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 outran 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 neck pain. 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: PROVEN IMAGING AUC 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 list at right and pages 5 through 15). Although these Proven Imaging CPMs specifically focus on the appropriate use of advanced imaging, they can rightly 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 18). 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.

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 levelling 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 Pathway” 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 (e.g., neck pain and suspected cancer), 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 the elements of this presentation below and key information provided in each test recommendation box as shown at right. There is also 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 symbol indicates a common clinical scenario.

Underlining indicates a hyperlink to another document or to a page within the same document, as appropriate.

**NP + suspected spinal infection**

**DECISION NODE #7A**

**AUC met (IF ANY)?**
- Fever/chills and/or pain with rest or at night
- Other risk factors*

**Imaging: primary recommendation**
- MRI cervical spine w/ and w/o contrast

**Imaging: alternative recommendation**
- CT cervical spine w/ and w/o contrast

**Significant positive result?**
- Epidural abscess
- Phlegmon with mass effect on nerve root/spinal canal
- Instability

**CONSULT** with neurosurgery and/or spine surgery (EMERGENCY)

**Imaging: primary recommendation**
- MRI cervical spine w/ and w/o contrast

**Imaging: alternative recommendation**
- CT cervical spine w/ and w/o contrast

**Significant positive result?**
- Osteomyelitis/discitis

**REFER** to infectious disease

**FOLLOW UP** in 1 to 2 weeks

**Clinical suspicion still high?**

**REFERR to the Neck Pain CPM or other system-wide protocol. Imaging not recommended**

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. Tables indicate if the test is a primary recommendation or alternate recommendation. 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 2. MRI cervical spine WITH AND WITHOUT contrast appropriate use indications

(PRIMARY recommendation)

☐ Neck pain without improvement + prior cervical spine surgery (NO suspicion of hardware failure) (IF ANY)
  ☐ Worsening neck pain
  ☐ New or acute radiculopathy
  ☐ Weakness
  ☐ High suspicion of disc disease adjacent to hardware

☐ Neck pain with suspected cancer (IF ANY)
  ☐ History of cancer
  ☐ Multiple cancer risk factors
  ☐ High suspicion of cancer

☐ Neck pain with suspected spinal infection (IF ANY)
  ☐ Fever / chills and / or pain with rest or at night
  ☐ Other risk factors (ANY): immunocompromised patient, other site of infection, IV drug use

See abbreviations on page 2
PROVEN IMAGING FOR Neck Pain (NP)

NECK PAIN (NP) CARE PATHWAY ALGORITHMS

DECISION NODE #1

NP without complicating features

AUC met (IF ALL)?
≥ 3 months of symptoms and adequate conservative treatment with no improvement

yes

Imaging: primary recommendation
MRI cervical spine w/o contrast

3 II $ R0

Imaging: alternative recommendation
CT cervical spine w/o contrast

3 II $ R3

no

no

REFER to the Neck Pain CPM or other system-wide protocol.
Imaging not recommended.

yes

Significant positive result?

- Severe spinal canal stenosis
- Neural foraminal stenosis
- Nerve root or cord compression
- Instability
- Mass
- Fracture

yes

REFER to ortho/neuro spine surgeon

OR

non-operative specialist (PM&R / pain management)

CONTINUE conservative measures
AND

CONSIDER referral to multidisciplinary spine center

DECISION NODE #1 KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 21 through 24)
**PROVEN IMAGING FOR Neck Pain (NP)**

**DECISION NODE #2**

**NP + weakness (gradual onset of upper motor neuron symptoms and/or myelopathy)**

AUC met? (If ANY):
- Hyperreflexia / Hoffman’s sign
- New-onset Babinski or clonus
- New-onset gait or balance abnormalities
- Upper extremity weakness

yes →

**EMERGENCY REFERRAL IF SUDDEN ONSET**
Emergency spine consult if high suspicion

**Imaging: primary recommendation**
- MRI cervical, thoracic, and lumbar spine w/o contrast
  - Level of Evidence: II
  - Intermountain Measure: $$$
  - Radiation: R0 (0 mSv)
- MRI brain w/o contrast
  - Level of Evidence: II
  - Intermountain Measure: $
  - Radiation: R0

