bottom of each care pathway page.

The decision node box encompasses recommended advanced imaging based on the presence of evidence-based appropriate use criteria (AUC) or expert consensus (where evidence does not exist).

The Arabic number in the green box indicates an evidence ranking derived from the OCEBM scale. For this scale, the lower the number, the stronger the evidence ranking.

The Roman numeral in the orange box indicates an evidence ranking derived from the Fryback & Thornbury scale. For this scale, the higher the number, the stronger the evidence ranking.

Cost rankings are indicated based on a range developed from the CMS Global Relative Value Units (RVUs) as follows:

$ = 0 – 5 RVU
$$ = 5 – 10 RVU
$$$ = 10 – 15 RVU
$$$$ = 15+ RVU

Radiation risk rankings use the scale developed by the American College of Radiology. This rating framework offers the following six levels for adult effective dose range risk:

R0 = 0 mSv
R1 = < 0.1 mSv
R2 = 0.1 – 1 mSv
R3 = 1 – 10 mSv
R4 = 10 – 30 mSv
R5 = 30 – 100 mSv

An alternate imaging recommendation has been included for when the primary recommendation is contraindicated or the alternative recommendation may be clinically appropriate.

This symbol indicates an Intermountain internal measure. Intermountain measures incidence of significant positive results on advanced imaging tests.

This red flag signifies an urgent or emergency situation (sometimes this red flag indicates a scenario that may require bypassing the AUC logic).

Downstream care recommendations are general guidelines and are subject to the discretion of individual healthcare providers and the providers’ system protocols.
## Point-of-order checklists

For each advanced imaging test (e.g., MRI and CT), there is a checklist that compiles all of the appropriate use criteria from each clinical scenario (shown in the care pathways) for that test. These are presented in a checklist format for the provider to select the appropriate scenario AND the criteria that apply to the patient’s situation.

### Tables included on pages 23 through 28 indicate if the test is a primary recommendation or alternative recommendation.

### TABLE 8. MRI cervical spine WITHOUT CONTRAST (trauma protocol) appropriate use indications

<table>
<thead>
<tr>
<th>(PRIMARY recommendation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ HA + head and/or neck trauma (WITHOUT suspicion of cervical artery trauma):</td>
</tr>
<tr>
<td>□ CT brain/head or CT cervical spine completed</td>
</tr>
<tr>
<td>(WITH ANY OF THE FOLLOWING):</td>
</tr>
<tr>
<td>□ Suspected brain contusion</td>
</tr>
<tr>
<td>□ Suspicion for occult fracture or ligamentous injury</td>
</tr>
<tr>
<td>□ Known spondyloarthropathy (AS or DISH)</td>
</tr>
<tr>
<td>□ Persistent neurologic deficit</td>
</tr>
</tbody>
</table>
**HEADACHE (HA) CARE PATHWAY ALGORITHMS**

**DECISION NODE #1**

- **Existing HA disorder + clinical progression**
  - **AUC met?**
    - **yes**
      - Imaging: primary recommendation
        - MRI brain w/o contrast: NA** NA** $ R0
        - Imaging: alternative recommendation
          - CT brain/head w/o contrast*: NA** NA** $ R3
      - **yes**
    - **no**
      - PROVIDE additional care as clinically warranted. Imaging not recommended.

- **Significant positive result?**
  - **yes**
    - Secondary cause of HA identified
  - **no**
    - FOLLOW UP in outpatient setting AND CONSIDER referral to neurology

- **CONSULT with neurology OR REFER to neurology (URGENT)**

---

* MRI rather than CT should be performed for HA, except in emergency situations or when MRI is contraindicated.
** Based on expert opinion in the absence of literature-based evidence.

---

**LEGEND**

- Clinical Scenario
- Urgent or Emergency Situation
- 2 OCEBM Level of Evidence
- Fryback & Thornbury Level of Evidence
- Intermountain Measure
- RO (0 mSv) $ (0 – 5 RVUs)
- R3 (1 – 10 mSv) $ (5 – 10 RVUs)
- R4 (10 – 30 mSv) $ (10 – 15 RVUs)
- $ (15+ RVUs) See page 2 – 3 for explanation.

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INTERMOUNTAIN IMAGING CRITERIA FOR **Headache (HA)**

**DECISION NODE #2**

**Chronic HA + refractory / debilitating pain**

- AUC met?
  - Headache persistent for at least 3 months

**Imaging: primary recommendation**

- MRI brain w/o contrast
  - NA**
  - NA**
  - $ R0

**Imaging: alternative recommendation**

- CT brain/head w/o contrast*
  - NA**
  - NA**
  - $ R3

**Significant positive result?**

- Secondary cause of HA identified
  - yes

  - **CONSULT with neurology OR REFER to neurology (URGENT)**

  - no

  - **FOLLOW UP in outpatient setting AND CONSIDER referral to neurology**

---

**LEGEND**

- Clinical Scenario
- Urgent or Emergency Situation
- OCEBM Level of Evidence
- Fryback & Thornbury Level of Evidence
- Intermountain Measure
- RO (0 mSv)
- R3 (1 – 10 mSv)
- R4 (10 – 30 mSv)
- $ (0 – 5 RVUs)
- $S (5 – 10 RVUs)
- $$$ (10 – 15 RVUs)
- $$$S (15+ RVUs)

---

* MRI rather than CT should be performed for HA, except in emergency situations or when MRI is contraindicated.

