Through its Proven Imaging 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 PROVEN IMAGING?**

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. These 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 Proven Imaging 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

**WHAT’S INSIDE?**

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PROVEN IMAGING FOR Headache (HA)

OVERVIEW: PROVEN IMAGING APPROPRIATE USE CRITERIA CONTENT

Intermountain Proven Imaging appropriate use criteria (AUC) support clinicians in providing evidence-based care to the patients they serve. Although appropriate use of Proven Imaging 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/proven-imaging/.

The care process model approach
Designed as Care Process Models (CPMs), the Proven Imaging 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 Proven Imaging 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, Proven Imaging 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, Proven Imaging 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. The OCEBM 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.

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.

Abbreviations used in this CPM

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUC</td>
<td>appropriate use criteria</td>
</tr>
<tr>
<td>CMS</td>
<td>Centers for Medicare and Medicaid Services</td>
</tr>
<tr>
<td>CPG</td>
<td>clinical practice guideline</td>
</tr>
<tr>
<td>CPM</td>
<td>care process model</td>
</tr>
<tr>
<td>CSF</td>
<td>cerebral spinal fluid</td>
</tr>
<tr>
<td>CT</td>
<td>computed tomography</td>
</tr>
<tr>
<td>CTA</td>
<td>computed tomographic angiography</td>
</tr>
<tr>
<td>ENT</td>
<td>ear, nose, and throat</td>
</tr>
<tr>
<td>HA</td>
<td>headache</td>
</tr>
<tr>
<td>ICP</td>
<td>intracranial pressure</td>
</tr>
<tr>
<td>LP</td>
<td>lumbar puncture</td>
</tr>
<tr>
<td>MRA</td>
<td>magnetic resonance angiography</td>
</tr>
<tr>
<td>MRI</td>
<td>magnetic resonance imaging</td>
</tr>
<tr>
<td>OCEBM</td>
<td>Oxford Centre for Evidence-based Medicine</td>
</tr>
<tr>
<td>PCP</td>
<td>primary care provider</td>
</tr>
<tr>
<td>PET</td>
<td>positron emission tomography</td>
</tr>
<tr>
<td>RVU</td>
<td>relative-value units</td>
</tr>
<tr>
<td>TA</td>
<td>temporal arteritis</td>
</tr>
<tr>
<td>TN</td>
<td>trigeminal nerve</td>
</tr>
<tr>
<td>V1</td>
<td>ophthalmic nerve</td>
</tr>
<tr>
<td>V2</td>
<td>maxillary nerve</td>
</tr>
<tr>
<td>V3</td>
<td>mandibular nerve</td>
</tr>
</tbody>
</table>
PROVEN IMAGING FOR Headache (HA)

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).
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.

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

<table>
<thead>
<tr>
<th>Appropriate use indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>(PRIMARY recommendation)</td>
</tr>
<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$

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

**Significant positive result?**

- **yes**
  - Secondary cause of HA identified
  - CONSULT with neurology OR REFER to neurology (URGENT)

- **no**
  - FOLLOW UP in outpatient setting
    - AND
    - CONSIDER referral to neurology

---

* 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**
- **OCEBM 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)

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**PROVEN IMAGING FOR Headache (HA)**

---

**DECISION NODE #2**

**Chronic HA + refractory / debilitating pain**

- **AUC met?**
  - **Headache persistent for at least 3 months**
    - yes → **Imaging: primary recommendation**
      - MRI brain w/o contrast: NA** | NA** | $ | R0
    - no → PROVIDE additional care as clinically warranted. Imaging not recommended.