AND/OR

**Imaging: alternative recommendation**
- CT myelogram cervical and thoracic spine
  - Level of Evidence: III
  - Intermountain Measure: $$$
  - Radiation: R4
- CT brain/head w/ and w/o contrast
  - Level of Evidence: II
  - Intermountain Measure: $
  - Radiation: R3

yes →

**Significant positive result?**
- Spine/cord compression
- Severe spinal canal stenosis
- Large disc herniation
- Brain mass

no →

**DECISION NODE #2 KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 21 through 24)
**PROVEN IMAGING FOR Neck Pain (NP)**

**DECISION NODE #3-1**

NP + trauma (ALL settings)

**AUC met?**
- Significant trauma (ED setting)
  - **yes**
  - **EMERGENCY trauma evaluation**
    - **Imaging: primary recommendation**
      - CT cervical spine w/o contrast
        - Level of Evidence: 3, II, $, R3
  - **no**

**AUC met? (If ANY)**
- Questionable findings or inadequate coverage on cervical spine radiograph
- Elevated clinical suspicion with negative radiograph
- Known spondyloarthropathy (AS or DISH)
  - **yes**
  - **REFER to the Neck Pain CPM or other system-wide protocol. Imaging not recommended.**
  - **no**

**DECISION NODE #3-2**

**AUC met?**
- CT cervical spine completed AND (ANY)
  - **yes**
  - **Imaging: primary recommendation**
    - MRI cervical spine w/o contrast
      - Level of Evidence: 5, I, $, R0
  - **no**

**Significant positive result?**
- Fracture
- Dislocations
- Unstable alignment
  - **yes**
  - **REFER to ortho/neuro spine surgeon (URGENT)**
  - **no**

**SIGNIFICANT positive result (ANY)?**
- Fractures
- Dislocations
- Unstable alignment
  - **yes**
  - **AUC met?* (If ANY)**
    - Questionable findings or inadequate coverage on cervical spine radiograph
    - Elevated clinical suspicion with negative radiograph
    - Known spondyloarthropathy (AS or DISH)
    - Persistent neurologic deficit
      - **yes**
      - **Imaging: primary recommendation**
        - MRI cervical spine w/o contrast
          - Level of Evidence: 5, I, $, R0
      - **no**
  - **no**

**MANAGE** in the ED per clinical judgement OR **FOLLOW UP** (non-surgical) in 1-2 weeks for all other settings

---

**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 Neck Pain (NP)

DECISION NODE #3 KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 21 through 24)
**DECISION NODE #4A-1**

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

**Imaging: primary recommendation**
- CT brain/head w/o contrast: NA* NA* $ R3
- CTA head and neck (include cervical spine CT reformatted from CTA data set): 3 II $$$$ R3

**Consider EMERGENCY referral**

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

**CONSULT with neurology and/or interventional radiology**

---

**DECISION NODE #4A-2**

**AUC met (IF ANY)?**
- Questionable CTA findings
- High clinical suspicion with negative CTA

**Imaging: primary recommendation**
- MRA head and neck: 4 II $$$$ R0

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

**REFER to the Concussion CPM and/or Neck Pain CPM or other system-wide protocol. Imaging not recommended.**

---

**DECISION NODE #4A KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 21 through 24)
PROVEN IMAGING FOR Neck Pain (NP)

DECISION NODE #4B-1

AUC met (IF ANY)?
- Headache or facial pain
- Neurologic deficit(s) and/or stroke
- Horner syndrome: miosis, ptosis, and anhidrosis

Consider EMERGENCY referral

Imaging: primary recommendation
CTA head and neck

Significant positive result?
- Intracranial and/or cervical artery dissection

CONSULT with neurology and/or interventional radiology

DECISION NODE #4B-2

AUC met (IF ANY)?
- Questionable CTA findings
- High clinical suspicion with negative CTA

Imaging: primary recommendation
MRA head and neck

Significant positive result?
- Intracranial and/or cervical artery dissection

DECISION NODE #4B KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 21 through 24)
**PROVEN IMAGING FOR Neck Pain (NP)**

**DECISION NODE #5A**

NP without improvement + prior cervical spine surgery (NO suspicion of hardware failure)

AUC met (IF ANY)?
- Worsening neck pain
- New or acute radiculopathy
- Weakness
- High suspicion of disc disease adjacent to hardware

Yes

**URGENT SPINE SURGERY REFERRAL**
if radiculopathy with weakness/disabling

**Imaging: primary recommendation**
- MRI cervical spine w/ and w/o contrast
  - 3 II $$$ R0

**Imaging: alternative recommendation**
- CT myelogram cervical spine
  - 2 III $$SS$$ R4

Yes

Significant positive result?
- Spinal stenosis
- Adjacent level disease
- Acute/new disc herniation
- Infection

Yes

REFER to ortho/neuro spine surgeon

No

REFER to the Neck Pain CPM or other system-wide protocol. Imaging not recommended.