** Based on expert opinion in the absence of literature-based evidence.

** PROVIDE additional care as clinically warranted. Imaging not recommended.

---

See abbreviations on page 2.
Focal neurologic deficits are considered in conjunction with headache as EITHER “acute” (onset < 24 hours ago) as indicated below OR “not acute” (onset > 24 hours ago or persistent) as indicated on page 8.

**DECISION NODE #3A**

HA + focal neurologic deficits (acute)

AUC met?

**ANY OF THESE** with onset < 24 hours ago:
- Altered mental status
- Weakness
- Sensory loss
- Visual symptoms (diplopia, field cut, etc.)
- Language deficit (aphasia)

yes → **EMERGENCY REFERRAL AND ACTIVATE** code stroke

Imaging: primary recommendation

<table>
<thead>
<tr>
<th>CT brain/head w/o contrast (STAT)</th>
<th>2</th>
<th>II</th>
<th>$</th>
<th>R3</th>
</tr>
</thead>
</table>

AND CONSIDER

| CTA head and neck; CT perfusion | 1 | II | $$$$ | R3 |

no → **PROVIDE** additional care as clinically warranted. Imaging not recommended.

**DECISION NODE #3A KEY EVIDENCE**


For a full list of references for all decision nodes, see bibliography on page 30.)
**Headache (HA)**

**DECISION NODE #3B**

**AUC met?**

Any of these with onset > 24 hours ago or persistent:
- Altered mental status
- Weakness
- Sensory loss
- Visual symptoms (diplopia, field cut, etc.)
- Language deficit (aphasia)

**yes**

**CONSIDER EMERGENCY REFERRAL**

**Imaging: primary recommendation**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Level of Evidence</th>
<th>Intermountain Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRI brain w/o contrast</td>
<td>II</td>
<td>$</td>
</tr>
</tbody>
</table>

**AND CONSIDER**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Level of Evidence</th>
<th>Intermountain Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRA head and neck</td>
<td>II</td>
<td>$555</td>
</tr>
</tbody>
</table>

**Imaging: alternative recommendation**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Level of Evidence</th>
<th>Intermountain Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT brain/head w/o contrast</td>
<td>II</td>
<td>$</td>
</tr>
</tbody>
</table>

**AND CONSIDER**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Level of Evidence</th>
<th>Intermountain Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTA head and neck*</td>
<td>II</td>
<td>$555</td>
</tr>
</tbody>
</table>

**no**

**PROVIDE** additional care as clinically warranted. Imaging not recommended.

**DECISION NODE #3B KEY EVIDENCE**


For a full list of references for all decision nodes, see bibliography on page 30.

---

**LEGEND**

- **Clinical Scenario**
- **Urgent or Emergency Situation**
- **OCEBM Level of Evidence**
- **Fryback & Thornbury Level of Evidence**
- **Intermountain Measure**
  - R0 (0 mSv)
  - R3 (1–10 mSv)
  - R4 (10–30 mSv)
- **RVUs**
  - $ (0–5 RVUs)
  - $$ (5–10 RVUs)
  - $$$ (10–15 RVUs)
  - $$$$ (15+ RVUs)

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**INTERRUPT IMAGING CRITERIA FOR Headache (HA)**

**DECISION NODE #4**

**HA + elevated bleeding risk***
- New or worsening headache
- Patient currently taking an anticoagulant

**AUC met (IF BOTH)?**
- Yes → **CONSIDER EMERGENCY REFERRAL for acute symptoms**
- No → **PROVIDE additional care as clinically warranted. Imaging not recommended.**

**Imaging: primary recommendation**
- CT brain/head w/o contrast
  - NA**
  - NA**
  - $ R3

**Significant positive result?**
- Yes → CONSULT with neurology and/or neurosurgery (EMERGENCY)
- No → FOLLOW UP in outpatient setting

**Urgent or Emergency Situation**
- Clinical Scenario
- OCEBM Level of Evidence (2)
- Fryback & Thornbury Level of Evidence (II)
- Intermountain Measure
  - $ (0 – 5 RVUs)
  - $ (5 – 10 RVUs)
  - $ (10 – 15 RVUs)
  - $ (15+ RVUs)

---

**Risk factors include anticoagulant treatment, low platelets, liver dysfunction, etc.**

**Based on expert opinion in the absence of literature-based evidence.**

---

See abbreviations on page 2.
Suspected subarachnoid hemorrhage

**AUC met?**
- Sudden severe headache
- ANY OF THESE:
  - Peak pain within 1 hour of onset
  - Age > 40 years
  - Neck pain or stiffness
  - Witnessed loss of consciousness
  - Sudden or severe headache triggered by cough/sneeze, Valsalva, sex, or exercise/exertion
  - Limited neck flexion on exam

**SYMPTOM ONSET > 6 HOURS?**
- no
- yes

**CONSIDER EMERGENCY REFERRAL for acute symptoms**

**Imaging: primary recommendation**
- CT brain/head w/o contrast (STAT)
- CTA head and neck

**Imaging: alternative recommendation**
- CT brain/head w/o contrast AND CTA head and neck
- MRA brain/head w/o contrast AND MRA neck w/o contrast

**Significant positive result?**
- Hemorrhage
- Stroke
- Aneurysm

**Imaging: primary recommendation**
- CTA head and neck

**Imaging: alternative recommendation**
- MRI brain w/o contrast AND MRA brain/head w/o contrast AND MRA neck w/o contrast