**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?**

- yes → Secondary cause of HA identified
  - 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
- R0 (0 mSv) $ (0 – 5 RVUs)
- R3 (1 – 10 mSv) $ (5 – 10 RVUs)
- R4 (10 – 30 mSv) $ (10 – 15 RVUs)
- See page 2 – 3 for explanation.
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**

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)

**EMERGENCY REFERRAL AND ACTIVATE** code stroke

**Imaging: primary recommendation**

- CT brain/head w/o contrast (STAT)  
  - 2  
  - II  
  - $  
  - R3

**AND CONSIDER**

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

**FOLLOW** Institutional Acute Ischemic Stroke Protocol

- 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.
**PROVEN IMAGING FOR Headache (HA)**

**DECISION NODE #3B**

HA + focal neurologic deficits (NOT acute)

**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)

**CONSIDER EMERGENCY REFERRAL**

**Imaging: primary recommendation**
- MRI brain w/o contrast: 2 II $ R0

**AND CONSIDER**
- MRA head and neck: 4 II $$ $ R0

**Imaging: alternative recommendation**
- CT brain/head w/o contrast: 2 II $ R3

**AND CONSIDER**
- CTA head and neck*: 1 II $$ $ R3

**DECISION NODE #3B KEY EVIDENCE**

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


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**DECISION NODE #4**

**HA + elevated bleeding risk***

**AUC met (IF BOTH)?**
- New or worsening headache
- Patient currently taking an anticoagulant

---

**CONSIDER EMERGENCY REFERRAL for acute symptoms**

---

**Imaging: primary recommendation**

<table>
<thead>
<tr>
<th>CT brain/head w/o contrast</th>
<th>NA**</th>
<th>NA**</th>
<th>$</th>
<th>R3</th>
</tr>
</thead>
</table>

---

**Significant positive result?**

- yes
  - Hemorrhage
    - CONSULT with neurology and/or neurosurgery (EMERGENCY)
  - no
    - FOLLOW UP in outpatient setting

---

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

---

See abbreviations on page 2.

---

**LEGEND**

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

---

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PROVEN IMAGING FOR Headache (HA)

DECISION NODE #5

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

yes → CONSIDER EMERGENCY REFERRAL for acute symptoms

no → PROVIDE additional care as clinically warranted

Imaging: primary recommendation
CT brain/head w/o contrast (STAT) 1 II $ R3

Imaging: alternative recommendation
CTA head and neck 2 II $ R3

MRI brain w/o contrast 2 II $ R0

MRA brain/head w/o contrast NA* NA* $$ R0

MRA neck w/o contrast 1 II $$ R0

Significant positive result?
- Hemorrhage
- Stroke

yes → CONSULT with neurology and/or neurosurgery (EMERGENCY)

no → PROVIDE additional care as clinically warranted

Presence of both?
- Negative CT head < 6 hours from onset of symptoms
- Normal neuro exam

yes → PROVIDE additional care as clinically warranted

no → 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.

PROVIDE additional care as clinically warranted

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Dubosh NM, Bellolio MF, Rabinstein AA, Edlow JA. Sensitivity of early brain computed
tomography to exclude aneurysmal subarachnoid hemorrhage: A systematic review
Jayaraman MV, Mayo-Smith WW, Tung GA, et al. Detection of intracranial aneurysms:
Multi-detector row CT angiography compared with DSA. Radiology.
Pascual J, Iglesias F, Oterino A, Vázquez-Barquero A, Berciano J. Cough, exertional, and
sexual headaches: An analysis of 72 benign and symptomatic cases. Neurology.

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

DECISION NODE #6

HA + known or suspected cancer

AUC met?

New headache

yes →

Imaging: primary recommendation

MRI brain w/ and w/o contrast

2  II  $  R0

Imaging: alternative recommendation

CT brain/ head w/ and w/o contrast

2  II  $  R3

no →

CONSIDER consult or referral to neurology

Significant positive result?

Intracranial malignancy

yes →

CONSULT with neurosurgery, neuro-oncology, and/or neurology (URGENT)

no →

PROVIDE additional care as clinically warranted. Imaging not recommended.

DECISION NODE #6 KEY EVIDENCE


For a full list of references for all decision nodes, see bibliography on page 30.)
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.
DECISION NODE #7B

AUC met (IF ANY)?
- Visual symptoms
- Increased pain when lying down
- Increased pain in the morning
- Pain aggravated by Valsalva

yes → Imaging: primary recommendation
- MRI brain w/ and w/o contrast:
  - 4
  - 1
  - $\$$
  - R0
- AND
- MR venogram brain/head w/ and w/o contrast:
  - 4
  - 1
  - $\$$\$$
  - R0

Significant positive result?
yes → Venous sinus thrombosis

no → Imaging: alternative recommendation
- CT brain/head w/o contrast:
  - NA**
  - NA**
  - $
  - R3
- AND
- CT venogram brain/head:
  - 5
  - 1
  - $\$$
  - R3

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.