No

**MANAGE** with conservative measures per Neck Pain CPM (or other system-wide protocol) for 3 months

**(If NOT improved)** CONSIDER referral to ortho/neuro spine surgeon or multidisciplinary spine center

DECISION NODE #5A KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 21 through 24)
**PROVEN IMAGING FOR Neck Pain (NP)**

**DECISION NODE #5B**

- **AUC met (IF ANY)?**
  - Yes: CT cervical spine w/o contrast
  - No: Refer to ortho/neo spine surgeon

- **Imaging: primary recommendation**
  - 2  III  $  R3

- **Significant positive result?**
  - Yes: Refer to ortho/neo spine surgeon
  - No: Manage with conservative measures per Neck Pain CPM (or other system-wide protocol) for 3 months + (If NOT improved) Consider referral to ortho/neo spine surgeon OR multidisciplinary spine center

**DECISION NODE #5B KEY EVIDENCE**


(For a full list of references for all decision nodes, see bibliography on pages 21 through 24)
**PROVEN IMAGING FOR Neck Pain (NP)**

**DECISION NODE #6**

- **NP + suspected cancer?**
  - Yes: **Imaging: primary recommendation**
    - MRI cervical spine w/ and w/o contrast
    - Level of Evidence: 1, IV, $\$, R0
  - No: **Imaging: alternative recommendation**
    - CT cervical spine w/ and w/o contrast
    - Level of Evidence: 3, II, $$$, R4

- **Significant positive result?**
  - Yes: **CONSULT** with internal medicine, neurology, or oncology
  - No: **FOLLOW UP** in 1–2 weeks

- **Clinical suspicion still high?**
  - Yes: **REFER to oncology**
  - No: **CONSULT** with neurosurgery and/or spine surgery

---

**DECISION NODE #6 KEY EVIDENCE**

American College of Radiology. ACR Appropriateness Criteria® Chronic Neck Pain.

(For a full list of references for all decision nodes, see bibliography on pages 21 through 24)
PROVEN IMAGING FOR Neck Pain (NP)

DECISION NODE #7A

NP + suspected spinal infection

AUC met (IF ANY)?
- Fever / chills and/or pain with rest or at night
- Other risk factors*

yes →

Imaging: primary recommendation
MRI cervical spine w/ and w/o contrast
1 IV $$$ R0

Imaging: alternative recommendation
CT cervical spine w/ and w/o contrast
3 II $$$ R4

yes →

Significant positive result?
- Epidural abscess
- Phlegmon with mass effect on nerve root / spinal canal
- Instability

yes →

CONSULT with neurosurgery and/or spine surgery (EMERGENCY)

no →

Osteomyelitis / discitis

yes →

REFER to infectious disease

no →

FOLLOW UP in 1 – 2 weeks

Clinical suspicion still high?

yes →

REFER to the Neck Pain CPM or other system-wide protocol. Imaging not recommended.

no →

DECISION NODE #7A KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 21 through 24)

* Other risk factors include, but are not limited to, immunocompromised patient, other site of infection, and IV drug use.
PROVEN IMAGING FOR Neck Pain (NP)

NP + suspected meningitis*

AUC met (IF ALL)?
- Fever
- Neurologic symptoms (ALOC, cranial neuropathy)

yes → Imaging: primary recommendation
MRI brain w/ and w/o contrast
4  II $5  R0

no → Imaging: alternative recommendation
CT brain/head w/ and w/o contrast
4  II $  R3

yes → Significant positive result?
- Abscess
- Epidural infection
- Skull base infection
- Evidence of infection with increased intracranial pressure

no → REFER to neurosurgery (URGENT)

PERFORM lumbar puncture** to fully evaluate for meningitis

REFER to the Neck Pain CPM or other system-wide protocol. Imaging not recommended.