**CONSULT with neurology and/or neurosurgery (EMERGENCY)**

**Presence of both?**
- No further imaging indicated. **
- PROVIDE additional care as clinically warranted.

**CONSIDER lumbar puncture vs additional imaging. USE shared decision making to select the best modality for each patient after weighing the potential for false-positive imaging and the pros and cons associated with lumbar puncture.**

---

**LEGEND**
- Clinical Scenario
- Urgent or Emergency Situation
- OCEBM Level of Evidence
- Fryback & Thornbury Level of Evidence
- Intermountain Measure
- R0 (0 mSv)
- R3 (1 – 10 mSv)
- R4 (10 – 30 mSv)
- $0 (0 – 5 RVUs)
- $5 (5 – 10 RVUs)
- $$ $5 (10 – 15 RVUs)
- $$ $ (15+ RVUs)

* Based on expert opinion in the absence of literature-based evidence.
** Normal CT brain w/o contrast (3rd generation scanner) within 6 hours of symptom onset in an ED headache patient with a normal neuro exam can rule out non-traumatic subarachnoid hemorrhage.

---

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For a full list of references for all decision nodes, see bibliography on page 30.)
**DECISION NODE #6 KEY EVIDENCE**


For a full list of references for all decision nodes, see bibliography on page 30.

**LEGEND**

- Clinical Scenario
- Urgent or Emergency Situation
- Level of Evidence
- Level of Evidence
- Fryback & Thornbury Level of Evidence
- Intermountain Measure
- R0 (0 mSv) $ (0–5 RVUs)
- R3 (1–10 mSv) $ (5–10 RVUs)
- R4 (10–30 mSv) $ (10–15 RVUs)
- $ (15+ RVUs) See page 2–3 for explanation.
Headache with elevated intracranial pressure (ICP) or papilledema are considered in terms of chronicity – EITHER acute or subacute/chronic (see below) – AND in terms of known or suspected hypercoagulable state (see page 14). See abbreviations on page 2.

* Including dehydration.
** Based on expert opinion in the absence of literature-based evidence.

**DETECTION NODE #7A**

- **AUC met (IF ANY)?**
  - Yes:
    - Imaging: primary recommendation
      - MRI brain w/and w/o contrast: 4 I $ S $ R0
  - No:
    - PROVIDE additional care as clinically warranted

- **Significant positive result?**
  - Mass lesion(s)
    - Yes:
      - REFER to ophthalmology for papilledema AND CONSIDER neurology referral for evaluation of idiopathic intracranial hypertension
    - No:
      - CONSULT with neurosurgery, neuro-oncology, and/or neurology (URGENT)
  - Hydrocephalus
    - Yes:
      - CONSULT with neurosurgery and/or neurology (URGENT)
    - No:
      - CONSIDER emergency referral for acute symptoms
**INTERMOUNTAIN IMAGING CRITERIA FOR Headache (HA)**

**DECISION NODE #7B**

**Imaging: primary recommendation**

- MRI brain w/ and w/o contrast
  - Level of Evidence: 4
  - Measure: 1
  - RVUs: $ (10 – 15 RVUs)
  - Dose: R0

**Imaging: alternative recommendation**

- CT brain/head w/o contrast
  - Level of Evidence: NA
  - Measure: NA
  - RVUs: $ (5 – 10 RVUs)
  - Dose: R3

**Significant positive result?**

- Venous sinus thrombosis
  - Yes → CONSULT with neurology (EMERGENCY)

**DECISION NODE #7 KEY EVIDENCE**


For a full list of references for all decision nodes, see bibliography on page 30.

* Including dehydration.
** Based on expert opinion in the absence of literature-based evidence.

See abbreviations on page 2.
INTERMOUNTAIN IMAGING CRITERIA FOR **Headache (HA)**

**DECISION NODE #8**

- **HA + suspected meningitis**
  - **AUC met (IF EITHER)?**
    - yes → **CONSIDER EMERGENCY REFERRAL for acute symptoms**
      - Imaging: primary recommendation
        - CT brain/head w/o contrast
          - Level of Evidence: 2
          - Measure: $ (0 – 5 RVUs)
          - Risk: R3
      - Imaging: alternative recommendation
        - MRI brain w/ and w/o contrast
          - Level of Evidence: 2
          - Measure: $ (5 – 10 RVUs)
          - Risk: R0
    - no → PROVIDE additional care as clinically warranted. Imaging not recommended.

- **Significant positive result?**
  - yes → CONSULT with neurosurgery if brain abscess (EMERGENCY)
    - Findings suggestive of:
      - Meningitis
      - Encephalitis
  - no → CONSIDER referral to medicine, ICU, infectious disease, and/or neurology

**DECISION NODE #8 KEY EVIDENCE**


For a full list of references for all decision nodes, see bibliography on page 30.

**LEGEND**

- Clinical Scenario
- Urgent or Emergency Situation
- OCEBM Level of Evidence
- Fryback & Thornbury Level of Evidence
- Intermountain Measure
- RO (0 mSv)
- R3 (1 – 10 mSv)
- R4 (10 – 30 mSv)
- $ (0 – 5 RVUs)
- $ (5 – 10 RVUs)
- $ (10 – 15 RVUs)
- $ $ $ $ (15+ RVUs)
Headache in conjunction with suspected cervical artery dissection is considered EITHER "with acute trauma" (see below) OR "without acute trauma" (see page 17).