PROVERE additional care as clinically warranted. Imaging not recommended.

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**PROVEN IMAGING FOR Headache (HA)**

**DECISION NODE #8**

**HA + suspected meningitis**

- **AUC met (IF EITHER)?**
  - 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
  - **Level of Evidence**: II
  - **Measure**: $ (0 – 5 RVUs)
  - **Impaction**: R3

**Imaging: alternative recommendation**
- MRI brain w/ and w/o contrast
  - **Level of Evidence**: II
  - **Measure**: $$ (5 – 10 RVUs)
  - **Impaction**: R0

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

*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.*

**DECISION NODE #8 KEY EVIDENCE**


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

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

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

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

**Significant positive result?**
- Cervical spine injury
- Intracranial and/or cervical artery dissection

**Imaging: primary recommendation**
- MRI brain w/o contrast
- MRA head and neck

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

**CONSIDER EMERGENCY REFERRAL for acute symptoms**

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

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

**DECISION NODE #9B**

**HA with neck/facial pain + suspected cervical artery dissection (WITHOUT acute trauma)**

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

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

**Consider EMERGENCY referral**

**Significant positive result?**
- Intracranial and/or cervical artery dissection
  - yes: CONSULT with neurology and/or interventional radiology
  - no: R 0 (0 mSv)

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

**Imaging: primary recommendation**
- MRI brain w/o contrast
- MRA head and neck

**Significant positive result?**
- Stroke
  - yes: CONSULT with neurology and/or interventional radiology
  - no: R 0 (0 mSv)

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

*Include CT cervical spine reformat from CTA data set.*

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

**DECISION NODE #9 KEY EVIDENCE**


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

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**PROVEN IMAGING FOR Headache (HA)**

### DECISION NODE #10

**CONSIDER EMERGENCY REFERRAL for acute symptoms**

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

**Imaging: primary recommendation**

<table>
<thead>
<tr>
<th>CT brain/head w/o contrast</th>
<th>Imaging</th>
<th>RVUs</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>III</td>
<td>$</td>
<td>R3</td>
</tr>
</tbody>
</table>

**AND/OR**

<table>
<thead>
<tr>
<th>CT cervical spine w/o contrast</th>
<th>Imaging</th>
<th>RVUs</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>III</td>
<td>$$</td>
<td>R3</td>
</tr>
</tbody>
</table>

**Significant positive result?**
- Cranial or spinal injury

**CONSULT** with neurology and/or neurosurgery

**AUC met?**
- 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

**Imaging: primary recommendation**

<table>
<thead>
<tr>
<th>MRI brain w/o contrast</th>
<th>Imaging</th>
<th>RVUs</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>III</td>
<td>$</td>
<td>R0</td>
</tr>
</tbody>
</table>

**AND/OR**

<table>
<thead>
<tr>
<th>MRI cervical spine w/o contrast (trauma protocol)</th>
<th>Imaging</th>
<th>RVUs</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>III</td>
<td>$$</td>
<td>R0</td>
</tr>
</tbody>
</table>

**Significant positive result?**
- Cranial or spinal injury

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

---

**Legend**

- **Clinical Scenario**
- **Urgent or Emergency Situation**
- **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 (15+ RVUs)

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DECISION NODE #10 KEY EVIDENCE


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

**LEGEND**

- **OCEBM Level of Evidence**
  - 2

- **Fryback & Thornbury Level of Evidence**
  - II

- **Intermountain Measure**
  - $0 – 5 RVUs
  - $5 – 10 RVUs
  - $10 – 15 RVUs
  - $15+ RVUs

---

**HA + suspicion for giant cell / temporal arteritis**

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

---

**DECISION NODE #11**

**Imaging: primary recommendation**
- MRI brain w/o contrast
  - 2
  - II
  - $R0$

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

---

**Significant positive result?**

**yes**
- CONSULT with neurology

**no**
- **FOLLOW UP** in outpatient setting, **AND CONSIDER** referral to neurology and/or rheumatology

---

**DECISION NODE #11 KEY EVIDENCE**


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

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

DECISION NODE #12

HA + trigeminal distribution*

AUC met?