DECISION NODE #7B KEY EVIDENCE


(For a full list of references for all decision nodes, see bibliography on pages 21 through 24)

*Imaging not generally indicated for meningitis without associated neurologic symptoms

**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
### TABLE 1. MRI cervical spine WITHOUT CONTRAST appropriate use indications

(PRIMARY recommendation)

- **Neck pain without complicating features**
  - ≥3 months of symptoms and adequate conservative treatment with no improvement

- **Neck pain with trauma (ALL settings)**
  - Significant trauma (ED setting)
  - CT cervical spine w/out contrast completed WITH ANY OF FOLLOWING
    - Suspicion of occult fracture or ligamentous injury
    - Known spondyloarthropathy (AS or DISH)
    - Persistent neurologic deficit

- **OR**
  - Questionable findings or inadequate coverage on cervical spine radiograph
  - Elevated clinical suspicion with negative radiograph
  - Known spondyloarthropathy (AS or DISH)

- **AND**
  - CT cervical spine w/out contrast completed WITH ANY OF FOLLOWING
    - Suspicion of occult fracture or ligamentous injury
    - Known spondyloarthropathy (AS or DISH)
    - Persistent neurologic deficit

### TABLE 2. MRI cervical spine WITH AND WITHOUT contrast appropriate use indications

(PRIMARY recommendation)

- **Neck pain without improvement + prior cervical spine surgery (NO suspicion of hardware failure) (IF ANY)**
  - Worsening neck pain
  - New or acute radiculopathy
  - Weakness
  - High suspicion of disc disease adjacent to hardware

- **Neck pain with suspected cancer (IF ANY)**
  - History of cancer
  - Multiple cancer risk factors
  - High suspicion of cancer

- **Neck pain with suspected spinal infection (IF ANY)**
  - Fever/chills and/or pain with rest or at night
  - Other risk factors (ANY): Immunocompromised patient, other site of infection, IV drug use
## TABLE 3. MRI brain WITH AND WITHOUT contrast appropriate use indications

(PRIMARY recommendation)

- Neck pain with suspected meningitis (IF ALL)
  - Fever
  - Neurologic symptoms (ALOC, cranial neuropathy)

## TABLE 4. MRI cervical, thoracic, and lumbar spine WITHOUT contrast appropriate use indications

(PRIMARY recommendation)

- Neck pain with weakness (gradual onset upper motor neuron symptoms and/or myelopathy) (IF ANY)
  - Hyperreflexia/Hoffman’s sign
  - New onset Babinski or clonus
  - New onset gait/balance abnormalities
  - Upper extremity weakness

## TABLE 5. MRI brain WITHOUT contrast appropriate use indications

(PRIMARY recommendation)

- Neck pain with weakness (gradual onset upper motor neuron symptoms and/or myelopathy) (IF ANY)
  - Hyperreflexia/Hoffman’s sign
  - New onset Babinski or clonus
  - New onset gait/balance abnormalities
  - Upper extremity weakness

## TABLE 6. MRA head and neck appropriate use indications

(PRIMARY recommendation)

- Neck pain with suspected cervical artery dissection (acute trauma)
  - IF ANY
    - Headache or facial pain
    - Neurologic deficit(s) and/or stroke
    - Horner syndrome: miosis, ptosis, anhidrosis
  - AND
    - Both CT brain/head w/out contrast AND CTA head/neck completed

  WITH ANY OF FOLLOWING
  - Questionable CTA findings
  - High clinical suspicion with negative CTA

- Neck pain with suspected cervical artery dissection (not acute trauma)
  - IF ANY
    - Headache or facial pain
    - Neurologic deficit(s) and/or stroke
    - Horner syndrome: miosis, ptosis, anhidrosis
  - AND
    - CTA head/neck completed

  WITH ANY OF FOLLOWING
  - Questionable CTA findings
  - High clinical suspicion with negative CTA
### TABLE 7. CTA head and neck appropriate use indications

<table>
<thead>
<tr>
<th>PRIMARY recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Neck pain with suspected cervical artery dissection (acute trauma) (IF ANY)</td>
</tr>
<tr>
<td>□ Headache or facial pain</td>
</tr>
<tr>
<td>□ Neurologic deficit(s) and/or stroke</td>
</tr>
<tr>
<td>□ Horner syndrome: miosis, ptosis, anhidrosis</td>
</tr>
<tr>
<td>□ Neck pain with suspected cervical artery dissection (not acute trauma) (IF ANY)</td>
</tr>
<tr>
<td>□ Headache or facial 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 8. CT brain/head WITHOUT contrast appropriate use indications