**DECISION NODE #9A**

**AUC met (IF ANY)?**
- Facial or neck pain
- Neurologic deficit(s) and/or stroke
- Horner syndrome: Miosis, ptosis, anhidrosis

**CONSIDER EMERGENCY REFERRAL for acute symptoms**

**Imaging: primary recommendation**
- CT brain/head w/o contrast
  - NA** NA** $ R3
  - AND
  - CTA head and neck*
  - 1 II $$$$ R3

**Significant positive result?**
- Cervical spine injury
  - yes → CONSULT with neurosurgery and/or orthopedic spine
  - no → Significant positive result?
- Intracranial and/or cervical artery dissection
  - yes → CONSULT with neurology and/or interventional radiology
  - no → Significant positive result?
- Stroke
  - yes → CONSULT with neurology and/or interventional radiology
  - no → Stroke

**Reporting AUC met (IF ANY)?**
- • Facial or neck pain
- • Neurologic deficit(s) and/or stroke
- • Horner syndrome: Miosis, ptosis, anhidrosis

**Imaging: primary recommendation**
- MRI brain w/o contrast
  - 5 II $ R0
- MRA head and neck
  - 4 II $$$$ R0

**Refer to the Concussion CPM and/or Neck Pain CPM or other system-wide protocol**

---

* Include CT cervical spine reformats from CTA data set.
** Based on expert opinion in the absence of literature-based evidence.
HA with neck/facial pain + suspected cervical artery dissection (WITHOUT acute trauma)

**DECISION NODE #9B**

**AUC met (IF ANY)?**
- Neurologic deficit(s) and/or stroke
- Horner syndrome: Miosis, ptosis, anhidrosis

**Consider EMERGENCY referral**

**Imaging: primary recommendation**
- CTA head and neck* 1 II $$$$ R3

**Significant positive result?**
- yes
  - CONSULT with neurology and/or interventional radiology

**no**

**AUC met (IF ANY)?**
- CTA completed
- Clinical suspicion with negative CTA

**Imaging: primary recommendation**
- MRI brain w/o contrast 5 II $ R0
- MRA head and neck 4 II $$$$ R0

**Significant positive result?**
- yes
  - Stroke
- no

**REFER to the Concussion CPM and/or Neck Pain CPM or other system-wide protocol**

---

*Include CT cervical spine reformats from CTA data set.

---

**LEGEND**
- **Clinical Scenario**
- **Urgent or Emergency Situation** 2 OCEBM Level of Evidence
- **Fryback & Thornbury Level of Evidence** II
- **Intermountain Measure**
  - R0 (0 mSv)
  - R3 (1–10 mSv)
  - R4 (10–30 mSv)
  - $ (0–5 RVUs)
  - $ (5–10 RVUs)
  - $ (10–15 RVUs)
  - $ (15+ RVUs)

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INTERMOUNTAIN IMAGING CRITERIA FOR **Headache (HA)**

**DECISION NODE #9 KEY EVIDENCE**


For a full list of references for all decision nodes, see bibliography on page 30.)
**INTERMOUNTAIN IMAGING CRITERIA FOR Headache (HA)**

**LEGEND**
- **Clinical Scenario**
- **Urgent or Emergency Situation**
- **CEBM Level of Evidence**
- **Fryback & Thornbury Level of Evidence**
- **Intermountain Measure**

**DECISION NODE #10**

**HA + head and/or neck trauma (without suspicion of cervical artery trauma)**

- **AUC met (IF ANY)?**
  - Acute or subacute head and/or neck trauma

**CONSIDER EMERGENCY REFERRAL for acute symptoms**

**Imaging: primary recommendation**

- **CT brain/head w/o contrast**
  - Level of Evidence: II
  - Measure: $3\hspace{1cm}R$3
- **CT cervical spine w/o contrast**
  - Level of Evidence: II
  - Measure: $$3\hspace{1cm}R$3

**Significant positive result?**

- **yes**
  - CONSULT with neurology and/or neurosurgery
- **no**
  - **AUC met?**
    - yes
      - **Imaging: primary recommendation**
        - **MRI brain w/o contrast**
          - Level of Evidence: II
          - Measure: $4\hspace{1cm}R$0
        - **MRI cervical spine w/o contrast (trauma protocol)**
          - Level of Evidence: II
          - Measure: $$4\hspace{1cm}R$0
      - **CONSULT with neurology and/or neurosurgery**
    - no
      - **AUC met?**
        - yes
          - **Imaging: primary recommendation**
            - **CT brain/head or CT cervical spine completed (WITH ANY OF THE FOLLOWING):**
              - Suspected brain contusion
              - Suspicion for occult fracture or ligamentous injury
              - Known spondyloarthropathy (AS or DISH)
              - Persistent neurologic deficit
            - **CT brain/head or CT cervical spine w/o contrast**
              - Level of Evidence: II
              - Measure: $3\hspace{1cm}R$3
            - **CT cervical spine w/o contrast**
              - Level of Evidence: II
              - Measure: $$3\hspace{1cm}R$3
          - **CONSULT with neurology and/or neurosurgery**
        - no
          - **REFERR to the Concussion CPM and/or Neck Pain CPM or other system-wide protocol**

See abbreviations on page 2.
DECISION NODE #10 KEY EVIDENCE


For a full list of references for all decision nodes, see bibliography on page 30.)
**INTERMOUNTAIN IMAGING CRITERIA FOR Headache (HA)**

**LEGEND**

OCEBM Level of Evidence

Fryback & Thornbury Level of Evidence

Intermountain Measure

$ (0 – 5 RVUs)

$ (5 – 10 RVUs)

$ (10 – 15 RVUs)

$ (15+ RVUs)

**DECISION NODE #11**

HA + suspicion for giant cell/ temporal arteritis

**AUC met (IF ALL)?**
- New or progressive headache
- Age > 50
- Visual symptoms

**DECISION NODE #11 KEY EVIDENCE**


* Based on expert opinion in the absence of literature-based evidence.