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

- yes
  - Imaging: primary recommendation
    - MRI brain w/ and w/o contrast (trigeminal protocol)
      - Level of Evidence: II
      - Measure: $ (0 – 5 RVUs)
      - R0
    - Imaging: primary recommendation
      - CT brain/head w/ and w/o contrast***
      - Level of Evidence: II
      - Measure: $ (0 – 5 RVUs)
      - R0

- no
  - 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.

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)
- (0-5 RVUs)
- $ (5-10 RVUs)
- $$$ (10-15 RVUs)
- $$$$ (15+ RVUs)

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# TABLE 1. MRI brain WITHOUT CONTRAST appropriate use indications

<table>
<thead>
<tr>
<th>PRIMARY recommendation</th>
<th>(PRIMARY recommendation)</th>
<th>ALTERNATIVE recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Existing HA disorder + clinical progression:</td>
<td>□ HA + head and/or neck trauma (WITHOUT suspicion of cervical artery trauma):</td>
<td>□ Suspected subarachnoid hemorrhage (IF ANY):</td>
</tr>
<tr>
<td>□ Significant increase in headache frequency, severity, or duration</td>
<td>□ CT brain/head or CT cervical spine completed</td>
<td>□ Negative CT head &gt;6 hours from onset of symptoms</td>
</tr>
<tr>
<td>□ Chronic HA + refractory/debilitating pain:</td>
<td>□ Suspected brain contusion</td>
<td>□ Abnormal neuro exam</td>
</tr>
<tr>
<td>□ Headache persistent for at least 3 months</td>
<td>□ Suspicion for occult fracture or ligamentous injury</td>
<td>□ High clinical suspicion</td>
</tr>
<tr>
<td>□ HA + focal neurologic deficits (NOT acute):</td>
<td>□ Known spondyloarthropathy (AS or DISH)</td>
<td></td>
</tr>
<tr>
<td>ANY OF THESE: with onset &gt; 24 hours ago or persistent:</td>
<td>□ Persistent neurologic deficit</td>
<td></td>
</tr>
<tr>
<td>□ Altered mental status</td>
<td>□ HA + suspicion for giant cell/temporal arteritis (IF ALL):</td>
<td></td>
</tr>
<tr>
<td>□ Weakness</td>
<td>□ New or progressive headache</td>
<td></td>
</tr>
<tr>
<td>□ Sensory loss</td>
<td>□ Age &gt; 50</td>
<td></td>
</tr>
<tr>
<td>□ Visual symptoms (diplopia, field cut, etc.)</td>
<td>□ Visual symptoms</td>
<td></td>
</tr>
<tr>
<td>□ Language deficit (aphasia)</td>
<td>□ HA w/ neck/facial pain + suspected cervical artery dissection (WITHOUT acute trauma):</td>
<td></td>
</tr>
<tr>
<td>□ HA + suspected cervical artery dissection (WITH ACUTE trauma) (IF ANY):</td>
<td>□ Neurologic deficit(s) and/or stroke</td>
<td></td>
</tr>
<tr>
<td>□ Facial or neck pain</td>
<td>□ Horner syndrome: Miosis, ptosis, anhidrosis</td>
<td></td>
</tr>
<tr>
<td>□ Neurologic deficit(s) and/or stroke</td>
<td>AND EITHER:</td>
<td></td>
</tr>
<tr>
<td>□ Horner syndrome: Miosis, ptosis, anhidrosis</td>
<td>□ Miosis, ptosis, anhidrosis</td>
<td></td>
</tr>
<tr>
<td>AND EITHER:</td>
<td>AND EITHER:</td>
<td></td>
</tr>
<tr>
<td>□ CTA completed</td>
<td>□ CTA completed</td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>□ Clinical suspicion with negative CTA</td>
<td>□ Clinical suspicion with negative CTA</td>
<td></td>
</tr>
</tbody>
</table>

The provider must check BOTH:
1. The box next to the relevant clinical scenario
2. EACH AUC box that applies to the patient’s situation
### 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
  - **AND EITHER:**
    - 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
  - **AND EITHER:**
    - CTA completed
    - Clinical suspicion with negative CTA