<table>
<thead>
<tr>
<th>PRIMARY recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Neck pain with suspected cervical artery dissection (acute trauma) (IF ANY)</td>
</tr>
<tr>
<td>□ Headache or facial 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 9. CT brain/head WITH AND WITHOUT contrast appropriate use indications

<table>
<thead>
<tr>
<th>ALTERNATIVE recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Neck pain with weakness (gradual onset upper motor neuron symptoms and/or myelopathy) (IF ANY)</td>
</tr>
<tr>
<td>□ Hyperreflexia/Hoffman’s sign</td>
</tr>
<tr>
<td>□ New onset Babinski or clonus</td>
</tr>
<tr>
<td>□ New onset gait/balance abnormalities</td>
</tr>
<tr>
<td>□ Upper extremity weakness</td>
</tr>
<tr>
<td>□ Neck pain with suspected meningitis (IF ALL)</td>
</tr>
<tr>
<td>□ Fever</td>
</tr>
<tr>
<td>□ Neurologic symptoms (ALOC, cranial neuropathy)</td>
</tr>
</tbody>
</table>
## TABLE 10. CT cervical spine WITHOUT contrast appropriate use indications

**PRIMARY recommendation**

- Neck pain with trauma (ALL settings)
  - Significant trauma (ED setting)
  - OR (IF ANY)
  - Questionable findings or inadequate coverage on cervical spine radiograph
  - Elevated clinical suspicion with negative radiograph
  - Known spondyloarthropathy (AS or DISH)

- Neck pain with prior cervical spine surgery (with suspicion of hardware failure) (IF ANY)
  - Negative cervical spine radiograph with flex/ex lateral + AP/lateral
  - Equivocal plain film findings

**ALTERNATIVE recommendation**

- Neck pain without complicating features
  - ≥3 months of symptoms and adequate conservative treatment with no improvement

## TABLE 11. CT cervical spine WITH AND WITHOUT contrast appropriate use indications

**ALTERNATIVE recommendation**

- Neck pain with suspected cancer (IF ANY)
  - History of cancer
  - Multiple cancer risk factors
  - High suspicion of cancer

- Neck pain with suspected spinal infection (IF ANY)
  - Fever/chills and/or pain with rest or at night
  - Other risk factors (ANY): immunocompromised patient, other site of infection, IV drug use

## TABLE 12. CT myelogram cervical spine appropriate use indications

**ALTERNATIVE recommendation**

- Neck pain without improvement + prior cervical spine surgery (NO suspicion of hardware failure) (IF ANY)
  - Worsening neck pain
  - New or acute radiculopathy
  - Weakness
  - High suspicion of disc disease adjacent to hardware

## TABLE 13. CT myelogram cervical and thoracic spine appropriate use indications

**ALTERNATIVE recommendation**

- Neck pain with weakness (gradual onset upper motor neuron symptoms and/or myelopathy) (IF ANY)
  - Hyperreflexia/Hoffman’s sign
  - New onset Babinski or clonus
  - New onset gait/balance abnormalities
  - Upper extremity weakness
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 intermountainphysician.org and selecting Care Process Models in the Tools and Resources drop down menu.

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

Patient education:
• Spine Guide (English)
• Managing Chronic Pain (English)
• Managing Chronic Pain: Treatment Options (English) / (Spanish)
• Pain Medicine Tracker (English) / (Spanish)

Related Care Process Models (CPMs):
• Neck Pain CPM
• Prescribing Opioids for Chronic Pain CPM
• Imaging Radiation Exposure CPM
**PROVEN IMAGING FOR Neck Pain (NP)**

**BIBLIOGRAPHY**

**NODE #1**


**NODE #2**


BIBLIOGRAPHY, CONTINUED


NODE #4A and #4B


NODE #5A


BIBLIOGRAPHY, CONTINUED

NODE #5B


NODE #6


NODE #7A


BIBLIOGRAPHY, CONTINUED

NODE #7B


REFERENCES (from pages 1 through 3)


Proven Imaging Development Group
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