**Imaging: primary recommendation**

MRI brain w/o contrast

**Imaging: alternative recommendation**

CT brain/head w/o contrast

**Significant positive result?**

**no**

**no**

**CONSULT** with neurology

**FOLLOW UP** in outpatient setting, **AND CONSIDER** referral to neurology and/or rheumatology

**DECISION NODE #11 KEY EVIDENCE**

For a full list of references for all decision nodes, see bibliography on page 30.
INTERMOUNTAIN IMAGING CRITERIA FOR Headache (HA)

DECISION NODE #12

HA + trigeminal distribution*

AUC met?
Positive neurologic symptoms (including but not limited to altered sensation)**

- yes
- no

Imaging: primary recommendation
MRI brain w/ and w/o contrast (trigeminal protocol)

- Positive neurologic symptoms (including but not limited to altered sensation)
- MRI brain w/ and w/o contrast (trigeminal protocol)

- R0
- II
- $$$

- Significant positive result?
- no

FOLLOW UP in outpatient setting AND CONSIDER referral to neurology for medically refractory TN

- yes

CONSULT with ENT / neurosurgery

- no

Imaging: primary recommendation
CT brain / head w/ and w/o contrast***

- V1: Orbital, periorbital, frontal/ethmoid sinuses.
- Imaging not generally needed in patients with TN symptoms and a normal exam. Consider alternative diagnoses (sinusitis, mastoiditis, and/or dental pathology).
- MRI rather than CT should be performed for HA, except in emergency situations or when MRI is contraindicated.

- Significant positive result?
- no

CONSULT with neurology and/or neurosurgery

- yes

PROVIDE additional care as clinically warranted. Imaging not recommended

DECISION NODE #12 KEY EVIDENCE


For a full list of references for all decision nodes, see bibliography on page 30.)

See abbreviations on page 2.
### TABLE 1. MRI brain WITHOUT CONTRAST appropriate use indications

<table>
<thead>
<tr>
<th>(PRIMARY recommendation)</th>
<th>(ALTERNATIVE recommendation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Existing HA disorder + clinical progression:</td>
<td>□ Suspected subarachnoid hemorrhage (symptom onset &gt; 6 hours)</td>
</tr>
<tr>
<td>□ Significant increase in headache frequency, severity, or duration</td>
<td>□ Sudden severe headache</td>
</tr>
<tr>
<td>□ Chronic HA + refractory / debilitating pain:</td>
<td>AND ANY OF THESE:</td>
</tr>
<tr>
<td>□ Headache persistent for at least 3 months</td>
<td>□ Peak pain within 1 hour of onset</td>
</tr>
<tr>
<td>□ HA + focal neurologic deficits (NOT acute):</td>
<td>□ Age &gt; 40 years</td>
</tr>
<tr>
<td>ANY OF THESE: with onset &gt; 24 hours ago or persistent:</td>
<td>□ Neck pain or stiffness</td>
</tr>
<tr>
<td>□ Altered mental status</td>
<td>□ Witnessed loss of consciousness</td>
</tr>
<tr>
<td>□ Weakness</td>
<td>□ Sudden or severe headache triggered by cough/sneeze,Valsalva, sex, or exercise/exertion</td>
</tr>
<tr>
<td>□ Sensory loss</td>
<td>□ Limited neck flexion on exam</td>
</tr>
<tr>
<td>□ Visual symptoms (diplopia, field cut, etc.)</td>
<td>□ Suspected subarachnoid hemorrhage (IF ANY):</td>
</tr>
<tr>
<td>□ Language deficit (aphasia)</td>
<td>□ Negative CT brain/head w/o contrast&gt;6 hours from onset of symptoms</td>
</tr>
<tr>
<td>□ HA + suspected cervical artery dissection (WITH ACUTE trauma) (IF ANY):</td>
<td>□ Positive CT brain/head w/o contrast</td>
</tr>
<tr>
<td>□ Facial or neck pain</td>
<td>□ Abnormal neuro exam</td>
</tr>
<tr>
<td>□ Neurologic deficit(s) and / or stroke</td>
<td>□ High clinical suspicion</td>
</tr>
<tr>
<td>□ Horner syndrome: Miosis, ptosis, anhidrosis AND EITHER:</td>
<td></td>
</tr>
<tr>
<td>□ CTA completed</td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>□ Clinical suspicion with negative CTA</td>
<td></td>
</tr>
<tr>
<td>□ HA w/ neck/facial pain + suspected cervical artery dissection (WITHOUT acute trauma):</td>
<td></td>
</tr>
<tr>
<td>□ Neurologic deficit(s) and / or stroke</td>
<td></td>
</tr>
<tr>
<td>□ Horner syndrome: Miosis, ptosis, anhidrosis AND EITHER:</td>
<td></td>
</tr>
<tr>
<td>□ CTA completed</td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>□ Clinical suspicion with negative CTA</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 2. MRA head and neck appropriate use indications

(PRIMARY recommendation)