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

(ALTERNATIVE recommendation)

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

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

(ALTERNATIVE recommendation)

- **Suspected subarachnoid hemorrhage (IF ANY):**
  - Negative CT head > 6 hours from onset of symptoms
  - Abnormal neuro exam
  - High clinical suspicion
### 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>☐ HA + suspected meningitis (IF EITHER):</td>
</tr>
<tr>
<td>☐ New headache</td>
<td>☐ Fever</td>
</tr>
<tr>
<td>☐ Suspected elevated ICP or papilledema (NO hypercoagulable state)* (IF ANY):</td>
<td>☐ Nuchal rigidity</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 elevated ICP or papilledema (known or suspected hypercoagulable state)* (IF ANY):</td>
</tr>
<tr>
<td>☐ Visual symptoms</td>
</tr>
<tr>
<td>☐ Increased pain when lying down</td>
</tr>
<tr>
<td>☐ Increased pain in the morning</td>
</tr>
<tr>
<td>☐ Pain aggravated by Valsalva</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>
<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>
## 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>□ HA + elevated bleeding risk** (IF BOTH):</td>
<td>□ Suspected elevated ICP or papilledema (NO hypercoagulable state)*** (IF ANY):</td>
</tr>
<tr>
<td>□ New or worsening headache</td>
<td>□ Visual symptoms</td>
</tr>
<tr>
<td>□ Patient currently taking an anticoagulant</td>
<td>□ Increased pain when lying down</td>
</tr>
<tr>
<td>□ HA + suspected meningitis*** (IF EITHER):</td>
<td>□ Increased pain in the morning</td>
</tr>
<tr>
<td>□ Fever</td>
<td>□ Pain aggravated by Valsalva</td>
</tr>
<tr>
<td>□ Nuchal rigidity</td>
<td>□ HA + suspected elevated ICP or papilledema (known or suspected hypercoagulable state)**** (IF ANY):</td>
</tr>
<tr>
<td>□ HA + suspected cervical artery dissection (WITH ACUTE trauma) (IF ANY):</td>
<td>□ Visual symptoms</td>
</tr>
<tr>
<td>□ Facial or neck pain</td>
<td>□ Increased pain when lying down</td>
</tr>
<tr>
<td>□ Neurologic deficit(s) and/or stroke</td>
<td>□ Increased pain in the morning</td>
</tr>
<tr>
<td>□ Horner syndrome: Miosis, ptosis, anhidrosis</td>
<td>□ Pain aggravated by Valsalva</td>
</tr>
<tr>
<td>□ HA + head and/or neck trauma (WITHOUT suspicion of cervical artery trauma):</td>
<td>□ HA + suspicion for giant cell / temporal arteritis (IF ALL):</td>
</tr>
<tr>
<td>□ Acute or subacute head and/or neck trauma</td>
<td>□ New or progressive headache</td>
</tr>
<tr>
<td>STAT</td>
<td>□ Age &gt; 50</td>
</tr>
<tr>
<td>□ HA + focal neurologic deficits (ACUTE): ANY OF THESE (with onset &lt; 24 hours ago):</td>
<td>□ Visual symptoms</td>
</tr>
<tr>
<td>□ Altered mental status</td>
<td>□ Increased pain when lying down</td>
</tr>
<tr>
<td>□ Weakness</td>
<td>□ Increased pain in the morning</td>
</tr>
<tr>
<td>□ Sensory loss</td>
<td>□ Pain aggravated by Valsalva</td>
</tr>
<tr>
<td>□ Visual symptoms (diplopia, field cut, etc.)</td>
<td>□ HA + suspicion for giant cell / temporal arteritis (IF ALL):</td>
</tr>
<tr>
<td>□ Language deficit (aphasia)</td>
<td>□ New or progressive headache</td>
</tr>
<tr>
<td>□ Suspected subarachnoid hemorrhage:</td>
<td>□ Age &gt; 50</td>
</tr>
<tr>
<td>□ Sudden severe headache</td>
<td>□ Visual symptoms</td>
</tr>
<tr>
<td>AND ANY OF THESE:</td>
<td>□ Increased pain when lying down</td>
</tr>
<tr>
<td>□ Peak pain within 1 hour of onset</td>
<td>□ Increased pain in the morning</td>
</tr>
<tr>
<td>□ Age &gt; 40</td>
<td>□ Pain aggravated by Valsalva</td>
</tr>
<tr>
<td>□ Neck pain or stiffness</td>
<td>□ HA + suspicion for giant cell / temporal arteritis (IF ALL):</td>
</tr>
<tr>
<td>□ Witnessed loss of consciousness</td>
<td>□ New or progressive headache</td>
</tr>
<tr>
<td>□ Sudden or severe headache triggered by: cough / sneeze, Valsalva, sex, or exercise / exertion</td>
<td>□ Age &gt; 50</td>
</tr>
<tr>
<td>□ Limited neck flexion on exam</td>
<td>□ Visual symptoms</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