- HA + focal neurologic deficits (NOT acute)
  (ANY OF THESE with onset > 24 hours ago or persistent):
  - Altered mental status
  - Weakness
  - Sensory loss
  - Visual symptoms (diplopia, field cut, etc.)
  - Language deficit (aphasia)
- HA + suspected cervical artery dissection (WITH acute trauma) (IF ANY):
  - Facial or neck pain
  - Neurologic deficit(s) and/or stroke
  - Horner syndrome: Miosis, ptosis, anhidrosis
  - CTA completed
  - Clinical suspicion with negative CTA
- HA + suspected cervical artery dissection (WITHOUT acute trauma) (IF ANY):
  - Neurologic deficit(s) and/or stroke
  - Horner syndrome: Miosis, ptosis, anhidrosis
  - CTA completed
  - Clinical suspicion with negative CTA

### TABLE 3. MRA brain/head WITHOUT CONTRAST appropriate use indications

(ALTERNATIVE recommendation)

- Suspected subarachnoid hemorrhage (symptom onset > 6 hours)
  - Sudden severe headache
  - ANY OF THESE:
    - Peak pain within 1 hour of onset
    - Age > 40 years
    - Neck pain or stiffness
    - Witnessed loss of consciousness
    - Sudden or severe headache triggered by cough/sneeze, Valsalva, sex, or exercise/exertion
  - Limited neck flexion on exam
- Suspected subarachnoid hemorrhage (IF ANY):
  - Negative CT brain/head w/o contrast > 6 hours from onset of symptoms
  - Positive CT brain/head w/o contrast
  - Abnormal neuro exam
  - High clinical suspicion

### TABLE 4. MRA neck WITHOUT CONTRAST appropriate use indications

(ALTERNATIVE recommendation)

- Suspected subarachnoid hemorrhage (symptom onset > 6 hours)
  - Sudden severe headache
  - ANY OF THESE:
    - Peak pain within 1 hour of onset
    - Age > 40 years
    - Neck pain or stiffness
    - Witnessed loss of consciousness
    - Sudden or severe headache triggered by cough/sneeze, Valsalva, sex, or exercise/exertion
  - Limited neck flexion on exam
- Suspected subarachnoid hemorrhage (IF ANY):
  - Negative CT brain/head w/o contrast > 6 hours from onset of symptoms
  - Positive CT brain/head w/o contrast
  - Abnormal neuro exam
  - High clinical suspicion

See abbreviations on page 2.
# POINT-OF-ORDER CHECKLISTS, CONTINUED

## TABLE 5. MRI brain WITH AND WITHOUT CONTRAST appropriate use indications

<table>
<thead>
<tr>
<th>PRIMARY recommendation</th>
<th>ALTERNATIVE recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ HA + known or suspected cancer:</td>
<td></td>
</tr>
<tr>
<td>□ New headache</td>
<td></td>
</tr>
<tr>
<td>□ Suspected elevated ICP or papilledema (NO hypercoagulable state)* (IF ANY):</td>
<td></td>
</tr>
<tr>
<td>□ Visual symptoms</td>
<td></td>
</tr>
<tr>
<td>□ Increased pain when lying down</td>
<td></td>
</tr>
<tr>
<td>□ Increased pain in the morning</td>
<td></td>
</tr>
<tr>
<td>□ Pain aggravated by Valsalva</td>
<td></td>
</tr>
<tr>
<td>□ HA + suspected elevated ICP or papilledema (known or suspected hypercoagulable state)* (IF ANY):</td>
<td></td>
</tr>
<tr>
<td>□ Visual symptoms</td>
<td></td>
</tr>
<tr>
<td>□ Increased pain when lying down</td>
<td></td>
</tr>
<tr>
<td>□ Increased pain in the morning</td>
<td></td>
</tr>
<tr>
<td>□ Pain aggravated by Valsalva</td>
<td></td>
</tr>
</tbody>
</table>

### TRIGEMINAL PROTOCOL

| HA + trigeminal distribution**: |
| Positive neurologic symptoms (including but not limited to altered sensation***) |

* Including dehydration.

** V1: Orbital, periorbital, frontal/ethmoid sinuses; V2: Cheek, maxillary sinus, upper teeth; V3: Jaw, lower teeth.

*** Imaging not generally needed in patients with TN symptoms and a normal exam. Consider alternative diagnoses (sinusitis, mastoiditis, and/or dental pathology).

---

## TABLE 6. MR venogram brain / head WITH AND WITHOUT CONTRAST appropriate use indications

<table>
<thead>
<tr>
<th>PRIMARY recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ HA + suspected meningitis (IF EITHER):</td>
</tr>
<tr>
<td>□ Fever</td>
</tr>
<tr>
<td>□ Nuchal rigidity</td>
</tr>
</tbody>
</table>

---

## TABLE 7. MRI cervical spine WITHOUT CONTRAST (trauma protocol) appropriate use indications

<table>
<thead>
<tr>
<th>PRIMARY recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ HA + head and/or neck trauma (WITHOUT suspicion of cervical artery trauma):</td>
</tr>
<tr>
<td>□ CT brain / head or CT cervical spine completed</td>
</tr>
</tbody>
</table>

### (WITH ANY OF THE FOLLOWING):

| Suspected brain contusion |
| Suspicion for occult fracture or ligamentous injury |
| Known spondyloarthropathy (AS or DISH) |
| Persistent neurologic deficit |

---

See abbreviations on page 2.
### TABLE 8. CT brain/head WITHOUT CONTRAST appropriate use indications*