<table>
<thead>
<tr>
<th>PRIMARY recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ HA + focal neurologic deficits (ACUTE):</td>
</tr>
<tr>
<td>ANY OF THESE (with onset &lt;24 hours ago):</td>
</tr>
<tr>
<td>□ Altered mental status</td>
</tr>
<tr>
<td>□ Weakness</td>
</tr>
<tr>
<td>□ Sensory loss</td>
</tr>
<tr>
<td>□ Visual symptoms (diplopia, field cut, etc.)</td>
</tr>
<tr>
<td>□ Language deficit (aphasia)</td>
</tr>
</tbody>
</table>

### TABLE 10. CTA head and neck appropriate use indications

<table>
<thead>
<tr>
<th>PRIMARY recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Suspected subarachnoid hemorrhage (IF ANY):</td>
</tr>
<tr>
<td>□ Negative CT head &gt;6 hours from onset of symptoms</td>
</tr>
<tr>
<td>□ Abnormal neuro exam</td>
</tr>
<tr>
<td>□ High clinical suspicion</td>
</tr>
<tr>
<td>□ HA + suspected cervical artery dissection (WITH ACUTE trauma)* (IF ANY):</td>
</tr>
<tr>
<td>□ Facial or neck pain</td>
</tr>
<tr>
<td>□ Neurologic deficit(s) and/or stroke</td>
</tr>
<tr>
<td>□ Horner syndrome: Miosis, ptosis, anhidrosis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ALTERNATIVE recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ HA + suspected cervical artery dissection (WITHOUT ACUTE trauma)* (IF ANY):</td>
</tr>
<tr>
<td>□ Neurologic deficit(s) and/or stroke</td>
</tr>
<tr>
<td>□ Horner syndrome: Miosis, ptosis, anhidrosis</td>
</tr>
</tbody>
</table>

### TABLE 11. CT brain/head WITH AND WITHOUT CONTRAST appropriate use indications*

<table>
<thead>
<tr>
<th>ALTERNATIVE recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ HA + known or suspected cancer</td>
</tr>
<tr>
<td>□ New headache</td>
</tr>
</tbody>
</table>

**TRIGEMINAL PROTOCOL**

<table>
<thead>
<tr>
<th>HA + trigeminal distribution**:</th>
</tr>
</thead>
</table>
| □ 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).

* Include CT cervical spine reformats from CTA data set.
**TABLE 12. CT venogram brain/head appropriate use indications**

(INTERNATIONAL 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 13. 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 Proven Imaging CPMs, Intermountain provides topical CPMs that have been developed by expert clinical teams. They can be accessed by navigating to http://www.intermountainphysician.org and selecting Care Process Models in the Tools & Resources drop down menu.

To access Intermountain’s Proven Imaging CPMs and supporting materials, visit: https://intermountainhealthcare.org/services/imaging-services/proven-imaging/.

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)

Related Care Process Models (CPMs):
- Concussion CPM
- Neck Pain CPM
- Prescribing Opioids for Chronic Non-Cancer Pain CPM
- Imaging Radiation Exposure CPM

http://www.intermountainphysician.org
Proven Imaging Resources web page

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PROVEN IMAGING FOR **Headache (HA)**

### 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**
NODE #8


NODE #9


NODE #10


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. Send feedback to ProvenImaging@imail.org.

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