<table>
<thead>
<tr>
<th>PRIMARY recommendation</th>
<th>ALTERNATIVE recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HA + elevated bleeding risk</strong></td>
<td><strong>Existing HA disorder + clinical progression</strong>:</td>
</tr>
<tr>
<td><strong>(IF BOTH)</strong>:</td>
<td>Valor surgical increase in headache</td>
</tr>
<tr>
<td>- New or worsening headache</td>
<td>frequency, severity, or duration</td>
</tr>
<tr>
<td>- Patient currently taking an</td>
<td><strong>HA + focal neurologic deficits (ACUTE): ANY OF THESE (with onset &lt; 24 hours ago)</strong>:</td>
</tr>
<tr>
<td>anticoagulant</td>
<td>- Altered mental status</td>
</tr>
<tr>
<td><strong>HA + suspected meningitis</strong></td>
<td>- Weakness</td>
</tr>
<tr>
<td><strong>(IF EITHER)</strong>:</td>
<td>- Sensory loss</td>
</tr>
<tr>
<td>- Fever</td>
<td>- Visual symptoms (dioplia, field cut, etc.)</td>
</tr>
<tr>
<td>- Nuchal rigidity</td>
<td>- Language deficit (aphasia)</td>
</tr>
<tr>
<td><strong>HA + suspected cervical artery dissection (WITH ACUTE trauma)</strong></td>
<td><strong>HA + focal neurologic deficits (NOT acute): ANY OF THESE: with onset &gt; 24 hours ago or persistent</strong>:</td>
</tr>
<tr>
<td><strong>(IF ANY)</strong>:</td>
<td>- Altered mental status</td>
</tr>
<tr>
<td>- Facial or neck pain</td>
<td>- Weakness</td>
</tr>
<tr>
<td>- Neurologic deficit(s) and/or stroke</td>
<td>- Sensory loss</td>
</tr>
<tr>
<td>- Horner syndrome: Miosis, ptosis, anhidrosis</td>
<td>- Visual symptoms (dioplia, field cut, etc.)</td>
</tr>
<tr>
<td><strong>HA + head and/or neck trauma (WITHOUT suspicion of cervical artery trauma)</strong>:</td>
<td>- Language deficit (aphasia)</td>
</tr>
<tr>
<td>- Acute or subacute head and/or neck trauma</td>
<td><strong>Suspected subarachnoid hemorrhage (symptom onset &gt; 6 hours)</strong>:</td>
</tr>
<tr>
<td></td>
<td><strong>Sudden severe headache AND ANY OF THESE:</strong></td>
</tr>
<tr>
<td></td>
<td>- Peak pain within 1 hour of onset</td>
</tr>
<tr>
<td></td>
<td>- Age &gt; 40</td>
</tr>
<tr>
<td></td>
<td>- Neck pain or stiffness</td>
</tr>
<tr>
<td></td>
<td>- Witnessed loss of consciousness</td>
</tr>
<tr>
<td></td>
<td>- Sudden or severe headache triggered by: cough/sneeze, Valsalva, sex, or exercise/exertion</td>
</tr>
<tr>
<td></td>
<td>- Limited neck flexion on exam</td>
</tr>
<tr>
<td><strong>STAT</strong></td>
<td><strong>Suspected subarachnoid hemorrhage (symptom onset &gt; 6 hours)</strong>:</td>
</tr>
<tr>
<td></td>
<td><strong>Sudden severe headache AND ANY OF THESE:</strong></td>
</tr>
<tr>
<td></td>
<td>- Peak pain within 1 hour of onset</td>
</tr>
<tr>
<td></td>
<td>- Age &gt; 40</td>
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<td>- Neck pain or stiffness</td>
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<td></td>
<td>- Witnessed loss of consciousness</td>
</tr>
<tr>
<td></td>
<td>- Sudden or severe headache triggered by: cough/sneeze, Valsalva, sex, or exercise/exertion</td>
</tr>
<tr>
<td></td>
<td>- Limited neck flexion on exam</td>
</tr>
</tbody>
</table>

* MRI rather than CT should be performed for headache, except in emergency situations or when MRI is contraindicated.

** Risk factors include anticoagulant treatment, low platelets, liver dysfunction, etc.

*** CT head is not required prior to every lumbar puncture, but is recommended if have clinical suspicion of elevated intracranial pressure or altered mental status.

**** Including dehydration.
# TABLE 9. CTA head and neck, CT perfusion appropriate use indications

**PRIMARY recommendation**

- **HA + focal neurologic deficits (ACUTE):**
  - ANY OF THESE (with onset < 24 hours ago):
    - Altered mental status
    - Weakness
    - Sensory loss
    - Visual symptoms (diplopia, field cut, etc.)
    - Language deficit (aphasia)

- **Suspected subarachnoid hemorrhage (symptom onset > 6 hours):**
  - Sudden severe headache

**AND ANY OF THESE:**

- Peak pain within 1 hour of onset
- Age > 40
- Neck pain or stiffness
- Witnessed loss of consciousness
- Sudden or severe headache triggered by: cough/sneeze, Valsalva, sex, or exercise/exertion
- Limited neck flexion on exam

- **Suspected subarachnoid hemorrhage (IF ANY):**
  - Negative CT brain/head w/o contrast > 6 hours from onset of symptoms
  - Positive CT brain/head w/o contrast
  - Abnormal neuro exam
  - High clinical suspicion

- **HA + suspected cervical artery dissection (WITH ACUTE trauma)* (IF ANY):**
  - Facial or neck pain
  - Neurologic deficit(s) and/or stroke
  - Horner syndrome: Miosis, ptosis, anhidrosis

- **HA + suspected cervical artery dissection (WITHOUT ACUTE trauma)* (IF ANY):**
  - Neurologic deficit(s) and/or stroke
  - Horner syndrome: Miosis, ptosis, anhidrosis

* Include CT cervical spine reformats from CTA data set.

---

# TABLE 10. CTA head and neck appropriate use indications

**PRIMARY recommendation**

- **Suspected subarachnoid hemorrhage (symptom onset > 6 hours):**
  - Sudden severe headache

**AND ANY OF THESE:**

- Peak pain within 1 hour of onset
- Age > 40
- Neck pain or stiffness
- Witnessed loss of consciousness
- Sudden or severe headache triggered by: cough/sneeze, Valsalva, sex, or exercise/exertion
- Limited neck flexion on exam

- **Suspected subarachnoid hemorrhage (IF ANY):**
  - Negative CT brain/head w/o contrast > 6 hours from onset of symptoms
  - Positive CT brain/head w/o contrast
  - Abnormal neuro exam
  - High clinical suspicion

- **HA + suspected cervical artery dissection (WITH ACUTE trauma)* (IF ANY):**
  - Facial or neck pain
  - Neurologic deficit(s) and/or stroke
  - Horner syndrome: Miosis, ptosis, anhidrosis

- **HA + suspected cervical artery dissection (WITHOUT ACUTE trauma)* (IF ANY):**
  - Neurologic deficit(s) and/or stroke
  - Horner syndrome: Miosis, ptosis, anhidrosis

* Include CT cervical spine reformats from CTA data set.

---

# TABLE 11. CTA head and neck appropriate use indications*

**ALTERNATIVE recommendation**

- **HA + focal neurologic deficits (NOT acute):**
  - ANY OF THESE (with onset >24 hours ago or persistent):
    - Altered mental status
    - Weakness
    - Sensory loss
    - Visual symptoms (diplopia, field cut, etc.)
    - Language deficit (aphasia)

---

# TABLE 12. CT brain / head WITH AND WITHOUT CONTRAST appropriate use indications*

**ALTERNATIVE recommendation**

- **HA + known or suspected cancer**
- **New headache**

**TRIGEMINAL PROTOCOL**

- **HA + trigeminal distribution****:
  - Positive neurologic symptoms (including but not limited to altered sensation***)

---

* MRI rather than CT should be performed for headache, except in emergency situations or when MRI is contraindicated.

** V1: Orbital, periorbital, frontal/ethmoid sinuses; V2: Cheek, maxillary sinus, upper teeth; V3: Jaw, lower teeth.

*** Imaging not generally needed in patients with TN symptoms and a normal exam. Consider alternative diagnoses (sinusitis, mastoiditis, and/or dental pathology).
### TABLE 13. CT venogram brain/head appropriate use indications

(AlTERNATIVE recommendation)

- HA + suspected elevated ICP or papilledema (known or suspected hypercoagulable state)* (IF ANY):
  - Visual symptoms
  - Increased pain when lying down
  - Increased pain in the morning
  - Pain aggravated by Valsalva

* Including dehydration.

### TABLE 14. CT cervical spine WITHOUT CONTRAST appropriate use indications

(PRIMARY recommendation)

- HA + head and/or neck trauma (WITHOUT suspicion of cervical artery trauma):
  - Acute or subacute head and/or neck trauma

See abbreviations on page 2.
RESOURCES

Intermountain provides educational materials designed to support providers in their efforts to care for, educate, and engage patients and their families.

**Intermountain’s patient education materials** complement and reinforce clinical team interventions by providing a means for patients to reflect and learn in another mode and at their own pace.

**Intermountain’s Care Process Models (CPMs)** outline evidence-based guidelines for patient care. In addition to the suite of Intermountain Imaging Criteria CPMs, Intermountain provides topical CPMs that have been developed by expert clinical teams. They can be accessed by navigating to [http://www.intermountainphysician.org](http://www.intermountainphysician.org) and selecting **Care Process Models** in the **Tools & Resources** drop down menu.

To access Intermountain’s Imaging Criteria CPMs and supporting materials, visit: [https://intermountainhealthcare.org/services/imaging-services/intermountain-imaging-criteria/](https://intermountainhealthcare.org/services/imaging-services/intermountain-imaging-criteria/).

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**Fact sheets:**
- **Computed Tomography (CT) Scan**
  - (English) / (Spanish)
- **Spine Injury and Orthotic Braces**
  - (English) / (Spanish)

**Patient education:**
- **Managing Chronic Pain**
  - (English)
- **Pain Medicine Tracker**
  - (English) / (Spanish)

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**Related Care Process Models (CPMs):**

- **Concussion CPM**
- **Neck Pain CPM**
- **Prescribing Opioids for Chronic Non-Cancer Pain CPM**
- **Imaging Radiation Exposure CPM**
BIBLIOGRAPHY

NODE #1
Recommendations based on expert opinion in the absence of literature-based evidence.

NODE #2
Recommendations based on expert opinion in the absence of literature-based evidence.

NODE #3

NODE #4
Recommendations based on expert opinion in the absence of literature-based evidence.

NODE #5

NODE #6

NODE #7
**BIBLIOGRAPHY, CONTINUED**

**NODE #8**

**NODE #9**

**NODE #10**

**NODE #11**

**NODE #12**
REFERENCES (from pages 1 and 2)


This CPM presents a model of best care based on the best available scientific evidence at the time of publication. It is not a prescription for every physician or every patient, nor does it replace clinical judgment. All statements, protocols, and recommendations herein are viewed as transitory and iterative. Although physicians are encouraged to follow the CPM to help focus on and measure quality, deviations are a means for discovering improvements in patient care and expanding the knowledge base.